



Beyond wind, sand and marram grass

Drawing lessons from Denmark and the Netherlands for dynamic dune management on the island of Sylt (Germany)

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Front image: Kupsten on the stossface of a migrating dune on Sylt, Germany; 20.08.2018

Abstract

Whereas aeolian dynamics in dunes fields are increasingly appreciated and supported along many coastal areas in north-western Europe, this strategic shift and the paradigmatic transition have not yet happened on the German Wadden island of Sylt. Thus, this study chooses a qualitative approach to derive lessons for a potential dune management strategy from the Netherlands and Denmark. To include the physical processes and limitations of particular dune fields and the institutional underlying human intervention, coastal dunes were conceptualised as Coupled Human And Natural Systems (CHANS). Besides policy documents, 14 semi-structured interviews and recent scientific presentations were used to develop conceptual models of the three strategies.

Five lessons were derived from the Dutch and Danish dune management strategies. The Danish approach of allowing natural dynamics including coastal retreat increased public participation is impracticable and undesirable. The same is true for the approach chosen at the Danish Nationalpark Thy to include the public much more into nature management. By contrast, the Dutch strategy of compensating the sediment transported from the beach to the hinterland by beach nourishment is practicable and desirable. The Danish past-oriented approach of preserving a cultural landscape and the Dutch more future-oriented strategy to manage dunes multifunctional according to the current societal and ecological needs are principally practical and desirable, if they are adjusted to the domestic institutional and physical characteristics of Sylt.

Eventually, the lessons were incorporated in a praxis-oriented framework for initiating this strategic change at three levels, namely the management of the foredunes, the secondary inland dunes and public information. All in all, a qualitative approach can enrich dune management but should be connected with quantitative examinations to unfold its full potential

Key words: Lesson drawing; Institutional analysis; Coupled Human And Natural Systems; Coastal dunes; Wadden Island

German Summary

Fragestellung

In den letzten Jahrzehnten ist entlang der nordwesteuropäischen Küsten eine zunehmende Stabilisierung der Dünen zu beobachten, die auf eine lange Phase mit erhöhter äolischer Aktivität folgt. Diese gegenwärtige Stabilisierung ist zumeist auf direkte menschliche Eingriffe wie Bepflanzung mit heimischen und gebietsfremden Arten, geänderte Landnutzungsformen oder Landschaftsfragmentierung sowie indirekte Beeinflussung wie erhöhte atmosphärischer Stickstoffeinträge zurückzuführen. Aus ökologischer Perspektive führt dies dazu, dass Wind keine Habitats für Pioniergesellschaften schaffen kann; die Folge ist eine Überalterung des Dünengebiets. Zudem stellt der Windtransport ein Förderband dar, das Sand vom Strand ins Hinterland transportiert. Langfristig trägt dies dazu bei, sandige Barrieren an einen steigenden Meeresspiegel anzupassen.

Aus diesen Gründen wird äolische Dynamik in Dünenfeldern entlang vieler Küstengebiete in Nordwesteuropa zunehmend wertgeschätzt und die Managementstrategien werden an diese Erkenntnisse angepasst. Auf der deutschen Nordseeinsel Sylt hat dieser Paradigmenwechsel bislang kaum stattgefunden. Auch dort ging in den vergangenen Jahren eine starke Stabilisierung der Dünenlandschaft mit einem Rückgang der Biodiversität einher. Welche Lehren lassen sich also für ein dynamischeres Dünenmanagement auf Sylt von anderswo ziehen?

Methodologie und Methoden

Mithilfe eines qualitativen Ansatzes geht diese Masterarbeit dieser Frage nach. Dieser Ansatz bezieht explizit sowohl die objektiven physikalischen Prozesse als auch die den menschlichen Eingriffen zugrundeliegenden subjektiven formellen und informellen Institutionen, mit ein. Die Westküste Sylts ist beispielsweise durch ein steiles Küstenvorfeld und recht grobes Sediment gekennzeichnet. Deswegen werden Küstendünen als komplexe, sogenannte „Gekoppelte Menschliche und Natürliche Systeme (Coupled Human And Natural Systems) konzipiert. Im Laufe der Zeit entwickeln sich diese nicht die sich nicht linear entwickeln und neue funktionsfähige Zustände erreichen. Als potentielle Spender wurden die Küstendünen Dänemarks und der Niederlande gewählt. Die drei Länder erstrecken sich entlang eines Dünenbandes mit ähnlichen geologischen, klimatischen und ökologischen Charakteristika. Auch in Bezug auf die formellen Institutionen und Wirtschaftskraft ähneln sich die drei Systeme. Neben politischen Dokumenten wurden 14 semistrukturierte Interviews und einige aktuelle wissenschaftliche Präsentationen verwendet, um konzeptionelle Modelle der drei Systeme und ihrer Managementstrategien zu entwickeln.

Ergebnisse

Fünf Lektionen wurden aus den niederländischen und dänischen Dünenmanagementstrategien abgeleitet. Der dänische Ansatz, natürliche Dynamik einschließlich Küstenrückzug zuzulassen, ist gegenwärtig weder akzeptierbar noch praktikabel. Gleiches gilt für den Ansatz des dänischen Nationalparks Thy, die Öffentlichkeit sehr stark und formell in den Managementprozess für die Naturgebiete zu integrieren.

Im Gegensatz dazu ist die niederländische Strategie, äolische Dynamik wo immer möglich, zuzulassen und das vom Strand ins Hinterland transportierte Sediment durch Strandvorspülungen zu kompensieren, generell praktikabel und wünschenswert. Für diesen Ansatz sind die gegenwärtigen Mengen, die an Sylts Westküste vorgespült werden, nicht ausreichend. Höherer Sandersatz sollte zunächst ein flacheres Profil im Küstenvorfeld geschaffen werden, um übermäßigen Abtransport ehe im Anschluss Vordünen nicht mehr befestigt werden und

Der dänische Ansatz zur Erhaltung einer Kulturlandschaft und die niederländische Dünen multifunktional gemäß den aktuellen gesellschaftlichen und ökologischen Erfordernissen zu bewirtschaften sind prinzipiell beide praktikabel und wünschenswert, sofern sie an die institutionellen und physischen Besonderheiten von Sylt angepasst werden.

No	Lehre	Beurteilung	
1	Natürlichen Küstenrückgang, wo möglich zulassen	Weder praktikabel noch wünschenswert	
2	Starke Einbindung der Öffentlichkeit in den Managementprozess der Naturgebiete	Weder praktikabel noch wünschenswert	
3	Bewahrung der Kulturlandschaft Dünenheide	Ungewollte technische Lösung? <i>ODER</i>	Praktikabel und wünschenswert?
4	Intensives, multifunktionelles Management von Dünengebieten		
5	Dynamisches Vordünen-Management	Praktikabel und wünschenswert	

Zu diesen institutionellen Besonderheiten gehört eine besonders stark ausgeprägte Ablehnung von Sandflug, die sich im Motto „Dünenschutz ist Inselschutz“ manifestiert.

Diskussion und Schlussfolgerungen

Um an geeigneten Stellen ein dynamischeres Dünenmanagement zu initiieren, müssen diese Lehren in eine breitere Strategie für einen tiefgreifenden Politikwechsels in den Dünen eingebunden werden. Diese strategische Änderung wird dafür in drei Ebenen, nämlich das Management der Vordünen sowie der sekundären Inlanddünen und eine konzertierte Öffentlichkeitsarbeit. Weiterhin sollte zwischen Zielen die kurzfristig erreichbar sind, wie eine Sicherung der gegenwärtigen Artenvielfalt und längerfristigen Zielen wie dynamischeren Vordünen oder eines deutlich gewandelten öffentlichen Ansehens der Dünen. Generell kann eine qualitative Perspektive das Management von Küstendünen bereichern; um das Potential voll auszuschöpfen, sollte sie mit quantitativen Untersuchungen kombiniert werden.

List of abbreviations

Abbreviation	Meaning
a BP	Years before present (i.e. 1950)
BfN	Bundesamt für Naturschutz (German national authority for nature conservation)
BMEL	Bundesministerium für Ernährung und Landwirtschaft (German ministry for nutrition and agriculture)
AWI	Alfred-Wegener-Institute for Polar and Marine Research
CHANS	Coupled Human And Natural System
IenM	Ministerie van Infrastructuur en Milieu (Dutch Ministry for Infrastructure and the Environment)
IenW	Ministerie van Infrastructuur en Waterstaat” (Dutch Ministry of Infrastructure and Water Management)
LKN.SH	Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz des Landes Schleswig-Holstein (Federal authority for coastal protection, National Park and Marine Protection of the State of Schleswig-Holstein)
LLUR	Landesamt für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (Federal Authority for agriculture, environment, and rural areas)
MELUR.SH (until 2017)	Ministerium für Energiewende, Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (Ministry for energy transition, agriculture, environment and rural areas of the State of Schleswig Holstein)
MELUND (since 2017)	Ministerium für Energiewende, Landwirtschaft, Umwelt, Natur und Digitalisierung des Landes Schleswig-Holstein (Ministry for energy transition, agriculture, environment, nature and digitalisation of the State of Schleswig Holstein)
NLWKN	Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (Federal authority for coastal protection, National Park and Marine Protection of the State of Lower Saxony)
NST	Naturstyrelsen (National authority responsible for nature protection)
RWS	Rijkswaterstaat (national coastal protection authority of The Netherlands)
SBB	Staatsbosbeheer (National forestry agency, also responsible for nature conservation on national property)
SF	Sölring Forining (Regional nature and heritage conservation society on the island of Sylt in Schleswig-Holstein)

SW	Naturschutzgesellschaft Schutzstation Wattenmeer e.V. (Regional nature conservation trust at the Wadden Sea of Schleswig-Holstein)
UNB-NF	Untere Naturschutzbehörde des Kreises Nordfriesland (Nature Conservation Agency of the administrative district of North Frisia)
WWF	World Wide Fund for nature

List of Tables

Table 1: Different institutional levels according to Jong and Mamadouh (2002).....	19
Table 2: Desirability and Practicability of a lesson according to Rose (1991, 2002)	19
Table 3: Ecosystem services provided by coastal dunes according to Pérez-Marqueo et al. (2013, p. 291). Important services within the context of this study are highlighted in bold	29
Table 4: Comparison of the national expenditures of F = France, B = Belgium, NL = The Netherlands, D =Germany and DK = Denmark.	36
Table 5: List of the seminar talks used within this study	40
Table 6: List of the interviews conducted. The questionnaires and interview summaries for each interview are listed in the Appendix.....	43
Table 7: This study derives these five lessons from the Netherlands and Denmark	69
Table 8: Strategic evaluation of the lesson: Manage coastal retreat where it poses no threat	70
Table 9: Strategic evaluation of the lesson: Use more public participation in the management of the nature areas on Sylt	71
Table 10: Strategic evaluation of lesson: Strive to maintain the cultural dune heath landscape.....	73
Table 11: Strategic evaluation of the lesson: Intense, multifunctional management of dune fields..	74
Table 12: Strategic evaluation of the lesson: Introduce dynamic foredune management.....	76
Table 13: Summarized results of the evaluation of the five lessons.....	78

List of Figures

- Figure 1: A) A ribbon of dunes (yellow) lines the south-eastern North Sea coast. B): The island of Sylt consists of a glacial moraine core (brown), marshland (blue) and two spits with dunes (yellow). ... 11
- Figure 2: The waning of aeolian activities and the subsequent succession has been caused by the interplay of many human direct and indirect interventions 12
- Figure 3: Every lesson is both embedded in its own formal (left) and informal (right) institutional context on different levels, and receives a place within the domestic institutional network. Figure based on the typology of institutional levels as presented in Table 1. 17
- Figure 4: Within the framework of Spaans and Louw (2009), the red line marks the highest chances of success for different degrees of lesson drawing (lines) depending on the relation of the systems (columns): Transplantation or "Xeroxing" may happen only within countries whereas highly different policy systems merely support inspiration. 18
- Figure 5: Following dissatisfaction, Rose (2002) identifies 10 sequential steps for lesson-drawing, which he groups into three phases. The last phase is of minor importance here. 20
- Figure 6: Dunes form the uppermost part of the sediment sharing system of a beach. 23
- Figure 7: The morphological continuum described by Psuty (2004, p.18) links different morphological dune types to the sediment input to the beach, which decreases from the river mouth at the left towards the right. 24
- Figure 8: Dune morphologies: a) Without vegetation, the wind creates small, short-lived barchanoid dunes like here on Süderoogsand, Germany, 20.06.2017 b) When vegetation like *Elymus farctus* and *Ammophila arenaria* can establish, small embryonic dunes develop like here on Amrum (Germany) 11.11.16 c) Ongoing sediment input allows embryonic dunes (here covered with *Hockenya peploides* and *Elymus farctus*) to evolve into a foredune covered with *Ammophila arenaria* 13.05.2019, Hulsig, DK d) Winter storms have eroded a fore dune on, Spiekeroog, 01.03.2014. At such dune cliffs, the sand is exposed to wind erosion and thus might initiate aeolian dynamics. e) Aeolian erosion turn small blwouts into secondary, parabolic dunes, which eventually detach from the beach, Amrum, 20.06.2017 f) The migrating dunes Raabjerg mile covers the pine forest as it traverses from west (right) to east (left), Hulsig, DK, 21.09.2016 255
- Figure 9: Aeolian transport and marine washovers act as a conveyor belt for sediments, which allows the sandy spit to adjust to a rising sea-level 26
- Figure 10: With increasing distance from the coast, the decreasing sediment supply leads to decreasing amount of nutrient supply and hence ecological succession proceeds. 28
- Figure 11: Migrating dunes set back vegetation on a large scale. 288
- Figure 12: Environmental factors and human actions support (+) or hamper (-) the growth of plants and therefore increase or decrease the mobility or stability of coastal dunes..... 30
- Figure 13: The comparison of a topographic map from 1878 dunes with recent monitoring data on vegetation illustrates that Sylt underwent drastic changes within the last 150 years: Increased and different land-use resulted in more permanent immobile settlements and also stabilised the dunes. By means of a classification scheme, both datasets were made comparable. More information is provided in Appendix I 34
- Figure 14: The conceptual framework distinguishes between the three levels of both formal and informal institutions that make up the particular dune management strategy and their interaction with the physical landscape. The most important policy fields are nature conservation and coastal protection. 388
- Figure 15: The slightly altered SWOT scheme allows to strategically assess the practicability and desirability of lessons separately..... 39
- Figure 16: Flow chart depicting the research process. The rectangles refer to the steps for lesson drawing from Rose (2002), the rectangles with the rounded corners to the sub-research questions, the ellipses refer to elements from methodology and methods and the rhombes represent intermediate results. Numbers and letters in brackets refer to passages in the text. CM stands for Conceptual Model, NL refers to the Netherlands and DK to Denmark. The methods are almost exclusively qualitative, merely at one place, a quantitative GIS analysis was used. 45

Figure 17: When nourishing, the sediment deposition happens either directly on the beach (top) or in the foreshore area (below)	47
Figure 18: Each nature reserve on the island of Sylt is accompanied by a non-governmental organisation as a warden. For the dune areas, these are the “Sölring Foring” (SF) and the “Schutzstation Wattenmeer (SW) The "Naturschutzgemeinschaft Sylt" (NSG) takes care of two heathland areas on the glacial moraine core.....	48
Figure 19: Signs bearing the slogan "Dünenschutz ist Inselchutz" (Protecting dunes protects the island, a) still can be found in the dunes although the marram plantations (b) have long been succeeded by heathland. Noter the year 1943 written on the sign.	49
Figure 20: Typically, the hiking trails through the dunes run straight from the street and the parking places through the dunes to the beach. This is illustrated by figures B and C. A shows the location of B and C.	50
Figure 21: Barbed wire and signs should separate the sensitive nature from human destruction. The sign on the right states: “Do not enter! The dunefield is protected as a nature reserve! Only the four-legged sheep may use the elephant paths!!”	51
Figure 22: Raabe (1964, p.174) distinguished between the natural coastal heathlands of the dunes (XXX) and the heathlands on the moraine cores that were the result of human use ().....	52
Figure 23: Conceptual Model for the dune management approaches on the island on Sylt, here represented by the flag of the district of North Frisia.	52
Figure 24: Impressions from the dunes on Sylt: a) Foredunes with a small sand-drift dike in front of the foredunes, 28.08.2016 b) Stabilised Foredunes at the west coast, 28.08.16 c) Dune slack close to Rantum, 19.03.16 d) Stabilised dunes and one of the last migrating dunes in the Listland dune field	53
Figure 25: 300 out of 400 km of Dutch coastline are lined by coastal dunes	54
Figure 26: The zoning plan for the Meijendeel dunes north of The Hague	57
Figure 27: The conceptual model for the Dutch dune management strategy	58
Figure 28: Impressions from Dutch coastal dunes: Dynamic dune management: a) Blowout in the foredunes. Source: (Beeldbank RWS, 02.08.11, ID: 411796) b) Large-scale dune mobilisation on Terschelling. Source (Beeldbank RWS, 25.03.2007, ID: 298044)	59
Figure 30: 800 km ² of coastal dunes line the Jutish North Sea coast. Dune fields explicitly referred to in the text are indicated. Source: (Bohn and Gollub 2004)	60
Figure 31: The current joint agreement for the Jutish west coast stipulates how much coastal retreat is acceptable for each coastal segment; here indicated in blue. Grey marks the calculated coastal retreat without nourishment. Blue lines indicate areas without coastal protection.....	62
Figure 32: The conceptual model of the Danish dune management strategies.	65
Figure 33: Impressions from the Danish coastal dunes. Undisturbed natural processes: a) At some places, where the coast is allowed to retreat, this causes bunkers from WWII to fall off the dunes and end up on the beach like at Hirtshals, 22.09.2016 b) Coastal erosion close to Skagen intersects the foredunes and creates blowouts, 21.09.2016.	66
Figure 34: At two sites at the northern spit, no human assets are located until 500 m behind the foredune. Once the foreshore has been further stabilised and there is enough sediment available, foredune stabilisation could stop there.	77
Figure 35: Suggestive sketch, how the three lessons can be incorporated into a strategy for a far-reaching policy change in coastal dune management on Sylt.....	79

Table of contents

Abstract.....	1
German Summary.....	2
List of abbreviations	4
List of Tables	5
List of Figures.....	6
Table of contents	8
1. Introduction.....	10
1.1. Dune Stabilisation: a widespread phenomenon	10
1.2. The specific challenges of Sylt (Germany).....	10
1.3. Drawing lessons from dynamic dune management.....	13
1.4. Research question.....	14
1.5. Outline of the thesis.....	15
2. Theoretical background.....	15
2.1. Lesson drawing	15
2.1.1. Motivation for lesson drawing	15
2.1.2. General ideas behind lesson drawing	16
2.1.3. Perspectives on the institutional context.....	17
2.2. Ten steps for lesson drawing.....	20
2.2.1. Looking for policies elsewhere	20
2.2.2. Transforming lessons into policies	21
2.3. Humans and coastal dunes. A complex relationship.....	22
2.3.1. Coastal dunes: shaped by sand, wind and plants.....	23
2.3.2. Coastal Dunes as a sediment conveyor belt for spits and barrier islands.....	26
2.3.3. Ecological succession of dunes.....	27
2.3.4. Human use of dunes	29
2.3.5. Introducing ‘Dune Management’	31
2.3.6. Coastal dunes as Coupled Human And Natural Systems (CHANS)	32
3. Methodology	35
3.1. Qualitative research approach	35
3.2. The Netherland and Denmark as potential donors	35
3.3. Conceptual Model of dune management.....	37
3.4. Strategic evaluation of the lessons.....	38
3.5. Data collection	39
3.5.1. Literature analysis.....	39
3.5.2. Seminar talks.....	40
3.5.3. Semi-structured interviews	41
3.5.4. Ethical standards	43
3.6. The research process	44

4.	Results.....	46
4.1.	Dune Management on Sylt.....	46
4.1.1.	Characteristics of the coast of Sylt.....	46
4.1.2.	Formal institutions	46
4.1.3.	“Protecting dunes protects the island”	49
4.1.4.	Other informal institutions	50
4.1.5.	Effects on the landscape	54
4.2.	Dune Management in the Netherlands	54
4.2.1.	Characteristics of the Dutch coastal landscape.....	54
4.2.2.	Formal institutions	55
4.2.3.	Informal institutions	56
4.2.4.	Effects on the landscape	60
4.3.	Dune Management in Denmark	60
4.3.1.	Physical Characteristics of the Danish west coast	60
4.3.2.	Formal Institutions.....	61
4.3.3.	Informal Institutions	63
4.3.4.	Effects on the landscape	65
5.	Discussion.....	67
5.1.	Methodological considerations.....	67
5.2.	Missing vision for the dunes on Sylt.....	67
5.3.	Strategic evaluation of the lessons.....	68
5.3.1.	Manage coastal retreat wherever it poses no threat	69
5.3.2.	Use more public participation in the management of the nature areas on Sylt.....	71
5.3.3.	Strive to maintain the cultural dune heath landscape.....	71
5.3.4.	Intense, multifunctional management of dune fields	74
5.3.5.	Introduce dynamic foredune management.....	75
5.4.	A transition perspective on lessons	77
6.	Conclusions.....	81
6.1.	Lesson drawing as an appropriate approach for coastal dune management	81
6.2.	Lessons for the dunes on Sylt.....	82
	Acknowledgements.....	83
	Publication bibliography	84
	Appendices	x

1. Introduction

1.1. Dune Stabilisation: a widespread phenomenon

Coastal dunes are an important part of the long winding European coastline (Heslenfeld et al. 2004, p. 336). Despite different climatic circumstances, coastal dunes develop at every sandy beach that is sufficiently large enough. There, the interplay of sediment, wind and plants create dunes which then connect the terrestrial with the marine sphere (Martínez et al. 2004, p. 4; Warren 2013, p. 112). Many dune plants are highly adapted to the harsh environmental conditions, which are characterized by low availability of nutrients and water, extreme temperature, aeolian sediment relocation and salt spray (Martínez et al. 2013, p. 4). Biodiversity, though, is only one of the many services coastal dunes provide to humans; others include the provision of soil and food, cultural value, purification as well as the storage of fresh water and the protection of coastal flooding (Pérez-Marqueo et al. 2013, p. 291). For many millennia, thus, humans have been using coastal dunes by growing crops, grazing livestock, forestry, etc. In some cases this resulted in over-exploitation of the dunes and increased aeolian activity (Provoost et al. 2011).

This pattern has changed drastically during the course of the 20th century. In Europe, more than 25 % of Europe's coastal dunes have been destroyed since 1900 and 55 % of the remainder has been altered drastically (Heslenfeld et al. 2004, p. 336). Increased dune stabilization has become a wide-spread phenomenon on many European coastal dune fields. This often was the result of a decline in agricultural use, dune stabilization, collapsing rabbit populations and increased atmospheric nitrogen deposition (Provoost et al. 2011). Nevertheless, dunes still remain important for the people in their vicinity as they provide fresh water and space for recreation and shelter from coastal flooding. These services, though, require greater dune mobility (van der Biest et al. 2017).

This is also true for the ribbon of dunes that fringes of the southern and south-eastern coast of the North Sea from Calais (France) to Skagen (Denmark, see Figure 1A). Along this coastal stretch of more than 1,100 km, many large scale dunefields can be found. They both exist at the mainland coast as on the chain of barrier islands that separate the tidal flats of the Wadden Sea from the open North Sea (Heslenfeld et al. 2004, p. 337). Also there, dune fixation is considered a large problem (Groot et al. 2017a; Oost et al. 2012).

1.2. The specific challenges of Sylt (Germany)

The island of Sylt is a large link within this chain of barrier islands; it is located at the west coast of Schleswig-Holstein (Germany, see Figure 1A): Sylt comprises an area of about 99 km² and has mostly developed around Pleistocene moraine cores. When sea-level rose after the last glacial period, the erosion of these cores provided the material for the formation of two elongated spits pointing in southern and northern direction (Bayerl and Higelke 1994; Tillmann and Wunderlich 2013). The combination of the solid core with two spits give the islands its characteristic shape and its overall

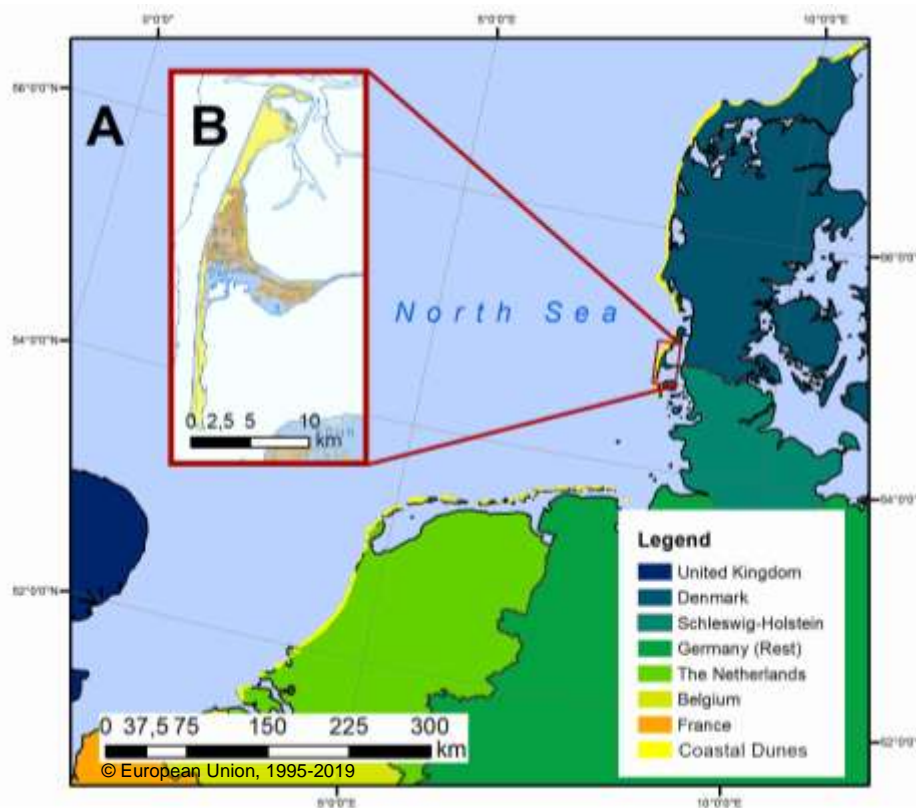


Figure 1: A) A ribbon of dunes (yellow) lines the south-eastern North Sea coast. B): The island of Sylt consists of a glacial moraine core (brown), marshland (blue) and two spits with dunes (yellow). Sources: (Bohn and Gollub 2004; Kaufhold 2012)

length of almost 40 km (see Figure 1B). On these spits, dunes carried sediment from the eroding western beach to the sheltered eastern back-barrier beach. Besides *washover* events during storm tides, this conveyor belt of sediments has allowed the spits to adapt both vertically and horizontally to the rising sea-level for centuries (Lindhorst et al. 2008; Priesmeier 1970; Tillmann and Wunderlich 2013).

However, already Priesmeier (1970) observed that aeolian dynamics on the northern spit were seizing. Following a phase with high dune mobility (Bartels 2013, pp. 20–24), a phase of rigorous dune fixation commenced in the mid-19th century. Since then, the island has increasingly become a popular and crowded tourist destination (Schlaugat 2013, p. 204). With more than 600,000 guests spending more than 4.5 million nights on the island in 2017, Sylt is an important regional touristic hotspot (Insel Sylt Tourismus-Service GmbH 2018). To protect the new, touristic infrastructure, foredunes and mobile dunes were planted with marram grass (*Ammophila arenaria*) and trees like Black pine (*Pinus nigra*) and the non-native Japanese rose (*Rosa rugosa*). Once the dunes were fixed, succession started and was supported by increased atmospheric nitrogen deposition as well as the steady decline in traditional land-use forms like sod-cutting and grazing. The introduction of beach nourishment as the main form of coastal protection since 1972 also prevented the re-initiation of aeolian dynamics (Osswald et al. 2019). Today, only three mobile dunes continue their journey across the spit. For a transect across the Northern spit, Osswald et al. (2019) reconstructed, that in

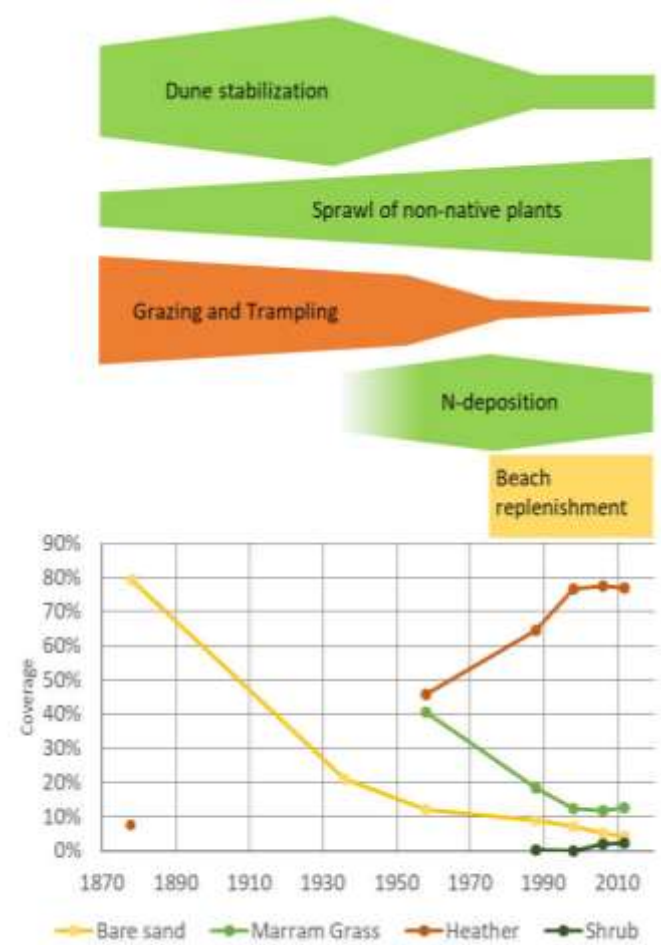


Figure 2: The waning of aeolian activities and the subsequent succession has been caused by the interplay of many human direct and indirect interventions. Source: (Osswald et al. 2019)

1878 almost 80 % of the landscape was dominated by aeolian processes; this share steadily declined to less than 20 % in 2012. In turn, heathland expanded and was joined in the last decades by shrubs and trees (see Figure 2).

This development has serious impacts: First, the waned sediment conveyor belt makes it impossible for the spit to adjust vertically and horizontally to the rising sea-level in the long run (Oost et al. 2012). Given the expected sea-level rise as a consequence of anthropogenic climate change, the island needs a high adaptive capacity to face fast rising water levels. Depending on the study and the scenario chosen, the sea-level in the North Sea is likely to rise about 10 to ca. 100 cm until 2100 and will continue to rise after 2100 (Oost et al. 2017). According to Bamber et al. (2019), the global sea-level rise might even reach 2 m until 2100. The consequences of these high-end scenarios can be assessed best by taking a look back

into the time. During the Holocene transgression, sea-level in the southern North Sea rose approx. 1.25 m per century between 5,000 and 7,000 a BP. The barrier islands of the North Sea, however, did only fully develop when sea-level rise decelerated. During the last 3,000 years, the average sea-level increased much slower with ca. 11 cm per century (Behre 2007). Nevertheless, Sylt faced serious erosion during these millennia.

The second, short term consequence of over-stabilization is a threat of a substantial loss in biodiversity (Shanmugam and Barnsley 2002). Once aeolian activity has seized a succession towards the climax state sets in - at the expense of pioneer and early succession stages. On the other hand, a new established patch where wind erosion can remove soil and sediment provides habitat for such pioneer species (Arens et al. 2013b, pp. 110–111; Groot et al. 2017a). Furthermore, waning aeolian dynamics cause the particular sensitive habitats of wet dune slacks to shrink as they are encroached by vegetation (Shanmugam and Barnsley 2002). On Sylt, many endangered plant species like the bog pondweed (*Potamogeton polygonifolius*) or the bog orchid (*Hammarbya paludosa*) grow in wet dune slacks (Haacks et al. 2015). These are also an important refuge for the Natterjack Toad (*Bufo calamita*) (Grosse et al. 2006). As these dune slacks are increasingly encroached with vegetation, the population of *Bufo calamita* is shrinking. As this species is strongly protected according to Annex IV of the EU Council Directive 92/43/EC (The 'Habitats directive'), their population must be

maintained (Sölring Foriining et al. 2016). Given this undesirable state, proceeding with the current management approach poses no option.

1.3. Drawing lessons from dynamic dune management

In general, there is no lack of ideas how to alter this undesirable state. Re-initiation of dune mobility on the German Wadden islands has been demanded e.g. by Oost et al. (2012). For, the island of Sylt, Osswald et al. (2019) suggest to nourish more sand to the western beach while not suppressing aeolian dynamics by marram plantations and brushwood fencing. Furthermore, tunnels might be able to conciliate the conflict between migrating dunes and static roads (Osswald et al. 2019; Reise and MacLean 2015, p. 79). However, no measures have been taken to 'reactivate' the dunes so far.

However, dune stabilization is no exclusive problem of Sylt. As reviewed by Provoost et al. (2011), many coastal dune fields are currently experiencing increased stabilization. Therefore, it makes sense to take a look at the strategies elsewhere to counteract a certain problem, since ideas that have been proven successful elsewhere are usually more convincing than pure speculation (Rose 1991). In Schleswig-Holstein, for instance, the Environmental Ministry (MELUR-SH) and the World Wide Fund for nature (WWF) conducted a joint study on climate adaptation measures at sedimentary coasts around the globe (WWF Deutschland 2015).

In general, lesson drawing is about learning from strategies and policies elsewhere and adapt lessons for the own context (Rose 1991, 2002). Thus, it is not only about *what* to do, but also about *how* to do it. The way humans are interfering with e.g. dune landscapes on Sylt and elsewhere are not only guided by the physical surrounding. Instead, also institutions, i.e. by norms, regulations and shared strategies play a major role (Crawford and Ostrom 1995). A classic example would be the wide-spread ban of leaving the paths within dunes to prevent damage to the marram grass. This ban has far-reaching implications for the ecological and geological reality of dunes (Reise and MacLean 2018, p. 176). Other examples include regulations about coastal and nature protection or rules about the responsibility of certain actors. Therefore, this study not only wants to look at ideas that have been developed elsewhere, but also at how they are implemented.

As rules vary from place to place, this of course sets limits to the potential of draw lessons. What did work elsewhere, does not necessarily need to work within the own context. Nevertheless, drawing lessons from other cases bears large potential for improving a situation at hand (Dolowitz and Marsh 1996; Rose 1991). The examination of several case studies has shown that policies tend to have greater success if they use more than one potential donor policy (de Jong et al. 2002, p. 288). Hence, this study looks at two potential donor countries: 1) The Netherlands and 2) Denmark.

1.4. Research question

Thus, this thesis aims to examine and find answers to the question: *What physical and institutional elements of the Dutch and Danish coastal dune management strategies are suitable and desirable for a more dynamic dune management strategy on the island of Sylt (Germany)?*

Arguably, this question needs to be broken down into further sub-questions. Besides a general, robust understanding of lesson drawing and coastal dune management, it especially needs detailed understanding of the particular local situations in their context. Thus, important sub questions are:

1. *What are typical physical features and institutions that shape the dune-management strategies on Sylt, in the Netherlands and in Denmark?*
2. *What lessons can be drawn from the donor countries? This includes also lessons on what not to do (Rose 1991).*
3. *Which strategies are actually desirable and practicable for the context of Sylt?*

Answering these questions and comparing the different situations thus allows to formulate and discuss potential lessons that could contribute to a more dynamic dune management strategy on Sylt. As Clarke and Rendell (2015) argue, besides the objective physical characteristics, i.e. the geological and ecological features and processes, also social aspects, such as the human use of the dunes and the rules and ideas that underlie this use, need to be studied. Once more, the whole is more than the sum of its parts. Within this study, coastal dunes are therefore conceptualized as Coupled Human And Natural Systems (CHANS) (Liu et al. 2007a). Besides this practical relevance, examining coastal dune management from a qualitative point of view adds a seldom perspective on the multidisciplinary discussion about coastal dune management. First, whereas many studies quantitatively examine the physical consequences of a specific policy on coastal dunes like Bakker et al. (2012) or Arens et al. (2013b), this study instead picks up the plea of Clarke and Rendell (2015) asking dune management to not focus solely on the habitats of coastal dunes, but also to the human communities and their historic development that co-created them. Following Hesse-Biber (2017, p. 12) this acknowledges the existence of more than objective ‘truth’.

Second, this study is case-oriented and emphasizes the particular contexts. By contrast, Oost et al. (2012) have developed a framework for future, dynamic barrier-island management, which includes also dunes. Their study clearly addresses the physical problems resulting from shortcomings of current strategies and provides a framework based on the generic ideas of Integrated Coastal Zone Management (ICZM) and the physical processes. However, their study area crosses several countries with different legislations and institutions. Here, a different approach is chosen, which aims to find a tailor-made solution for a particular case. In doing so, not only empirical findings play a role, but also *Phronesis*, which Flyvbjerg (2006) circumscribes with practical knowledge and ethics.

1.5. Outline of the thesis

The sub-questions raised above also guide the structure of the thesis: In chapter 2, the basic ideas and concepts behind lesson drawing are explained. Furthermore, dune landscapes are conceptualized as dynamic CHANS and their basic processes are described as well. This concept helps to make sense of the information gathered through this research. Chapter 3 explains the tools being used to collect data and information, namely the analysis of policy documents and semi-structured interviews. In the following, Chapter 4 depicts the cases accordingly. The presentation and discussion of the lessons as well as of the concepts and methods used is done in Chapter 5. Eventually, the conclusions proposed in Chapter 6 complete the study.

2. Theoretical background

2.1. Lesson drawing

2.1.1. Motivation for lesson drawing

Being dissatisfied with the current state usually initiates the quest for a new strategy to overcome these flaws. But, how to rationally develop a new strategy? Rose (1991) suggests three options: The first is to search within the own past and current standard procedures: How capable are they of coping with the problem? Here, this arguably is no option, as the adverse consequences of dune fixation have been already described by Priesmeier (1970) and otherwise might have been solved already. Furthermore, the dune-management strategies on Sylt up to now have worsened the ecological state of the dunes (Osswald et al. 2019)

Then, the second option is to develop a new dune management strategy from scratch and basically by trial and error. Although Warren (2013, p. 208) argues, that this might be an option for the management of small dune fields, solutions that have worked elsewhere often are politically more legitimate than unbound and speculative ideas (Dolowitz and Marsh 1996; Rose 1991).

The last major option is to look elsewhere for institutional arrangements that have solved a similar problem. Another practical benefit is, that the wheel has not to be reinvented. Being not a frontrunner allows to observe the others experimenting and drawing conclusions from their successes. In case of urgent problems, this does not only saves costs but also time. The success of policies often depends on details (Rose 2002). Arguably, this seems a very promising solution in this case, as dune fixation is perceived as a problem at many other places (Provoost et al. 2011; Pye et al. 2014; Groot et al. 2017a).

Although this framework follows a convincing logic, James and Lodge (2003, p. 189) are doubtful whether lesson drawing can be separated from other forms of evidence-based policy as *“lesson drawing’ is broadly similar to conventional accounts of how policy-makers strive to make ‘rational’ policy decisions, especially if ‘lesson drawing’ is defined broadly as drawing positive and negative lessons across time and space.”*

Arguably, this general criticism is of merely theoretical importance. Although it might indeed not be a totally new form of policy, the frameworks of Rose (1991, 2002) help to draw lessons in a scientific

and professional manner. At the same time, the concepts of lesson drawing might be adjusted by other political theories. Therefore, the remainder of that chapter will develop a tailored perspective for drawing lessons for dynamic dune management on Sylt.

2.1.2. General ideas behind lesson drawing

When developing a concept for lesson drawing, it is important to first define, *what* a lesson is: The argumentation of Rose (1991, p. 7) provides a starting point, when he states that “*a lesson [...] is a conclusion about subject after the fact from observation or experience*”. Examining foreign strategies and practices leads to conclusions how the problem is solved elsewhere.

Whereas this definition is rather broad and incorporates almost everything from small justifications over procedures, programmes to ideologies (de Jong and Mamadouh 2002, p. 24), lesson drawing as defined by Rose (1991) is neither about the actual process of learning, nor is it dealing with the spread of big ideas or pure symbolism. Instead it focuses on concrete future- and action-oriented ideas for the development of a new policy. Also big ideas only can become effective when they are tied to real actions (Rose 2002). Although the concept of “resilience” as laid out by Folke (2006) is important for flood protection and climate adaptation, it remains too vague to be of practical use for lesson-drawing.

Lesson drawing is not just a privilege of governmental authorities; also local pressure groups, political parties or think tanks as well as individuals such as policy entrepreneurs, experts and consultants may look elsewhere for lessons to learn, alter them and combine them according to their preferences and ideas.

Lessons, though, cannot simply be copied and implemented within the own system, as the potential donor’s institutional arrangements deviate from the own. Instead, generic lessons about the donor’s policy need to be adapted to provided tailored fit to the recipient. Often, high hopes are connected with the adaptation of a foreign policy, yet, it has happened that a certain policy did not work as expected or even at all (de Jong and Mamadouh 2002, p. 27). Even best-practice policies that axiomatically are supposed to work everywhere, might fail under the special, domestic circumstances. Pagonis and Thornley (2002, 181 f.) conclude from their case study on urban development projects in Moscow that the neo-liberal attempts of market involvement within these projects were cushioned by the still prevailing power of the former Soviet city administration. So, the following question is decisive: “Under what circumstances and to what extent will a programme that works there also work here?” (Rose 2002, p. 5).

Consequently, this question cannot be answered from a quantitative point of view alone. As Hennink et al. (2011, p. 12) argues, an interpretive and thus also constructivist approach is more capable of understanding the varying reasons, paradigms and cultural influences on a subject of interest. These paradigms reject the positivist assumption of one overall truth or solution lying hidden and waiting to be discovered (Rose 1991; Hesse-Biber 2017, p. 12).

On the other hand, Rose (1991) states that “[...] *technical feasibility is taken for granted in abstract theories of social science that assume perfect fungibility*.” Albeit a car running in summer in Death Valley might also work at wintertime in Fairbanks, Alaska, this study has to take into account the

objective physical realities, which exist independent from the ideas of humans. Taking a global perspective Martínez et al. (2013, p. 1) report that dunes can be found under almost every climatic conditions, at prograding or retreating coastlines with a macro- or a micro-tidal influence. However, these characteristics do influence the behaviour of the dunes and set limits to the will and the ideas behind intervention. So the question can be rephrased holistically: Is the lesson observed actually helpful to solve the problem within the own technical and institutional context?

2.1.3. Perspectives on the institutional context

The question of fit is hardly answerable with empirical facts as it is a matter of perspective on institutions. Although these can vary greatly, they rest on the same basic assumptions: In general, *“institutions are enduring regularities of human action in situations structured by rules, norms, and shared strategies, as well as by the physical world. The rules, norms, and shared strategies are constituted and reconstituted by human interaction in frequently occurring or repetitive situations.”* (Crawford and Ostrom 1995, p. 582). Furthermore, common literature distinguishes between formal institutions, which contain all the rules and arrangements developed and enforced by official channels, who also execute punishments in case of disobedience and informal institutions. They include all the rules that exist and are enforced outside official channels. Being usually unwritten and not defined explicitly, they usually are rather vague and more difficult to grasp. Informal and formal institution may be in line with each other or conflicting (Helmke and Levitsky 2004).

Furthermore, de Jong and Mamadouh (2002) distinguish three different, yet interrelated and nested levels of institutions following Ostrom (1982). All of them are interesting for lesson-drawing. The highest is *the constitutional level*. It provides the overarching institutional background, in front of

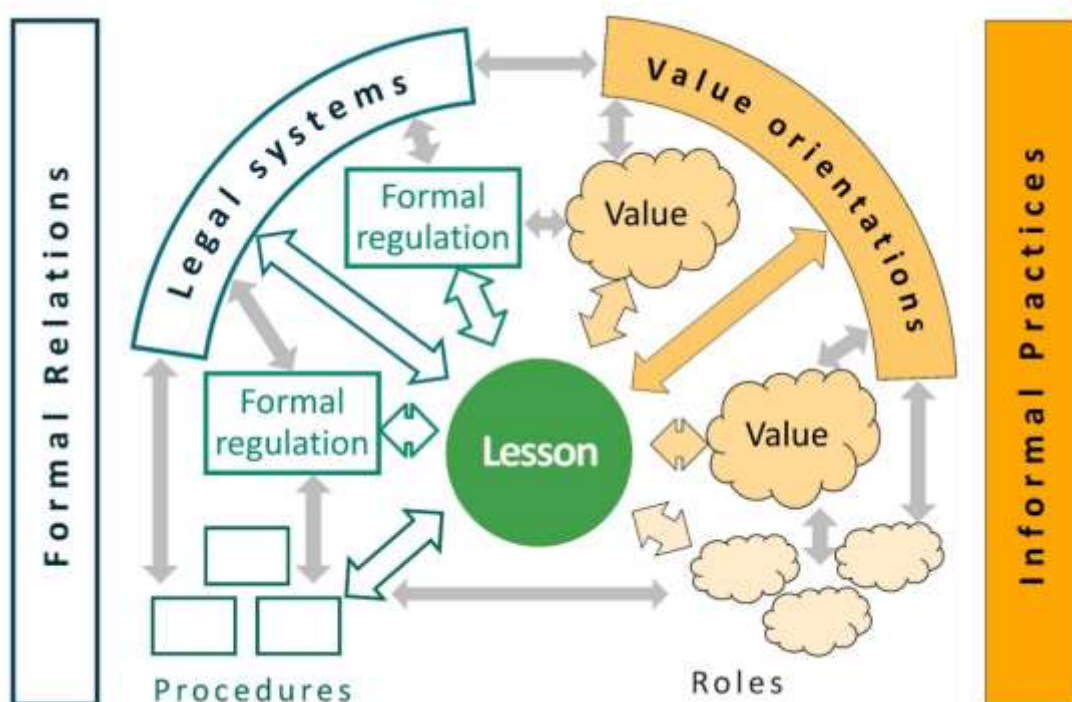


Figure 3: Every lesson is both embedded in its own formal (left) and informal (right) institutional context on different levels, and receives a place within the domestic institutional network. Figure based on the typology of institutional levels as presented in Table 1.

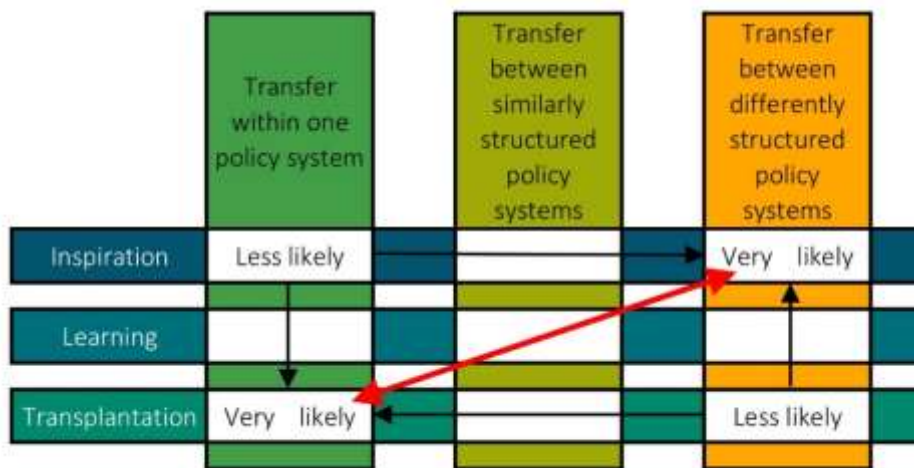


Figure 4: Within the framework of Spaans and Louw (2009), the red line marks the highest chances of success for different degrees of lesson drawing (lines) depending on the relation of the systems (columns): Transplantation or "Xeroxing" may happen only within countries whereas highly different policy systems merely support inspiration.

which decisions are made. Since the era of the enlightenment, for instance, the general perception has established, that mankind can and should tame virtually every force of nature in case it poses a danger. This perceived duty still underlies current coastal and dune management strategies (Jakubowski-Tiessen 2011).

The level of policy areas encompasses the different organisations and actors as well as their relations that develop, maintain and alter policies, programmes, etc. According to Alexander (2005), this is the level, which is most interesting, when it comes to the actual (re-)design of institutions.

The lowest level is *the operational level*: It comprises all the rules, ideas and activities which individual actors make use of when navigating through the operational level.

Combining the distinction between formal and informal as well as the three levels of institutions, de Jong and Mamadouh (2002, p. 23) have separated different, mutually influencing institutional domains (see Table 1). As every lesson contains one and more institutions, it both had a distinct place within the "donor" framework and will receive a place within the own institutional network (see Figure 3) Two perspectives have emerged to assess the "fit" of a lesson into the own institutional system.

The first perspective is very aware of the high interrelatedness of formal and informal institutions. This network has developed through time and is therefore quite resistant to change. This stickiness sets clear limits to purposeful intervention and is generally quite sceptical about adding foreign institutions into the own network. If it happens, it should be ensured, that the "donor" network is very similar to the "receiving" institutional network, so that the new institution "fits" in the domestic context (de Jong and Mamadouh 2002, pp. 26–29).

Table 1: Different institutional levels according to Jong and Mamadouh (2002).

Level of action	Formal Relations	Informal practices
Constitutional level (Ground rules)	Legal Systems	Value orientations
Level of policy area (relations between governmental bodies)	Formal regulations	Informal codes
Operational level (daily activities)	Procedures	Roles

An important idea for assessing the suitability of a lesson are the “families of nations”: According to the similarity of their legal culture and the philosophical and social roots, states can be grouped. The closer, two states (or other socio-cultural entities) are related, the more likely is it that a lesson might fit into its new context (Lalenis et al. 2002, p. 33). When taking a lesson from a donor country with very similar (different) socio-cultural system, a policy in general needs to manipulate that lesson less (more) (de Jong and Mamadouh 2002, pp. 26–29; Hytönen 2014). Spaans and Louw (2009) have developed a concept that relates the intensity of lesson drawing within one policy sector to the relationship of “donor” and “receiver”: Direct “Xeroxing” is merely possible within one country; de Jong et al. (2002, p. 290) argue that in the aftermath, the direct implementation of foreign policies often is considered a mistake. Similarly structured policy sector supports learning, whereas a very different “donor” provides hardly more than inspiration (see Figure 4). However, empirical studies also delivered evidence of rather direct implementation of lessons between very different systems (de Jong et al. 2002, pp. 288–289). Furthermore, de Jong and Haran (2002, p. 212) conclude from their case study about the refurbishment of the London Underground that also a transfer within the same ‘family’ can fail.

Such findings give rise to a more pragmatic perspective on lesson drawing. Their point of departure is that institutions are basically constructions of the human mind, that are constantly evolving and therefor can be adjusted to the own, current needs. From that point of view, there are only limited restrictions to add foreign policies to the own network of regulations and rules (de Jong and Mamadouh 2002, pp. 23–26). Rose (2002) furthermore argues, that a policy should remove all “irrelevant” historic-institutional “ballast” in order to develop a clear idea of the policy. Nevertheless, not everything that *could* be done, also *should* be done. Thus, Rose (1991) suggests a framework that incorporates both practicability and desirability as criteria (see Table 2). Implicitly, though, the *possibility* of implementing that lesson is not questioned.

Table 2: Desirability and Practicability of a lesson according to Rose (1991, 2002)

	High desirability	Low desirability
High practicality	Doubly attractive	Unwanted technical solution
Low practicality	Siren call	Doubly rejected

Consequently, this strategy prefers straight-forward policies that offer clear solutions for simple problems. The higher the inherent complexity of the problem and of the policy are, the lower are the

chances of success. Increased complexity makes it more difficult to predict the potential outcome of a policy transfer (Dolowitz and Marsh 1996).

These two perspectives are not excluding each other; together they rather supply a spectrum between a bold and optimistic attitude and a rather deterministic and cautious attitude. Arguably, both ends mark rather extreme perspectives. Only distinguishing between black and white might cause policies to be changed randomly or to be cemented. This study considers both ends and aims to navigate the shades of grey in between. This can happen by adapting the intensity of lesson drawing as described above or also by combining lessons from different countries. The latter also might increase the chance of a successful lesson implementation (de Jong et al. 2002, p. 288). Besides, also the complexity of the problem guides the quest for lessons.

2.2. Ten steps for lesson drawing

Rose (2002) describes 10 steps to structure the process of lesson drawing that can be applied regardless of the complexity of the problem (see Figure 5). Nevertheless, as every policy is individual stems from a unique background and should be introduced into a distinct institutional setting, lesson drawing is applied to particular context of the case at hand. The ten steps can be grouped into 2 phases:

2.2.1. Looking for policies elsewhere

Again, the dissatisfaction with a current state, marks the beginning for the quest for a solution. The first step then is a problem definition; important dimensions of a problem are both the perceived urgency and the scale of the problem. The perception of the problem guides the observation of foreign policies. There can be many differing and even contradicting perceptions of the problem, though. Depending on their own background, actors perceive different things as (most) important. Consequently, they also have different opinions about their favourite solution. In this context, also lesson drawing is just a tool, which – if used by different parties – can lead to differing results. Hence a robust, broad and thorough problem description is needed (Rose 2002).

Once the problem is defined precisely enough, the next question arises: Where to look for lessons? Within this second step, potential political entities to draw lessons from have to be identified. Supra-national alliances, nations, Federal states, municipalities can be such political entities. From that set of entities, then the most convincing, suitable have to be distilled and separated. This is an important step, as the selection of countries limits the lessons that can be drawn and therefore is highly responsible for the success of the policy (Rose 2002; de Jong and Mamadouh 2002, p. 27).

Having selected one or more donor, the third step is to study, how a certain policy contributes to solve the problem by rules and regulations. Rose (2002) stresses the importance of not only studying policy reports but also of having a closer look at the policy and investigating its actual effects by talking to people who are affected by this policy. Thereby, their satisfaction with the programme can be verified. However, every change produces winners and losers (de Jong and Mamadouh 2002, p. 20). Having grasped the effects of the policy allows to assess the actual success of a certain policy.

Having found a successful policy, the next step is to conceptualize a model of that policy. What causes lead to which effects? This step requires careful balancing of the cautious, context-aware end of the spectrum as well as its bold, creative counterpart. Rose (2002) argues that this model should include not more than the aspects that are utterly needed for a policy. These comprise the institutional – thus laws, regulations and rules –, the administrative, the personal requirements as well as the expected costs and the people affected. He also suggests, to remove all institutional “ballast” such as the history and the cultural context. But as argued in section 2.1.3, a different institutional context may cause a drawn lesson to end up as a flop rather than a great success. Therefore, it is indeed necessary to include the supporting or limiting contextual circumstances into this model.

2.2.2. Transforming lessons into policies

It is these differences within the institutional circumstances that often restrict direct “Xeroxing” or copying. Instead, the abstract model developed in step 4 has to be transformed into a new policy that fits the domestic framework. Step 5 is about designing a new policy: Rose (2002) argues that this is less depending on empirical findings than on experience and skill.

In theoretical terms, lesson drawing therefore has to move beyond the realm of *episteme*, as described by Flyvbjerg (2006, p. 359), who conceptualizes organizational research with the help of the three intellectual virtues defined by Aristotle; these are: *techne*, the mentioned *episteme* and, finally, *phronesis*. Whereas *techne* is of no relevance here, the difference between the latter two is decisive: *Techne* refers to universal, abiding knowledge, gained by rationality and empirical analysis; it forms the basis for the natural sciences (Flyvbjerg 2006, p. 359). *Phronesis*, though, is often connected “prudence” and “common sense”. It includes consulting about future-oriented actions based on close examination of the case at hand as well as consultation about moral values and interests, including power relations (Flyvbjerg 2006, pp. 360–362). Findings based on *phronesis* are a particular strength of the social sciences. Also lesson drawing strongly relates on *phronesis*. Why a certain lesson is drawn in that way or is altered not necessarily can be backed-up by empirical evidence but rather by arguments.

The following steps of Rose (2002) are basically crosschecking, whether this lesson is both desirable and practicable (see Table 2). As argued above, this should include both subjective institutional as objective physical opportunities and barriers. Within this study, Steps 6 to 9 are therefore merged into one step. These checks focus on different levels. Experts can judge by empirical methods - such as calculations - what the actual effects of this new policy might be; they can also put numbers to the resources needed.

However, it is also important to look for institutions and organization, this policy could be tied to. Basically, a suitable mesh within the complex web of existing, domestic institutions must be found. This, and the political fit, though, is no empirical question: Who would profit from that policy and how politically powerful are these actors? However, politics are a volatile field and the tides for the policy developed at hand thus might change in the future. Developing a new policy needs a future-oriented perspective. What is unthinkable today, might well be possible tomorrow. A lesson might be able to initiate a substantially different policy. Such a radical policy change is also termed a transition (Huitema et al. 2011).

But, how to design a policy that will stimulate change which is not yet acceptable? Huitema et al. (2011) describe five strategies that policy entrepreneurs make use of to start a transition:

1. *Developing new ideas*: Whereas there is often no lack of new concepts and strategies, these might be advertised and implemented in different ways. Where supra-national pressure is high, this might support or coerce the implementation of new concepts. On the other hand, ideas that stem from the inside of a country are more likely to be implemented in a bottom-up process. Also hybrids are possible.
2. *Building coalitions*: Coalitions of actors are more successful in spreading these ideas. These coalitions can be created by shared values, shared interests or just by being forced by external factors to cooperate. Within this network it is important to develop convincing, powerful narratives, to agree on minimum compromises and to involve also official administrative organizations.
3. *Timing*: Crises of the established policy constitute “windows of opportunity”, in which policy entrepreneurs may gain a hearing with the media and organization for their new ideas more easily. Both a sudden, external event as a political or organizational change can be a crisis. However, crises often are interpreted in several ways that both support or challenge the existing policy.
4. *Managing networks*: Beyond building coalitions for change it is also important to maintain good relationships within the existing organizational network and to involve experienced and influential actors therein.
5. *Venue shopping*: In many cases, issues are discussed parallel in several forums, like scientific seminars, political meetings, etc. These forums or venues can be manipulated by moving departments between ministries, installing committees, creating platforms for meetings, or by incorporating powerful stakeholders like the EU to increase pressure.

Especially for the early stage of a transition, Meadowcroft (2009) stresses the importance of developing policies that still fit the old system and the future one. Also Pilot projects are an option to prove the opportunities and limits of a policy. These findings support the development of new strategies and provide help when assessing their practicability.

This might also ease their conversion from a plan into an applied procedure. Once a lesson has been converted into a strategy, this strategy then has to be implemented into the institutional framework: the political sphere then takes over in Step 10 (see Figure 5). When arguing in favour of a new policy, it is these 5 strategies above that might help to introduce a policy transition based on lessons drawn elsewhere.

2.3. Humans and coastal dunes. A complex relationship

As described in section 2.2.1, the first step is a thorough understanding of the problem. This chapter provides a basic overview about the most important physical processes of coastal dune fields under temperate climate conditions as well as human use. Whereas paradigms and institutions steer the human interference with landscapes such as dunes, their reaction is determined by physical and ecological processes, which exist beyond interpretation. Anyway, these must be especially and thoroughly considered when designing lessons for coastal dunes. Therefore, this chapter starts with

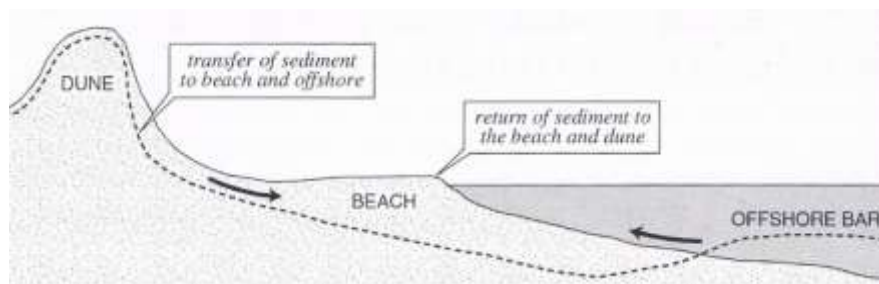


Figure 6: Dunes form the uppermost part of the sediment sharing system of a beach. Source: (Psuty 2004, p. 12)

a positivist perspective on dune processes. Where possible, these will be illustrated by examples from the dunes that fringe the southern North Sea.

2.3.1. Coastal dunes: shaped by sand, wind and plants

At many sandy coastlines of the globe, dunes connect the terrestrial with the marine sphere. They develop at sandy beaches under climatic conditions ranging from polar to tropical. Thus the particular interplay of sand, wind and vegetation create a great range of morphological features and habitats (Martínez et al. 2004, pp. 3–5).

Warren (2013, pp. 5–31) explains the physical processes behind aeolian transport in great detail; here this long story is cut short: Depending on the roughness of the surface, loose grains of unconsolidated sediment are transported by the wind as soon as the lift produced by this shear stress exceeds a particular threshold. It depends on a variety of factors such as the grain size and the amount of water stored in the sediment. Eventually, the interplay between aeolian erosion, transport and deposition and the form of the sediment body creates a small, barchan-like dune (Warren 2013, p. 41). Such dunes can be found on beaches or e.g. the North Frisian sand banks, where they are washed away again by the waves.

Unlike in desert dunes, the humid climate along the North Sea coast supports plant growth. Sherman and Hotta (1990, p. 24) describe, how vegetation increases the displacement height, at which aeolian transport starts, so that less sediment is lifted from the ground. Thereby, the vegetation increasingly traps sediment. A small embryonic dune is stabilized by vegetation. Van Puijenbroek et al. (2017) describe how the interplay of multiple factors influence the development of embryonic dunes. It is supported by a wide beach and much rain in the growing season, whereas a high storm intensity is detrimental to their development. Eventually, the small embryonic foredune develops into a foredune; the marram grass (*Ammophila arenaria*) is the most important plant contributing to dune growth (Warren 2013, p. 116). Along the North Sea foredunes can easily exceed 10 m in height. Basically, the development of dunes is determined by the interplay of wind, sand and marram.

The marine and aeolian processes shaping both beaches and dunes result in complex interactions (Warren 2013, p. 114). Psuty (2004, p. 22) has developed a conceptual model linking dune morphology to the spatial or temporal variation in sediment supply of the beach. As Figure 6 illustrates, these primary dunes form the uppermost part of the sediment-sharing system of a sandy

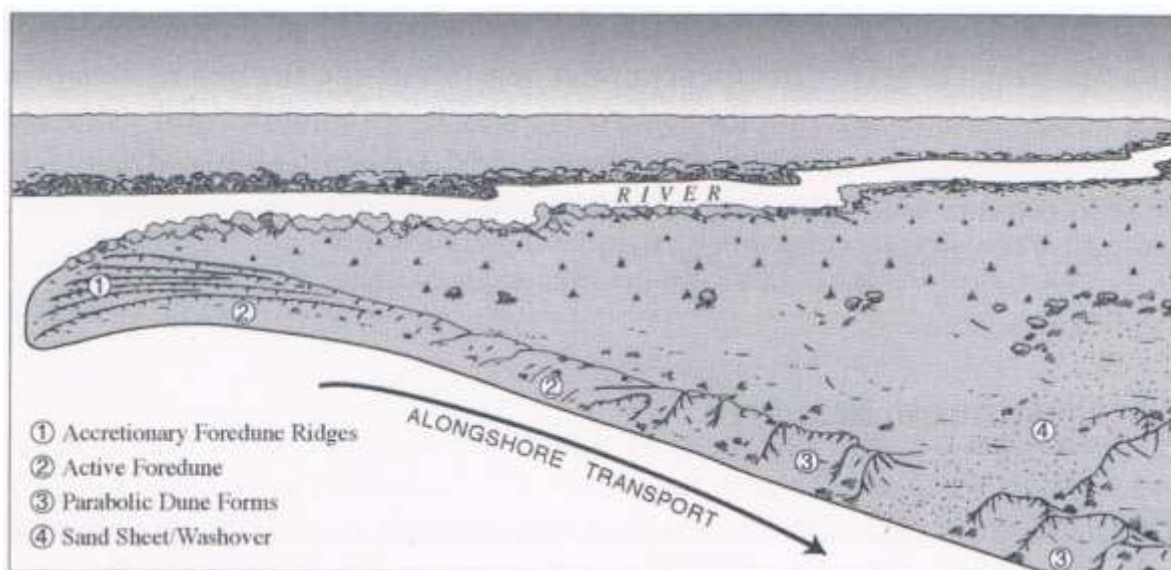


Figure 7: The morphological continuum described by Psuty (2004, p. 18) links different morphological dune types to the sediment input to the beach, which decreases from the river mouth at the left towards the right.

beach, which further includes the actual beach plain as well as the intertidal ridges and runnels as the subtidal bars.

Figure 7 illustrates that, high sediment input leads to a rapidly prograding beach. As dune ridges are forming in front of each other rather rapidly, the single ridges do not have much time to grow and thus they stay comparably low. The morphological result are many low dune crests running more or less parallel to the beach and are separated by coast-parallel valleys. Priesmeier (1970) describes that pattern for the northern hooked spit on Sylt, the Ellenbogen; it can also be found at the Southern end of Texel (the Netherlands). With less sediment supply to the beach, more sand is transported to the existing foredune ridge, which in turn grow bigger.

Also, under a slowly retreating beach, foredunes might be able to maintain their morphological integrity as long as the sediment transport behind the dunes equals the losses during storms. Psuty (1990, p. 175) has studied this process of a foredune retreating landward in detail on Fire Island (USA) and Priesmeier (1970) has observed this trend on Sylt, too. Within coastal retreat, single events that occur randomly like huge storms have a large impact, too. As described by Carter et al. (1990, pp. 218–223) wave and currents undercut the seaward slope of the dune, causing it to collapse and form a steep cliff. During calm periods, wind and plants stabilize the dune ridge. At these times, aeolian transport is also highest during storm events (Arens et al. 1995).

When the sediment budget becomes even more negative, though, the foredune loses too much sediment: Bare areas no longer close again, but turn into blowouts, from which large amounts of sediment are blown into the hinterland. Eventually, this blowouts might detach from the foredune and turn into a parabolic dune (Carter et al. 1990, p. 234). While the blowout is the central part of the dune, two vegetated arms often attach them to the foredune (Robertson-Rintoul 1990, p. 58). Sand is eroded from the deflation plain at the windward side of the dune and deposited at the slipface of the dune. Finally, at a heavily eroding beach, the dunes are washed away by storms, and the sea enters the hinterland, creating washover platforms (Psuty 2004, p. 19), which can be found on many

Drawing lessons from Denmark and the Netherlands for dynamic dune management on the island of Sylt (Germany)

of the Wadden islands, e.g. the “Leegde” on Spiekeroog (Germany) or “De Slufter” on Texel” (the Netherlands) (Groot et al. 2017b).

However, this model rather over-simplifies these processes. Masselink et al. (2014, p. 294) stress that the sediment budget of dunes and the beach change on different time scales. Additionally, Warren



Figure 8: Dune morphologies: a) Without vegetation, the wind creates small, short-lived barchanoid dunes like here on Süderoogsand, Germany, 20.06.2017 b) When vegetation like *Elymus farctus* and *Ammophila arenaria* can establish, small embryonic dunes develop like here on Amrum (Germany) 11.11.16 c) Ongoing sediment input allows embryonic dunes (here covered with *Hockenya peploides* and *Elymus farctus*) to evolve into a foredune covered with *Ammophila arenaria* 13.05.2019, Hulsig, DK d) Winter storms have eroded a fore dune on, Spiekeroog, 01.03.2014. At such dune cliffs, the sand is exposed to wind erosion and thus might initiate aeolian dynamics. e) Aeolian erosion turn small blwouts into secondary, parabolic dunes, which eventually detach from the beach, Amrum, 20.06.2017 f) The migrating dunes Raabjerg mile covers the pine forest as it traverses from west (right) to east (left), Hulsig, DK, 21.09.2016

(2013, p. 116) states, that at many places the conditions vary greatly along rather short coastal segments.

The sand that is carried landwards by a parabolic dune is no longer available for the sediment sharing system of the beach and dunes as conceptualized by Psuty (2004). He therefor refers to these dunes as secondary. On the island of Sylt, Priesmeier (1970) describes, how these parabolic dunes merge into larger, mobile dunes with a large straight crest, oriented perpendicular to the prevailing wind direction. Petersen and Pott (2005) and Reinke (1903) describe many former dunes migrating along the German Wadden Sea coast, of which now only three continue their journey across the northern spit of Sylt; additionally, Råbjerg mile still continues its journey across Skagen peninsula (Anthonson et al. 1996). Figure 8 provides an overview over different dune morphologies.

2.3.2. Coastal Dunes as a sediment conveyor belt for spits and barrier islands

Although the secondary dunes are no part of the sediment-sharing system of the beach, they are an important element on the bigger scale of sandy barriers (Oost et al. 2012). Spits and barrier islands are created by currents, waves and wind and are among the most dynamic coastal features, which quickly respond to changes in sea-level. Lindhorst et al. (2008) have investigated the development of the northern spit of Sylt, which had undergone phases of accretion and erosion. Depending on the rate of sea-level-rise, sediment transport via aeolian transport or via overwash processes was dominant. Hence dunes contribute to the process, of “barrier rollover”, as described in Figure 9 by

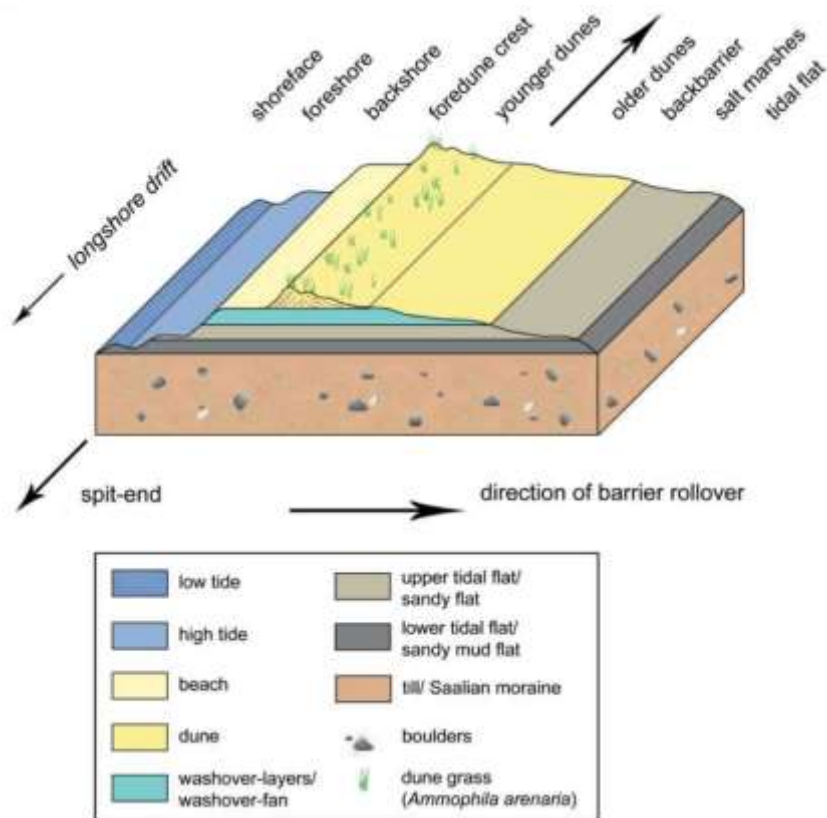


Figure 9: Aeolian transport and marine washovers act as a conveyor belt for sediments, which allows the sandy spit to adjust to a rising sea-level. Source: (Tillmann and Wunderlich 2013, p.604)

Tillmann and Wunderlich (2013). Thereby, sediment is eroded at the exposed beach, carried across the spit or barrier and deposited on top of the former back-barrier sediments. Priesmeier (1970) already describes the aeolian conveyor belt: Secondary dunes detach from the seaward foredune ridge, exceed the rate of coastal retreat and cross the spit until they are eroded at the back-barrier coast.

Additionally, as the groundwater table of the spit is connected to the sea-level, they rise together. On the island, this eventually increases sediment cohesion in the top-soil limiting deflation. Thereby, the relative vertical position of the spit to the sea-level is maintained. Studies reviewed by Oost et al. (2017) suggest that the sea-level in the North Sea is likely to rise about 10 to ca. 100 cm until 2100 and will continue to rise after 2100. According to Bamber et al. (2019), the global sea-level rise might even reach 2 m in 2100. Soft sedimentary structures like the Barrier islands or the two spits of Sylt need additional “leverage” if they should be able to adapt to sea-level-rise. A static dune landscape can no longer act as such a sediment conveyor belt. Therefore, Oost et al. (2012) and Feagin et al. (2010) argue in supporting and allowing more dynamic processes on these sedimentary structures. There are, however, limitations, to that process: If sea-level is rising too fast, the natural adaptive capacity of the barrier is exceeded. It drowns and a new barrier forms landward in the area of the former backbarrier lagoon (Masselink et al. 2014, p. 251).

Reviewing phases of dune formation, Provoost et al. (2011) concludes that both phases of falling and rising sea-level initiate phases of dune mobility. A falling sea-level exposes more sediment to aeolian transport which leads to dune formation. A rising sea-level leads to erosion and a subsequent aeolian reworking of the sediment. However, this is not necessarily the case, as other factors like human use are also important.

2.3.3. Ecological succession of dunes

The presence and intensity of aeolian dynamics among other factors determines the different successional stages of the coastal dunes. Maun (2004, p. 132) suggests that burial by sand in many embryonic or foredune plants results in multiple physiological reactions leading to more rapid plant growth. As burial ceases, so does the plant growth rate. Along the European coast, the most prominent example is the abovementioned marram grass (*Ammophila arenaria*), which is capable of stabilizing large amounts of sediment and thereby supports dune growth (van der Putten 1990). Shortly after sand deposition ends, the colonization of the sediment by parasites starts to weaken the plant (van der Stoel et al. 2002). Especially the seaward slope is almost exclusively covered with *A. arenaria*, as it tolerates the harsh conditions. Arens et al. (1995) describe, how the interaction of wind and dune topology results in strong, jet-like currents which transport sand behind the foredune. This basically means, that any object in the way is literally ‘sandblasted’. Comparable less sediment, though, is transported further landward. Measurements of both Priesmeier (1970) and Arens et al. (2002) illustrate the aeolian sorting: The finer grainsizes are blown farther into the hinterland.

Leuschner and Ellenberg (2017, pp. 73–85) describe the ongoing succession (see Figure 10). With much sediment deposition, the environmental factors change greatly. Species that are adapted to nutrient poor conditions do not tolerate the harsh conditions on the foredune that increasingly take over. In the beginning, the white dunes turn into grey dunes, which are colonized by pioneer species

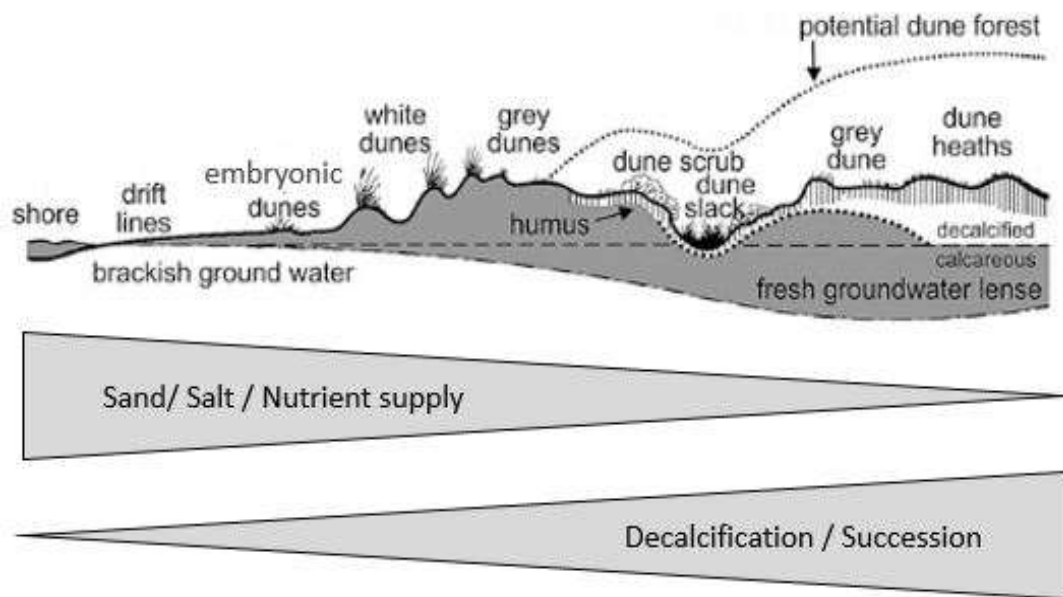


Figure 10: With increasing distance from the coast, the decreasing sediment supply leads to decreasing amount of nutrient supply and hence ecological succession proceeds. Source: (Leuschner and Ellenberg 2017, p 69, adapted)

and are often rich in mosses and lichens. As the dunes become more stable, heathland develops. The Crowberry (*Empetrum nigrum*) often marks the transition between the grey dune and the dune heaths; it tolerates more sand than the Common heather (*Calluna vulgaris*), which takes over as the dune landscape stabilizes further. Finally, shrubs like the Sea buckthorn (*Hippophae rhamnoides*) and trees take over, but still sediment redistribution influences the distribution of habitats. The Creeping willow (*Salix repens*) tolerates more sediment burial than the aforementioned *H. rhamnoides*. Eventually, a forest might evolve. Special invertebrate assemblages are associated with different vegetation structures (Brunbjerg et al. 2015).

In deflated areas, where the groundwater table reaches the surface at least seasonally, highly specialised species form very diverse communities. There, temporary anoxia and stagnant water are further environmental stressors. (Grootjans et al. 2004) explain how biomass accumulation within these slacks supports succession and eventually silting up of the slack.

Hence, it needs disturbances to set back succession and to provide habitats for pioneer vegetation. However, as Tsoar (2005) describes, it does need higher aeolian sheer stress to destabilize a dune area than to keep it active. Nevertheless, blowouts develop naturally at places, where vegetation is

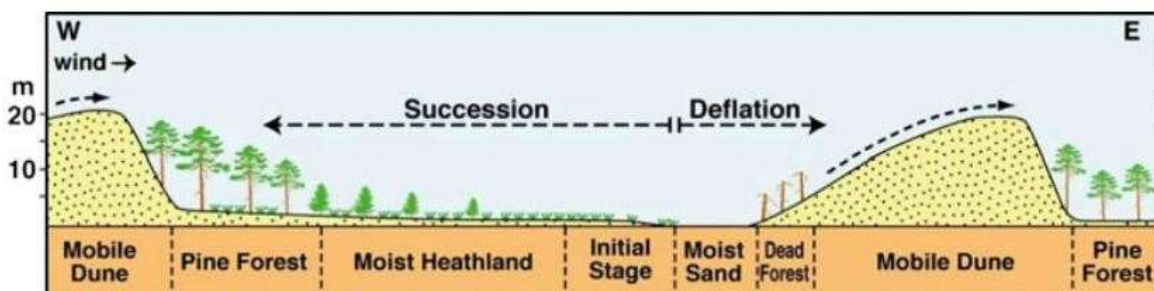


Figure 11: Migrating dunes set back vegetation on a large scale. Source: (Arens et al. 2013b).

damaged by e.g. erosion or trampling or grazing by animals as well as human use. As mentioned by Abhar et al. (2015) further important factors that initiate and influence blowouts are the local topography, climatic variability and especially the local wind-regime. On a large scale, migrating dunes bury, override and thereby kill established vegetation. After the dune has moved on, it leaves bare soil that can be colonized again and thereby sets back succession (see Arens et al. 2013b).

2.3.4. Human use of dunes

All around the globe and thus also in Europe humans have lived from, with and in the coastal dunes and gained resources like water, food, fodder, etc. Table 3 provides an overview of the most important services dunes provide to humans. As van der Biest et al. (2017) state, many of these Ecosystem Services depend on the dynamic processes within the landscape, too.

Table 3: Ecosystem services provided by coastal dunes according to Pérez-Marqueo et al. (2013, p. 291). Important services within the context of this study are highlighted in bold

Supporting	Provisioning	Regulatory	Cultural/aesthetic
Soil formation	Drinking water	Flood protection	Recreation tourism
Primary production	Food	Climate regulation	Aesthetic value / Art
Nutrient cycling	Fibre and fuels	Water storage	Cultural value
Water cycling	Genetic resources	Pest/disease regulation	Spiritual value
Photosynthesis	Medicine	Pest control	Social relations
Carbon storage	Ornamental	Water purification	Education/science
Habitat diversity	Mineral extraction	Pollination	

Arens et al. (2013b, p. 109) group human activities and environmental factors according to their effect on the dune landscape: Do they stabilize or destabilize dunes? In general, the struggle between mobile and stable dunes can be reduced to the trial of strength between the plants and their endeavours to grow and the power of the wind. Environmental changes like increased precipitation or less storminess favour plant growth and consequently lead to an increase in biomass. The dune landscape stabilizes. Climatic deterioration like during the little Ice Age, in turn supports a dynamic dune landscape as described by Clemmensen et al. (2015) for the dune fields on the Skagen Spit. Arens et al. (2013a) list most important human activities and their effect on dune landscape (see Figure 12).

Provoost et al. (2011) gives examples how early European civilizations usually destabilized dune areas. The need of fuel for pottery or a lighthouse such as on the Danish island of Anholt resulted in a mobilisation of dunes. At many places, marram was collected, which also increased dynamics (see section 2.3.3). The same is true for grazing, which in some cases was very intense. Koehn (1961, p. 179) further describes the use of marram also as fodder during the winter on Sylt until 1922. Especially rabbits were introduced and pampered as game animals in many medieval dune landscapes in north-western Europe (Baeyens and Martínez 2004, p. 280).

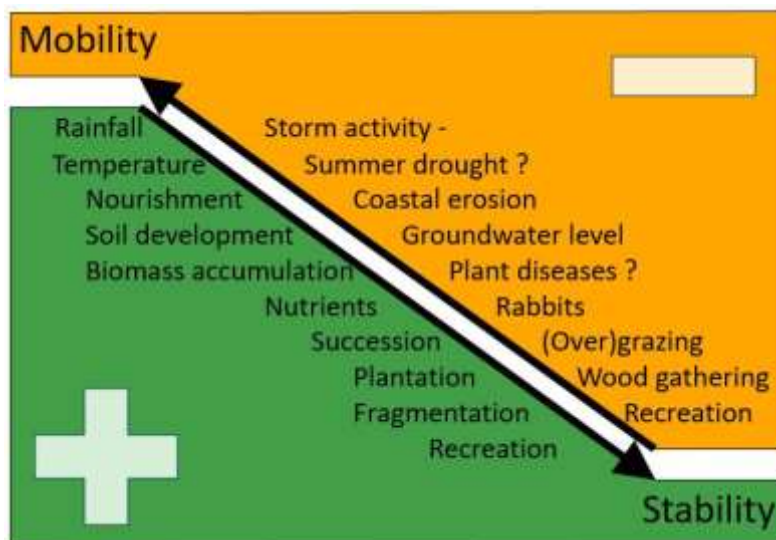


Figure 12: Environmental factors and human actions support (+) or hamper (-) the growth of plants and therefore increase or decrease the mobility or stability of coastal dunes. Source: (Arens et al. 2013a)

This relationship between humans and dunes has experienced great changes since then: When subsistence and agricultural use of the dunes faded away, nature conservation commenced. Baeyens and Martínez (2004, p. 282) observe this trend of increasing at many dune fields in north-western Europe. Therefore the situation here is less alarming compared to the global trend of (global) overuse and ecological degradation described by Martínez et al. (2013, p. 5).

Nevertheless, Provoost et al. (2011) observe an overall stabilization of coastal dunes in north-western Europe, which is caused by six reasons, of which the first is the above-mentioned change in land-use. Many traditional land-uses such as sod-cutting and grazing have been disappearing. Second, the introduction of the viral infect *Myxomatosis* since the 1950s causing the repeated collapse of north west European rabbit population. Third, the nitrogen input in coastal dunes has increased drastically as a consequence of the burning of fossil-fuels. Although the emissions have peaked in the 1970s and 1980s and have been declining since then, they are still above the critical threshold at many places. It leads to increased succession or -depending on the soil type – to grass encroachment (Remke et al. 2009a; 2009b). The fourth reason, the impact of climate change, is still debated, as it the climatic interactions with due systems are complex: The vegetation, though, profits from increased concentrations of CO₂ and the longer vegetation period. Furthermore, as e.g. Becherer et al. (2018) and Oost et al. (2017) expect a substantial increase in sea-level rise in the Wadden Sea area, this will also exacerbate coastal erosion (see also section 2.3.2).

More directly again, Provoost et al. (2011) also observe an increased active fixation of dunes as well as an anthropogenisation of dunes since 1900. The latter refers to afforestation which has happened at many places as well the introduction of non-native species. As reviewed by Groot et al. (2017a) the most prominent species probably is the Japanese Rose (*Rosa rugosa*); on many Wadden Sea islands it cover around 2 % of the dune area; on Sylt it reaches 3 % and 12 % on the East-Frisian island of Wangerooge (Groot et al. 2017a). Other important neophytes are the Heath star moss (*Campylopus introflexus*), the Rum Cherry (*Prunus serotina*) and- more locally - the American cranberry (*Vaccinium macrocarpon*). Most of them are currently spreading. Groundwater extraction not only

limits the adaptive capacity of barrier islands but also directly affects the plant communities of the dune slacks (Groot et al. 2017a).

Additionally, coastal tourism has become more important, it leads to both intersection and fixation. Bartels (2013, 23f.) describes how entire migrating dunes have been stabilised on Sylt to prevent arable land, houses, infrastructure, and later on bunkers from being buried by dunes and shifting sands. According to Jakubowski-Tiessen (2011, p. 61) both reasons are part of a positive feedback loop called the “Save-Development Paradox”: the more a coastline is fortified, the more monetary values accumulate behind the dikes, because the area temporally is perceived as “safe”. This in turn leads to a higher demand on fortification and protection as the risk perception finally changes again. Provoost et al. (2011) concludes that there are still large challenges ahead for managing coastal dunes.

2.3.5. Introducing ‘Dune Management’

Today, the various different interests of coastal protection, tourism, nature conservation, etc., collide in the dunes and call for reconciling management. First, how should ‘dune management’ be defined then? Paraphrasing Stevenson (2011, p. 343), dune management “*is initiated, when human well-being is threatened by [a] lack of ecosystem services, which results in environmental policies*”. Thereby, the actions of modern societies to safeguard their way of living can be clearly separated from spontaneous interaction of early hunters and farmers, which merely aimed at subsistence.

Arens et al. (2013a) argue, that dune management mostly is a combination of coastal protection and nature conservation. However, this means that these two policy sectors basically have to cooperate. As van Slobbe et al. (2013) describe for the Dutch coast, the traditional approach of coastal protection has been solving narrowly-defined technical problems, mostly with hard structures. At the same time, the establishment of the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (Habitat Directive) in 1992 demanded the establishment of a network of strongly protected habitats whose preservation of is of great importance to the EU community (Evans 2006; Heslenfeld et al. 2004, p. 344). Especially habitats that depend on aeolian activity - the grey dunes, heathlands with *E. nigrum* and wet dune slacks - have become increasingly rare. Therefore, they have overriding importance according to Appendix 1 of the EU’s Habitats Directive (BfN 2018). Due to this, the member states have to develop management plans for their areas and document the status and the implementation of measures to preserve the ecological status of these areas (BfN 2014). van der Meulen et al. (2017) e.g. present the case of the Spanjaardse Duinen which have been created by humans to compensate for nature losses by the harbour extension in nearby port of Rotterdam.

Besides differing interests, Siepel et al. (2010) sketch more dilemmas, dune managers are confronted with, as not all demands can be brought together. First, there is a dilemma between long-term and short-term benefits. Whereas current species and specimens profit from no intervention, future habitats yet to grow would benefit. In general, they conclude, that dune management should bear the coming century in mind and have an operational time of 5 to 10 years. Furthermore, the natural values such as habitats protected by European and national law need to be balanced with other conservation interests such as cultural values or also geomorphological diversity.

Finally, this shows how human attitudes and rules eventually have large effects on the landscape, such as the modernist paradigm of the enlightenment, Jakubowski-Tiessen (2011) describes. These attitudes change, though. During the past 700 years, Clarke and Rendell (2015) identify three subsequent paradigms that steered dune management in north-western Europe: The first is the sheer acceptance of moving sand which resulted in the diffuse retreat from areas that are affected from moving sand. Second, the dunes were stabilised as much as possible by planting and by strict land-use regulations. The dunes turned into the '*restless enemy of all fertility*' (Clarke and Rendell 2015, p. 415). Eventually, the dynamic processes are increasingly seen as beneficial and are increasingly allowed.

2.3.6. Coastal dunes as Coupled Human And Natural Systems (CHANS)

As argued above, dune management thus has to overcome the traditional separation of physical and social perspectives on dunes. Here it is postulated to conceptualize coastal dunes as 'Coupled human and natural systems' (CHANS), if it wants to be capable of tackling the nested and interrelated problems. The concept of CHANS has been applied in other studies, where the genuinely human endeavour for safety collides with natural processes. Also McNamara and Werner (2008) or van Slobbe et al. (2013) overcome the traditional separation between humans and 'nature' in their studies on coastal management. Liao (2014) and Kelley and Brothers (2009) explicitly refer to the concept of CHANS in their case studies on the impacts of hard flood defences on natural systems at Washington and Maine, respectively (both USA). As both cases are characterized by multiple problems that mutually influence, this conceptualisation is promising for coastal dunes as well.

Liu et al. (2007a; 2007b) describe CHANS as inherently complex. Baeyens and Martínez (2004, p. 283), Provoost et al. (2011), Arens et al. (2013b, p. 122), or Abhar et al. (2015) explicitly characterise coastal dunes as complex systems and Lithgow et al. (2013, p. 309) refers to coastal dune management as a complex task. With help of Figure 13, the following section wants to argue that - on behalf of other dunes - the dune fields of Sylt coastal dunes show the characteristics of CHANSs given by Liu et al. (2007a):

1. *Reciprocal effects and feedback loops*: There are numerous examples of feedback loops, e.g. Reijers et al. (2019) describe, how *A.arenaria* has developed an optimized expansion strategy that traps sediment which in turn stimulates its growth, as long as there is sufficient sediment input. The "Save-Development Paradox" as introduced by Jakubowski-Tiessen (2011) in section 2.3.5. is another example as is bush encroachment: Baeyens and Martínez (2004, p. 283) mention, that once bushes like *H. rhamnoides* have established, their seeds are spread by birds and mammals.
2. *Nonlinearity and Thresholds*: Recalling Tsoar (2005), the aeolian sheer stress has to exceed a certain limit to cause erosion in a stabilised area, whereas a much lower shear stress is sufficient to keep a dynamic system open. Consequently, external factors like increased storminess or overgrazing become fully effective after exceeding a threshold. Provoost et al. (2011) elaborate on the multiple switches of dune fields between dynamic and mobile phases. In the past 150 years, also Sylt has developed from a mobile into a stable landscape (see Figure 13).

3. *Surprises*: Baeyens and Martínez (2004, p. 283) call the basically human-induced outbreak of *Myxomatosis* a ‘surprise’. Another unforeseeable and sudden event that caused long-term disturbance was the construction of a causeway for the railway (see Figure 13) from the island to the mainland. Schlaugat (2013, p. 207) mentions that this dam did not only stimulate Sylt’s economic growth but also allowed foxes to colonize the island and decimate the breeding birds. The excrements of birds until then locally had stimulated plant growth (Vauk and Prüter 1987, p. 59).
4. *Legacy effects*: In the dunes of Sylt still the effects of interventions done decades or centuries ago can be seen. Grootjans et al. (2004) describe, how - during World War II - sods were cut from the dune slacks to disguise the fortifications at many places along the North Sea. Neuhaus (1994) describes that sod-cutting also rejuvenated the vegetation in dune slacks at the Listland.
5. *Spatial couplings and heterogeneity*: A CHANS is nested in bigger systems and contains smaller systems. Here, coastal dunes are coupled to systems like atmospheric circulations or the climatic changes. Bartels (2013, p. 21) mentions the destabilising effects of the little ice age on the coastal dunes on Sylt and the human settlements therein. Also the atmospheric nitrogen resulting in dune stabilisation mostly is not produced in the dunes, but elsewhere. The island of Sylt itself also can be broken further down into subsystems. Kolumbe (1928) explains, how the remote character of the Listland (see Figure 13) could only be preserved for so long because it has been privately owned for centuries.
6. *Resilience*: The coastal dunes of Sylt are resilient; i.e. that they robust and thus able to withstand certain disturbances. Small blowouts might close after a couple of years and dune cliffs stabilize on their own. Dunes and their inhabitants are also capable to adapt to large-scale developments, as Figure 13 illustrates: In pre-industrial times 1878, the dunes were mostly used by a few people for agricultural purposes Living with dynamic dunes, though, included that e.g. the parish of Rantum had to be relocated several times (Bartels 2013, p. 20). Today, tourism has replaced agriculture, resulting in stronger and more connections to the mainland (see Figure 13). Additionally, Osswald et al. (2019) describe how the interplay of hardly any agricultural use, atmospheric eutrophication, plantation and fragmentation led to rapid stabilisation. Nevertheless, in both states the CHANS was functioning in a way that it allowed humans to live on the island and harboured species. Obviously, both states also have their backdrop. What once were excessive dynamics burying homesteads now is a lack of dynamic processes threatening the high biodiversity and lowering the island’s adaptive capacity to sea-level rise.

What does this mean for management, though? Dune fields are sensitive systems that are easily altered by environmental changes including the actions of humans. First, time cannot be turned back, because CHANS are constantly evolving and changing through time. Hence, as also argued by Provoost et al. (2011), not a randomly chosen and often unachievable historic state should be the goal of dune management but changes need to be incorporated and aim for new goals. Second, when intervening, especially unintended side-effects are likely to occur. The history of introducing new species is a plea for care.

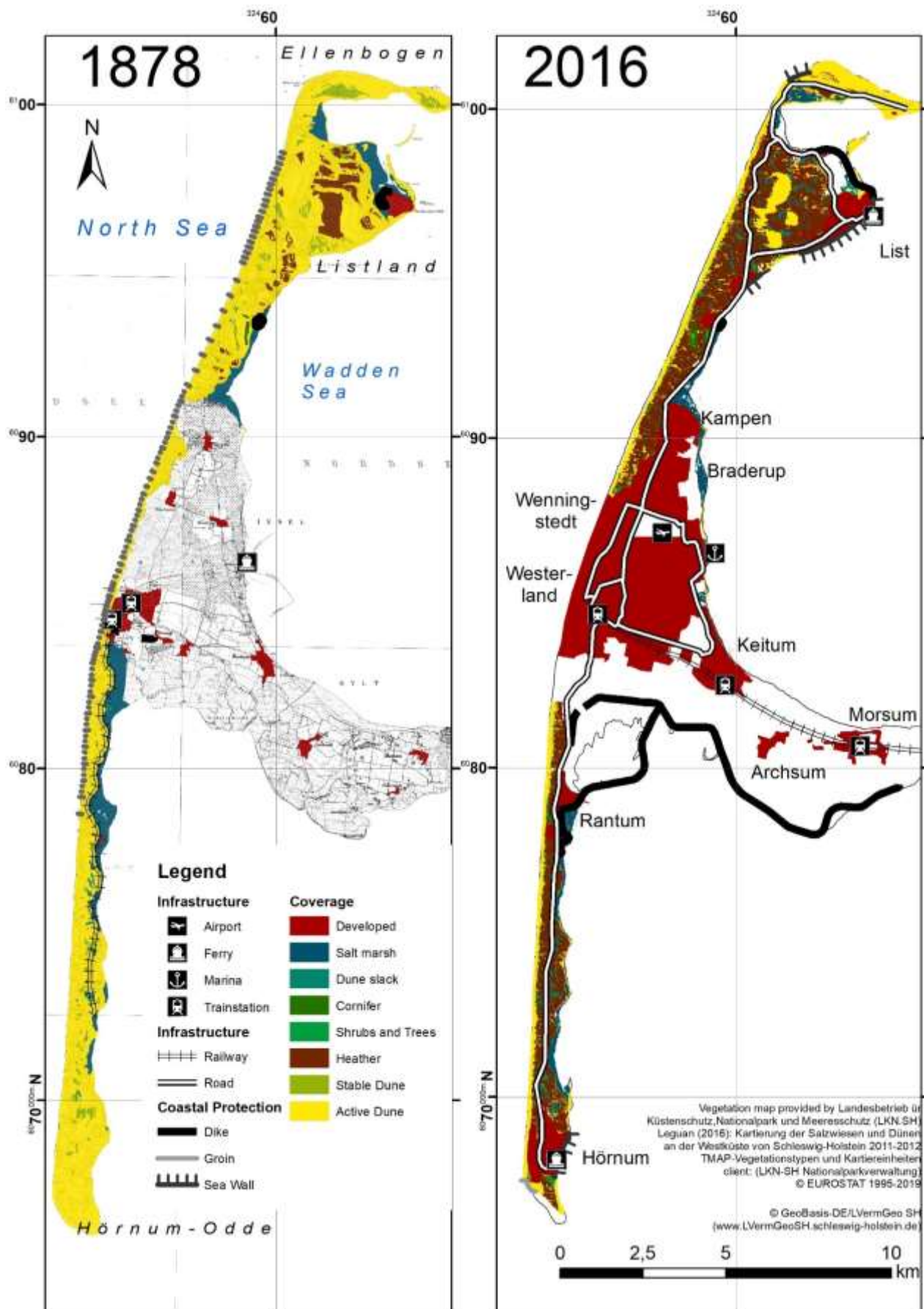


Figure 13: The comparison of a topographic map from 1878 dunes with recent monitoring data on vegetation illustrates that Sylt underwent drastic changes within the last 150 years: Increased and different land-use resulted in more permanent immobile settlements and also stabilised the dunes. By means of a classification scheme, both datasets were made comparable. More information is provided in Appendix I

But the examples of intended and unintended dune reactivation and especially of dune stabilisation shows both that care is needed and suggests that many side-effects can be handled by technical means and scientific investigation. The heterogeneity of CHANS, thirdly, allows to conclude that as the circumstances are different, not everything that works at A necessarily has the same consequences at B. This links back to the approach of lesson drawing: What can actually be learned from the management of other dune areas for the dunes on Sylt?

3. Methodology

3.1. Qualitative research approach

As described above, the current state of the dunes on Sylt is undesirable as it is threatening the local biodiversity and reducing the adaptive capacity of the island. Recalling the research question, this study wants to explore, how other political entities elsewhere manage the dunes to learn lessons from them that are applicable given the institutional and physical context of the island of Sylt.

Section 2.1 stresses the importance of the institutional surrounding for lesson drawing. This calls for a qualitative research approach as it allows according to Hennink et al. (2011, p. 10) to “*identify the social, cultural, economic or physical context, in which activities take place*”. Thus it highlights that reality is subjective and that multiple truths can coexist alongside each other (Berg 2010, p. 8). Hesse-Biber (2017, p. 12) further points to an inductive and interpretative strategy as the scientific mode of knowledge generation instead of quantitative measurements.

This choice for a qualitative research approach does not mean that the objective physical externalities as depicted in section 2.3 are of no importance. Arguably, they are incorporated in the strategies: Clarke and Rendell (2015) refer to the first regulation dealing with the issues of sand drift in Great Britain being passed in the time of increased aeolian activities. Also early strategies and laws on fighting sand drift show an understanding of the basic processes.

More specifically, the 10 steps for lesson-drawing of Rose (2002) guide the further research process. They can be distinguished into two phases (see Figure 5). In a first step, the policies in two donor countries are selected and evaluated: this corresponds well to research question 1. The second phase is about developing lessons and transferring them into suggestions for actual policies, which is also the aim of sub-questions 2 and 3 (see Section 1.4). Figure 15 shows the entire research process; in the following, minuscule in brackets like e.g. (a) refer to connections in that figure.

3.2. The Netherland and Denmark as potential donors

A decisive question is: Where to look for lessons? The global occurrence of coastal dunes (Martínez et al. 2013, p. 1), also offers a cornucopia of different management strategies to learn from. For instance there exists evidence from Israel (Pua 2013) or Australia (NSW Department of land and water conservation). Of course, some of these strategies are more practicable and desirable than others; however, this study cannot examine all these strategies and procedures. How to choose the most promising study objects?

First of all, it is most promising to look at the countries that are part of the dune belt around the southern North Sea and of which the dunes of Sylt are part of (see Figure 1A). These dunes share similar characteristics regarding plant species as well as climatic (Bohn and Gollub 2004, p. 427) and geological conditions (Heslenfeld et al. 2004, p. 337). The argument of van der Meulen et al. (2014), that climate and lithology are both the most important ecological components of the system of coastal dunes, are also the ones most difficult to alter supports this perspective. They further share the problem of increased dune stabilization during the last decades (Provoost et al. 2011). Furthermore, all countries manipulate their beach profile by nourishments (Hanson et al. 2002; Pranzini et al. 2015). Of course, minor physical and ecological differences remain with regard to exact plant composition, tidal range and soil properties as described by Provoost et al. (2011) or Bohn and Gollub (2004, pp. 418–431). Notwithstanding these differences, it can be assumed that measures applied at one place will have similar effects on Sylt. Also the experiences made elsewhere might be better applicable to Sylt and might reduce the chance of sudden, unwanted side-effects.

This leaves this study with six countries to learn from: Arguably, the United Kingdom may be excluded, as the dunes along the east coast are more sheltered from the severe westerly gales that strongly affect the dunes of France, Belgium, the Netherlands, Germany including Lower Saxony and Schleswig-Holstein and Denmark; the study aims to focus merely on two of them. How to distil the two most promising donors out of these five? Besides the physical fit, also political and institutional factors matter.

Rose (2002) describes important criteria that guide the quest for potential “donors”. First, donor and recipient should have similar resources at their disposal. As an organization with limited money and personal faces serious problems when it tries to adopt a policy from a donor where plenty of both is available, this is an important criteria. All five countries are economically powerful and their governments have billions of Euros at their disposal (EUROSTAT 2019). This criteria excludes no country (see Table 4).

Table 4: Comparison of the national expenditures of F = France, B = Belgium, NL = The Netherlands, D =Germany and DK = Denmark. Annotations: Source: (EUROSTAT 2019)

<i>National Expenditures</i>	<i>F</i>	<i>B</i>	<i>NL</i>	<i>DK</i>	<i>D</i>
<i>(Mil. € and % of National GDP)</i>	<i>1,294,000</i>	<i>228,986</i>	<i>313,265</i>	<i>149,793</i>	<i>1,439,839</i>
	<i>(56.5)</i>	<i>(52.2)</i>	<i>(42.5)</i>	<i>(51.2)</i>	<i>(43.9)</i>

Second, evidence to learn from must exist. This includes that strategies have been developed and that their implementation and success is assessed and documented (Rose 2002). There is evidence on coastal dune restoration in every of the five donors, but Lower Saxony. Albeit drawing lessons from the East-Frisian islands would probably have allowed a more direct transfer (see Figure 4), a static dune management is prevailing (NLWKN 2010, p. 20). Instead, dynamic dune management is a central part of the current Dutch national protection strategy (Delta Programme Coast 2013, p. 48). Also Denmark is currently studying the potentials of aeolian transport in coastal dunes (Kystdirektoratet 2019d).

Third, the institutional frameworks should be compatible, to assess, how a lesson fits the domestic network of institutions. How can these 5 states be grouped? The idea of the families of nations becomes important: From a legal perspective, all countries have their roots in Civil Law; the territorial organisation is highly different though: France is a classic example for a highly centralized state, whereas Belgium and Germany consist of Federal states that are more independent than the regions in the decentralised of Denmark or the Netherlands (Lalenis et al. 2002, p. 36; Perlitz and Seger 2004). This is important as it does affect responsibilities within the fields of nature conservation and nature protection. Arguably, Sylt can learn more from its decentralised neighbours.

From a cultural perspective, though, Sylt has the strongest ties to Denmark and the Netherlands, as it was partially Danish until 1864 and shares the Frisian identity with the north of the Netherlands (Steensen et al. 2013). Also the dune management strategies of the Netherlands and Denmark are also historically linked to Sylt. When Sylt had become Prussian after the war of conquest against Denmark 1864, the victorious Prussians also rigorously re-organized the dune management strategy on Amrum, Sylt and Rømø. The responsible state officer then made use of the knowledge gained in Denmark and the Netherlands and combined them with the strict hierarchical organization of Prussian authorities (LKN.SH 2016b, p. 11). Lessons drawn from Dutch dune management were used on the East-Frisian islands as well (Ahlhorn 2018, p. 64).

However, Lalenis et al. (2002, p. 49) argue that the importance of the families of nations is waning, as supra-national bodies are gaining power. As all countries are members of the EU, their policies are aligned by paramount European legislation. In this context, the abovementioned Habitat Directive is a prominent example (see section 2.3.5). Eventually, although all five states are quite similar to each other and part of the European Union, the Netherlands and Denmark seem to be most suitable donor countries.

3.3. Conceptual Model of dune management

Next, it is necessary to develop a model, why and how a certain policy works elsewhere (see section 2.1.1). Dune management has been already defined in section 2.3.4. According to Arens et al. (2013a), the policy fields of nature conservation and coastal protection currently are the most important policy fields for dune management; of course are also other interests like tourism, recreation, drinking water production or agriculture. This study, though, focuses on the first two pillars, as these are identified as most relevant for the recipient island of Sylt.

These policy fields influence the institutions that make up dune management. Therefore, the conceptual model distinguishes between the three formal institutional domains identified by de Jong and Mamadouh (2002, p. 23). As depicted in Figure 14, the conceptual model does not distinguish between the political origins of the institutions, as it is expected that there are values that underlie both policies. The focus of regulations and values receives greatest attention here: As Alexander

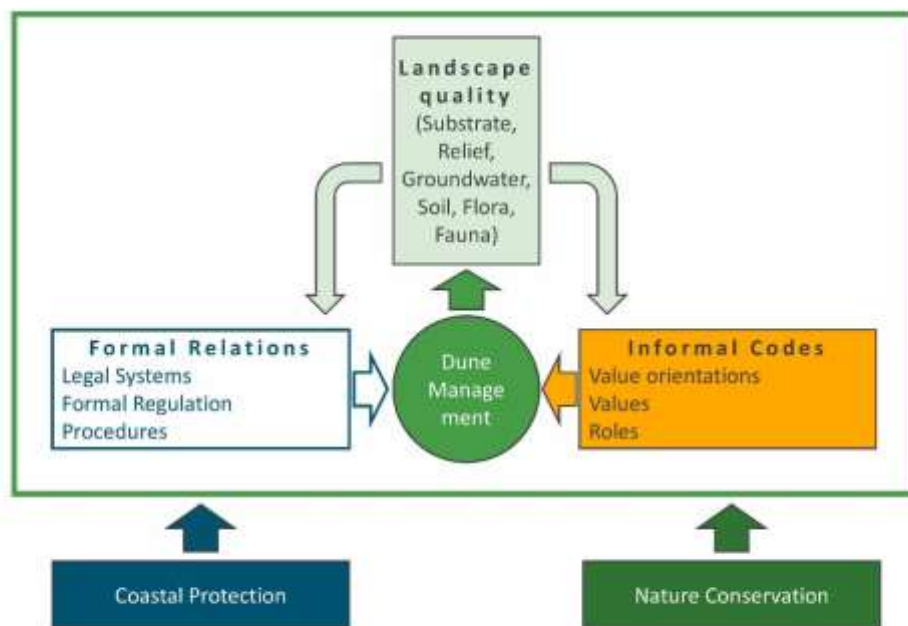


Figure 14: The conceptual framework distinguishes between the three levels of both formal and informal institutions that make up the particular dune management strategy and their interaction with the physical landscape. The most important policy fields are nature conservation and coastal protection.

(2005) argues, this is the levels, where strategies and policies are developed, framed and legitimized by the constitutional level. By contrast, the individual level is of minor interest, nevertheless it is helpful identifying actors that initiated change (see Figure 14).

Nevertheless, what are the effects of the Danish and Dutch dune management strategy on the landscape? Did the strategies reach their goals? Looking at the success of a strategy allows to assess the desirability of this approach. Therefore, the quality, i.e. the characteristics of the dune landscape is the fourth element of the framework. In turn, there are physical constraints to the strategies. One cannot deconstruct physical processes.

Eventually, the lessons are also derived from comparing the three conceptual models. Rose (2002, p. 12) basically refers to the concept of *Phronesis* when he describes the design process of a lesson as “an art requiring judgement and skill. Whereas assembling a computer or a car engine may require following every step in a model exactly, the models used in programme design are products of ‘fuzzy logic’ that tolerate a certain amount of variability”. Once more, there is no ideal path to design a lesson. Here, the Danish and Dutch meso-level strategies that result in actions directly influencing dune landscapes were converted into single potential lessons at the desk (i). These lessons are discussed (o – r) and only the most promising eventually merge into a programme suggestion (s).

3.4. Strategic evaluation of the lessons

Eventually, the lessons have to be evaluated from a future-oriented, strategic perspective (b). Figure 3 shows the lesson in its institutional context, to which it has to fit in a way that the lesson is both desirable and practicable. Put differently: Looking at the specific internal characteristics of a lesson

in front of a particular external surrounding, reveals opportunities and risks. This basically is also the description of a SWOT analysis according to Piercy and Giles (1989). SWOT stands for ‘Strength – Weaknesses – Opportunities – Threats’. Schawel and Billing (2012, p. 249) argue that a SWOT analysis allows to identify actions needed. Arguably, this helps to define prerequisites that must be fulfilled before a lesson can be implemented. Finally, this method has been applied within the context of coastal dunes by Heslenfeld et al. (2004, p. 348) or WWF Deutschland (2015).

SWOT analysis, though, is commonly used to evaluate the current position and options of companies as described, e.g. by Schawel and Billing (2012, pp. 249–251) or Judt and Klausegger (2016). Notwithstanding the different context, the framework arguably can be slightly modified to be a useful tool within the context of lesson drawing. Each lesson has its strengths and weaknesses. Looking at them from the external context of the recipient reveals opportunities and risks. Obviously, there are opportunities that are desirable, but not practicable and vice versa. Therefore, the external perspective also distinguishes between ‘desirability’ and ‘practicability’.

3.5. Data collection

In general, Hesse-Biber (2017, p. 9) lists many different possible methods to obtain data and analyse them. However, not every source of information is equally helpful and promising for each of the questions. This study uses three ways of collecting information in the different research steps, as is explained in the data collection framework (see Figure 15) and the following sections.

Each way of data collection comes along with its own strengths and weaknesses. Thus, the resulting data need to be juxtaposed and treated differently. Berg (2010, p. 6) argues that data triangulation allows to compensate the shortcomings of one method by another and thus add validity to the results.

3.5.1. Literature analysis

There exists an extensive body of literature written about coastal dunes. Classified as unobtrusive by Berg (2010, p. 268), document analysis allows to develop the foundation walls of the conceptual frameworks in a fast and uncomplicated way.

Therefore, mostly recent documents published by governmental authorities were retrieved from their web pages and analysed. They allow to develop a basic framework of the particular strategies – especially of the formal institutions. For the two donors the overall goal of the literature analysis is to understand the basic cause-effect relationships and the role of the most relevant actors. For Sylt, a deeper understanding is required; therefore it receives greater attention. As documents published by authorities and organisations have different purposes and functions, they also offer different kind of information. Hence, a political strategy is different from a status report published by an environmental agency. Thus, this study and the publication bibliography therein distinguishes between three different types of documents:

1. *Grey Literature* contains information or statistics that are published by public or private parties. These information might or might be not generated scientifically, in any case, the content is not related to any kind of political strategy

2. *Policy Documents*, by contrast, describe the results or the implementation status of a political strategy. These can result from binding European, national or federal law or be the result of parliamentary actions. They are generally descriptive in character.
3. *Strategies and visions* finally include explorative studies, political declarations of intent or demand for the future.
4. *Scientific Literature* includes all sources that are output of research, especially articles that have been published in scientific, mostly peer-reviewed journals.

Thus, scientific articles still remain relevant. Although policy documents play a leading role, quantitative scientific examinations are capable of independently assess the actual effects of these policies on dune landscapes.

The insights gained from the literature also guide the subsequent selection of the interviewees and provide the knowledge basis for the questionnaires and the interviews.

3.5.2.Seminar talks

Table 5: List of the seminar talks used within this study

Talk	Title	Place	App
Nijssen 5/13/2019	Functional restoration of bogs and dunes. Lessons from 25 years of practice and research	Hulsig (DK)	XVIII
Lindholm 5/14/2019	Cattle on loan - enabling private cattle herds to be built without investment costs	(Hulsig DK)	XIX
Frisk, Lindholm 5/14/2019	Different approaches to remove <i>Rosa rugosa</i> at the LIFE REDCOHA and the LIFE REWETDUNE Project	Grenen (DK)	XX
Jespersen 5/15/2019	Test of methods to combat <i>Prunus serotina</i>	Kragkovhede Prison (DK)	XXI
Wolf 6/3/2019	National Park 2.0. A new standard for Dutch National parks: scale, international exposure, new combinations	Oldenburg (Oldb) (D)	XXII

One of the drawbacks of studying older documents is that there is a time lag between the actual development of new insights and their adaptation in policy or scientific documents. Using meetings of dune managers thus provides a fruitful and pragmatic resource of both potential interview partners and recent knowledge. This in turn also allows to assess policy documents from an updated point (d) and thus allows for temporal triangulation (Berg 2010, p. 7).

The LIFE REWETDUNE & LIFE WETHAB Final seminar in Hulsig, Denmark, took place from 13th to 15th May 2019 and provided insights and lessons learned during two large-scale restoration projects of coastal dunes and beach-ridge plains at the northern tip of Denmark, Skagen. Besides contacts to later interviewees, the following presentations also provide detailed insights into

management strategies. Abstracts of these presentations are provided in the Appendices XVII and XVIII, respectively.

3.5.3. Semi-structured interviews

Relying exclusively on literature analysis is no appropriate tool to gain insights into foreign strategies and the informal institutions behind them (e). Among other functions, they determine how strict formal rules and regulations are executed and enforced. Also not every aspect of a policy might be explained in literature publicly available, let alone in a language, the researcher is able to fully understand. Policy documents written in Danish or especially in Dutch are not very helpful within this research. Instead, Rose (2002, p. 9) stresses that *“to understand how a programme works [elsewhere], it is important to go there in order to learn what printed documents leave out.”* He also suggests to ask questions to the people involved in these programmes.

It is thus beneficial to approach experts with a series of broad overarching questions that have been prepared in advance. This allows the interviewer to set the focus of the conversation and leaves enough leverage for the interviewer to express their own opinion about the issues discussed (Hennink et al. 2011, p. 110). However, the interview guide should not be considered a checklist, instead questions may be paraphrased, altered or deleted during the course of the interview. This makes semi-structured interviews as described above a popular method, which in this case is also promising (Brinkmann 2014, p. 286; Taylor et al. 2015, p. 119). Following the suggestions of Hennink et al. (2011, pp. 112–114), the questions follow the order of opening, key and closing questions. The interview guides are attached (see Table 6). Compared to group interviews, such individual interviews also create a higher level of trust (Brinkmann 2014, p. 289).

Furthermore, Berg (2010, p. 122) argues, that a set of prepared questions improves the quality of telephone interviews, too. Although face-to face interviews are preferred, as they allow to include the whole spectrum of human communication such as gestures and mimics (Berg 2010, p. 123), some interviews need to be conducted via telephone due to the large travel distances, e.g. to Denmark or Sylt. For the same reason, the interview with (DK-01) happens via e-mail. Here, Berg (2010, p. 127) stresses the loss of the interactive character of the conversation on top of the disadvantages of a telephone interviews. On the other hand, e-mail conversation is mostly independent from time and space.

Chapter 2 describes lesson drawing and the characteristics of coastal dunes. This knowledge underlies the interview guides. Furthermore, the following questions were the starting point for the interview guides:

1. *What are the overall values that underlie the particular strategies?* This includes the common perspectives on coastal dunes. The image dunes bear influence the decisions that end in strategies.
2. *What are central goals of the policies and how should they be achieved?* The goals of a strategy dictate the use of tools such as planting marram and build brushwood fences for stabilization or introducing cattle. With different goals, these tools can be used differently, too.

3. *How does the physical environment influence the strategy?* In their definition of institutions, Crawford and Ostrom (1995) stress the importance of the environmental conditions for the development of institutions. The coastal dunes of Denmark's west coast, of Sylt and of the Netherlands have been created and are still shaped by very similar processes. Nevertheless, there might be special circumstances that set limits to certain strategies. Not everything might work under the harsh environmental conditions on Sylt.
4. *How is flood safety maintained?* Flood protection of coastal dunes is of course paramount and must be ensured by every strategy. Several storm floods during the last millennia have proven the destructive power of storm surges around the North Sea. The desire for flood safety should not be treated like a flexible, changeable institution among others (Rieken 2011).

Following the idea of *Phronesis*, the interviews were seen as an iterative process (f), i.e. that knowledge gained from one earlier interview was pragmatically used for writing the next interview guide. Each interview was prepared individually, the interview guides are attached in the Appendices IV to XVI. Also Hennink et al. (2011, p. 111) highlights the cyclical nature of interviewing with conducting, summarising or transcribing them and finally distilling key information from them that are useful for the next interview. This process also happens via validation through policy documents or other types of literature (g).

This cyclic approach can also be found in lesson drawing. One might need to gather additional information about the domestic problem after looking at a foreign policy. This, however, is likely to lead to new questions, yet unanswered.

When selecting the interviewees, it is important that the interviewees cover a broad range of perspectives (Taylor et al. 2015, p. 107). Moving bottom-up Rose (2002) distinguishes between the people that are actually receiving the programmes and people that are involved on a low service level. Then there are high-ranking governmental officials that design the programme and are knowledgeable about its backgrounds. These are accompanied by experts from outside the actual sector that have developed the strategy and finally reformers and critics, which are especially aware of the negative sides. Arguably, one interview partner could be a member of two or maybe even more categories.

Due to lacking resources this study mostly focused on foreign experts. For the case of Sylt, also the people that are actually working within the policies were included to a greater degree. Besides, Whiting (2008) summarizes the demands on a helpful interviewee; not only should they be knowledgeable about the topic of interest but also able to reflect about the issue and – of course - be willing to talk.

Depending on the interviewees' preferences, the conversations are conducted in either English or German. Wherever possible the interviews are recorded, this allows to write thorough summaries of the content; the summaries are attached to this thesis (see Appendices III to XVII). The records are not published for reasons of anonymity.

Table 6: List of the interviews conducted. The questionnaires and interview summaries for each interview are listed in the Appendix.

Interview	Agency, authority, etc.	Date	Form	Length (min)	Officials	Outs. Experts	Reformers	Int. Actors	App.
DK-01	University of Aalborg	01.05.19	E-mail	-	X	X			III
DK-02	Kystdirektoratet, Lemvig	09.05.19	Phone	45	X			X	IV
DK-03	Nationalpark Thy	27.05.19	Phone	50				X	V
DK-04	Naturstyrelsen (NST)	28.05.19	Phone	45	X			X	VI
NL-01	Deltares, The Hague	20.05.19	Personal	~180	X				VII
NL-02	Duinonderzoek, Soest	21.05.19	Personal	50	X				VIII
NL-03	<i>SBB, Groningen, cancelled</i>	<i>22.05.19</i>	<i>Personal</i>		X			X	
NL-04	IenM, The Hague	04.06.19	Personal	45	X				IX
SH-01	Naturschutzgemeinschaft Sylt e.V., Keitum (Sylt)	01.06.19	Personal	90	X			X	X
SH-02	AWI, List (Sylt)	02.06.19	Personal	100	X	X			XI
SH-03	SW	04.06.19	Phone	30				X	XII
SH-04	LKN-SH, Husum	07.06.19	Personal	50	X			X	XIII
SH-05	UNB-NF, Husum	07.06.19	Personal	45				X	XIV
SH-06	LLUR, Flintbek	07.06.19	Personal	50	X				XV
SH-07	WWF, Husum	17.06.19	Personal	40	X	X			XVI
SH-08	Sölring Foriining	18.06.2019	Phone	40				X	XVII

3.5.4. Ethical standards

Ethical standards are an important aspect of research: As Hesse-Biber (2017, p.66 ff.) explains, complying to ethical standards ensures the trustworthiness and integrity of both the research process and its results. The scientific endeavour for new insights must not compromise the welfare of the participants.

In this study, ethical aspects do mostly affect the interviews. They are based on mutual trust and here compromising and stressful situation might arise during the conversation. To allow all actors to speak as freely as they want, anonymity and confidentiality throughout and after the research process are guaranteed in a consent form (see Appendix II A(English) and B (German)) as described by

Hesse-Biber (2017, p. 73). Therein it is also asked, whether the interviews may be recorded for later summary.

Especially in North Frisia, the topic of dune management is sensitive, as it causes different perspectives and viewpoints to clash. Dune stabilization on the islands is often based on traditions and equalled with coastal protection (Reise and MacLean 2018, p. 176; Fischer 2011, p. 33). On the other hand, there are strong interests of nature protection involved. If they wish, the interviewees are send the summaries for correcting aspects where they feel misunderstood.

3.6. The research process

Eventually, the abovementioned theoretical demands have to be transferred into a practicable and achievable research process. This especially means that there simply is hardly time for conducting several cycles of lesson-drawing. Figure 14 provides a schematic overview over the research strategy.

The selection of the most promising donor countries (a) in Section 3.2 follows a thorough literature analysis about all three management strategies (b, see Section 3.5.1). Already now, a first conceptual model of the dune management strategy of Sylt is developed (h), providing hints for what to look for elsewhere. After that, the first interviewees were selected and the interviews prepared (g): In the first series, seven Dutch (NL-01 to NL-03) and Danish (DK-01 to DK-04) interviewees that have been involved in dune management projects themselves are asked for first-hand experiences and insights. Making use of the conceptual model, a model for each dune management strategy is developed (h).

At the desk, the Danish and Dutch strategic elements that rather directly affect the coastal dune were identified and used as preliminary lessons (i). These ideas guide two long, explorative interviews on Sylt (SH-01 and SH-02, k). These aim mostly to grasp the special circumstances on the island on Sylt. The insights from these interviews allow for modifications on the conceptual framework of Sylt (m) and on the lessons (n).

These lessons that are tested in the second series of eight interviews with actors involved in dune management on Sylt (o). Lessons or aspects of these lessons are discussed with six interviewees that are related with the dune management (SH-03 to SH-08). Their opinions meet in the s of the lessons (p) and were joined by additional insights from the literature (r). The desk evaluation of these discussions finally leads to a proposal how to implement them on Sylt (s).

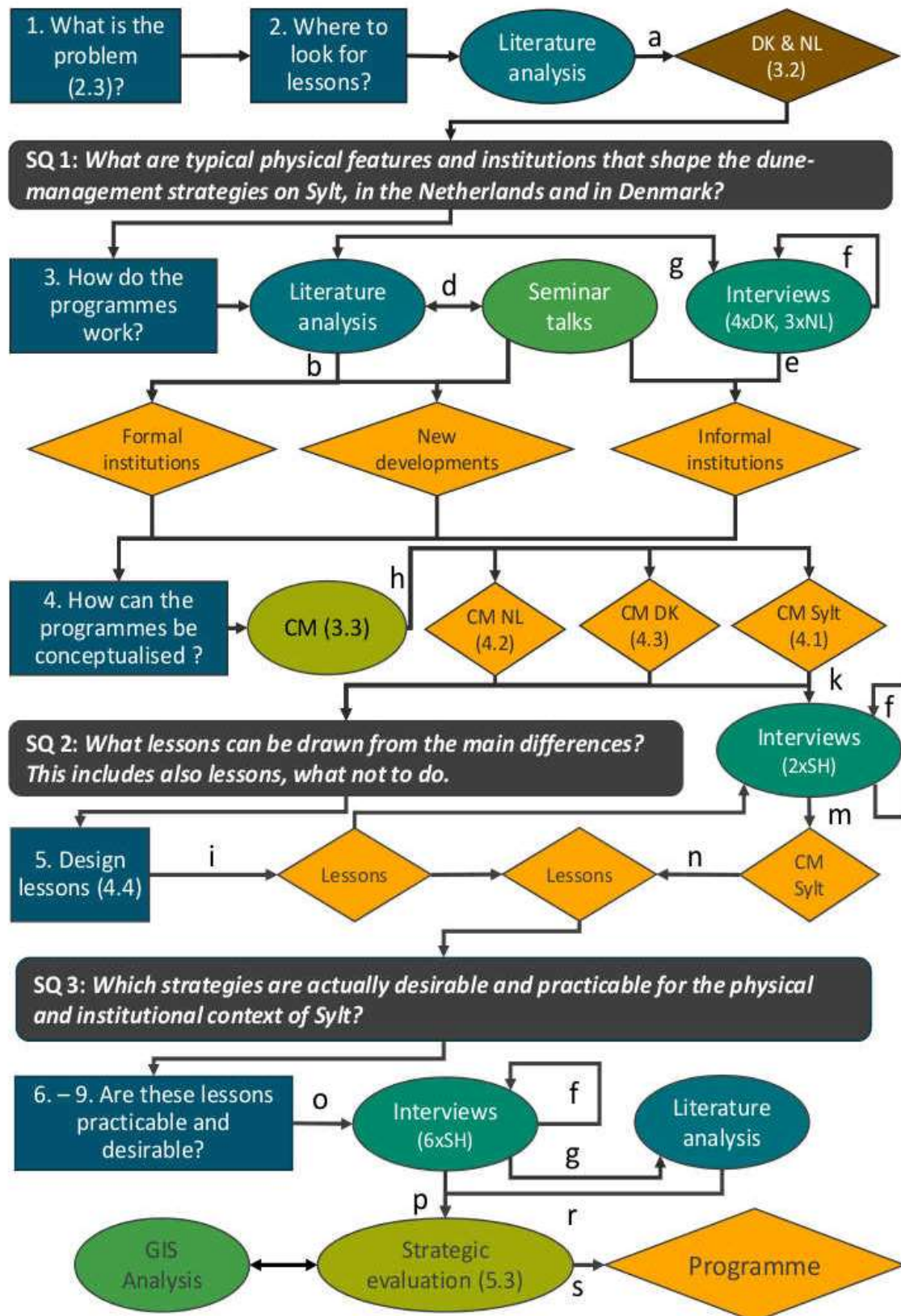


Figure 15: Flow chart depicting the research process. The rectangles refer to the steps for lesson drawing from Rose (2002), the rectangles with the rounded corners to the sub-research questions, the ellipses refer to elements from methodology and methods and the rhombes represent intermediate results. Numbers and letters in brackets refer to passages in the text. CM stands for Conceptual Model, NL refers to the Netherlands and DK to Denmark. The methods are almost exclusively qualitative, merely at one place, a quantitative GIS analysis was used.

4. Results

4.1. Dune Management on Sylt

4.1.1. Characteristics of the coast of Sylt

An overview over the most important physical and ecological processes within coastal dunes is given in Chapter 2.3. Nevertheless, it is important to point to some characteristics of the particular coastal dune fields in the following presentation of the three dune management frameworks.

Figure 1B depicts Sylt's special geological structure. Oost et al. (2012) describe how the central core maintains the position of the island westward of its neighbours. Some of the dunes are located on top of this eroding glacial core. The sectoral plan for Sylt describes, how the island was exposed to severe erosion by waves and tidal currents. Already Reinke (1903) describes the consequences: A steep beach and foreshore profile allows high waves to approach the coast; during storms, wave heights close to the coast can well exceed 5 m (MELUR.SH 2013, p. 16). Gaps in the sub-tidal bars focuses erosion on some points along the coast. Consequently, the coastline has been retreating about 1 m for decades (MELUR.SH 2013, p. 35). Until 1984, buildings had to be demolished to pre-empt coastal retreat according to MELUR.SH (2013, p. 55). The retreating coastline also provided the sediment for the formation of mobile dunes.

Furthermore, Sylt is exposed to a micro-tidal hub ranging between 1.80 and 2 m (LKN.SH 2016c, p. 6), which is around the same level as in the central part of the Netherlands (Sha and van den Berg 1993) and higher than at the Danish Westcoast (Saye and Pye 2006). As the tidal hub at Sylt has increased throughout the last century, SH-04 (6/7/2019) explains that the erosional forces of the tidal currents have likewise. Thus, more sediment is transported through the tidal inlets into the back barrier tidal flats. This is in line with the modelling results of Hofstede et al. (2016). Especially, at the island tips, the tidal currents are the dominating force (LKN.SH 2016c, p. 16).

Finally, Ellenberg and Leuschner (2017, p. 65) report that the sand found on Sylt is rather coarse and virtually lime-free; Priesmeier (1970) reports medium grainsizes of 0.5 to 0.8 mm the western beach. As a comparison, Arens et al. (1995) measured medium grainsizes around 0.2 mm at their Dutch beach study sites. Gripp and Simon (1940) describe the layer of coarse Pliocene fluvial kaolin sands underlying Sylt at many places. The submarine outcrops of this sandy layer are used as a sediment reservoir for the current beach nourishments, too. As Warren (2013, p. 26) explains, the coarser the grain size, the higher wind forces are needed to initiate aeolian transport.

4.1.2. Formal institutions

In general, the political organisation of Germany as a Federal Republic results in the fact that the Federal State of Schleswig-Holstein has the biggest responsibility for nature conservation and coastal protection. Its recent "Generalplan Küstenschutz", (General plan for coastal protection), published as MELUR.SH (2013, pp. 21–25), describes that the German constitution shifts the responsibility for coastal protection to the coastal Federal states, which have to define appropriate regulations. Nevertheless, protecting humans and assets along the German coast is a national interest. Therefore,

the national government provides subsidiary funding of 70 % for new coastal protection structures. Thus, national grants have to be met with Federal money. Maintenance remains the sole task of the Federal States. Furthermore, there is a national fund to allow the further implementation of projects to maintain the current levels of safety as a measure of climate adaptation (MELUR.SH 2013, p. 25; BMEL 2019, p. 105).

As for Schleswig-Holstein, the Federal Law on Water defines that coastal protection basically is the task of the party benefitting from the measures. Measures nevertheless must be granted by the organisation in charge: This is first the Ministry for the Environment and Agriculture (MELUND.SH) and the subordinate authority (LKN.SH) respectively. The islands are thus an exception; here both organisations are responsible for both the protection of humans and their assets against flooding and coastal retreat (MELUR.SH 2013, pp. 21–25).

Furthermore, the interference with other legal interests such as nature conservation and the protection of historical monuments are clearly arranged, as the LKN.SH also fulfils the tasks of the lower nature conservation authority. The “General Plan” also specifies that all measures have to be carried out with smallest environmental impact possible and – where necessary – need to be compensated (MELUR.SH 2013, p. 11).

There also exists a sectoral plan for Sylt published by the LKN.SH. The single documents are updated continuously and describe the current procedures. Currently, beach and foreshore nourishments constitute the backbone of coastal protection on Sylt (LKN.SH 2016e, pp. 15–18). As Figure 16 illustrates, beach nourishment refers to the deposition of the sediment right on the beach, foreshore nourishment means that the sand is already stored at the subtidal bars.

According to LKN.SH (2016a), the state of the coastline before the beginning of the nourishments acts as a reference. In accordance to MELUR.SH (2013, p. 37), foreshore nourishments are a promising future tool and would be cheaper, too. In practice, though, SH-04 (6/7/2019) explains that due to the strong tidal currents the stabilisation of the foreshore basically has to proceed from the centre of the island to the spits and is thus far from being accomplished. Currently each year 1 million m³ of sand are deposited at the west coast of Sylt. LKN.SH (2016e, 18 f.) calculates that this is equal to an annual nourishing volume of 300 m³ m⁻¹ coastline and expenditures of ca. 6 million € a⁻¹.

In addition, the dunes and the beach are further stabilised: LKN.SH (2016b, p. 5) explains that bio-technical coastal protection aims to first establish and preserve a continuous foredune ridge. Therefore, blowouts and small washovers are closed off with brushwood fences and later on with marram plantations. Since the beach nourishments are an established practice, sand-drift-dikes are

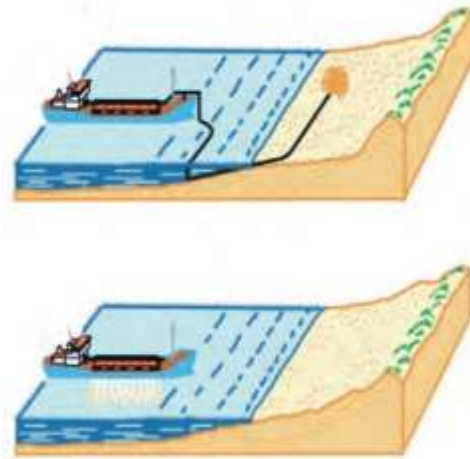


Figure 16: When nourishing, the sediment deposition happens either directly on the beach (top) or in the foreshore area (below). Source (MELUR.SH 2013, p. 37).

created with brushwood and marram planting to protect the foredune and to prevent aeolian sand transport into built-up areas.

According to LKN.SH (2016b, p. 28) marram plantation and brushwood fences in front of the foredunes are capable of trapping up to $11 \text{ m}^3 \text{ m}^{-1} \text{ a}^{-1}$ sediment. Along the entire west coast, this results in an additional sediment buffer of 4 million m^3 sand. SH-04 (6/7/2019) stresses the importance of this buffer for the event of a large gale.

A similar structure underlies the public nature conservation. Again, the Federal state is the most powerful actor: SH-05 (6/7/2019) explains that again the MELUND.SH is the uppermost authority in charge. Together with the subordinate federal authority for agriculture, environment and rural areas (LLUR), the ministry declares new nature reserves and is responsible for the strategic orientation of nature conservation. The LLUR is also responsible for developing the management plans for the nature reserves including the dunes on Sylt. The lower authorities for nature conservation at a district level have the tasks of granting and implementing measures. To finish projects successfully, an intense cooperation of the authorities is indispensable.

Additionally, as illustrated by Figure 17, the development of each nature reserve is monitored and accompanied by a Non-Governmental Organisation (NGO) as a warden. According to SH-03 (6/4/2019) their main task is to enforce the executive orders about the nature reserves as far as possible. In return, they receive some financial support. However, any endeavour for farther reaching measures thus is a matter of motivation.

The dunefields of Sylt are also protected as a geotope, however, as SH-06 (6/7/2019) argues, this title entails no legally binding protection. Important legislative tools are first the EU Habitats Directive as described in section 2.3.5 and the legal protection of Biotopes. Together, both exert a high pressure on the authorities to maintain or improve the ecological status of preserved habitats and areas.

SH-06 (6/7/2019) and SH-03 (6/4/2019) thus stress the importance of developing and implementing management plans for the Habitat areas on Sylt as they are binding. When it comes to the protection of dunes, SH-06 (6/7/2019) also refers to the fact that once a group of trees is a forest according to the Federal Forestry Law, it is legally



Figure 17: Each nature reserve on the island of Sylt is accompanied by a non-governmental organisation as a warden. For the dune areas, these are the "Sölring Foriing" (SF) and the "Schutzstation Wattenmeer" (SW). The "Naturschutzgemeinschaft Sylt" (NSG) takes care of two heathland areas on the glacial moraine core.

protected, as it is a federal goal to enhance the afforested area in Schleswig-Holstein. However, when the firs on the Northern Spit have been cut down in 2019, this was not an obstacle.

4.1.3. “Protecting dunes protects the island”

Most interview partners referred to the overwhelming paradigm for intervention in dune landscapes that “protecting dunes protects the island”. The history of dune management paradigms as presented by LKN.SH (2016b, pp. 6–16) fits well with the changing paradigms Clarke and Rendell (2015) identify: In the early 15th century a phase of increased aeolian activity commenced. As also the resources for large stabilisation campaigns lacked, aeolian dynamics were only tamed there by marram plantations, where they posed an urgent danger to human assets and were accepted elsewhere as was coastal retreat.

This situation changed in 1864, when Sylt came under Prussian dominion, which coincided with the commencing tourism industry on the island. The resulting spiral of economic development and need for coastal protection is described in section 2.3.4; here, it resulted in the creation of artificial foredunes: These artificial foredunes were sought to prevent beach and foredune erosion. The foredunes behind the artificial foredunes were stabilised systematically as well. Within a few decades a paradigm shift occurred.

Eventually, efforts were made to also stabilise the migrating dunes that until then traversed both spits. In the beginning, this happened to both protect the increasing tourism infrastructure and later also the military bunkers, barracks, etc. that were had been erected during the world wars. It was then that the slogan “Protecting dunes protects the islands” was established on the signs marking marram plantations as illustrated by Figure 18. Dune fixation continued also after World War II and is still practiced.

This paradigm fits to the „will to subdue nature“, as Fischer (2011, p. 35) calls an underlying attitude behind the coastal protection strategy of Schleswig-Holstein. Especially, dynamic nature is regarded an enemy that must be ruled over. Reise and MacLean (2018, p. 179) paraphrase this as follows: “*Changeable dunes, which did not stick to the maps, were considered a nuisance* [own translation]”.

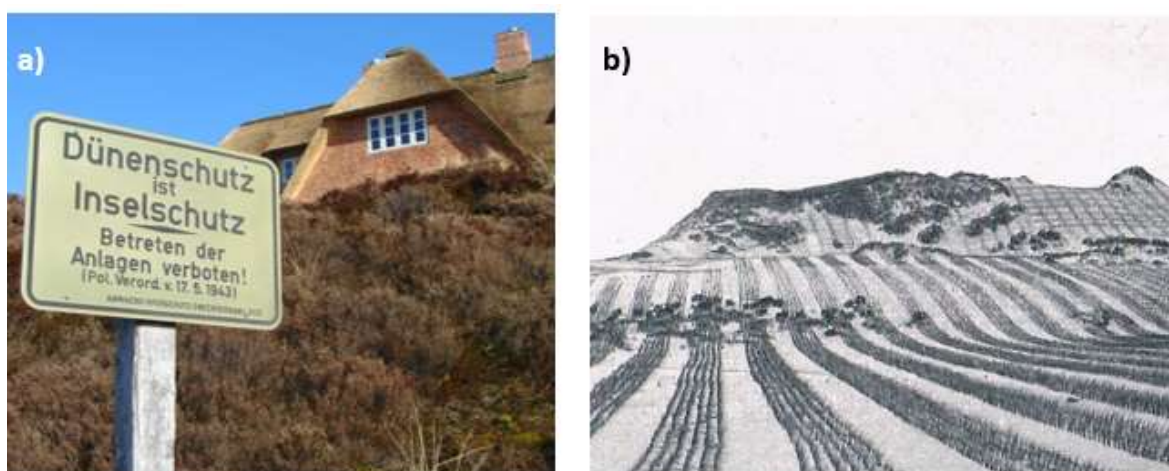


Figure 18: Signs bearing the slogan “Dünenschutz ist Inselerschutz” (Protecting dunes protects the island, a) still can be found in the dunes although the marram plantations (b) have long been succeeded by heathland. Note the year 1943 written on the sign. Sources: a) Karsten Reise b) (Kolumbe 1928)

This attitude is nothing particular for Sylt, though. Winiwarter and Bork (2015, 144 f.) describe a similar paradigm for the straightening projects of the upper Rhine in Germany in the late 19th century. The more the dunes on Sylt stabilise, the better they hence fit to this paradigm.

Since then, this paradigm has been internalised: With regard to coastal dunes SH-02 (6/2/2019) sees hardly any difference between the old-established islanders, regular tourists and people that have moved to the island since then. Whereas kids roaming around and women plucking berries in the dunes were a common image in the 1950s and '60s, it hardly happens anymore. SH-01 (6/1/2019) also observed, that the tourist advertisements stopped to show people walking to the dunes; instead the landscape became merely the backdrop for leisure activities. Consequently, the public interest in the dunes is rather low: SH-02 (6/2/2019) and SH-03 (6/4/2019) point to the low demand for public dune excursions on Sylt.

Instead, SH-01 (6/1/2019) observes how people enforce this rule by themselves: First, as everyone stays on the pathways, less people dare to leave the tracks. Second, those who do so, are reprimanded immediately. Eventually, SH-02 (6/2/2019) fears that the connection between islanders and tourists and “their” dunes has been disrupted by the established paradigm. Thus, the paradigm shift towards embracing and tolerating dynamic processes has yet to be initiated.

4.1.4. Other informal institutions

The slogan “Protecting dunes protects the island” almost formed a symbiotic relationship with the principles of nature conservation at that time. First SH-02 (6/2/2019) and SH-03 (6/4/2019) explain that there is a long tradition of nature conservation trying to separate ‘ordinary’ people from nature.

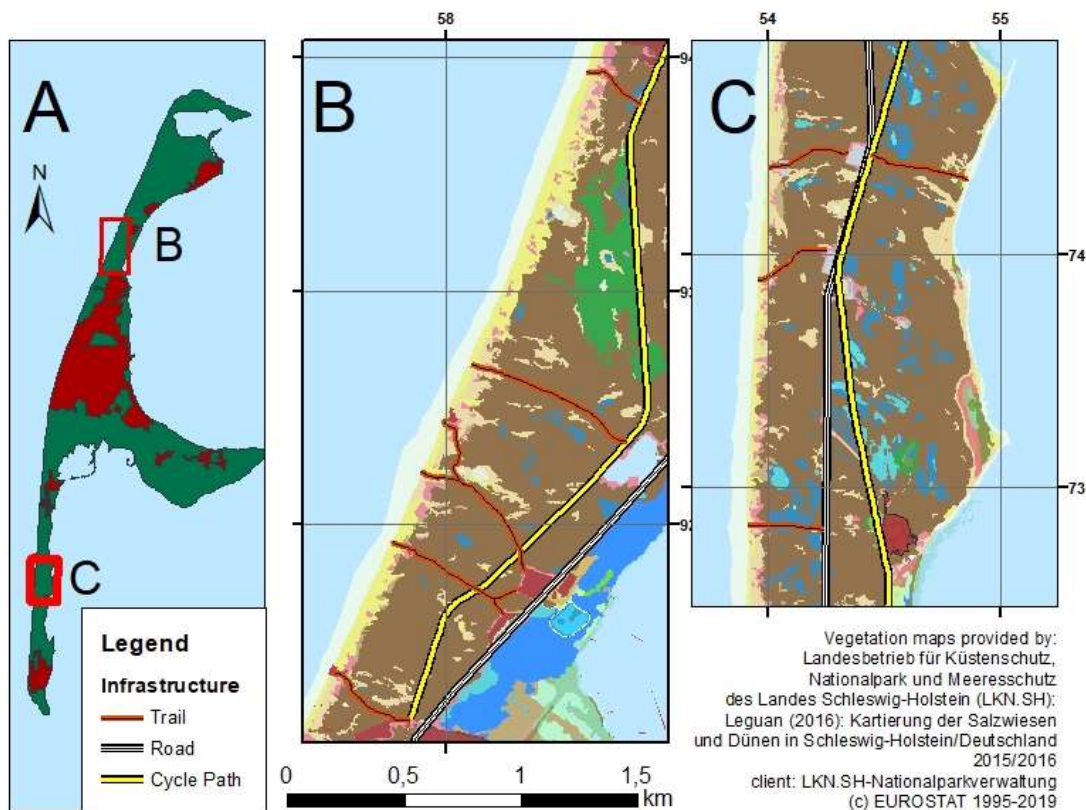


Figure 19: Typically, the hiking trails through the dunes run straight from the street and the parking places through the dunes to the beach. This is illustrated by figures B and C. A shows the location of B and C.



Figure 20: Barbed wire and signs should separate the sensitive nature from human destruction. The sign on the right states: "Do not enter! The dunefield is protected as a nature reserve! Only the four-legged sheep may use the elephant paths!!" Source: Karsten Reise

This idea occurs throughout the nature conservation history of the Listland (see Figure 13). In 1966 the Bundesanstalt für Vegetationskunde, Naturschutz und Landschaftspflege concluded that the increasing numbers of tourists had to be led to the beaches along a few corridors to prevent irretrievable destruction of the vegetation. Their suggestion, though, included to incorporate lookouts at scenic points along these pathways. This part of the recommendation, however remained unrecognized: As shown by Figure 19, the pathways usually run straight from the parking place to the beach. Any elephant pathways are closed off with marram plantations and road signs. However, this separating attitude continued after the visitors were guided on the pathways. Almost 30 years later, Neuhaus (1994) still focuses on a banning all forms of human use from the dunes. This is in line with the statement of Winiwarter and Bork (2015, p. 135) that German nature conservation is still stuck in protecting small-scale objects rather than environmental processes and maintains an hierarchical character and a sectoral approach as can be seen in Figure 20. Clearly separated sectoral responsibilities become also apparent within the formal regulations such as the guidelines of BMEL (2019, p. 106) granting national subsidies to coastal protection. Besides the segregating attitude Winiwarter and Bork (2015, p. 137) also highlight the importance of the American romantic ideal of preserving sublime wilderness for nature conservation in the dunes. As SH-02 (6/2/2019) and SH-07 (6/17/2019) explain this idea also underlies the idea of nature conservation in the adjacent national park of the Wadden Sea, where salt marshes and tidal flats should develop dynamically and free from human intervention. This idea also influenced nature conservation in the dunes on Sylt: Koehn (1961, p. 47) asked a decisive question, whether the dune heathlands are of natural origin or are product of human use like the heathlands on the moraine cores. Based on botanical surveys Raabe (1964) categorized the coastal heathlands as natural final stage of succession in the dunes. Then, the climate was considered too harsh to allow natural growth of trees, Consequently, SH-02 (6/2/2019) points to the fierce discussion about pine plantations on the neighbouring island of Amrum in the 1960s. Although later findings reviewed by Leuschner and Ellenberg (2017, p. 83) rejected that hypothesis, SH-01 (6/1/2019) explains that nevertheless, the conclusions of Raabe (1964) have been considered valid until today.

SH-03 (6/4/2019) further states that it is indeed difficult to get nature conservation measures started. Years of rapid increase in real estate values have caused social disruptions. More and more buildings are replaced by luxury holiday homes and are no longer inhabited permanently. A climate of distrust is the consequence. Despite the formal option to enforce measures by court decisions. SH-05 (6/7/2019) and SH-08 (6/18/2019) emphasize the need to convince the local stakeholders, especially the landowners. According to SH-03 (6/4/2019) this is especially difficult in the Listland (see Figure 13) which is owned by an association of heirs.

Hence it is one of the current challenges to explain the needed paradigm shift from refusing any human-caused disturbance to purposeful intervention (SH-05 6/7/2019). So far, only minor interventions have happened to restore wet dune slacks for the preservation of the Natterjack toad. SH-05 (6/7/2019) explains that the discussion about a strategy for future nature conservation that goes beyond minor and local interventions to remove shrubs and trees in the dunes of Sylt is only at the beginning: Whereas the SF strives to preserve the cultural landscape of the dunes as of 1700 to 1800 (SH-08 6/18/2019), the SW focuses more on the habitats and wants to preserve the small-scale, patchy mosaic of dune habitats



Figure 21: Raabe (1964, p.174) distinguished between the natural coastal heathlands of the dunes (XXX) and the heathlands on the moraine cores that were the result of human use (|||).

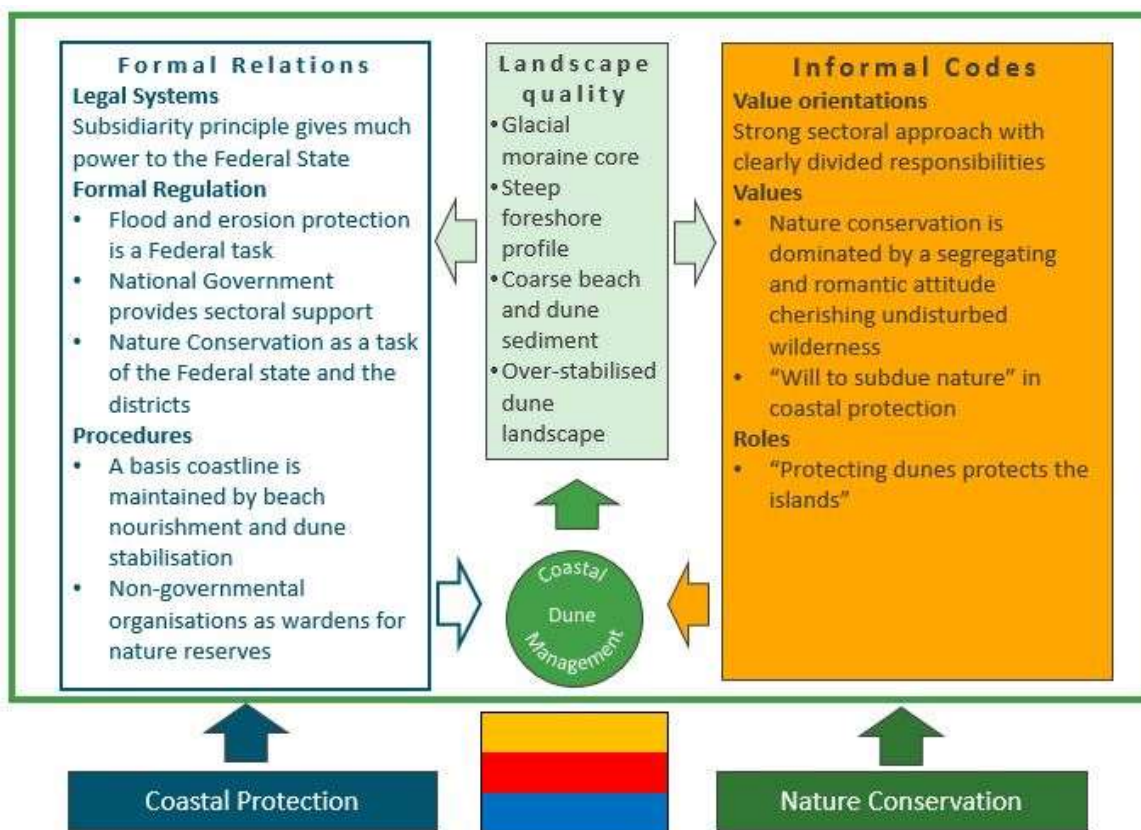


Figure 22: Conceptual Model for the dune management approaches on the island on Sylt, here represented by the flag of the district of North Frisia.

(SH-03 6/4/2019). SH-06 (6/7/2019) further lays out the goal of a self-maintaining system, which receives fresh sediment input from the beach.

According to SH-07 (6/17/2019), the same is true for the discourse about climate adaptation. In 2015, governmental and non-governmental actors from nature conservation and coastal protection have agreed on a “Strategy for the Wadden Sea 2100” (MELUR.SH 2015). It contains options for adapting the Wadden Sea area of Schleswig-Holstein to a sea-level rise of up to 0.8 m until 2100 and explicitly includes the islands. Its two main pillars are sediment management and hard coastal protection and it aims for both preserving the ecological values of the Wadden Sea as well as the flood safety of the coastal population. SH-07 (6/17/2019) stresses that the strategy is non-binding; it is a common



Figure 23: Impressions from the dunes on Sylt: a) Foredunes with a small sand-drift dike in front of the foredunes, 28.08.2016 b) Stabilised Foredunes at the west coast, 28.08.16 c) Dune slack close to Rantum, 19.03.16 d) Stabilised dunes and one of the last migrating dunes in the Listland dune field, 28.08.16

agreement which aims to guide future actions in the Wadden Sea area, including coastal protection and nature conservation. However the strategy so far has merely stimulated research, but its first transfer into action still has to happen. Figure 22 depicts the conceptual model of the dune management strategy on Sylt.

4.1.5. Effects on the landscape

As described in Chapter 1.2 and illustrated by Figure 23 the dunes of Sylt have been increasingly stabilising over the last decades with an increasing succession going on as a result of fragmentation, eutrophication and deliberate dune fixation for several reasons. Already Priesmeier (1970) stated that this interrupted the conveyor belt of sediments across the spit. Along the coastline, though, the nourishment have caused far-reaching changes: the beaches got wider and allowed the establishment of artificial foredunes as well as maintaining a continuous line of foredunes with the help of brush-wood fences and marram plantations (LKN.SH 2016b, p. 5).

Nourishments in the foreshore area allowed to also partly stabilise the ridge and runnel system, which before had been steepening, as SH-04 (6/7/2019) describes. However this is not true for the entire coastline. Along the island tips the foreshore profile still steepens due to fast-flowing tidal currents (LKN.SH 2016e, p. 17).

4.2. Dune Management in the Netherlands

4.2.1. Characteristics of the Dutch coastal landscape

Mulder et al. (2011) divide the 400 km of Dutch coastline into three parts (see Figure 24): Tide-dominated estuaries are the dominating feature of the southern Delta; most of them – except the Eastern Scheldt are currently blocked by dams and storm surge barriers, respectively. By contrast, the Holland coast is mostly shaped by the actions of storm waves. The Wadden coast, again is tide-dominated and features a chain of barrier islands. This reflects the varying tidal hubs described by Sha and van den Berg (1993) as being around 4 m in the southern part, around 2 m in the central

part and increasing again to the North.

According to Mulder et al. (2011), out of these 400 km coastline, about 300 km are protected by dunes from coastal flooding. These dunes vary in width from narrow single dune ridges to wide dune fields. Located at the Delta of the large rivers Meuse, Scheldt and Rhine, about one third of the country is located below the sea-level. Thus, van Koningsveld et al. (2008) explain that post-glacial

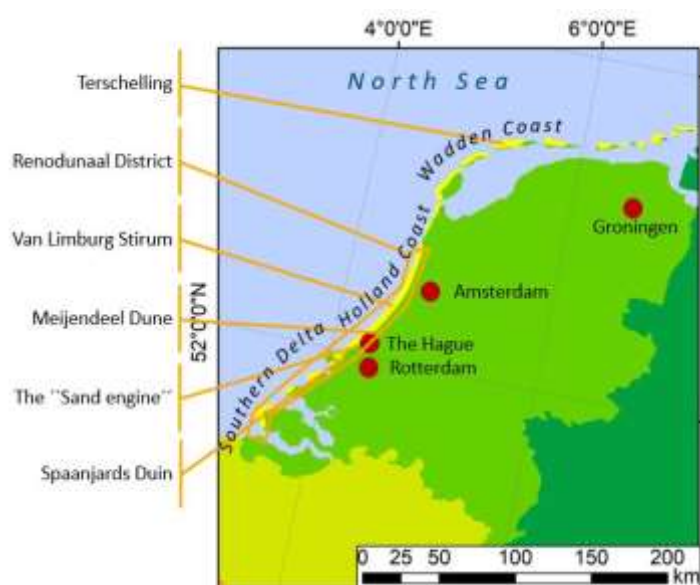


Figure 24: 300 out of 400 km of Dutch coastline are lined by coastal dunes

sea-level rise has been a major force altering the state and position of the Dutch coastline; consequently, the effects of an increased sea-level rise will have far-reaching consequences such as increased coastal erosion. Arens and Wiersma (1994) lay out how the rising sea-level over the past centuries resulted in coastal retreat and thus in high aeolian activity.

At the same time, this low-lying Delta, At the same time, the high population density of ca. 460 persons km⁻² and a strong economy demands safety from coastal and riverine flooding van Koningsveld et al. (2008) In turn, Arens et al. (2013b) describe that the economic activities lead to increased nitrogen emissions supporting dune stabilisation. According to Groot et al. (2017a) the atmospheric nitrogen deposition in the Netherlands reaches almost 15 kg N ha⁻² a⁻¹ and thus are often exceeding the critical values of 10 to 15 kg N ha⁻¹ a⁻¹.

4.2.2. Formal institutions

van Koningsveld et al. (2008) and Mulder et al. (2011) provide descriptions of the development of the formal Dutch water management sector, which results in the current pattern. The “Ministerie van Infrastructuur en Waterstaat” (Ministry of Infrastructure and Water Management, IenW) bears the ultimate responsibility for strategic flood defence on the Wadden islands and of the large dams, coastline management including beach nourishment and overall supervision, including strategic planning. The subordinate national authority is “Rijkswaterstaat” (Directorate-General for Public Works and Water Management, RWS). According to NL-04 (6/4/2019), the strong central position of the state allows to implement innovations quicker than in countries, where coastal protection is decentralised like in Germany. This also results in high flood safety standards, which should be further increased in the future. IenW et al. (2018) aim to reduce the individual risk of mortality due to flooding to 1 in 100,000 per year.

On the next lower level, the provinces have the task to integrate the national plans for water management into their plans for economic development. They further supervise the regional “Hoogheemraadschappen” (Water boards) (Mulder et al. 2011). According to van Koningsveld et al. (2008) the water boards are almost as old as the organised efforts for coastal protection in the Netherlands. NL-01 (5/20/2019) describes that they carry out the actual measures in the coastal foredunes. Eventually, Mulder et al. (2011), the hierarchy is not solely top-down, as the national authorities ask the lower levels including the municipalities as well as private actors for advice.

Cooperation is also reflected within the national programme on climate adaptation. NL-04 (6/4/2019) describes that in 2010 the (second) Delta Programme was launched to prepare the Netherlands for the effects of climate change. The Delta Programme has its legal roots in the Delta Act and works mostly independent from the other governmental organisations. Furthermore, as stated by IenM and EZLI (2011) the Delta Programme does not carry out the measures but coordinates between different public and private actors. It also prepares strategies which are then transferred into law by the parliament. The decision about the future flood safety standard described by IenW et al. (2018) was a Delta Decision as was the “Decision on Sand” (Delta Programme Commissioner 2015). Taking into account the general adaptability of a sandy shoreline to a rising sea-level as described in chapter 2.3.2, the Delta Programme Coast (2013, p. 30 and p 122) explains

that it is the aim to substitute the missing the sediment. This means that additional sediment is added at the coastal foundation in deeper waters

This decision basically is the intensified continuation of the previous coastal management strategy since the 1990s. De Jong et al. (2014) report that it was after a series of severe gales along the coast in the late 1980s that it was decided on a national level to stop coastal retreat by means of introducing a reference coastline (Basiskustlijn) which should be maintained by beach nourishments. At the same time, Arens et al. (2013a) explain that the decision for dynamic dune management was made: This means that wherever possible, the coastal foredunes are no longer stabilised as described e.g. by van der Putten et al. (1990). Before the era beach of nourishments, Arens and Wiersma (1994) summarize that massive dune stabilisation efforts reduced the aeolian transport to $3\text{-}3.5\text{ m}^3\text{ m}^{-1}\text{ a}^{-1}$. As described by Löffler et al. (2011, p. 22) fences and marram plantations were used on the islands to create “Stuifdijken” (sand-drift-dikes) that since then have trapped sediment efficiently. The beach nourishments led to an increased sediment input of about $10\text{ m}^3\text{ m}^{-1}\text{ a}^{-1}$ into the dunes according to Arens et al. (2013b).

For nature conservation, Wolf (6/3/2019) describes, the provinces have been responsible since 2012. NL-01 (5/20/2019) explains, that they e.g. set up the guidelines for management of Habitat reserves. Private and public landowners then follow these guidelines for the actual management of their nature areas. Nature conservation of course interferes with other policy sectors, the preservation of archeologically important sites is a task of the municipalities.

More indirect, NL-02 (5/21/2019) describes, also the national policy is important here. To reduce the impacts of the high nitrogen emissions into the atmosphere, the “Programma Aanpak Stikstof” (PAS). Therein, it was decided that nature managers may receive substantial additional funding for combating the effects of nitrogen deposition. In turn, economic development and increased nitrogen emissions are permitted close to particular Natura 2000 areas. Many dune restoration projects receive money from PAS. Only in May, though, the PAS was voted down by the highest court (Raad van State 2019).

4.2.3. Informal institutions

The low-lying location of the Dutch Delta resulted in frequent flooding throughout the millennia, as e.g. van Koningsveld et al. (2008) report. Especially the “Watersnoodramp” of 1953, causing almost 2,000 fatalities in the Scheldt estuary is an important driver for maintaining and increasing coastal safety as NL-04 (6/4/2019) describes. Nevertheless, the overall attitude towards coastal management is different than in Germany: Winiwarter and Bork (2015, pp. 42–43) describe how the Dutch have been constantly intervening with the natural processes in the last centuries to re-shape the natural surroundings to their needs. Thus, NL-04 (6/4/2019) considers the Dutch relation attitude towards coastal management rather self-confident. However, as Wolf (6/3/2019) argues, this leads to the almost complete loss of undisturbed wilderness in the Netherlands.

This perception of having control can be closely related to a comparably strong will to experiment, observed also by SH-06 (6/7/2019): NL-04 (6/4/2019) refers to the experiments that are currently conducted in the tidal inlets between the Dutch Wadden islands. In her talk about the future of the

Dutch national parks Wolf (6/3/2019) mentions the will to experiment as a typical attitude in nature management, too. NL-02 (5/21/2019) describes how the closing of a drinking water channel in the Limburg van Stirum dunes re-initiated large scale aeolian dynamics.

Despite this observed appreciation of experiments, though, NL-01 (5/20/2019), NL-02 (5/21/2019) and SH-07 (6/17/2019) describe that also in the Netherlands, dynamic dunes are not cherished everywhere and face resistance especially on the islands like Terschelling or in Zeeland in the south of the Netherlands. With regard to the initial resistance of the Waterboards, NL-02 (5/21/2019) sets out that their scepticism quickly vanished when realising that the additional sediment input into the dunes did not affect flood safety. Additionally SBB Terschelling (2012) states that more than 90 % of the visitors would prefer the dynamic dune landscape over the older, static one.

In his case study about Rijkswaterstaat de Jong (2002, p. 68) calls the “Consensus culture” as something particular Dutch. Also SH-07 (6/17/2019) considers the communicative, consensus-seeking attitude towards problems a characteristic difference to Germany. NL-01 (5/20/2019) explains, for example, that there exists no regulatory framework that tells how the dynamic foredune management should look like: RWS, the Waterboards and the landowners negotiate about the best strategy at each setting.

This “consensus culture” makes it also easier to reconcile multiple uses of areas, as space is scarce. van der Meulen et al. (2004, pp. 268–275) provide the example of the Meijendeel Dunes north of The Hague: Whereas their primary use was the production of drinking water, subsequently nature conservation and recreation became established and are done and financed by the water company. Many dune fields are well-used for recreation. Furthermore, coastal dunes are considered a particular Dutch landscape, as NL-04 (6/4/2019) confirms. An important tool within this process were zoning plans, which also include natural core areas which are free of use. Also Wolf (6/3/2019) considers zoning plans very helpful when it comes to integrating different land use forms in nature areas. As described by Waternet (2015) or Dunea (2019), dunefields, especially along the Holland coast are intensively managed to support biodiversity, protect dune habitats and allow recreation at



Figure 25: The zoning plan for the Meijendeel dunes north of The Hague. Source (van der Meulen et al. 2004, p. 270)

the same time. In comparison to Germany, SH-07 (6/17/2019) highlights the focus on managing nature and designing landscapes, which is also emphasized by NL-04 (6/4/2019).

All three strands accumulate in the emerging, but somewhat vague paradigm of “Building with nature”: Van der Meulen et al. (2015) consider it to be nature based-designs that deliberately make use of natural processes

and materials that exist at a particular location. Van Slobbe et al. (2013) refer to designs that incorporate both societal needs, the existing, infrastructure as well as the environmental needs as “Building with nature”. These ideas underlie many ideas of current Dutch coastal management. Without mentioning the term, Löffler et al. (2011) suggest new approaches in barrier island management that rely on the ideas of building with nature. On Texel the Water board HHNK (2018) initiated the construction of an artificial sand dune landscape in front of the old dike. Arguably, the construction of these sites also compromise the integrity of the adjacent ecosystems. The Sand motor as described by NL-01 (5/20/2019) and van Slobbe et al. (2013) can be seen as a paradigmatic example of “Building with nature”: To overcome the drawbacks of current nourishment strategies a mega-nourishment of 20 million m³ sand was proposed. Initial concerns of stakeholders like the threat of groundwater salinization in the nearby dune field were included and eventually the construction began in 2010 to develop an attractive recreational area just off The Hague, to gain knowledge and to provide natural habitats, especially dune pioneer stages.

When it comes to the actual management of dunes, two different approaches besides were described: Nijssen (5/13/2019) describes how ecological traits of key species are used for habitat restoration according to the needs of these species and how they affect other species. For instance, Nijssen et al. (2014, p. 60) argue that too intense grazing keeps the vegetation too short to be an attractive breeding for the Northern Harrier (*Circus cyaneus*), whose breeding population has been strongly declining in the last years.

By comparison the geological restoration approach presented by, Arens et al. (2013a) focuses on the remobilisation of entire geomorphological entities. This approach turns out to need much aftercare

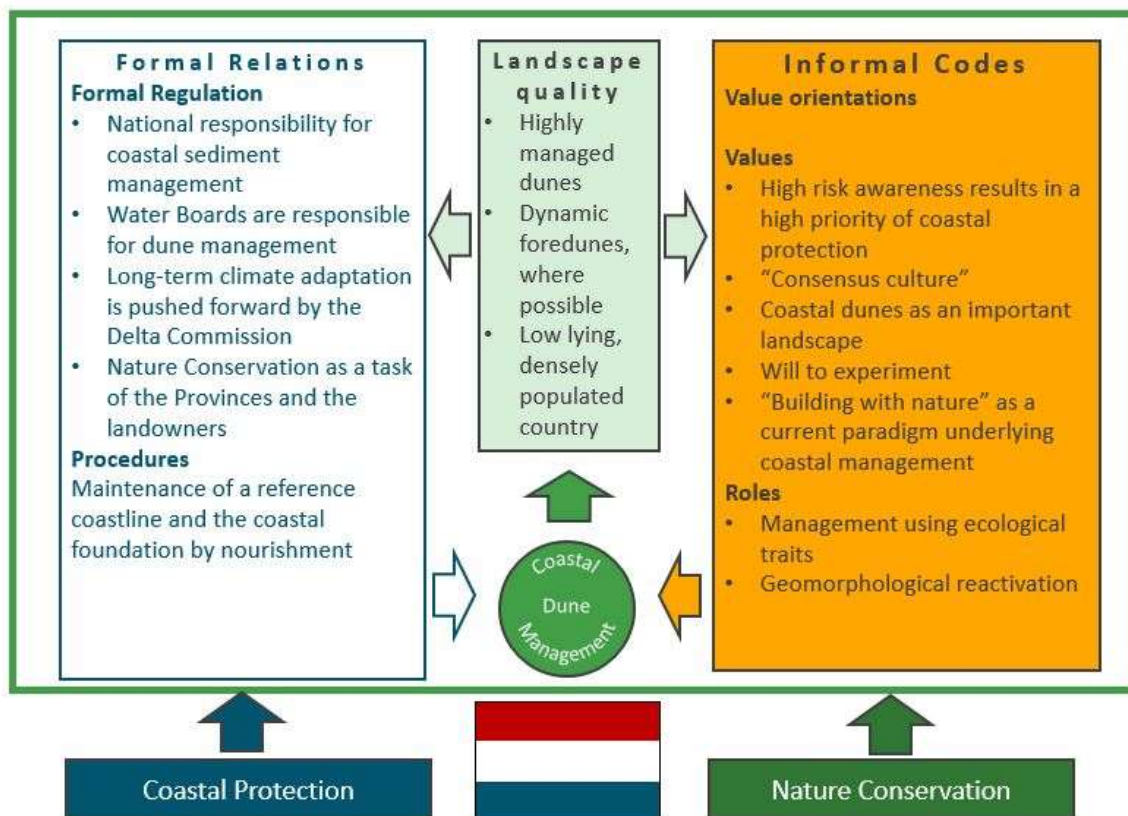


Figure 26: The conceptual model for the Dutch dune management strategy

at inland dunes, as the example of the Limburg van Stirum area shows. Vegetation removal on inland dunes does not lead to a long-term re-dynamisation, but to an increase of dynamic for 10-20 years and then results in a mosaic of dynamic patches, which is also ecologically valuable. Thus, follow-up removal of vegetation is necessary or the vegetation is just removed at the stossface. At the coastal foredunes, the situation is very different, as the natural stressors are much higher. When almost the

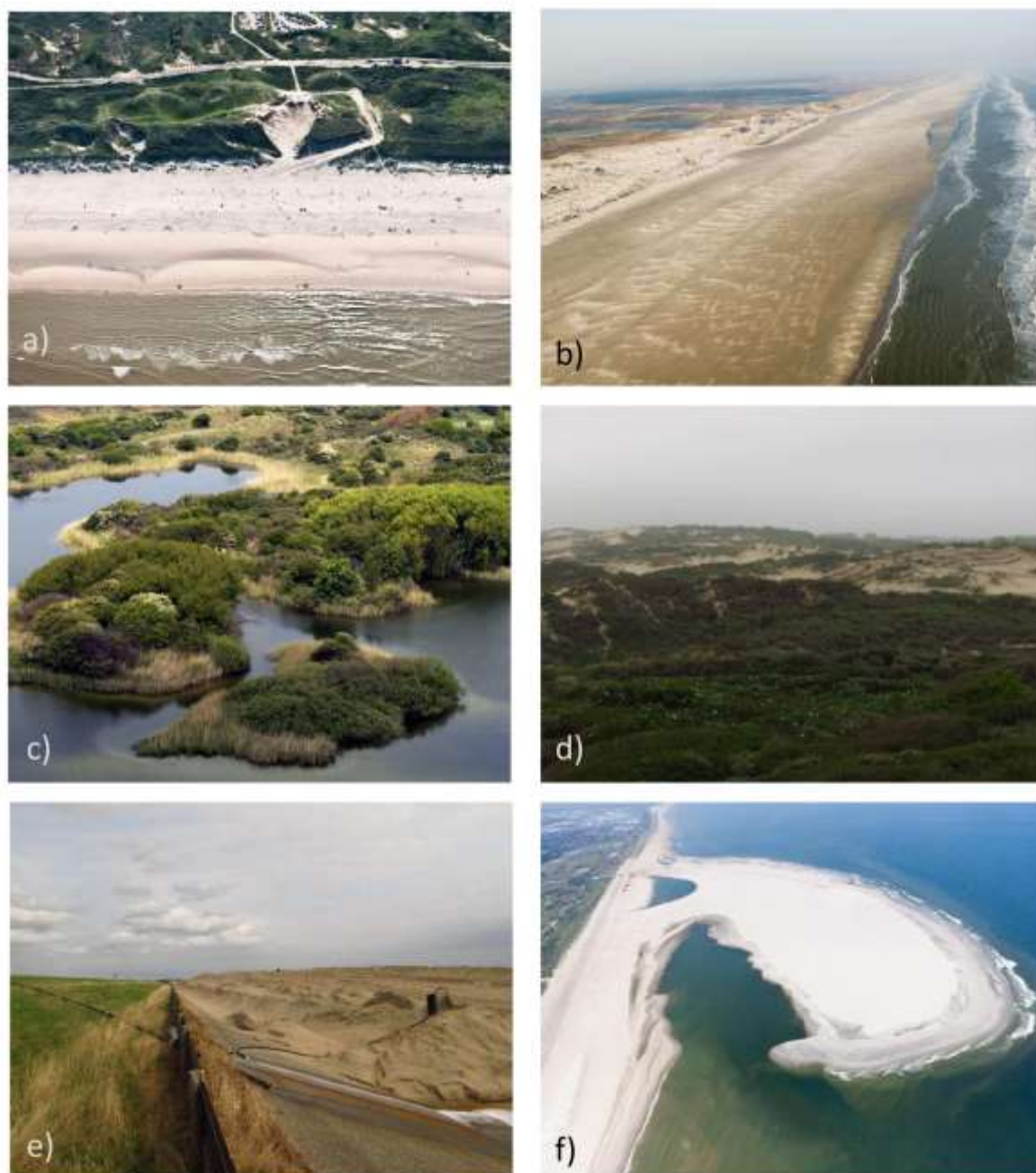


Figure 27: Impressions from Dutch coastal dunes: Dynamic dune management: a) Blowout in the foredunes. Source: (Beeldbank RWS, 02.08.11, ID: 411796) b) Large-scale dune mobilisation on Terschelling. Source: (Beeldbank RWS, 25.03.2007, ID: 298044) Managed inland dunes: c) The Meijendeel Dunes at The Hague are also used for drinking water production. Source: (Dunea 2019) d) Revitalised dunes at the Westduinpark in The Hague (20.05.2019). Building with nature: e) The construction of "Prins Hendrik dunes" in front of the old dike on Texel happens at the expense of the adjacent tidal flats, now covered by sand (28.08.2018) f) The mega nourishment "Sand motor" at The Hague extends over some two kilometres along the coast and contains about 20 million m³ sediment. Source: (Beeldbank RWS, 05.07.2011, IC 405317)

entire vegetation was removed by bulldozers in the foredunes on Terschelling, the entire dune ridge became mobile. Sediment was deposited as far as 300 m inland. At high foredunes notches can be cut into the foredunes to enhance the sediment transport into the hinterland. The base level of these notches remains well above the minimum height the foredunes must have to guarantee flood safety. The conceptual model of the Dutch dune management strategy is summarised by Figure 26.

4.2.4. Effects on the landscape

Figure 27 presents an overview of the effects the Dutch dune management strategy has on the landscape. The beach nourishments basically turned the retreating coast into a stable, if not prograding coast. Arens et al. (2013a) summarize that the effects of “Dynamic dune management” were different. Whereas the high sediment input in some dune parts “overpowers” the vegetation and leads to erosional features, at other places, it leads to the formation of a new ridge of foredunes in front of the others. In any case, de Jong et al. (2014) observe a time lag between the sediment deposition and the effect on the coastal dunes. In the long run, though, the dynamic management approach results in a more natural foredune development. Where dynamic dune management is not possible, though, the dunes remain stable. On the Wadden islands, Groot et al. (2017b) observe that intact sand-drift dikes are very effective in suppressing dynamics in the hinterland. The intense management aims for the conservation of habitats and biodiversity. NL-02 (5/21/2019) also observes, though, that dune managers aim for having to have a complete palette of habitats in their dunes, whereas this not necessarily reflects the natural state.

4.3. Dune Management in Denmark

4.3.1. Physical Characteristics of the Danish west coast

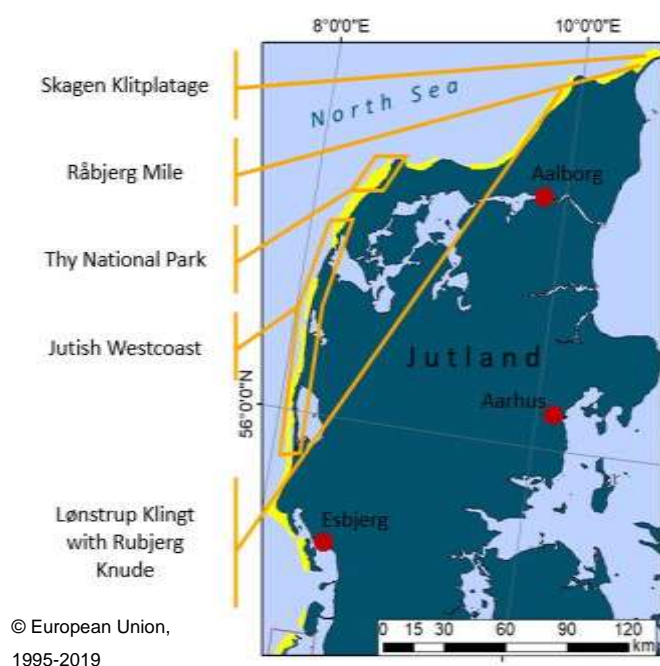


Figure 29: 800 km² of coastal dunes line the Jutish North Sea coast. Dune fields explicitly referred to in the text are indicated. Source: (Bohn and Gollub 2004)

The Danish coastline is very long – 7,400 km according to Hanson et al. (2002). Saye and Pye (2006) describe characteristics of the Western coastline: The coastline is mostly wave-dominated, especially strong westerly storms play a large role, causing surges up to 2.5 m above mean sea-level. The tides with a mean amplitude of 0.8 m, play a minor role. Also unique compared to Germany and the Netherlands, due to isostatic uplift the northern part and the northernmost spit, Skagen Spit, experienced prolonged phases with falling sea-level. (Clemmensen et al. 2001). Although Saye and Pye (2006) divide the entire coastline in many interrelated sediment cells, actually no

sediment leaves the national territory (DK-02 5/9/2019). This, by contrast is a different situation as on Sylt, where Sand nourished at the beach might end up in the Danish part of the Wadden Sea.

Almost along the entire length of 300 km, dunes line the coastline adding up to 800 km² according to Saye and Pye (2006). They distinguish between large dunefields that reach up to 10 km into the hinterland on top of former barrier systems or cliffs and less wide dune fields that are located on the barrier that close off fresh water lagoons from the North Sea (see Figure 29).

The natural dynamics in the dunes are usually comparably high, as soil pH is rather low and at the same time the atmospheric nitrogen input relatively low (DK-04 5/28/2019). At the coast, storms cause disturbances (DK-02 5/9/2019). Nevertheless, Brunbjerg et al. (2015) conclude that also the biodiversity in Danish dunes is decreasing due to stabilisation.

4.3.2. Formal Institutions

In general, national legislation and national authorities play an important role. Strict legislation apply in the coastal area (DK-01 5/1/2019). A first important legal instrument are the 'Beach protection zones' ('Strandbeskyttelseslinjer') (Kystdirektoratet 2019e); they regulate the land-use, especially the construction of houses within the coastal strip behind the beach. At the west coast of Jutland, this is replaced by 'Dune protection zone' ('Klitfredningslinjer'). Its purpose is to limit human use in the coastal stretch (100 to 300 m away from the coast line), it strives to maintain the status quo and to further prevent sand drift (Kystdirektoratet 2019c). Kystdirektoratet, the Danish Coastal authority, which is responsible for the regulations within this zone, was combined with the national authority for nature conservation, Naturstyrelsen (NST), which also improved the cooperation between the two authorities (DK-04 5/28/2019)

From a national perspective, the landowners are responsible for coastal protection. They have to apply at the particular municipality for permission to counteract coastal erosion and to consider the nature and other interests. According to DK-04 (5/28/2019), the 'Dune Revees' ('Klitfogder') that once were responsible for stabilising coastal dunes are merely of marginal importance today. Only at a the Jutish west coast (see Figure 29), where fragile spits separate the North Sea from the fjords, places of national interest, the national government stepped in (Kystdirektoratet 2012).

Hanson et al. (2002) describes, that in 1982, following serious storm events, a joint agreement was made between the local municipalities of Jutland and the Danish government to protect the coastline together. The costs are shared between the government and the municipalities, the first pays 50 % - 100 %. This strategy had 3 goals: First to establish a risk-based flood strategy that provides flood safety against a flood event statistically occurring every hundred or thousand years (Kystdirektoratet 2018, p8f.). Second, coastal retreat should be stopped in the proximity of towns and third, reduce the speed of coastal retreat, where it might pose a threat in the near future (Hanson et al. 2002). Every five years, the municipalities and the Danish Coastal Authority 'Kystdirektoratet' negotiate a plan on the treatment of the single coastal strips. As illustrated by Figure 30 the last agreement (2014-2018) distinguished between three impact categories based on two different strategies (DK-02 5/9/2019):

Beyond wind, sand and marram grass

1. *Stop coastal retreat* at stretches without hard coastal protection and a high of flooding
2. *Reduce retreat* at stretches
 - a. Without coastal protection but a higher probability of breaching as there exists a broad strip of beach in front of the dunes. There, coastal retreat should be reduced to 1 m/a^{-1} or less.
 - b. With a low risk of flooding. There coastal retreat should be reduced as far as possible, but at least to 3.2 m/a^{-1} (Kystdirektoratet 2018)

The measures mainly include beach nourishments and slope protection in front of the coastal dunes and the beach. The annual measures are designed based on monitoring (Kystdirektoratet 2018, p. 5, 2019b). To maintain the necessary safety levels, the dunes must have a width of 30 to 50 m and a certain height of up to 4.5 m. In practice, aeolian activities are allowed to take place wherever possible; only at places, where property is endangered, dune stabilization occurs (DK-02 5/9/2019).

When it comes to nature conservation, NST is an important actor: Together with the communities they are in charge of maintaining the good conservation status of the protected areas according to the Habitat directive, forestry and to provide opportunities for outdoor recreation (NST 2019c). DK-04 (5/28/2019) explains that therein the protection of the open dune heath landscapes is a major task. This entails the struggle against non-native pine species like the Mountain pine (*Pinus mugo*) or invasive species like *Rosa rugosa* as well as the restoration of the natural hydrology.

Besides the official nature conservation strategies, a different, much more participatory strategy for nature conservation has been chosen at the dunefields around Hanstholm (see Figure 29). Bazilchuk (2007) describes, how in 2008, they became the first Danish National park also partly because the comparatively high public support. The Danish Government (2004,

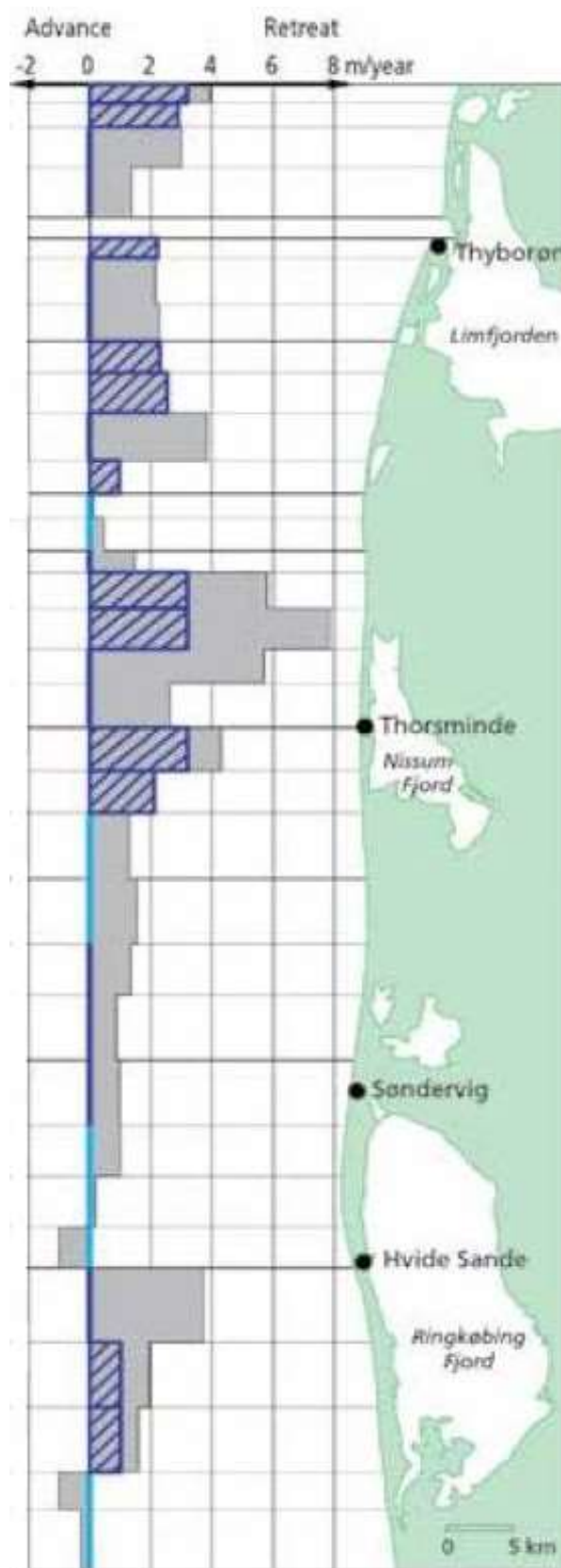


Figure 30: The current joint agreement for the Jutish west coast stipulates how much coastal retreat is acceptable for each coastal segment; here indicated in blue. Grey marks the calculated coastal retreat without nourishment. Blue lines indicate areas without coastal protection. Source: (Kystdirektoratet 2018)

p. 33) wanted to then future parks to *“represent different typical Danish habitats and landscapes, improve the flora and fauna and the way they spread, safeguard the dynamics of nature and the processes in ecosystems, and offer attractive and unique nature experiences for the Danish population and for tourists”*. Thus, the national park status does not add any additional protection status to the area (DK-03 5/27/2019).

(DK-03 5/27/2019) describes that two boards are actually responsible for the actual management and development in Thy Nationalpark. The first is the ‘Nationalpark Association’, and the ‘Nationalpark Council’. Whereas the first is mostly a board of experts, other stakeholders, such as surfers’ associations are by far the majority of the ‘Council’, which also decides about the management plan. This plan acts as the strategy of the park and also stipulates the measures that should be done. The current management plan includes management measures like conversion of dune plantations into more natural forests, combating non-native species and protect the lake habitats (Nationalparkfond Thy, 43ff.). Knudsen and Greer (2008) refer to original plans according to which the entire heath should be burned every 20 years. Also, some dune areas should remain bare. (DK-03 5/27/2019) describes how high public participation on the one hand leads to increased public support for the measures and strategies, but on the other hand makes it difficult to approve measures experts consider necessary, but are highly unpopular. For example, Knudsen and Greer (2008) cite the opposed views of some local farmers.

4.3.3. Informal Institutions

In general, the personal responsibility play a comparably large role in Denmark. This is reflected by the free access to the dunes (DK-02 5/9/2019); (DK-03 5/27/2019) explained that also the administration only has closed two areas permanently for public access and a few more during breeding season. Furthermore, coastal protection mostly is the task of the landowner (Kystdirektoratet 2019a). Additionally, DK-02 (5/9/2019) cautions that many people at the coast have been used to living at a retreating coast for centuries. One should not, though, consider this attitude to be omni-present, as cases of unauthorized coastal protection are reported, e.g. from Lønstrup (Kystdirektoratet 1/3/2018).

Cost-efficiency is of particular importance in both coastal protection and nature conservation. DK-02 (5/9/2019) explains that many private landowners decide to let erosion happen, as it simply is cheaper to relocate the buildings every few decades to coastal retreat than to permanently combat the erosion. (DK-03 5/27/2019) further explains that the Nationalpark authority of Thy wants to achieve as much with the money they have at their disposal. Therefore, they prefer to purchase the land use rights instead of buying the entire land. Finally, DK-04 (5/28/2019) provides another example: Sod-cutting, which is a particular costly measure is hardly applied in Denmark, because it simply is too expensive, whereas it, by contrast, would be applied more often in The Netherlands.

For centuries the Danish landscape has been intensively used for agriculture. Mostly two perspectives on dunes underlie the management approaches: First, the memories of the ‘Stor sandflugt’ (‘Great sandflight’) are mentally still very present. As described by Clemmensen and Murray (2006), the climatic deterioration during the little Ice Age and sparse vegetation mobilised most of the dunefields. Remnants of villages and especially churchyards buried under sheets of sand and also the

last active dunes and dunefields like at Skagen (NST 2017a, 2019a) or at Rubjerg (NST 2017b) are memorials illustrating the devastating consequences vividly and are well-visited. Only large-scale plantation efforts from the 19th century onwards together with decreasing storminess re-stabilised the dunefields. Thus, dynamic dunes are seen very sceptical until today: (DK-03 5/27/2019) tells that it is very difficult to explain the ecological benefits of bare sand areas to people. Notwithstanding, (DK-04 5/28/2019) observed local differences, e.g. between Skagen and Thy, because it was there that the 'Great Sandflight' started.

Second, DK-03 (5/27/2019) and DK-04 (5/28/2019) stress the importance of preservation of the cultural landscape, in particular of heathland. Knudsen and Greer (2008) reconstruct the romanticised transformation of heathland from an ordinary surrounding to a sublime, typical Danish 'wilderness' during the phase of emerging nationalism in Denmark. Poets, writers and painter played a crucial role in this process of advertisement and framing. As mentioned above (see section 4.3.2), the preservation of the coastal heath landscape is paramount goal of Thy National Park, as it contains the biggest coastal dune heathlands in Europe. However, the heathlands could only evolve to such an extent by human intervention at this place.

Consequently, the removal of non-native shrubs and conifers fits this cultural preference of heathland – not only at Thy Nationalpark. Projects like the REDCOHA Project also partly focus on the preservation of the dune heathland (NST 2019b). There and as well at the LIFE WETHAB project various methods to remove invasive shrubs as *Rosa rugosa* or *Prunus serotina* have been tested as Frisk, Lindholm (5/14/2019) summarize. It turned out that digging out the entire plant was most efficient and costed around 2 € m⁻². Slightly cheaper (0.8 to 1.5 € m⁻²), but less effective is shredding the plants with a biorotor mounted on a tractor (see Figure 33c). Bayer (2017) describes a biorotor as a mortising machine removing the plants with their roots from the soil. At Grenen – north of Skagen Klitplantage (see Figure 29) – 7 hectares covered with *R. rugosa*, the rose was mowed with a robot and then this cut down manually fortnight. After four years of treatment, the roses are diminishing. Eventually, they can be dug out. Nevertheless, Frisk, Lindholm (5/14/2019) assume that this treatment must continue for another six years. By contrast, cutting down *R. rugosa* and then cover the stubs with a light absorbing tarp, is very expensive (12 to 13 € m⁻²). Jespersen (5/15/2019) presents several methods to combat the American Black Cherry *Prunus serotina*, including the coverage of cut-down or small plants with black buckets or ringing, i.e. the removal of the inner and outer part of the trees' bark: The ringing thus turns out to be less effectioive as the trees vigorously develop new shoots after one year. Usually, after care or repeated interventions are necessary; further information is provided by the appendices.

Eventually, there is the micro-level: When restoring public nature areas, often, nature agency Denmark cooperates with local biologists (DK-01 5/1/2019). The LIFE REWETDUNE Project, e.g. is a collaboration between NST and the municipality of Fredrikshavn.

Although joint projects of NST and municipalities are a common procedure, DK-04 (5/28/2019) argues that projects are a doubled-edge sword: They allow, that something is done, but the aftercare needs to be guaranteed. Otherwise, the project money is basically wasted. Within the LIFE

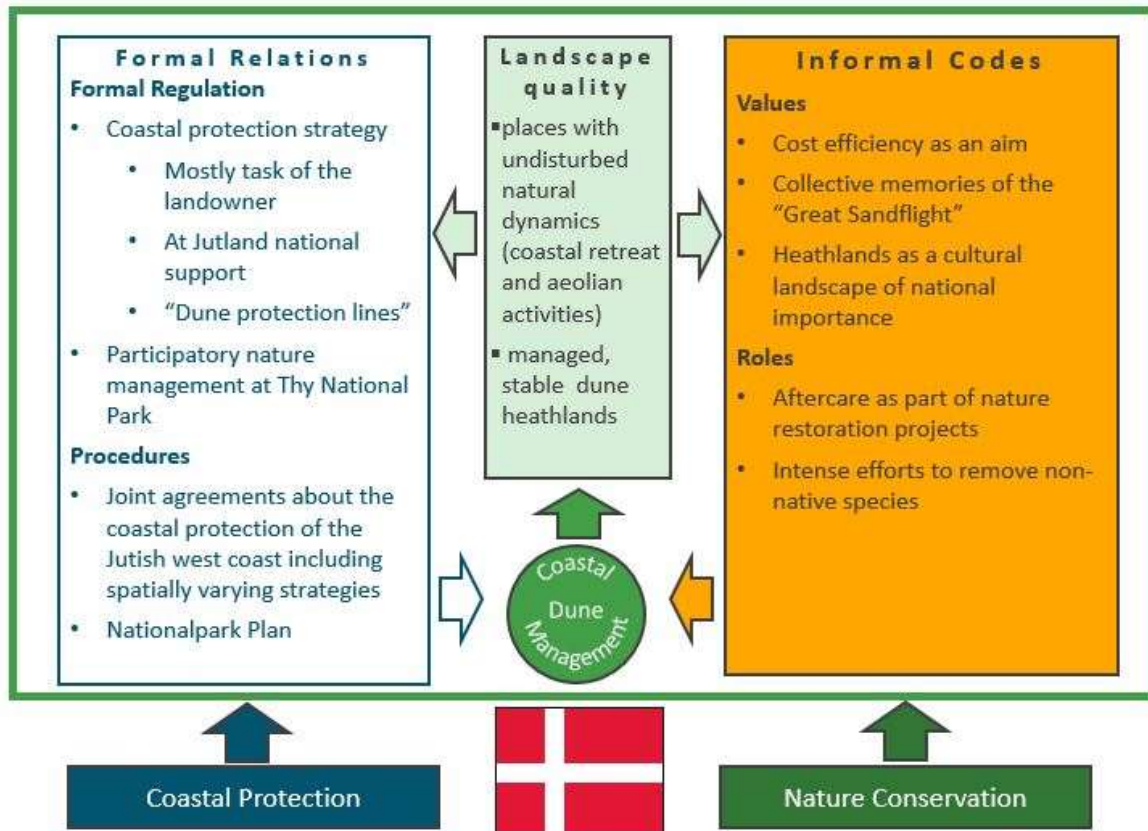


Figure 31: The conceptual model of the Danish dune management strategies.

REWETDUNE project, the preparations for the aftercare were included into the actual project. As Lindholm (5/14/2019) explains, the local stock Roe deer (*Capreolus capreolus*) and Red deer (*Cervus elaphus*) is not capable of keeping the heath landscape open. Already in the application for the project money, a budget for preparing an aftercare plan and buying a herd of Galloway cattle and the necessary equipment, such as fences and a trailer, was included. This cattle can be loaned by the private landowners for grazing on their property. After five years they have to return the herd, but may keep the excess for continuing grazing. More detailed information is provided in Appendix XVIII. Eventually, Figure 31 presents the conceptual model of the Danish approaches to coastal dune management.

4.3.4. Effects on the landscape

The different strategies have clear effects on the dune landscapes as illustrated by . At many places, the relics of former land use forms such as ditches still have a detrimental effect on the landscape. Furthermore, Saye and Pye (2006) mention that 300 ha of dunes at the Jutish west coast were afforested, many of them with the non-native Mountain Pine (*Pinus mugo*). The current nature conservation projects and measures are successful insofar, as they suppress the sprawl of non-native species and set back succession to provide space for new habitats. It does not lead, though, to increased aeolian dynamics.

On the other hand, there are areas, where dynamic processes are allowed to develop freely for centuries. At unprotected coastal strips such as at Skagen Klitplantage, in National Park Thy or at Lønstrup Klint, dynamic dunes can freely develop (NST 2016, 2017b; DK-03 5/27/2019). On her way



Figure 32: Impressions from the Danish coastal dunes. Undisturbed natural processes: a) At some places, where the coast is allowed to retreat, this causes bunkers from WWII to fall off the dunes and end up on the beach like at Hirtshals, 22.09.2016 b) Coastal erosion close to Skagen intersects the foredunes and creates blowouts, 21.09.2016.

*Preservation of the cultural landscape: c) removal of *Rosa rugosa* with a biorotor (Source: Bayer 2017, p.34) d) A dune plantation at Skagen has been cut down, the wood is piled up at the road. Source (NST 2019d)*

across Skagen Spit, Råbjerg Mile buries pines and provides pioneer habitats in the deflation plain behind her. The state has bought the land in the future trajectory to allow the dune (NST 2017a, 2018). Probably the many annual visitors support the migration of the dune, by roaming around keep it mostly free from vegetation (own observation).

Thus, the first research question, asking for the specific physical and institutional elements that underlay the particular strategies of dune management, is answered. The actual lecture drawing happens in chapter 5.

5. Discussion

5.1. Methodological considerations

The following chapters will mainly discuss the desirability and practicability of the lessons. Arguably, it is beneficial to first discuss the quality of the research process at this place and then move on to the actual lessons. In general, this study wants to draw lessons from the Dutch and Danish dune management for the dunes on the island on Sylt. This basically means that two nations are compared to a single island. However, recalling the heterogeneity of the CHANS (see section 2.3.6) means that the conceptual model of the “Dutch” or “Danish” dune management will remain fragmentary and possibly cannot be completed. In every case, this is far beyond the potential of this study. Furthermore, this study restricts itself to the sectors of coastal protection and nature conservation. In particular, the aspects of groundwater production and tourism turned out to be also relevant.

Also restrictions of the reality caught up with the goals of this research; especially time limited the depth of inquiry. The cancelled interview with SBB could only be partly compensated by e.g. the presentation of Wolf (6/3/2019). Longer interviews also would have provided more information, because it needs time to create a trustful atmosphere. The same is true for additional interviews with the LZV or private landowners on Sylt. Also many interviewees could have told more, but their own agenda did not allow it. Furthermore, longer interviews would have needed additional time for analysis. So undoubtedly, the conceptual models have some gaps.

Generally, flanking this qualitative analysis with quantitative methods also would have allowed a more thorough analysis of the practicability and desirability of the lessons. Especially estimations about sediment volumes or the costs of the strategies would have been helpful. How much additional sand would be needed to compensate for the aeolian ‘losses’ to the hinterland? Unfortunately, such questions cannot be answered in this study. Eventually, though, it appears that this study is able to develop and assess some lessons, but of course, there is more left to learn from.

5.2. Missing vision for the dunes on Sylt

What become especially apparent in the interviews with the interview partners for the dunes on Sylt, is the prevailing attitude towards the dunes. Chapter 4.1.3 describes the development of the paradigm that “only a stable dune is a good dune”. Taking this perspective, the current state of the dunes on Sylt are perfectly fine. “Protecting dunes protect the island” can be seen as a paradigmatic representation of the paradigm of stabilisation sketched by Clarke and Rendell (2015).

They also describe that this paradigm has been succeeded by a greater tolerance of aeolian dynamics. This paradigm shift is in its very infant stage on Sylt. Yet it is indispensable for revitalising the dunes on Sylt. Recalling the definition of institutions given by Crawford and Ostrom (1995, p. 582) they guide human actions and therefore influence the physical reality of the dunes. Also, SH-02 (6/2/2019) stress the need to develop new visions for the dunes, i.e. to reconnect the dune landscape with the people. Fischer (2011, p. 49) highlights the importance to overcome the dichotomy between the acting human and the nature at his disposal. However, Helmke and Levitsky (2004, p. 732)

review that “*when change [of informal institutions] occurs, it is expected to be slow and incremental.*”, as they lack the central steering. How could this paradigm shift be achieved then?

Here, lesson drawing, offers merely help on a procedural level. Although Knudsen and Greer (2008) present how poets and painters contribute to create the iconic perception of the Danish dune heathlands, this process iconised a landscape that then was common and widespread, as it was in Germany, too. By contrast, on Sylt, only fragmental remnants of the dynamic landscape of interest exist. Furthermore, SH-02 (6/2/2019) points to the plain fact that no farmers or craftsmen, that created the open, dynamic landscape are existing are alive anymore. Nevertheless, the dynamic remnants like blowouts, migrating dunes or the prograding dunes on the Ellenbogen (see Figure 13) should be increasingly presented to interested people as valuable “gems” of the coastal landscape. Also art classes could e.g. paint scenic parts of the landscape. As SH-02 (6/2/2019) suggests, tourists first visiting the island could act as incubators, as they probably have less reservations against dynamic dunes, who later motivate their hosts or other visitors to also pay a visit to the dunes. Additional pathways running parallel to the coast could connect some of the current trails and therefore make the dune landscape more accessible (SH-08 6/18/2019). Thereby, the lookout points to enjoy the scenic landscape that the Bundesanstalt für Vegetationskunde, Naturschutz und Landschaftspflege already demanded in 1966 could be incorporated, too.

Furthermore, SH-02 (6/2/2019) mentions the Dutch book series “Duinen en mensen” (Dunes and humans) which vividly presents the history, geology, ecology and conservation (Duinen en mensen.nl 2019). By contrast Reise and MacLean (2018) have created the first book exclusively focusing on the coastal dunes of the northern German Wadden Sea for more than a century. Further books could indeed help to alter the public opinion about the sandy ribbon fringing the coastline.

Additionally, SH-06 (6/7/2019) and other interviewees mention the increased pressure from the EU Habitats Directive as a catalyst for change. Before, SH-08 (6/18/2019) states, that especially some authorities lacked the will to. Also Helmke and Levitsky (2004) point to the importance of formal institutions to alter their informal companions. On Sylt, the Habitats Directive exerts high pressure on all participants as management plans for the areas are needed that e.g. prevent the further decline of population of *Bufo calamita*. The resulting interventions also alter the physical appearance of the landscape. According to SH-05 (6/7/2019) the works in the dunes were accompanied by guided tours at the site. Thereby, the formal regulations eventually change the informal codes.

5.3. Strategic evaluation of the lessons

Chapter 4 has provided answers to the first research question. So what lessons can be drawn from the observation of the Netherlands and Denmark? As summarised in section 2.1.2, Rose (1991) describes lesson drawing as observing the strategies that aim to solve a certain problem at the other place and then, in a second step, transfer it to the domestic system. Hence, lessons do not look at big concepts: Although, the ideas behind “Building with nature” (see chapter 4.2.3) are desirable, it arguably offers too little substantial to transfer it.

On the other hand, there are many practical lessons that can be learned on the micro-level, because these procedures mostly depend on the physical characteristics of the dunes. E.g. the methods of

removing non-native species tested in Denmark, might will be helpful when it comes to preparing restoration activities. However, they are basically tools, which need an overarching strategy that direct their use. Thus, this study focuses on strategic lessons. These lessons should aim for enhancing the situation of the dunes directly and not just indirectly as the Dutch “Programma Aanpak Stikstof” does. Besides, it seems questionable, whether a programma that is voted down by the court for a lack of effectivity, poses a desirable lesson. Also, the Danish “Klitfredningslinjer” (Dune protection lines) can be dismissed as they aim for dune stabilisation.

This leaves this study with five potential strategic lessons, which XYZ presents. Recalling the argument of Rose (1991) the development of lessons (Step 5, see Figure 15) has less to do with “science” in its narrow, Aristotelian sense, but more with “*Phronesis*”. Thus, the appropriateness of the lessons lie in the eyes of the reader. In the following, these lessons are presented and evaluated according to the scheme developed in section 3.4 to assess their practicability.

Table 7: This study derives these five lessons from the Netherlands and Denmark

No.	Lesson
1	Manage coastal retreat wherever it poses no threat
2	Use more public participation in the management of the nature areas on Sylt
3	Strive to maintain the cultural dune heath landscape
4	Intense, multifunctional management of dune fields
5	Introduce dynamic foredune management

5.3.1. Manage coastal retreat wherever it poses no threat

At the Jutish west coast, the public-public cooperation of the municipalities and Kystdirektoratet execute a coastal protection strategy, which focuses much on cost-efficiency. Where no property is endangered by erosion, the coast is allowed to retreat moderately (see Figure 30). The national level and the municipalities share the costs and negotiate a new agreement. DK-02 (5/9/2019) names the saved costs as a benefit. Furthermore, the erosion sets free sediment, which then counteracts coastal retreat elsewhere. As for the dunes, it allows the free and undisturbed development of dynamic processes. This coastal retreat is at the same time merely a temporal solution, as property might eventually be endangered after a couple of years. DK-02 (5/9/2019) also acknowledges that these 5-year plans are rather incapable of incorporating long-term goals such as climate adaptation.

Considering, the physical and institutional surrounding on Sylt, this strategy seems both impractical and undesirable. Although, SH-07 (6/17/2019) comments that undisturbed natural processes are desirable in the National Park area of the Wadden Sea, scepticism prevails: As SH-02 (6/2/2019) explains, only a partly deviation from the strategy of the Basis Coast Line, would cause fierce political opposition. Any change to this strategy seems illusory at the moment as well as in the foreseeable future: First, the preamble of the current “General plan for coastal protection” explicitly rejects the idea of an efficiency-based coastal protection strategy: “*Because of its fundamental importance for human safety, coastal protection cannot be subject to a strict cost-benefit analysis.*” (MELUR.SH 2013, p. 5). Presumably, if the Federal State would introduce this basically efficiency-based policy on

its own it would basically mean to cause a precedent for the other islands. Voices may rise to also cut the expenditures for coastal protection there as well.

Second, this policy relies on the involvement of the municipalities. Arguably, it is easier to accept to coastal retreat if its prevention would need own investments. Introducing such public-public partnerships would require a change in the jurisdiction, as coastal protection of the islands is task of Schleswig-Holstein (MELUR.SH 2013, p. 52). Non-official sources like Jürigs and Trost (1986, p. 207) refer to fierce discussions between the local and federal politicians when beach nourishments were introduced and which resulted in the current responsibility, with the State of Schleswig-Holstein paying the bill for the nourishments alone. In 2016, a westerly gale caused severe erosion at the southern tip, the uninhabited nature area “Hörnium Odde”. Although safety of Hörnium was not at stake, its major demanded more protection from the LKN.SH in the newspaper (Preker 2016)

Third, practical problems add on top. (SH-04 6/7/2019) warns that if only one part of the coast retreats, it would cause erosion at the flanks, especially stream-upwards. And none of the spits is yet ready to retreat over the entire length, because at some places infrastructure was affected. Also the particular situation in the foreshore area needs to be considered. Whereas SH-02 (6/2/2019) argues that the two buildings that are directly located at the west-coast of the Listland are principally movable by design, still the road leading to the Ellenbogen would be endangered by overwash processes. As summarized by Table 8 this lesson currently needs to be “doubly rejected” (see Table 2). On the northern spit, it might well pose a long-term option: There, the few houses and roads close to the west coast could be relocated comparably easily.

Table 8: Strategic evaluation of the lesson: Manage coastal retreat where it poses no threat

Strengths	Weaknesses
Nourishing less saves money	Landloss and coastal retreat occur
Erosion adds sediment into the system	Agreements only consider short time scales
Opportunities	Threats
Desirability: Coastal erosion fits to the paradigm of the adjacent national park: <i>Let nature be nature</i>	This drastic policy change would face lots of resistance at all political levels
Coastal retreat would initiate aeolian activities	Sharing costs for coastal protection assets on Sylt would set a precedence
Practicability: Less nourishment would allow money savings in the long run (?)	The erosion would proceed upstream and cause problems there
	The strategy only makes a difference on Sylt, where coastal retreat was acceptable
	The particular geological setting of Sylt complicates the situation

5.3.2. Use more public participation in the management of the nature areas on Sylt

As DK-03 (5/27/2019) describes it, the strong public participation in National Park Thy enhances the public legitimacy of nature conservation measures, because the “National Park Council” has to agree to the Management Plan (see section 4.3.2). Could such a discussion arena help to initiate a different attitude towards the dunes on Sylt? Although a high legitimacy of nature conservation would be desirable, arranging such a plenum seems not practical at the moment, turning this lesson into a “Siren call” (Table 2).

First, whereas Thy National Park contains 24,000 ha according to Bazilchuk (2007), all nature reserves on Sylt merely sum up to 3,600 ha (LKN.SH 2015). Arguably, creating a board for such a small area, which in turn is connected to a much larger network of protected areas, makes hardly sense.

Second, it is central to the lesson that the stakeholders involved have power to decide about the future of the area. Taking into account that the federal nature conservation agencies are already now not enforcing any measures against the will of the landowners (SH-05 6/7/2019), this would result in only little additional revenue. Instead, it could be used to block any change from the status quo more efficiently. Given the strong overall desire for stable dunes, this seems quite likely. Given the urgent need for action from a nature conservationist perspective, this is also undesirable. Thus, this lesson is also doubly rejected.

Table 9: Strategic evaluation of the lesson: Use more public participation in the management of the nature areas on Sylt

Strengths	Weaknesses
Public consent legitimises actions taken	Public disagreement can block unpopular measures
Opportunities	Threats
Desirability: Legitimation of nature conservation practices on Sylt	Effective long-term blockade off any change to status quo
Practicability:	Sylt is a comparably small area Already now, nothing happens against the will of the landowners

5.3.3. Strive to maintain the cultural dune heath landscape

The preservation of the cultural dune heath landscape is one of the big goals of public nature conservation in Denmark. Specifically for the dunes, DK-03 (5/27/2019) and DK-04 (5/28/2019) describe that this entails the preservation of the open dune landscape with grey dunes and heathlands. Therefore, succession must be set back in and trees and non-native shrubs need to be set back. Thereby, the idea of preserving a particular state allows to set clear goals which in turn result in specific actions; usually, these are sod-cutting, mowing, burning and grazing. Furthermore, it

acknowledges the past and current human influence on dunes. Provoost et al. (2011) provides multiple examples of how humans have drastically altered dune landscapes.

Most dune fields, however, have undergone several stable and mobile phases. Which state should then be preserved? The idea of preserving a cultural landscape allows to justify whatever state. There are practical drawbacks, too. Provoost et al. (2011) argue that measures like mowing and sod-cutting can influence the vegetation patterns, but not prevent the overall ageing of the landscape. Also the procedures can be discussed controversially: SH-03 (6/4/2019) points to the fact that burning heathland might lead to the local extinction of insect species, which are partially unable to fly.

Both the benefits and the drawbacks are also valid on Sylt. Preserving the cultural landscape, though, does not necessarily lead to increased dynamic dune management and is also not helpful in terms of climate adaptation.

Preservation of a certain state of the past includes a rigorous fight against invasive species, especially *Rosa rugosa*. As described in chapter 4.3.3 and also 4.2.3, there are numerous procedures tested currently, which are all used to relegate unwanted plants from the area once and forever. With regard to the invasive species on Sylt, several opinions exist: In general, SH-07 (6/17/2019) considers it desirable to strive for complete eradication of invasive species on e.g. one island in the Wadden Sea. Whereas, the other interviewees share this desire, they have practical reservations: SH-03 (6/4/2019) points to the fact that none of the Danish procedures has yet proven to allow complete eradication. SH-05 (6/7/2019) stresses that the very high costs of removing plants from the islands as all the material needs to be transported to the mainland.

SH-01 (6/1/2019) therefore suggests to invent three categories. There are areas on Sylt, especially around Westerland, where *R. rugosa* has covered almost entire dunes; there, combating *R. rugosa* would be a hopeless endeavour. Then there are dune areas, where at least the future spread of *R. rugosa* could be stopped. Finally, areas like the Ellenbogen could be kept free from *R. rugosa*.

Among others, SH-05 (6/7/2019) and SH-08 (6/18/2019) also consider the invasive Heath star moss (*Campylopus introflexus*) as a problem. Essl et al. (2014) consider it a large threat to biodiversity and ecological processes in the coastal dunes of north-western Europe and suggest that it could be removed by hand-plucking in its early stages. As Skowronek et al. (2017) conclude that this bryophyte is present on about 6 km² on Sylt, this hardly seems an option. Based on a small-scale review they conclude that burial by sand is considered the most practical option. However, re-establishing aeolian dynamics is not a goal of heathland conservation. Based on studies in the Dutch Renodunaal district, Kooijman (2015) concludes that only fresh sediment input can counteract the ageing of the landscape sustainably. Notwithstanding this conclusion, van Til and Groenendijk (2015) successfully used tools from heathland conservation, namely sod-cutting, and mowing together with soil removal to preserve the patchy, diverse mosaic of the grey dunes, which later on is maintained by grazing. Furthermore, the habitats of the grey dunes and the wet dune slacks as described in Chapter 2.3.3 are not necessarily covered by heathland preservation. SH-03 (6/4/2019) points to an important difference within the interpretation of the habitat types of the Habitats Directive. Evans (2006) explains the difficulty to separate the different dune habitats as they usually occur in a patchy mosaic. In Denmark, the Habitat type 2140 with the Crowberry *Empetrum nigrum*, is interpreted as

a mosaic including patches of grey dunes. This allows measures such as burning, which *E. nigrum* does not tolerate; anyway, they set the vegetation back. This interpretation is at odds with the German perspective on the habitat types according SH-03 (6/4/2019). Thus burning heathlands with *E. nigrum*, which are especially prominent on the southern spit, would require close cooperation with the responsible authorities at a Federal and national level.

On the other hand, there also is a long tradition of heathland preservation on the island of Sylt, as Raabe (1964) distinguished between the natural landscape of the coastal dune heathlands and the heathlands in the glacial core. There, SH-01 (6/1/2019) explains, mowing and burning have been executed in the last decades. For the coming years, SH-01 (6/1/2019), SH-05 (6/7/2019) and SH-06 (6/7/2019) refer to a large-scale, expensive heathland preservation project, where several hectares of heathland vegetation should be set back. There SH-08 (6/18/2019) explains that the SF aims to preserve the traditional dune landscape. Nevertheless, it is a controversial topic, too; e.g. using heavy machinery for sod-cutting into the dunes is still disputed. On the other hand, SH-03 (6/4/2019) explains that e.g. burning might be actually easier in the dunes than on the heathlands on the moraine core. Furthermore, the traditional use of the dunes has not totally vanished. Several sheep still graze in the Listland dunes. As SH-08 (6/18/2019) explains, a flock of sheep is financed commonly for the preservation of the heathland. So there are points where the new paradigm of preserving the cultural landscape could be attached to.

All in all, preserving offers several practical benefits, whereas its desirability remains unclear. Depending in the arbitrary choice of a reference state it might fail to achieve the bigger desirable goal of dynamic preservation. It would as well, though, justify the preservation of the dune landscape as of 1878 presented by Figure 13, which was also a result of human intervention. As presented in Table 10, it therefore can be categorized as both an “unwanted technical solution” according to Rose (2002) or as “doubly attractive”. In any case it would mean a change into the right direction.

Table 10: Strategic evaluation of lesson: Strive to maintain the cultural dune heath landscape

Strengths	Weaknesses
Preservation of the cultural landscape acknowledges and includes human intervention in the dune systems A reference state guides future action	The decision about the reference state is purely arbitrary
Opportunities	Threats
Desirability: Heathland preservation allows to maintain some habitats	It does not necessarily aim for restoring self-maintaining aeolian dynamics.
Practicability: Heathland preservation is already practiced on the island of Sylt	The island situation drastically increases the costs for removing any material It does not stop the overall ageing of the landscape and seems incapable of removing the invasive bryophyte <i>Campylopus introflexus</i>

5.3.4. Intense, multifunctional management of dune fields

Especially along the densely populated coast of Holland, dune fields are used for multiple purposes. As van der Meulen et al. (2004, pp. 268–275) lays out, zoning plans are an important tool to reconcile nature conservation, recreation and in many cases also drinking water production. The examples of the Meijendeel dunes or also the Amsterdam waterwork dunes (Waternet 2015) illustrate that this often leads to highly managed dune fields. For success, though, all actors in this approach need to seek consensus and also trust each other. Consequently, participants must be able and willing to lower their sights. It is especially the current situation between different stakeholder groups on Sylt, which SH-03 (6/4/2019) characterizes as distrustful, that might make it difficult to establish such a process and eventually a commonly agreed-on land-use and zoning plan. Furthermore, in the Netherlands, areas with such plans like the Meijendeel dunes are often intensively managed to preserve a certain status. Van der Meulen et al. (2017) describe, how a pre-defined areas should be covered with particular habitats at the Spaanjarde Duin north of Rotterdam’s harbour entrance. This approach arguably does not fit the German “romantic” attitude of favouring natural processes.

Nevertheless, reconciling different interests offers also opportunities for synergies: It would allow to both protect and enjoy nature at the same place. As drinking water production is only an issue in the Listland (see Figure 13), merely nature conservation and recreation need to cooperation. A gentle and appropriate strengthening of the recreational use of the area might in turn allow to “reconnect” people with the landscape of the dunes and raise the public interest for its conservation. Hiking trails in the dunes furthermore can be promoted as a new tourist attraction, especially as the Dutch dune areas show, that they are principally capable of handling many visitors. Also the temporal closure of some paths as practiced in Nationalpark Thy is an option to maintain a high level of protection. As the desirability once more cannot be assessed unambiguously, this lesson also might both be “Doubly attractive” or an “unwanted technical solution”.

Table 11: Strategic evaluation of the lesson: Intense, multifunctional management of dune fields

Strengths	Weaknesses
Allows to appropriately reconcile different land-use forms by expert judgement	Plans can only be developed in a consensus-seeking atmosphere
Opportunities	Threats
Desirability: A common land-use plan would allow to enjoy and protect nature at the same places and at the same time	It might lead to intensively managed dune areas The current climate of distrust and the existing set of detailed rules might hamper the negotiations
Practicability: Such strategies can also cope with large visitor numbers	

5.3.5. Introduce dynamic foredune management

Beach and foreshore nourishment in the Netherlands allowed to initiate the strategy of dynamic dune management in the Netherlands. Where possible, the coastal foredunes are no longer stabilised. This leads to aeolian sediment transport over and behind the foredunes; also blowouts can develop (see Figure 27a) and are even created in some places. As de Jong et al. (2014) explain, this leads to a more natural and dynamic character off the coastal foredunes. Furthermore, the additional sediment strengthens the foredunes in the long run and thus increase flood safety and may even reduce the need for work-intensive artificial dune strengthening measures. From an ecological point of view, Arens et al. (2013a) add that dynamic foredune management merely affects a few hundred metres behind the foredune ridge. There, additional measures would be needed. And of course the sediment blown behind the dunes needs to be replaced to maintain the reference coastline.

As the coastal protection strategy at the west coast of Sylt also aims at maintaining a reference state, SH-02 (6/2/2019) argues that the two strategies are most compatible. Basically Sylt could benefit from the abovementioned benefits, too. Additionally, the experiences of 150 years of dune fixation would allow to reduce the amount of dynamics if necessary. Here, the sole responsibility of the LKN for the sediment management arguably poses an opportunity compared to the Netherlands, where dune management requires cooperation between RWS and the Waterboards.

At the same time the sole responsibility of the Federal state results in some drawbacks: as more sediment also means that the nourishment would be more cost intensive. Most likely the Federal state of Schleswig-Holstein would have to pay for the additional nourishment volumes, though, because the national level only supports measures that are indispensable for maintaining for coastal safety (BMEL 2019, p. 106), which does not include long-term climate adaptation. Currently, as SH-04 (6/7/2019) states, only as much sediment is nourished as to maintain the status quo. This is much less than is nourished in the Netherlands, which aim to also consolidate the entire coastal foundation. Thus, dynamic foredune management on Sylt would require more sediment in the entire sediment sharing system of Sylt. In addition, more drastic interventions like cutting notches into the foredunes are incompatible with the current paradigms.

Also the physical circumstances pose an obstacle: Despite the nourishments, the coastal profile continues to be very steep. The measurements presented by LKN.SH (2019, p. 131 ff.) even show, that the coastal foreshore is still steepening. Thus, sediment that ends up in the runnels either by nourishments or by erosion during the winter is quickly transported into the back-barrier lagoon. Thus additional sediment nourished for aeolian sediment transport into the hinterland would not necessarily end up there, but in the tidal flats. Arguably, this sediment should not be considered as lost, as it contributes to the adaptation of the tidal flats to a rising sea-level. Hofstede and Stock (2018) argue that the beach nourishments at Sylt have had the very same effect so far. If the foreshore area was consolidated by additional sediment depositions more sediment in the foreshore area, this would then allow for dynamic fore dune management without compromising the reference coast line and flood safety.

Additionally, the continuous artificial dune ridge in front of the dunes currently traps the sediment before it can cause dynamics in the actual foredunes. Nevertheless, this lesson seems both desirable and practicable for initiating more aeolian dynamics at least along some dune stretches on Sylt.

Table 12: Strategic evaluation of the lesson: Introduce dynamic foredune management

Strengths	Weaknesses
Grand beach and foreshore nourishments allow aeolian sediment transport into the hinterland, where it rejuvenates the landscape	Additional measures are needed in the hinterland in addition to dynamic management of the foredunes
The additional sediment enhances the flood safety in the long run	The sediment needs to be replenished
Opportunities	Threats
Desirability: Additional sediment would be transported to the hinterland Instead of two actors like in the Netherlands, the LKN has the sole responsibility for sediment management on Sylt.	Due to its ultimate responsibility, the Federal state needed to pay for the additional sediment
Practicability: Dynamic foredune management fits to the idea of maintaining a reference coastline by beach nourishment	The “loss” of sediment to the hinterland needs to be compensated by additional nourishment
Too much dynamics can be reduced by marram plantations	It requires a consolidated foreshore, which is not case on Sylt

Assuming that additional nourishment volumes were deposited, it still would require coastal stretches without infrastructure close to the dunes. SH-02 (6/2/2019) suggest two areas at the northern spit. Despite its overall qualitative character, this study here makes use of a short, quantitative GIS-analysis. Buffering the seaward dune foot with 500 m width reveals that these two areas depicted by Figure 33 are the only coastal stretches on Sylt, where no houses or roads can be found within 500 m behind the foredune. Arguably, these areas are predestined as pilot sites, where experiments with additional sediment volumes could be started.

Although this strategy is the only one evaluated as doubly attractive, many questions are left open. As already argued in chapter 5.1, it needs more quantitative examinations to assess the consequences of introducing dynamic foredune management on Sylt, like the additional amount of sediment needed to compensate for the aeolian transport into the hinterland. The LKN.SH (2016b, p. 18) has calculated that brushwood fences and marram grass can trap up to $11 \text{ m}^3\text{m}^{-1}\text{a}^{-1}$. Only minor volumes reach the actual foredunes. In case, the artificial ridge was more permeable, these 11 m^3 would be removed from the actual beach to the hinterland. So, this is the absolute minimum sediment addition to the current nourishment volumes. On the other hand as NL-01 (05(20/19) illustrates using the

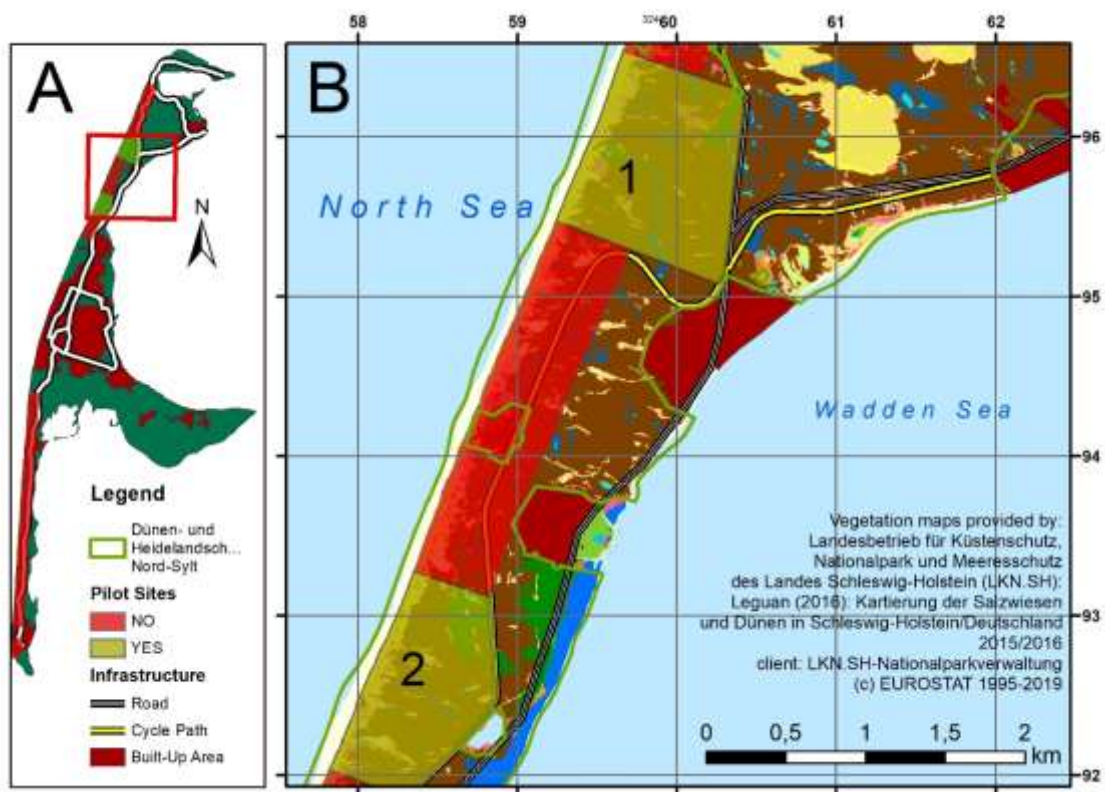


Figure 33: At two sites at the northern spit, no human assets are located until 500 m behind the foredune. Once the foreshore has been further stabilised and there is enough sediment available, foredune stabilisation could stop there.

example of the Sand motor too high sediment doses actually overpowers the dune plants and cause erosion.

Finally, what would probably happen at this places? As direct intervention into the foredunes is no option, it probably would take some years until visible change occurs. This is in line with the observations of de Jong et al. (2014) at the Dutch coastline. NL-02 (05/21/19) lays out that it is not yet fully understood when which amount of sediments increases dune height or causes erosion. Only when storms erode the stabilised artificial foredune or the foredune, aeolian dynamics could start subsequently in the foredunes at some places. Until then, some parts of the additional sediment would be carried away by storms.

5.4. A transition perspective on lessons

The previous section has basically the covered the steps 6 to 9 in the Framework of Rose (1991) and ended up with the following assessment of the lessons as Table 13 illustrates. The evaluation of framework in two cases could not deliver an unambiguous assessment. In both cases, the informal institutions between donor and recipient is different. The idea of strongly managed dune fields was mostly rejected, nevertheless the idea of creating zoning plans might be beneficial for Sylt. Eventually, these questions need to be arranged in a programme that might actually work in the context of Sylt. However, given the momentarily exclusive esteem for stable dunes, a much more dynamic dune management seems illusory and currently unachievable. As dune management on Sylt

thus is basically in need of a paradigm shift, the question must be more specifically: How can these lesson contribute to this transition, respectively?

Table 13: Summarized results of the evaluation of the five lessons

No	Lesson	Evaluation	
1	Manage coastal retreat wherever it poses no threat	Doubly rejected	
2	Use more public participation in the management of the nature areas on Sylt	Doubly rejected	
3	Strive to maintain the cultural dune heath landscape	Unwanted technical solution?	Doubly attractive?
4	Intense, multifunctional management of dune fields		
5	Introduce dynamic foredune management	Doubly attractive	

According to Huitema et al. (2011) these transitions are initiated by actors. The current coalition of nature conservationists that has evolved around the development of the artificial dune slacks, can be the nucleus for further change. Among others, SH-03 (6/4/2019) and SH-05 (6/7/2019) refer to the good cooperation among the evolving network of nature conservationists being a starting point for further and bigger projects. Furthermore, the management plans that have to be developed for the Habitat areas on Sylt demand action.

NL-02 (5/21/2019) separates inland dune management from foredune management, which includes lesson 5. Lessons 3 and 4 can be related to inland dune management. Thus, the programme needs to a) initiate a paradigm shift regarding the public perspective on coastal dunes on Sylt, and aim for a dynamic management of b) the foredune ridge and c) the dunes of the hinterland. Arguably, these three pillars are relying on each other. A paradigm change is a necessity to allow dynamic foredune management and also for managing the secondary dunes differently. Merely the deposition of fresh, lime and nutrient enriched sediment from the foredunes is able to rejuvenate the secondary dunes. In turn, changes in the primary and secondary dunes might contribute to the paradigm change. So, each one of the three aspects is indispensable and its absence reduces the success of its neighbours. As transitions take time (Huitema et al. 2011) three different time horizons are distinguished in Figure 34. This strategy is purposefully designed as a general, overarching sketch, as the future development of a CHANS to some extent remains unforeseeable. Currently, the inland dunes offer the greatest potential for action. There, the preservation of the existing habitats and species must have priority right now. For that purpose, the management plans that have to be developed anyway, are the appropriate tool. Therein it might be helpful to test varying methods within small-scale projects at different places to gain experiences. Arguably, the actors' different perspectives and perceptions are a benefit here, as e.g. the non-governmental wardens can choose approaches and tools, such as grazing, burning, etc., that they consider most appropriate.

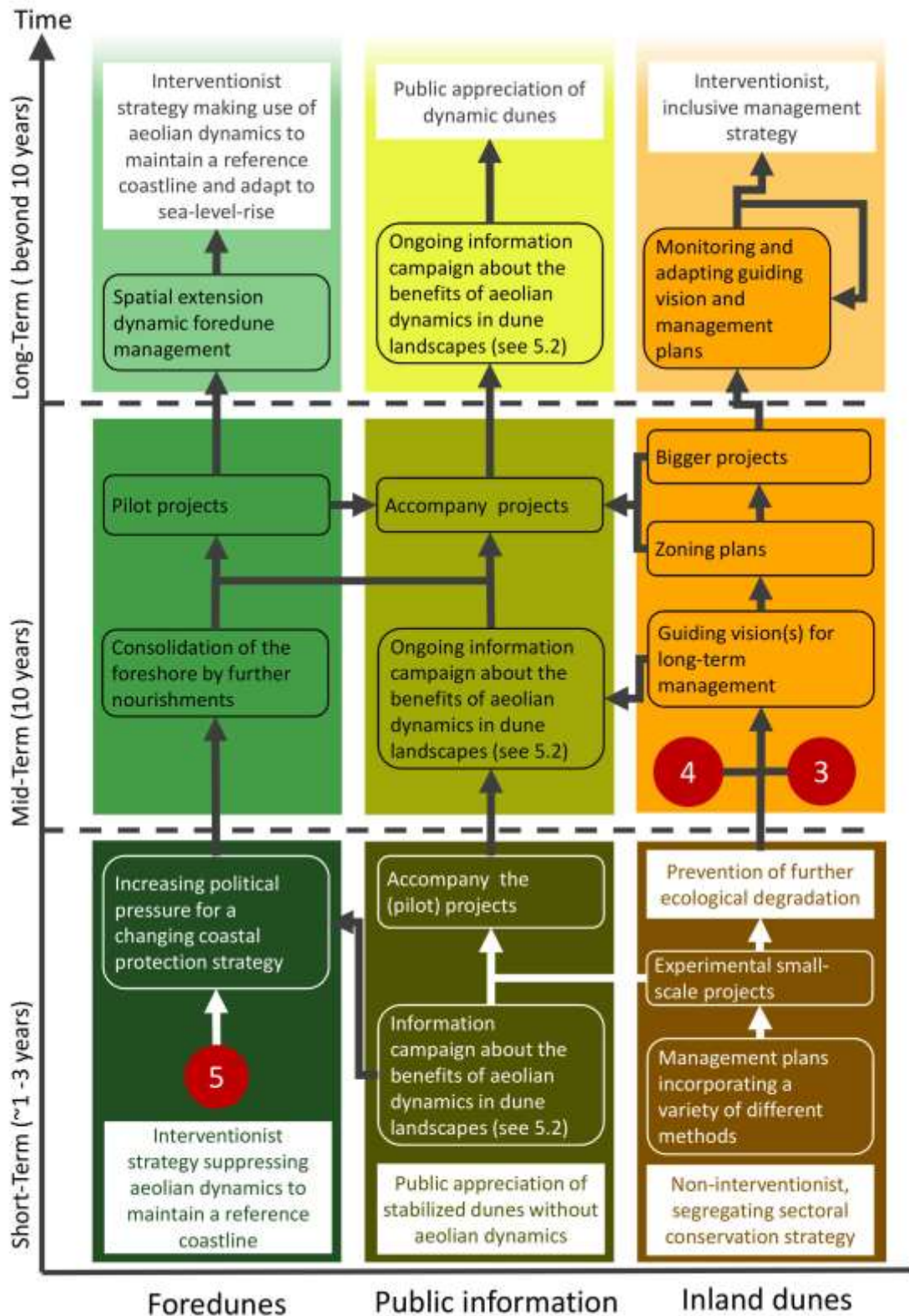


Figure 34: Suggestive sketch, how the three lessons can be incorporated into a strategy for a far-reaching policy change in coastal dune management on Sylt

On a mid-term time scale, there is need of a new guiding vision for the inland dunes. Arens et al. (2013a) and Siepel et al. (2010) stress the need to develop a long-term perspective for the management of dune areas. More concrete Kiwit and van der Hagen (2015) give reasons for long-term strategies: grazing should only be introduced for decades, as the fauna and flora needs time to

adapt to this disturbance. Although an overarching general consensus is desirable, differences in the management strategies for the particular areas may remain and not necessarily pose a problem.

This vision again touches the perceived relationship between humans and the surrounding landscape: How much intervention is desired and to what ends? In any case, it is advisable to reject the idea of preserving the dunes as a pristine, sublime wilderness without (hardly) any intervention at least for the short to mid-term time scale. This would require restarting the conveyor belt at the west coast. As SH-06 argues, however, this would require greater nourishment volumes, than are currently scheduled. Furthermore, the effects of aeolian sediment transport decrease behind the foredunes. To preserve habitats and species at a greater distance, additional interventions are required.

Both Denmark and the Netherlands offer examples for interventionist management strategies, which might fit. On the one hand, the Danish past-oriented strategy of preserving the cultural landscape can be connected with the goals of the SF. According to SH-08 (6/18/2019) the preservation of the dune landscape as it existed between 1700 and 1800 is the goal of the SF. Considering the descriptions of post-medieval Sylt by Bartels (2013) and Figure 13 would allow to justify the redynamisation of the dune landscape as a management goal. On the other hand, the idea of the SW to preserve habitats by reinitiating aeolian dynamics fit the visions of Löffler et al. (2011) as well as current Dutch management practices. Therein, the preservation of a cultural heritage plays a rather subordinate role.

Among others, this strategy has to develop point of views of issues like combatting neophytes, e.g. *Rosa rugosa*. Arguably, their existence on Sylt has to be accepted to a greater or lesser degree, as a total eradication is not feasible at the moment. Then, the experiences from projects carried out in the near future can be used (1e). Additionally, this vision should guide the development of zoning plans (2f). What needs to be discussed in the long run, too, is the future handling of the three migrating dunes, especially as the southernmost one, is approaching a road (Osswald et al. 2019). So far, according to SH-05 (6/7/2019) they did not play role in nature management, but their migration is important for climate adaptation. As migrating dunes are a rare phenomenon at the North Sea coast, lesson drawing could not offer any suggestions for the management of the migrating dunes. Eventually, this guiding vision should be transferred to updated management plans.

As the arguments and problems are known, a coordinated information campaign making use of the ideas discussed in chapter 5.2 advertising the multiple benefits of aeolian dynamics can commence at short notice. However, it will require years until actual effects might be perceptible. This campaign might closely accompany restoration projects in both the fore dunes and the inland dunes (see Figure 34).

By contrast, initiating a transition in the management of the foredunes will require more time and intense, persistent lobbyism of several actors to achieve a governmental decision about experimental changes in the current nourishment strategy on Sylt towards greater nourishment volumes in the first place and pilot projects for dynamic dune management subsequently. Therefore, the network of actors for change will have to extend into the sector of coastal protection. Besides, good arguments will be needed: Even if parts of the additional sediment will be eroded by tides and waves, they

eventually support the climate adaptation of the entire Wadden Sea area. Also stressing the historical evidence of importing lessons from Denmark and the Netherlands for coastal and dune management (see section 3.2) on Sylt might help to create a narrative. Anyway, it might well take years until increased aeolian processes might be observed at a potential pilot site.

In the long run, a reiterative circle of executing measures and monitoring their effects should refine the strategies. These experiences can then influence the future restoration or reactivation measures. Together with an increased appreciation of aeolian dynamics, even more ambitious measures like creating new migrating dunes at the western shoreline as SH-02 (6/2/2019) suggested, might be possible someday. Eventually, new standard procedures will establish and bring the transition phase to an end.

6. Conclusions

6.1. Lesson drawing as an appropriate approach for coastal dune management

Like at many places in north-west Europe, the dunes on the island of Sylt are over-stabilised; this poses both a threat to the long-term adaptation of the island's two attached spits to the projected rising sea-levels and to the biodiversity living in the dune fields. To overcome this undesirable state, this study took a qualitative pathway by drawing lessons from the Netherlands and Denmark. Both countries appeared to be the most suitable potential donor countries, not at least because their dune fields share many important physical characteristics with the dune fields on Sylt.

This links to a first conclusion. Arguably, the most examples of lesson drawing focus on policies that are actually independent from their physical surrounding e.g. the introduction of neo-liberal approaches to post-soviet Moscow. Here, the physical surroundings set much more strict limitations to dune management and thus to the practicability of foreign lessons. To incorporate both the physical characteristics and the institutions that underlie human intervention, dunes were conceptualised as Coupled Human And Natural Systems (CHANS). This approach furthermore acknowledges the non-linear but complex development of dune fields.

Despite these physical and complex restrictions, the approach of lesson drawing poses a realistic option to develop new strategies. Linking the effects of the underlying paradigms and especially the informal institutions to the effects they have on the physical landscape might support the decision for a certain strategy. In E.g. the Danish paradigm of preserving a certain state of the results in a different dune landscape, than the Dutch idea of managing landscapes according to the current and to the future needs. Thus a more constructivist approach can also enrich the field of coastal dune management, which is mostly dominated by quantitative studies.

This, however, should not turn down the importance of quantitative analyses for coastal dune management. Albeit this study was able to identify potential lessons to learn from Denmark and the Netherlands, it requires further calculations and analyses to develop more specific suggestions. Instead, it seems promising to merge both approaches in the future to combine the best from the two underlying philosophical and scientific strands. At the beginning of a study, a qualitative analysis

could identify the viable options from the cornucopia of options at hand. These options than could be examined thoroughly from a quantitative standpoint.

6.2. Lessons for the dunes on Sylt

Zooming in to the specific circumstances of Sylt, the qualitative approach of lesson drawing has proven helpful, too. Three lessons are identified that seem practicable and desirable for Sylt. First, to aim for the preservation of the cultural landscape offers a clear goal and acknowledges the human interventions in the past. Second, sorting different land use forms like recreation and nature conservation to allow better recreational use and third to introduce dynamic fore dune management as in the Netherlands. This basically would restart the sediment conveyor belt. For this purpose, two potential pilot sites on the northern spit are identified by a quantitative GIS-analysis.

However, these lessons cannot be implemented immediately, because partly the physical state of the coast does not allow for it and also, because the current paradigm “protecting dunes protects the island” favours the current situation with highly stabilised dunes.

Thus, a fundamental policy change, which might be about start now, needs to be achieved. Practical insights about such transitions are thus incorporated into a strategy, which distinguishes between short-term, mid-term and long-term actions. Furthermore, different strategies are needed for the primary (fore) dunes along the west coast of Sylt and the secondary inland dunes in the hinterland. These strategies should be joined with broad actions to initiate a paradigm change. This campaign also can start at short notice. At the inland dunes, small-scale measures that prevent further ecological degradation can contribute to the development of a long-term strategy for the inland dunes. Both the Danish approach to preserve an arbitrarily chosen reference state or the Dutch paradigm of interventionist habitat preservation are potential lessons. If and how they are incorporated is actually subject to further medium term discussion. A change in the strategy of foredune management needs to be closely connected to the broader discussion of climate adaptation in the Wadden Sea area. Also there, change seems realistically only within a couple of years.

Also here, further quantitative objective information need to be added to make this strategy work. Nevertheless, the meaningful, institutional effects of any action taken in the dunes on Sylt should play an important role in the future. To achieve persistent change towards a future-oriented, dune management strategy on Sylt both the sand in the dunes and their images in the heads of people need to move again.

Acknowledgements

Sometimes, writing this thesis reminded me of dune migration itself. Phases of still stand alternate with time spans of small progress. The difference between the two is hardly detectable for the naked eye. Finally, there are sometimes phases of retreat due to strong headwinds. Anyway, this thesis evolved from a sketchy idea on a sheet of paper to this document and I am very thankful for the following wind I received from various sides.

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Drawing lessons from Denmark and the Netherlands for dynamic dune management on the island of Sylt (Germany)

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Appendices

I.	Attribution of Habitats to the Prussian Topographic Map	xi
II.	Interview Permission forms	xii
A.	English	xii
B.	German	xiii
III.	DK-01: E-mail to Aarhus Universitetet	xiv
IV.	DK-02: Kystdirektoratet	xiv
A.	Questionnaire	xiv
B.	Interview Summary	xv
V.	DK-03: Thy National Park	xvi
A.	Questionnaire	xvi
B.	Summary	xvii
VI.	DK-04: Naturstyrelsen	xix
A.	Questionnaire	xix
B.	Summary	xix
VII.	NL-01: Deltares	xx
A.	Questionnaire	xx
B.	Interview Summary	xxi
VIII.	NL-02: Duinonderzoek	xxiii
A.	Questionnaire	xxiii
B.	Summary	xxiv
IX.	NL-04: Delta Commission	xxvi
A.	Questionnaire	xxvi
B.	Summary	xxvii
X.	SH-01: NSG Sylt	xxviii
A.	Questionnaire	xxviii
B.	Summary	xxix
XI.	SH-02: AWI Sylt	xxxiii
A.	Questionnaire	xxxiii
B.	Summary	xxxiv
XII.	SH-03: SW	xxxviii
A.	Questionnaire	xxxviii
B.	Summary	xxxix
XIII.	SH-04: LKN-SH	xli
A.	Questionnaire	xli
B.	Summary	xlii
XIV.	SH-05: Untere Naturschutzbehörde (UNB) des Kreises Nordfriesland	xliv
A.	Questionnaire	xliv
B.	Summary	xliv
XV.	SH-06: LLUR-SH	xlvi
A.	Questionnaire	xlvi
B.	Summary	xlvi

XVI.	SH-07: WWF Wadden Sea Office	xlix
A.	Questionnaire	xlix
B.	Summary	l
XVII.	SH-08: Sölring Forining	liii
A.	Questionnaire	liii
B.	Summary	liii
XVIII.	Seminar Talk: Functional restoration of bogs and dunes. Lessons from 25 years of practice and research	lv
XIX.	Seminar Talk: Cattle on loan - enabling private cattle herds to be built without investment costs	lvi
XX.	Different approaches to remove <i>Rosa rugosa</i> at the LIFE REDCOHA and the LIFE REWETDUNE Project	lvi
XXI.	Test of methods to combat <i>Prunus serotina</i>	lvi
XXII.	National Park 2.0. A new standard for Dutch National parks: scale, international exposure, new combinations	lvii

I. Attribution of Habitats to the Prussian Topographic Map

Figure 13 compares the First Prussian Map of Sylt from 1878, which mostly was a military map, with the latest vegetation mapping for the Trilateral Monitoring Assessment (TMAP). The coverage units have to both depict the most important habitats of a sandy spit and fit to both maps. This resulted in a set of rather broad categories, which mainly focused on the influence of aeolian dynamics. Nevertheless, the two datasets might not fit each other perfectly. Therefore no numbers or percentages of the single land cover types were calculated. This approach, however, allows an overall comparison of the state of the dune field in 1878 and 2016.

The Prussian map was merely digitized and the single features were attributed to the different categories. The more detailed TMAP vegetation types were chosen as the Natura2000 habitats did not cover fewer parts of the spit and also attributed to the categories which are presented in the following:

Prussian Map	Surface coverage	Communities Codes	TMAP
Sand	Active dunes (includes areas with sparse marram coverage)	X.0; X.1; X.2.1; X.2.2; X.3.1; X.4.1; X.5; X.9; X.12	
Grassland and meadows (in the dunefields)	Stable Dune (other)	X.10; X.11	
Heather	Heathland	X.6.1; X.6.2	
Wet grassland and meadows in the dunefields	Wet dune areas (wetlands in dune valleys)	H.1; H.1.1; H.1.2; H.1.3; H.1.4; H.5.1; H.6.1; H.6.2; H.7; H.8; H.9	
Shrubs and deciduous trees	Shrub and Trees	X.7; X.7.1; X.7.2; X.7.4; X.8.0; X.8.1; X.8.3	
Cornifers	Forest	X.8.2	
Grass and meadows at the	Saltmarsh (Grasslands and wetlands fringing the Wadden coast)	S.0.0; S.01; S.02; S.03; S.1.1; S.1.2; S.2; S.2.1; S.2.3; S.2.4; S.2/S.3; S.3; S.3.2; S.3.5; S.3.6; S.3.7; S.3.8; S.3.9; S.3.10; S.3.11; S.3.12; S.3.14; S.5.1; S.5.2; S.5.3;	
Built-Up	Developed	A; AA;	
	nna (unclassified)	o; PR; S.6.1; S.8; D	

II. Interview Permission forms

A. English

Permission interview form

Working title: A study to the possibilities and limits of drawing lessons from the Dutch and Danish dune management strategy to the island of Sylt (Germany)

The research

This research is the graduation assignment of Felix Oßwald for the master course 'Environmental and Infrastructure Planning' at the University of Groningen. The master is part of the Double-Degree-Master Course 'Water and Coastal Management' at the universities of Oldenburg and Groningen.

This study aims at deriving and discussing lessons from the Dutch and Danish strategies of coastal dune management which can be used at the island of Sylt (Germany). This research is supervised by dr ir. Terry van Dijk (t.van.dijk@rug.nl) from the University of Groningen.

What are you being asked to do?

You do not have to prepare for the interview, in this interview there is interest in your work experience within dune management projects. The conversation will last approximately last around an hour. You can always indicate during the conversation if you want to stop or take a break. You can also indicate when you do not want to answer a question.

How will the information from your interview be used?

1. Recording

The conversation may be recorded: YES NO

If the conversation is recorded, it will be carefully stored in a protected environment. Only the researcher himself and his supervisors can have access to the conversation.

Based on the recording a summary of the interview will be written for further processing. If you wish, you can check the summary and demand changes thereto.

The interview summary should be sent to the interviewee: YES NO

2. Anonymity

Within the thesis document, all interviewees remain anonym and will be quoted by their organization they work for. Furthermore, other personal and project data will be processed confidentially. This means that people who are outside the study will not have access to this data.

3. Processing

The results will be processed in the form of a master's thesis, the results of which will also be presented during the Graduate Research Day of the faculty of Spatial Sciences on 27 June 2019. This will be done by means of a presentation to fellow students, professors and other interested parties.

Permission

I hereby declare that I have been informed of:

1. The purpose of the investigation;
2. What is expected of me during and after the interview;
3. And what happens with my data.

Date: _____ Signature participant: _____

Date: _____ Researcher's signature: _____

B. German

Erlaubnis zur Verwendung von Informationen aus Interviewmaterial

Eine Studie zu den Möglichkeiten und Grenzen, von der niederländischen und dänischen Dünenbewirtschaftungsstrategie für die Insel Sylt (Deutschland) zu lernen

Die Forschung

Dieses Interview ist Teil der Abschlussarbeit von Felix Osswald für den Masterstudiengang ‚Environmental and Infrastructure Planning‘ an der Universität Groningen. Der Master ist Teil des Doppel-Master-Studiengangs ‚Water and Coastal Management‘ an den Universitäten Oldenburg und Groningen.

Diese Masterarbeit zielt darauf ab, Lehren aus den niederländischen und dänischen Strategien des Küstendünenmanagements abzuleiten und zu diskutieren, die auf der Insel Sylt (Deutschland) angewendet werden können.

Betreut und begutachtet wird diese Abschlussarbeit von Dr. Terry van Dijk (t.van.dijk@rug.nl) von der Universität Groningen.

Über das Interview?

Sie müssen sich nicht auf das Interview vorbereiten. In diesem Interview besteht lediglich Interesse an Ihrer Arbeitserfahrung in Dünenmanagementprojekten und Ihrer Beteiligung an dem in dieser Studie untersuchten Thema. Das Gespräch dauert ungefähr eine Stunde. Sie können das Gespräch jederzeit unterbrechen oder beenden. Sie können auch angeben, wenn Sie eine Frage nicht beantworten möchten.

Wie werden die Informationen aus Ihrem Interview verwendet?

1. Aufnahme

Das Interview darf aufgezeichnet werden: JA NEIN

Wenn das Gespräch aufgezeichnet wird, wird es sorgfältig gespeichert und in einer geschützten Umgebung gespeichert. Nur der Student und die Gutachter / Betreuer haben Zugang zu der Aufnahme. Basierend auf der Aufzeichnung wird für eine schriftliche Zusammenfassung erstellt.

Der Interviewpartner kann diese auf Wunsch einsehen und Änderungen einfordern JA NEIN

2. Anonymität

Die Masterarbeit wird keine Namen der Interviewpartner verwenden.. Darüber hinaus werden andere Personen- und Projektdaten vertraulich behandelt. Das bedeutet, dass Personen, die nicht an der Studie teilnehmen, keinen Zugriff auf diese Daten haben.

3. Verarbeitung

Die Ergebnisse werden in Form einer Masterarbeit aufbereitet, deren Ergebnisse auch am ‚Graduate Research Day‘ der Fakultät für Räumliche Wissenschaften am 27. Juni 2019 präsentiert werden. Dies erfolgt mittels einer Präsentation für Kommilitonen, Professoren und andere interessierte Parteien.

Genehmigung

Hiermit erkläre ich, dass ich über Folgendes informiert wurde:

1. Zweck der Untersuchung
2. Charakter und Dauer des Gesprächs?
3. Weiterverwendung der Daten?

Datum: _____ Unterschrift Teilnehmer: _____

Datum: _____ Unterschrift des Studenten: _____

III. DK-01: E-mail to Aarhus Universitetet

These three questions were sent to Aarhus Universitetet. The answers are indicated in blue.

- 1) At many places, the Danish North sea coast is protected by beach nourishments. As this has been happening for more than 30 years now. Are there any long-term trends visible in the dunes (like stabilization), that are caused by nourishments?

Danish dunes are definitely stabilizing

<https://www.sciencedirect.com/science/article/pii/S0006320714001359> (supplementary data 1); and <https://www.sciencedirect.com/science/article/pii/S0006320714004868?via%3Dihub> here: (appendix F in supplementary data)

I think it is very difficult to judge whether the changes are due to beach nourishment, climatic changes (at a long temporal scale) or increased nutrient levels for example. The effect of beach nourishment has not been tested – to my knowledge – most likely because of lack of data. But ‘Kystdirektoratet’/The Danish Coastal Authority which carries out the work may know more about this (<http://eng.kyst.dk/>).

- 2) There have been many effort about dune restoration projects in Denmark, for instance in the context of the EU- LIFE programme. Which organisation is usually taking lead within such a project? Is it usually the Ministry for Environment and Food (Miljø-og Fødevarer Ministeriet) or other organisations?

Several LIFE projects have been conducted in Danish dune areas. Most often Nature Agency Denmark collaborates with local biologist from the municipalities in the specific area (see for example <https://eng.naturstyrelsen.dk/nature-protection/nature-projects/life-redcoha-a-nature-restoration-project/>).

- 3) Is there anything you would consider “typically” Danish within the Danish dune management strategy?

I guess the very strict legislation within coastal areas is rather unique for Denmark – and that of course influences the management (not always in a positive way – biodiversity-wise as management to prevent sand drift is often prevalent although outdated from a biodiversity perspective. Biodiversity benefits from disturbance and dynamic processes but the legislation unfortunately stems from fear of sand drift).

Description of legislation (in Danish – sorry): <http://soeterritoriet.kyst.dk/love-og-regler.html>
<http://kysterne.kyst.dk/strandbeskyttelseslinjen.html>

IV. DK-02: Kystdirektoratet

A. Questionnaire

- 1) Introduction: What role play coastal dunes in your daily work?
- 2) Dune Protection lines (Klitfredningslinjen): In general the Klitfredningslinjer complete the strandbeskyttelses linjer at the west coast of Jutland. They aim to preserve the current coastal landscape and limit the uses thereof. Furthermore, sand drift should be prevented.
 - a) Who is responsible for transferring these rules into practice and control them?
 - b) What do these regulations entail? How much leverage do they provide for Kystdirektoratet or the other authorities in charge?
 - c) Two years ago, I visited dunes south of Skagen (kandestederne). There, coastal dunes were not as heavily stabilized. How does this fit with the klitfredningslinje?
- 3) Jutlands Westcoast: Kystdirektoratet is responsible for the coastal protection at the North Sea coast of Jutland in cooperation with the local communities:
 - a) How are coastal dunes treated there? (Systematically planted, etc.)
 - b) What role play the coastal communities (integration of other interests?). Has this role changed since 2018, when they became responsible
 - c) At many sites at the Jutland’s North Sea coast, coastal retreat is stopped by beach nourishment? What are the effects on the coastal dunes? (E.g. in the Netherlands it has been observed, that aeolian transport towards the hinterland increases or decreases due to a new foredune ridge)

Drawing lessons from Denmark and the Netherlands for dynamic dune management on the island of Sylt (Germany)

- d) Aeolian sediment transport is considered important. What role play these findings in the management of coastal dunes by Kystdirektoratet? What role does the Interreg “Building with nature” paly in this context?
- 4) Coastal erosion: At other places coastal retreat should not be stopped, but only slowed down. On Sylt, by comparison, a static baseline is defined, that should not be exceeded.
 - a) What are the most important criteria when it comes to designating such areas?
 - b) Why is coastal retreat publicly acceptable?

B. Interview Summary

[00:10]: What role play coastal dunes in your daily work at Kystdirektoratet?

In Denmark, coastal dunes are important in many cases, as they are the primary defence line, but they are also important habitats and are popular recreational sites; in Denmark, it is allowed to walk freely in the dunes.

[01:23]: Is Kystdirektoratet responsible for implementing and enforcing the rules of the Dune protection lines (Klitfredningslinjer)?

Quite strict regulations outside the cities within the dune protection lines; especially, there are high restrictions to building permanent houses. This partially due to the right of everyone to use the beach until the highwater line. On top, there are regulations for nature protection. These regulations are supervised by Kystdirektoratet. Additionally, the nature agency is responsible to manage the aeolian activities. The actions taken, though, depend on the surroundings. In (densely) built areas, the dynamics are suppressed by plantations, etc., whereas they are allowed to develop freely in places where they do not affect human construction. This strategy is applied at every large scale sandy coast; e.g. not only at the Jutish west coast, but e.g. also on the island of Anholt in the Baltic Sea.

Dynamic processes are also allowed for safety reasons: on a retreating coast, sediment, that is blown into the hinterland, increases the width of the dune and therefor reduces the risk of a flood event to happen

[09:30]: Is dune stabilization the general rule and are the areas of untamed nature the exception from that rule or is it the other way round?

The general rule is that authorities allow these processes to happen and only intervene, when it is considered necessary for safety reasons.

[10:30]: Managing coastal dunes is also about balancing the aforementioned different interests (nature conservation, coastal protection, tourism, etc.) Within this context: What role play the coastal communities (integration of other interests?). Has this role changed since 2018, when they became responsible?

For dune management, the local communities often play a minor role, for two reasons: First, managing of coastal dunes was no part of the coastal protection act of 2018 that gave responsibility to the local communities. Second, most of the coastal dunes are owned by the state anyway, so it is their responsibility to manage them accordingly

[13:20]: At many sites at the Jutland's North Sea coast, coastal retreat is stopped by beach nourishment? What are the effects on the coastal dunes? (E.g. in the Netherlands it has been observed, that aeolian transport towards the hinterland increases or decreases due to a new foredune ridge.)

The effect of beach nourishments depend on many factors, such as the grainsize or the storminess. The sediment used on Sylt is usually much coarser than in Denmark. Furthermore, nourished sediments consists of many grain sizes. The wind carries away the fine-grained particles from the upper layer of the nourished sediment wedge. After the beach sediment has been mixed again by a storm, the wind can again relocate fine-grained sediment. If such storm do not happen, aeolian activities seize. Also, easterly winds might blow sand from the backside of the dunes back to the beach

It also depends on the wind direction and the dune profile. If the profile is too steep, the wind may not be able to carry sand across the beach-dune system, but rather along this system.

[22:00]: Are the sediment conveyor belts that allow spits do grow vertically with the sea-level incorporated into a long-term coastal protection strategy?

The long-term effects of aeolian sediment transport are considered. Therefore, they allowed, wherever possible, as there is no stimulation needed. In some cases, also houses have to be given up. However, it is difficult at the Jutish west coast to incorporate such long-term goals, as the

management agreements between the Coastal authority and the municipalities only take a short-time perspective, as they only run for five years.

Nevertheless, the long-term strategy is to keep nourishing, as the eroded sand does not leave the sediment cell. Principally, it can be recycled by the nourishing vessels; nevertheless, this is quite expensive. Eventually, of course, it is a societal decision, how much money should be spend on coastal protection.

[27:30] Coastal erosion: At other places coastal retreat should not be stopped, but only slowed down. On Sylt, by comparison, a static baseline is defined, that should not be exceeded.

In some areas, this is indeed seen as an option: At the Jutish west coast for instance, nothing happens at coastal stretches, where coastal retreat will not affect any human infrastructure during the next five-year contract period, nothing happens and coastal retreat is allowed to take place. These coastal stretches are usually several kilometres long. This is also considered positively, as coastal retreat releases sediment that can reduce coastal retreat elsewhere and it provides habitat. At other places, the idea of a basis coastline (BCL) is applied. No coastal retreat is allowed there.

[33:50]: Why is coastal retreat publicly acceptable in Denmark?

First of all, at many places it has been a way of living for several centuries to relocate houses, when the coast retreated. Furthermore, as the landowners have to pay for the coastal protection by themselves, relocation of the houses often is favoured over coastal protection measures as it is cheaper.

[36:10]: On Sylt, coastal dunes have been stabilized for decades. Now the question is: What would happen to them, if the stabilization measures would be stopped. Would aeolian dynamics establish by themselves. Are there any comparable cases in Denmark?

The area around Rubjerg Knude Fyr, offers a nice example, when watched at Google Maps. From a certain moment on, much more dynamic processes can be observed. That is, when stabilization measures were halted.

V. DK-03: Thy National Park

A. Questionnaire

- 1) Working for a Danish National park: What are your tasks at Thy National Park?
- 2) Is there anything you would consider typically Danish when it comes to dune management in Denmark?
- 3) Thy National Park is rather young; it has only been opened in 2008.
 - a) What are the conservation goals of this national Park?
 - b) Is there something like a current standard procedure for dune management in Thy National Park?
 - c) How are these related to the Habitat Directive?
 - d) The National Park Board of each Danish national park should consist of members with strong relations to the area. They also have to develop a management plan. How does this affect the dune management at Thy National Park?
 - e) How was the area preserved before? What has changed?
- 4) Dunes are important habitats according to the Habitats Directive
 - a) What habitats does the current management strategy focus on?
 - b) Besides the habitats, what are central elements of nature conservation in the Dutch dunes?
- 5) The calcium content in the soil is an important parameter for the ecology of coastal dunes.
 - a) Are the dunes rich or poor in calcium?
 - b) What are the consequences for ecology and management?
- 6) Looking at Google Maps, the coastal foredunes seem hardly stabilized for coastal protection purposes. How does that influence the hinterland?
- 7) Projects: Projects are a common organisation form nowadays.
 - a) What role do they play in nature conservation at Thy National Park?
 - b) What are your experiences with projects?
 - c) What are typical project goals?
 - d) Dune management strategies often aim at combating succession and vegetation encroachment?

B. Summary

[02:08]: What are your tasks at Thy National Park?

Working as a Project Manager at National Park Thy includes involvement in many restoration projects. One focus is restoring the former hydrology of the areas: Once there merely meandered 35 km of natural streams within the National Park, whereas today the watercourses include 383 km of ditches and streams. The National Park authority strives to close as many of them as possible. Another important aspect are migration corridors for species that intersect the forest plantations separating the different dune areas.

Dealing with different landowners is also part of the job. Usually, the private landowners are more willing to participate in a project as they do not want to earn money from their land but own it mainly for leisure activities, as soil conditions are rather poor. In turn, public landowners often expect greater monetary revenues from e.g. forestry. Furthermore, the national ambitions in nature conservation also depend on the political support and thereby on the decisions and priorities of the current government in charge.

Furthermore, Public relations plays an important role within the National Parks' nature conservation strategy. People need to be informed about what is going on in the nature, as they are only willing to protect what they hold in high regard. This includes presenting news about success stories but also point to urgent problems and to challenge traditional points of views such as the role of big grazers and of forest fires. When there was a forest fire in the National Park area in early May 2019, the media strongly focused their attention on the damages and were less interested in the ecological opportunities the fire created.

[09:00]: The Danish national parks were opened only 10 years ago and have the goal to preserve the most scenic Danish landscape types. What are the actual conservation goals at National Park Thy?

National Park Thy has a total of six conservation goals. Among these are the preservation of the typical coastal dune heathlands as well as the heathland habitats. This includes especially the dune field at Hanstholm, which is the biggest coastal dune area of Europe. Another goal is the public access to the area and outdoor living, so that people can enjoy nature. A zoning plan helps to reconcile these partly contradicting goals and steers the visitors. Furthermore, two core zones remain closed throughout the entire year and four to five areas are closed for visitors during the breeding season of birds, i.e. from 01st April to 15th July every year.

[15:00]: There seems to be a strong public involvement into the management of National Park Thy. First, the public participated during the establishment of the National Park Thy. Second, the National Park Board steers the National Park; one of its tasks is to develop a management plan for the area. These members should have a strong connection to the local area. How does the public influence affect the management efforts?

There is a great public influence on the management of Thy National Park via the National Park Board. A council of 12 or 16 members from nature protection agencies (NGOs), bird life organisations, municipalities, local governments debates about management issues. Furthermore, there is the National Park board that has to decide about the implementation of the measures. There, different kinds of knowledge come together. One of its tasks is to agree on a management every six years. This plan than is laid out for public consultation.

[18:00]: It seems to be very democratic steering process. What are the advantages and disadvantages of such measures?

The high public involvement is a double-edged sword. It brings with it the advantage that every action that is made has been agreed on by the Board and therefor has the legitimization it needs. On the other hand, this makes it really difficult to implement measures the board members do not favour, as they usually lack the scientific background.

[20:40]: Parts of Thy National Park are also protected by the EU's Habitats Directive. What are the most important habitats?

Different protection schemes come together in National Park Thy. More than half of the national park area is protected as Natura 2000 sites; also more than 50 % of the area is designated nature conservation area (*fredning*). Furthermore, 75 % of the area is further owned by the government, also offers some protection. The status as a National Park itself does not provide any additional protection, besides some general considerations.

The most important habitats for conservation purposes are the grey dunes, wet dune slacks and dune lakes, whereas heathlands with *Empetrum nigrum* (Reving) are not prioritized habitat in Denmark. Important species are the crane (*Grus grus*), the Natterjack toad (Strandtudse; *Bufo calamita*) and the Crested newt (Stor vandsalamander, *Triturus cristatus*).

[26:50]: In The Netherlands, the active restoration of aeolian dynamics is a common process. What are typical management procedures in Thy National Park?

Compared to The Netherlands, nature conservation in the dunes of Thy National Park is only at the beginning. Here, the current focus is more about connecting the different dune fields, which includes to take farmland out of use by buying it.

[29:00]: The calcium content of the soil is an important parameter for the ecology of coastal dunes. Are the dunes in Thy National Park poor or rich in Calcium?

In the dunes of Thy National Park, two gradients of decreasing calcium content can be observed. First, the calcium content decreases as the landscape ages and succession proceeds. Whereas the soil of the grey dunes is rather rich in calcium, it is highly decalcified underneath the heathlands. Second, on a larger scale the soil in the North is generally richer in calcium, because the soil there is rich in shell fragments as a consequence of coastal uplift after the last glaciation.

[31:15]: Is there anything you would consider typically Danish when it comes to dune management in Denmark?

Probably, there is nothing exceptional Danish within the management of the Danish national parks. However, the democratic process that leads to the parks seems to be unique, as the Danish government develop an own definition of national parks, which does not fit into the IUCN criteria.

[34:00]: Projects are a common organisation form nowadays. What role do they play in nature conservation at Thy National Park?

As the conservation status of many areas is already quite good, the current goal is mainly to connect the habitats. Projects are a very suitable tool for that purpose as they allow to bundle the negotiations with many different landowners into few, bigger projects. Projects are also commonly used as the Danish national Parks must not own any land nor must they spend their budget on everyday care. They really are project organisations; while the everyday management and aftercare is done by other parties as negotiated before with the National Park authority

Often, for instance, the National Park buys the farm rights for a piece of land during the project period. Before the land use rights are then sold again, regulations for the follow-up use are set up. These rules include agriculture as well as hunting, forestry, altering the hydrology, etc. Nevertheless, arable land converted into nature area, might result in rather good price. There are different regulation lifespans possible, the goal is to preserve it forever. In some cases, also the land is bought for the project life span. Later on, the land may be handed over to a municipality or it might be sold again via an auction. However, this is much more expensive.

[47:00]: The dunes at Thy national Park have been used quite intensively for agriculture?

During the last centuries, people were living in very poor conditions in this area and when they tried to convert the poor sandy soil into arable land, they dug many ditches, also for watering the pine plantations later on

The ditches also cause another problem: when the water level is lowered the iron that has been chemically fixed by reduction oxidizes and enters the ditches. There, it results in severe pollution, some lagoons and ditches are uninhabitable.

[49:30]: How are the foredunes at the coast currently managed?

The foredunes have been stabilized until the 1990s by marram grass (*Ammophila arenaria*). Although no active management – besides the removal of the Japanese rose *Rosa rugosa* - happens at the moment by means of planting marram grass or nourishing the beach, the dunes do not re-mobilize by themselves. However, it is very difficult to explain the ecological value of bare sand patches to people.

It remains, however a difficult task to explain the ecological benefits of aeolian sediment transport to the locals, as the disastrous effects of coastal erosion sand burying fields and homesteads are still very present. The coast along the National Park has been eroding 4 m/a on average in the past centuries, coastal retreat summed up to 2 km at some places in some areas. Today, coastal erosion poses a problem in the settled areas but not in the National park, where the coast is allowed to retreat.

VI. DK-04: Naturstyrelsen

A. Questionnaire

- 1) Über Naturstyrelsen
 - a) Was sind Ihre Aufgaben bei Naturstyrelsen?
 - b) Wofür ist Naturstyrelsen zuständig?
 - c) Was sind die Ziele für den Naturschutz in den Dünen?
 - d) Der Interviewpartner von Kystdirektorat teilte mir mit, dass Naturstyrelsen auch für die Einhaltung der Klitfredningslinjer verantwortlich ist. Was sind die Aufgaben von Naturstyrelsen im Zusammenhang mit den Klitfredningslinjen?
- 2) In den letzten Jahren gab es zahlreiche LIFE Projekte in den dänischen Dünen.
 - a) Was sind die Vorteile und Nachteile von Projekten im Naturschutz?
 - b) Naturschutz in Dünen kämpft oft gegen Sukzession und Verbuschung. Ein Projekt kann nur kurzfristigen Erfolg liefern. Wie wird Verbuschung und Sukzession langfristig verhindert?
 - c) Welche Maßnahmen – z.B. bei der Verjüngung von Heide oder bei der Entfernung invasiver Arten wie *Rosa rugosa* - haben sich als besonders erfolgversprechend erwiesen?
- 3) Die FFH-Richtlinie stellt europaweit geltende Regeln für den Schutz von Habitaten und Arten auf
 - a) Was sind wichtige Dünenhabitats in Dänemark? (*Empetrum*?)
 - b) Naturschutz fokussiert sich nicht nur auf Habitats, sondern auch auf andere Ziele. Was sind weitere Ziele im Naturschutz? (Erhalt der Landschaft?)
 - c) Wer ist für den guten Erhaltungszustand gesetzlich verantwortlich? (Die lokalen Behörden oder Naturstyrelsen?)
- 4) In vielen Dünengebieten ist die Zeit des großen Sandflugs nach wie vor sehr präsent. Wie stark prägt die Erinnerung an den Großen Sandflug die Diskussion über den Umgang mit den dänischen Dünen?

B. Summary

[01:30]: Was sind die Ziele von Naturstyrelsen für die Dünengebiete?

Das Ziel von Naturstyrelsen ist ein möglichst naturnaher Zustand der Dünenlandschaft. Dafür werden die Dünen an vielen Stellen sich selbst überlassen. Dort finden keine menschlichen Eingriffe statt. Diese Strategie funktioniert an vielen Orten, da der atmosphärische Stickstoffeintrag in Dänemark im Vergleich zu Deutschland oder den Niederlanden sehr niedrig ist und die Böden eine sehr geringe Reaktionszahl von 4,5 bis 5 aufweisen. Das sorgt für dynamischere Bedingungen als z.B. in den Niederlanden: Es gibt mehr Windrisse und äolische Aktivität.

Eine große Rolle spielt auch Bekämpfung von nicht-heimischen Pflanzen wie der Kartoffelrose (*Rosa rugosa*). Auch versucht man, die Ausbreitung von Nadelgehölzen zu verhindern. Das dient auch dem Schutz der typischen, offenen dänischen Küstenheiden.

[06:30]: Naturstyrelsen betreut auch die Dünen in den sogenannten ‚Klitfredningslinjer‘ entlang der Küste. Was sind dort die Aufgaben von Naturstyrelsen?

Die Betreuung der klitfredningslinjer ist eine neue Aufgabe von Naturstyrelsen. Zuvor gab es ein eigenes Dünendirektorat als Teil vom Kystdirektorat, das sich noch immer in Lemvig befindet. Diese Behörde bearbeitet nach wie vor die Angelegenheiten, die die Dünen in den Klitfredningslinjer betreffen. Naturschutzeinsätze müssen mit dem Dünendirektorat in Lemvig abgesprochen werden; die Zusammenarbeit ist aber einfacher geworden, seit die beiden Behörden zusammengelegt wurden und demselben Ministerium unterstehen.

[13:00]: Die FFH-Richtlinie (Habitatdirektivet) stellt europaweit Regeln für den Naturschutz auf, um den Erhalt und den Schutz wichtiger Habitats zu gewährleisten. Was sind die wichtigsten Dünenhabitats in Dänemark?

Lange Zeit lag der Fokus auf den Grau- und Weißdünen (FFH-Code: 2130 und 2120). Seit EU-Projekte durchgeführt werden, rücken auch Dünen mit *Empetrum nigrum* (2140) und feuchte Dünentäler (2190) in den Fokus. Diese Habitats hängen zusammen und ergeben ein Gesamt-Mosaik und werden zusammen gepflegt. Neuerdings liegt der Fokus oft auf den feuchten Dünentälern; für diese ist die Herstellung der natürlichen Hydrologie sehr wichtig, indem Gräben geschlossen werden.

[19:55]: Die FFH-Richtlinie sieht ein Verschlechterungsverbot vor: Weder der Erhaltungszustand eines Habitats, noch die Größe einer geschützten Population darf sich verschlechtern. Wer ist in Dänemark für den guten Erhaltungszustand gesetzlich verantwortlich?

Generell ist der Landbesitzer verpflichtet, für einen guten Erhaltungszustand zu herzustellen und zu erhalten. Auf staatlichen FFH-Flächen übernimmt Naturstyrelsen diese Aufgabe, auf FFH-Gebieten sind die Gemeinden selbst dafür zuständig. Die Gemeinden müssen ebenfalls sicherstellen, dass die privaten Landbesitzer dieser Aufgabe nachkommen. Allerdings war dies oft nicht der Fall. Das änderte sich oft erst mit der Durchführung von Projekten, die von der EU gefördert wurden, wie die LIFE-Projekte. Ohne diese Projekte hätte sich der Erhaltungszustand vieler Dünengebiete in vielen Fällen nicht verbessert. In diesen Projekten arbeiten Naturstyrelsen und die Gemeinden oft zusammen in gemeinsamen Verwaltungsprojekten. Die Förderung der EU ermöglicht es, dass auch private Landbesitzer teilnehmen können, ohne dass ihnen Kosten entstehen.

Im Fall, dass der gute Erhaltungszustand verfehlt wird, kann die EU eines Tages auf Maßnahmen bestehen. Dann wäre die Gemeinde dafür zuständig, dass der Managementplan auf ihren und auf privaten Flächen umgesetzt wird.

[27:00]: In vielen Dünengebieten ist die Zeit des großen Sandflugs nach wie vor sehr präsent. Wie präsent ist die Erinnerung an den Großen Sandflug in der Diskussion über den Umgang mit den dänischen Dünen?

Der Sandflug war regional sehr unterschiedlich ausgeprägt. Der Große Sandflug begann zum Beispiel am Ende des 18. Jahrhunderts in der Gegend von Thy und breitete sich von dort entlang der Küste aus. Nordjütland war weniger stark betroffen; außerdem waren die Böden dort weniger wertvoll für die Landwirtschaft. Deswegen wurde in Thy stärker aufgeforstet als in Skagen; Ausnahmen sind Skagen Klitplantage und Bepflanzungen auf Grenen

Damals wurde das Dünendirektorat gegründet; seine Aufgabe war die Aufforstung der Flugsandgebiete. Die Aufforstungen sind längst eingestellt. Allerdings wird Sandflug nach wie vor überall dort bekämpft wo er Privateigentum bedroht. Der Staat kann die Festlegung und Bepflanzung von Dünen finanziell unterstützen.

[30:20]: Welche Rolle spielen die Dünenvogte(Klitfogeder) heute noch in der Dünenpflege in Dänemark?

Dünenvogte gibt es noch, allerdings deutlich weniger als noch vor 50 oder 100 Jahren. Im Gegensatz dazu gibt es die Aufgabe des Dünenförsters nicht mehr.

[32:50]: Was sind für Sie typisch dänische Maßnahmen und Strategien in der dänischen Dünenpflege?

Wie vermutlich überall, ist im dänischen Naturschutz oft knapp. Deswegen herrscht dort ein großes Bewusstsein für Effizienz: Man möchte mit dem vorhandenen Geld möglichst viel erreichen. Deshalb werden günstige Methoden bevorzugt. Zum Beispiel wird in den Niederlanden an einigen Stellen großflächig geplaggt. Plaggen wird in Dänemark nicht praktiziert, weil es als zu teuer gilt. Plaggen wäre höchstens auf Flächen mit der Bergkiefer (*Pinus mugo*) denkbar, dort könnte es billiger sein, als alle 5 Jahre die Bäume zurückzuschneiden

EU Projekte sind auch deshalb sehr beliebt, denn sie erlauben, dass mehr Naturschutzmaßnahmen durchgeführt werden. Viele Projekte hätten Staat und Gemeinden alleine nicht umsetzen können.

[39:10]: Was sind die Vor-und Nachteile von Projekten im Naturschutz?

Ein erster Vorteil von Projekten ist, dass überhaupt etwas für den Natur- und Landschaftsschutz getan wird. Je nachdem, wie groß das Projekt ist, fördert es außerdem die lokale Wirtschaft. Auf der anderen Seite ist die Nachpflege ein großes Problem. Wer soll den täglichen Betrieb bezahlen? Die Gelder dafür kommen nicht aus dem Projektbudget. Und wenn die Nachpflege nicht gewährleistet werden kann, ist das Problem unter Umständen umsonst gewesen.

VII. NL-01: Deltares

A. Questionnaire

- 1) What role do coastal dunes play in your daily work?
- 2) The EU's Habitat Directive is of great importance for my study as it sets the same strict standards for both The Netherlands and Denmark

Drawing lessons from Denmark and the Netherlands for dynamic dune management on the island of Sylt (Germany)

- a) The Habitats directive calls for a good conservation status and requests priority habitats and species not to deteriorate in quality and quantity. How does that fit with protection of natural processes?
- b) How much leverage does the Habitat-Directive leave for interpretation? (See also the case for the Spaanjarde duin, it takes about 20 years until grey dunes are fully developed)
- 3) Nature Conservation
 - a) Which authorities are responsible at different levels (Staatsbosbeheer)?
 - b) What are the goals of nature conservation besides habitat and species preservation as stipulated by the Habitats Directive? (Cultural artefacts, typical, romanticised landscape)
 - c) Many dunes like the ones in the Kennemerland are important freshwater reservoirs. Would these dunes be managed in a different way if that was not the case?
- 4) The current strategy of dynamic preservation strives to integrate and maintain all functions of the coast? How are coastal protection and nature conservation conciliated and coordinated?
 - a) Which authority is responsible for what? How do they interact?
 - b) What are these goals?
 - c) Flood safety is of course of paramount importance. How is it guaranteed that the dunes fulfil the safety standards?
 - d) Are there conflicts between coastal protection and nature conservation? Landward directed aeolian transport and coastal protection versus the amounts of habitats
- 5) The decision for dynamic management in 1990.
 - a) Every change generates winners and losers. Was there exceptional fierce resistance against a more dynamic dune landscape?
 - b) Has the public perception of dunes changed since then? (What role play information as provided in the Duinen en mensen series?)
 - c) (In Denmark, the era of the Great Sandflugt is still very present. Do similar collective memories exist in The Netherlands?)

B. Interview Summary

This interview happened in two stages. First the interviewee explained the background, the practicalities and the development of the Dutch Mega-Nourishment “Sand Motor” at the coast of The Hague. Hereafter, a semi-structured interview was conducted; as some of the questions were already answered implicitly within the first part, these questions were not repeated once more.

As the interview happened directly at the shoreline at a rather windy day, no record of the interview was made.

The Sand Motor

The Sand Motor at Kijkduin in The Hague is a showcase of the changing coastal management strategies in The Netherlands in the course of the fourth quarter of the 20th century. During the storms surge of 1953, the North Sea heavily eroded what was then a single ridge of foredunes along the Delfland coast; eventually, the remaining width of the dune was just ca. 20 m. After this event, the dune field was strengthened at the landward side during the 1960-1980s. A second strengthening happened during the weak-link programme; then, coastal stretches with a high risk of flooding were strengthened. The dunes at Kijkduin received an additional ridge of foredunes towards the seaside, which also included a beach nourishment. Currently the more landward situated dunes in the hinterland are grazed with sheep and goats to counteract the shrub encroachment; one of the cleared areas are now covered with sea holly (*Eryngium maritimum*). Further, the top of the new foredunes are notched at some places.

The site is located at the fringe between the municipality of Westland and the municipality of The Hague. During the second half of the Holocene a transgressing system of beach barriers has extended the coastline between the Rhine-Meuse-Estuarines, before erosion has become the dominant process around 2000 a BP. For already centuries man has tried to counteract the erosion has been. It started by the end of the 18th century with 3 groins. In the following decades 65 more groins were built perpendicular to the existing shoreline. However, they were incapable of stopping the overall coastal retreat/coastal erosion. This was only achieved by coastal beach nourishments; currently, both beach and foreshore nourishment are done. Whereas this does not stop the actual erosion process, but it stops the coastal retreat. The eroded material constantly was re-distributed by long-shore transport, and some of the nourished material was transported by the prevailing SW winds into the dunes.

These basic processes of a wave-dominated sandy shoreline were over time (and with experience gained) integrated into a concept to replace the repeated single nourishments of about $1 \text{ million m}^3 \text{ a}^{-1}$ by one large sand nourishment of 20 million m^3 that then should last for 20 years, at this particular stretch of coastline. While this basic idea of a mega-nourishment was developed at amongst others Rijkswaterstaat and Deltares, the implementation of the Sand Motor is the result of a unique cooperation between the Province of Zuid-Holland and the National government (i.e. Rijkswaterstaat). The province was interested in additional recreational area, which is scarce at the coast of South-Holland. Furthermore rare pioneer habitats should be able to develop on the sandy spit. The entire project was to be developed in a particular way: by Building with Nature.

Furthermore, due to financial crises from 2008 on, Rijkswaterstaat was able to negotiate a very favourable contract for the execution. Whereas 5 to 7 € m^{-3} is a common price for beach nourishment, the costs per cubic metre were as low as 2.5 € m^{-3} . This reduced the nourishment costs to roughly 50 million Euro. The total 21.5 million m^3 have been nourished as a hooked spit in August 2011 with a lagoon where it is attached to the beach, as well as a small originally salt water lake within the heart of the Sand Motor. Furthermore, a large monitoring and research program has monitored the further development of the mega-nourishment in great detail.

The lake was also a concession made to the local drinking water company of Dunea. Behind the dunes, the company recovers large quantities of drinking water for the residents of the area. They demanded measures to prevent intrusion of saltwater into the aquifer. Additional measures were the installation of a row of wells within the first ridge of foredunes constantly pumping water out into sea to prevent salinization of the fresh water lens.

Since 2011, the morphology of the spit has changed greatly: given the prevailing south-westerly winds and the morphology of the nourishment most of the longshore transport has taken place in a northerly direction and connected the spit with the beach; behind the spit, an intertidal lagoon has developed. Only the gully connecting this sheltered lagoon with the North Sea meanders across the spit. An erosion scarp at the southwestern flank of the spit is testimony to that erosion. All over the spit you can also find clear indicators for both overwash processes like disk-shaped stones and aeolian transport, e.g. wind ripples, an accumulation of coarse grains and shell fragments at the surface or a layered texture consisting of different strata with different grain sizes. Thus, cross-shore transport happens, too. The start of vegetation growth and of the dunes also has been indicating, that a fresh-water lens has developed after two years. Nourishing the Sandmotor also changed the morphology of the foreshore from a rather steep profile to a more gently dipping slope providing various habitats for different and more molluscs.

So, has the Sandmotor been a success? Recent calculations estimate that it will take up to 40 years until the entire Sandmotor has been distributed along the coast, which means a longer project lifespan than previously suggested. However, there has been less dune formation on the spit itself, most likely because the aeolian transport was too strong/too high exposure to strong winds.

Although the project received great national and international attention, there are clear limits to its transferability. Such a mega-nourishment needs to be tailored to the local coastal conditions and requires large amounts of sediment.

Questions

The Habitats directive calls for a good conservation status and requests priority habitats and species not to deteriorate in quality and quantity. How does that fit with protection of natural processes?

So far, aeolian processes have posed a problem to conservation status of the habitats of the Grey Dunes and especially the wet dune slacks, as these habitats are depending on wind erosion, as they might otherwise suffer from vegetation encroachment. Instead, aeolian dynamics contribute to preserve these valuable habitats.

At the Sandmotor, rare pioneer dune habitats have been created outside of a Natura 2000 area; consequently the Habitat Directive and their management obligations do not apply to these dunes yet. The habitats could become protected in due course.

Which authorities are responsible for nature conservation at different levels?

In general, it is the duty of the landowner to maintain the ecological status of the area. This includes private landowners or leaseholder such as the foundation 'Zuid-Hollands Landschap', drinking water companies like Dunea as well as public landowners like Staatsbosbeheer. Their activities have to fit the guidelines of the Provincial authorities; they also sign out the 'Natura 2000' – areas and control the obedience to these rules.

What are the goals of nature conservation besides habitat and species preservation as stipulated by the Habitats Directive? (Cultural artefacts, typical, romanticised landscape)

The responsibility for archaeological artefacts lies within the municipalities, as does the responsibility for the preservation of the cultural landscape. The latter has been recently handed over from the national level to the municipalities. As the Sandmotor is dredged material, archaeology does not play a role. However sometimes archaeological artefacts are found that were dredged from the ca. 20-24 m deep North Sea floor, and were transported by ship onto the Sandmotor.

But the municipalities influence the natural habitats of the beach-dune system also indirectly, as can be explained by the example of the Sandmotor, which lies within the jurisdiction of the municipality of Westland. There, no beach cleanings are done, which allows the rare pioneer plant assemblages to develop along the nutrient-rich drift-lines. Along beach of The Hague this is impossible, as the beach is cleaned regularly.

The policy of dynamic preservation strives to maintain also the other coastal functions besides flood and erosion control. This means that several authorities are involved. How do these authorities cooperate?

The strategy of dynamic preservation contains both the preservation of the Coastal Baseline as of 1990 by sand nourishments and the renunciation of dune stabilisation measures, wherever possible. At some places the foredunes gained height rapidly at a rate of up to 0.75 m/a⁻¹. The foredunes at Kijkduin currently are approx. 6 m high and have been notched to increase the sediment transport to the hinterland.

There are mainly two authorities involved in the actual management. For the coastal protection sector, these are the Water Boards (Hoogheemschap). In the case of The Hague and Westland area, it is the Hoogheemraadschap van Delfland. They are responsible for the everyday care of the dunes, such as planting marram where necessary. Rijkswaterstaat is the executive authority of the Ministry for Infrastructure and Water Management and responsible for the overarching strategies that ensure safety.

At the coastal dunes, they usually work together with the landowners. They both share the opinion that aeolian sand transport behind the foredunes is beneficial; this keeps the habitat in shape and active, and no higher authority is needed to keep these two parties accountable. Furthermore, there exist no formal procedures about the treatment of coastal dunes, the single measures are negotiated between the parties. This is possible as although large volumes of sediment transport into the foredunes of up to 10 to 14 m³m⁻¹a⁻¹ can be achieved, aeolian transport happens that slow that measures can be thoroughly negotiated.

For many years the prevailing motto for the treatment of coastal dunes has been fixation. Was there resistance against a more dynamic dune landscape?

For more than 500 years, the focus was merely on dune fixation and stabilization. The public reactions on this paradigm shift were different. At the Holland Coast, in general the reactions were rather positive for two reasons: First, a dynamic dune landscape is perceived more visually attractive and aesthetic compared to stabilized dune ridges overgrown with marram grass or shrubs. Second, there is a high level of trust into the coastal protection authorities; thus the prevailing attitude was that the Waterboards and Rijkswaterstaat knew what they are doing. Further to the South, though, in the province of Zeeland, the people have been more reluctant about dynamic dunes, as they were hit hardest by the storm surge of 1953.

Besides the storm surge of 1953, do other collective memories concerning coastal dunes exist? In Denmark, the era of the Great Sandflugt is still very present.

There has been a phase of high aeolian activity in the Netherlands as well in the late Middle age. However, the memories about these phase do not play a major role any more. People do complain however, every time a new nourishment is placed on the coast; after 1,5-2 years complaints vanish (due to stabilisation of the nourishment surface: desert pavement formation, start of vegetation growth etc.).

VIII. NL-02: Duinonderzoek

A. Questionnaire

- 1) What are your tasks at Duinonderzoek?

- a) Many different forms of dynamic dune management have been tried in The Netherlands. Some worked, some did not.
 - b) Is there something like a current standard procedure in the foredunes?
 - c) And for inland dunes?
 - d) How are these related to the Habitat Directive?
 - e) How have these experiments been introduced? Who were important actors?
- 2) Dunes are important habitats according to the Habitats Directive
 - a) What habitats does the current management strategy focus on?
 - b) Besides the habitats, what are central elements of nature conservation in the Dutch dunes?
 - 3) The strategy of Dynamic Preservation was introduced in the 1990s. This was a major paradigm shift as dune stabilization was the paradigm for the 500 years before
 - a) How was this paradigm shift initiated?
 - b) Who took initiative?
 - 4) Every change generates winners and losers. Was there exceptional fierce resistance against a more dynamic dune landscape?
 - 5) (According to the Delta Programme): Dynamic dune management is balancing the needs of nature conservation and coastal protection (and touristic development).
 - a) How are these two spheres conciliated?
 - b) Are there currently conflicts observable?
 - c) How do you ensure that safety it is not at risk?
 - 6) Is there something you would consider as typically Dutch within the context of dune management?
- B. Summary

[00:05]: What are your tasks at Duinonderzoek?

Duinonderzoek mostly is engaged for advising, preparing plans and monitoring of dune dynamics for both foredune and inland dune managers. Whereas in the inland dunes, questions mostly relate to ecology and the Natura 2000 sites, foredune managers are more concerned with coastal protection. Nevertheless, also the foredunes have been increasingly managed as nature areas during the last 15 years. Often, the work includes the preparation, implementation and monitoring of dune destabilization plans from a geomorphological perspective.

Since the first large dynamic dune management project in the Amsterdam waterwork dunes has happened in 1995, dune managers have become increasingly interested in dynamic dunes. There, a drinking water extraction canal was no longer needed. It was filled, but it was decided not to plant the area. This marked a turning point in dune management. For centuries, coastal dunes have been exclusively stabilized to maintain flood safety and prevent burial of arable land and villages – which in turn was partially caused by humans by grazing, wood gathering or rabbit breeding. As a consequence, the dune systems tended to be very mobile. Eventually, large-scale stabilization efforts commenced at the end of the 18th century and resulted in a phase of increased stabilization until the 1990s. It was only then that a more dynamic management strategy was possible, because with beach nourishments the coastal retreat was stopped.

In the following years, dynamic dune management became increasingly popular for nature conservation as it increased biodiversity by re-establishing patches of bare sand, creating opportunities for pioneer species and destroying climax vegetation by sand burial. Entire mobile dunes also lead to the development of highly diverse wet dune slacks.

[07:10]: Probably, such a paradigm shift after almost 500 years has created much resistance?

Dynamic dune management still faces some resistance, but much less than in its early days in the 1990s. Then, especially the waterboards, who are responsible for sea-defence feared for the robustness of their dunes and about flood safety. During the following years, this resistance waned as it was recognized that it did not lead to decreased flood safety, but instead allows to broaden the foredunes.

The introduction of the Natura 2000 network also gave rise to dynamic dune management, because for the preservation of grey dune habitats, some aeolian activity is required. Within Europe, the Netherlands have large grey dune areas. These habitats are very sensitive to atmospheric nitrogen deposition, which leads to encroachment by grasses like *Carex spec.* or *Chalamagrostis spec.*, which

in turn threatens the rare, endangered species living there. So, dynamic dunes help to protect these species.

More recently, the regulations behind Natura 2000 created another incentive for dynamic dune management. Because the nitrogen immissions into the Natura 2000 areas should not increase any further, this sets limits to economic development around these areas. Consequently, the national government has launched the Programma Aanpak Stikstof (PAS). Nature managers receive substantial additional funding to counteract the effects of nitrogen deposition, in turn, economic development and increased nitrogen emissions are permitted close to particular Natura 2000 areas. Currently, most of the dune management activities taking place in the Dutch dunes is related to the PAS. However, recently the judge (Raad van state) decided that the PAS program should stop, because it is not clear if the measures to counteract negative effects of nitrogen deposition work well. Lots of plans for economic development are now stopped, because no further increase of nitrogen deposition is allowed. For the grey dunes, the creation of small and big blowouts and remobilized parabolic dunes or notched foredunes are common measures, because by these measures large areas profit of some gentle sand burial (sand spray).

[15:05]: What are standard procedures for remobilising dunes? Is it more about creating small scale dynamics with blowouts or about remobilising entire parabolic dunes?

The solution is related to the requirements of the particular case. When the goal is to preserve grey dunes, often small-scale measures like creating blowouts are chosen by removing the vegetation and the top-soil. In this case, careful after-treatment is required to remove obstacles like roots for probably 5 years to end up with a clear, flat and sandy surface. If a connection with the foredunes is possible (grey dunes close behind the foredunes) increasing aeolian dynamics in the foredunes is also a solution. In some places it is enough to let the foredunes develop freely, and not interfere with small scale blowout and notch development. However, the outcome of such a measure is still uncertain. Comparing numerous experiments on soil removal conducted during the last 25 years revealed different developments: Whereas all sandy areas laid out before 2005 tended to stabilise relatively fast, patches created after 2005 still are very active. Probably, this can be related to climatic influences. Before 2005, there has been a series of rather wet summers whereas after 2005, many springs remained rather dry like in 2018.

[18:55]: In the Netherlands both calcified and decalcified dunes exist. How do the soil properties influence the management strategy?

In the past, the decalcified dunes were much more mobile than the decalcified dunes, as vegetation growth is stronger limited on calcium-poor dunes. Today, this pattern has changed completely due to nitrogen input. Calcareous dune soils are capable of taking higher nitrogen loads compared to decalcified dune soils before deteriorating. Probably, this has to do with micro-biological activities in the underground, but the reasons are still not fully understood. During the last five to ten years nitrogen input decreased to levels which are below the critical values for calcareous dune soils, but still above the levels of decalcified dune soils. Consequently, spontaneous reactivation of the calcareous dunes can be observed; at many places, new blowouts emerged or existing got bigger. On the decalcified dunes, plant growth increased and a layer of litter developed, creating a very solid surface and dense vegetation cover.

[22:55]: The habitats directive takes a strong focus on species and habitats. What are other objectives or side goals of nature conservation in The Netherlands?

In some places other types of landscape and other vegetation patterns are also considered as very important. For instance, the remnants of the old 'Zeedorpen' resulted in a typical landscape which are also characterised by a distinct vegetation. Furthermore, at some places cultural-historic aspects that are also important, such as bunkers from the German occupation period or the 'stuifdijken' (sand-drift-dikes). These straight features have often been created in the late 19th century and are still valued by local people as e.g. their (grand-) parents were involved in building them. This leads to some conflicts as they basically hamper aeolian transport. And of course, recreation is a very important aspect for dune managers.

[27:15]: How are the goals of coastal protection and nature conservation reconciled in the foredunes? How do the agencies involved work together?

In many cases, the water boards do the nature management themselves. In other cases, nature managers – who, e.g. are responsible for the dunes behind the foredunes - often define plans for their area that include also the foredunes and then try to involve the water boards, which often do not actively participate but allow the measures to be executed as long as certain requirements are met

for safety reasons. This includes for instance, that the base level of a notch in the foredunes does not exceed a certain minimum height. Regardless whether the water boards, the municipality or private owners like 'Natuurmonumenten' own the dunes, the provision of flood defence by the coastal dunes must not be affected by any other use. Informal cooperating plays a large role and the willingness of the waterboards to participate varies.

[30:55]: When creating a notch in the foredunes, how is flood safety for the hinterland maintained?

Although, the notch might be perceived as a gap in the foredune, the base of the notch mostly remains high around 6 metres above mean sea-level, which ensures that also during severe storm surges, the sea does not enter the valley behind. In areas with low foredunes and a wet dune slack, often the area cannot be really flooded, as the level of the dune slack also often is rather high. Furthermore, many beaches are very high as a result of beach nourishment, which results in a dune foot level of four to five metres above sea-level. A washover, by contrast, intersects the entire dune down to beach level.

[35:00]: Beach and shoreface nourishments have reversed the character of many beaches from an eroding state into a progradating character. However, the effects on coastal dunes are different: At some places, they result in less dynamic foredunes, as a new foredune ridge emerges in front of the older and is trapping the sediment, whereas at other places, beach nourishment leads to increased dynamics in the existing foredunes. Are there new insights into the mechanisms steering these different developments?

It still is not completely clear. The results of nourishments still cannot be forecasted in detail. It is for sure that because of the nourishments, the sand budget of foredunes turned positive almost everywhere. At many places, embryonic dunes are much more present than 30 years ago. The response to nourishments also depends on the vegetation pattern. Within densely vegetated foredunes, it is hard to generate spontaneous erosional features. Also, the response depends on the total amount of sand supply. On Terschelling, for instance, a newly attached sandbar increased the amount of available sediment by such an amount, that the embryonic dunes cannot trap all the sediment transported by wind. Instead the sand simply overruns the embryonic dunes and causes disturbance in the foredunes.

[39:15]. Is there anything you would consider typically Dutch within Dutch dune management?

It might not be a unique Dutch feature, but at least in The Netherlands there is no example of place where nature is left on its own – maybe apart from the Oostvaardersplassen. Within their areas, nature managers always want to do something and would to have an entire palette of the ecosystems.

IX. NL-04: Delta Commission

A. Questionnaire

- 1) What have been your tasks as a programme Leader for the The Delta Sub-Programme on the coast
- 2) The Delta Sub-Programme on the coast?
 - a) What role play coastal dunes within the Delta Sub-Programme on the coast
 - b) The Delta Sub-Programme on the coast is a strategy to prepare the Dutch coastline for the effects of climate change. Are these strategy merely guidelines or are they legally binding?
 - c) The idea of dynamic dune management was already introduced in the 1990s, which I would consider a rather quick implementation of scientific insights. The same was true of central ideas for climate adaptation after Hurricane Katrina 2005. How do you do that?
 - d) Collaboration between different sectors is needed to achieve the multiple goals. Who takes initiative to begin and accompany this process?
 - e) How do power imbalances affect this process?
- 3) Dynamic coastal management is applied where the dunes are wide enough
 - a) Does dynamic dune management include only the acceptance of dynamics that have been created by natural processes or also the active stimulation of processes?
 - b) Allowing aeolian transport into the hinterland removes sand from the beach. I would think that this leads to the need for greater nourishment amounts. How are additional costs justified?
 - c) This attitude of giving room to natural processes appears to me not as a capitulation of nature, but as a sign of self-confidence and trust in the own abilities to keep control. Would you consider this attitude something typical for The Netherlands?

- 4) The value and image of dunes as a typical coastal landscape in The Netherlands:
 - a) What does the public image of coastal dunes look like in The Netherlands?
 - b) Is there a great public interest in coastal dunes?
 - c) Is the new dynamic character perceived as added value?
 - d) Has the idea of dynamic dunes evoked public resistance? How do you deal with that?
- B. Summary

[00:08]: As a starting point: What have been your tasks as a programme leader for the Delta Programme on the coast?

The Delta Programme started in 2010 with the goal of long-term climate adaptation. For that purpose a resilient coast is needed. The task of the programme and therefore of the programme leader was to bring together different organisations to alter the ways to manage the coast together and to align the daily management with the long-term needs of the coastal areas. The tasks of the Delta Commission is not to execute or implement any measure, this was task of the members.

[02:10]: Are these goals more guidelines the members could oblige to or are they binding in some way?

Safety is an important, overarching motivation. All parties agree on that the loss of life or property should be avoided. The parties work together on that goal and convert these goals into their own agenda for the next years. However, as the future is unsure, there is need for an adaptive strategy, binding goals are therefore impossible.

The Minister of infrastructure and water management brings the Delta Programme, its agenda and the budget of the Delta Fund to the Parliament. The Parliament can discuss, adjust and approve these proposals. Eventually, this leads to nation-wide implementation. The Delta Fund (which is funded with taxes) ensures that there is money available over several years.

[05:35]: So, the goals of the Delta Programme are mainly cooperation, collaboration and communication?

Besides this coordinating role, the Delta Commission works as an independent organisation with an own Delta Commissioner to make it less vulnerable for short-term changes of the political agenda. To maintain independence e.g. the Delta Commissioner is assigned every five years and not every four as are the national parliament and the government.

[07:28]: Was it the Delta Commission, who took initiative to start this process of cooperation?

The Delta Commission started this process of cooperation. What was helpful therein, was that the programme team consisted of members of the different organisations like the Ministry of Spatial Planning and Environment, the Ministry of Transport and Water Management, the provinces, municipalities, the water boards and Rijkswaterstaat.

The cooperation works quite well, the shared goal keep them committed. Especially the first Delta Report, which also included high-end scenarios and the impacts of hurricane Katrina in New Orleans in 2005 led to increased awareness. Besides, the economic and touristic state of the coast and thus the spatial quality of the coastal area should be improved by the Delta measures. These rather short-term benefits also keep the parties attracted to the programme. Besides, also Rijkswaterstaat tries to increasingly incorporate the interests of other stakeholders.

Still, the stakeholders have different interests. This also splits the power: E.g. Rijkswaterstaat is responsible for the management of the coastal zone, including beach replenishment and dune protection, while the provinces have to maintain the economic prosperity of the region. Developing strategies and visions that include win-win situations as well as the different timelines of the partners reflects the ambition of the Delta Commission to attract a great variety of stakeholders. Thus, explorative and more concrete visualisations of future landscapes play an important role.

[19:10]: Dynamic coastal management is applied where the dunes are wide enough. Allowing aeolian transport into the hinterland removes sand from the beach. I would think that this leads to the need for greater nourishment amounts. How are additional costs justified?

The Dutch practices of beach nourishment are so cost-effective that these losses can be compensated without too much additional effort. The reasons for that are sediment extraction sites, which are located in shallow waters close to the coast and the common practice of foreshore nourishment, which cheaper and more environmentally-friendly than beach management.

Meanwhile, dynamic dune management has established as a common practice, wherever it is possible. This includes the creation of artificial dunes on top of dikes and hard structures like sea-walls and revetments.

[22:50]: The idea of dynamic dune management was proposed scientifically in the 1970s and was introduced in the 1990s, which is a rather quick implementation of scientific insights. The same was true of central ideas for climate adaptation after Hurricane Katrina 2005. It seems as The Netherlands are comparably fast in implementing new ideas.

From the perspective of innovation management, a time of 20 years is indeed a good achievement. There might be several potential reasons supporting this process: First, since the *watersnoodramp* of 1953 the awareness for flood risk in The Netherlands is really high. Second, Rijkswaterstaat is a very powerful and important organisation, as it has the responsibility for protection of the entire national coastline. In the Netherlands the responsibility for coastal protection is not divided into several compartments like it is done, e.g. in France. Third, there exists a strong scientific knowledge-base. Research institutes like Deltares are involved and universities, such as the University of Delft or Wageningen University. Fourth, there is a long Dutch tradition of landscaping. For centuries, polders have been created and thereby shaped the landscape according to the needs of the human inhabitants.

[28:15]: Dynamic dune management allows more natural processes than before. Different than maybe in Germany, this attitude of giving room to natural processes appears to me not as a capitulation of nature, but as a sign of self-confidence and trust in the own abilities to keep control. Would you consider this attitude something typical for The Netherlands?

Additionally to that self-confidence, there is also a high awareness, that hard structures cause erosion and thus create new problems. Also evidence from the United States showed that problems are worse around the hard structures.

Around the Wadden islands the situation is somewhat different. There, Rijkswaterstaat is currently executing a large-scale experiment with nourishing the ebb-deltas

[33:00]: Has there been resistance against these new strategies?

As most people benefitted from the measures, real resistance against particular measures only occurred in a few places, however, there emerged some questions that had to be answered: One example is that it was not sure in the beginning whether the sediment reservoirs were big enough to proceed with the current strategy.

[35:25]: Dunes are a typical element of the Dutch landscape. What image do coastal dunes have?

Coastal dunes constitute a part of the Dutch culture, they are important for recreation and are highly frequented and used for cycling, biking and fishing. They really are a place to go by themselves, but of course they also provide access to the public beaches.

[38:20]: During the last centuries there have been periods of increased aeolian activities, where migrating dunes buried fields and settlements. Play memories to these former times still a role?

During the projects conducted for the Delta Commission along the mainland coast, the idea of more dynamic dunes did not evoke great resistance. However, this might be different on the islands.

X. SH-01: NSG Sylt

A. Questionnaire

- 1) Die NSG Sylt als Betreuungsverein auf Sylt
 - a) Was sind die Ziele der NSG Sylt für die Sylter Heidegebiete, die sie betreut?
 - b) Was sind die Aufgaben eines Betreuungsvereins? Wo liegen Grenzen?
 - c) Welche Rolle spielen Ehrenamtler im Naturschutz der NSG?
 - d) Was charakterisiert die NSG Sylt im Vergleich zu anderen Naturschutzvereinen auf Sylt?
- 2) Heideschutz auf Sylt
 - a) Die Einsätze zum Plaggen und Brennen erfolgen nach Angaben der Homepage in enger Zusammenarbeit mit dem LLUR und der UNB des Kreises Nordfriesland. Wer ergreift bei diesen Einsätzen die Initiative?
 - b) Welche Rolle spielen die Landeigentümer?

- 3) Der ökologische Zustand der Sylter Dünen wird seit Jahrzehnten nicht besser. Dünenstabilisierung führen zu beschleunigter Sukzession und Ausbreitung gebietsfremder Arten. Beides bedroht nach der FFH-Richtlinie bedrohte Arten
 - a) Welche Form des Naturschutzes brauchen die Sylter Dünen?
 - b) Diese Feststellungen sind nicht neu? Warum hat sich so lange nichts getan?
 - c) In Dänemark und den Niederlande werden Dünen stärker in das Tourismuskonzept mit eingebunden, dort gibt es Hinweisschilder, Infotafeln, etc. Auf Sylt findet sich kein Dünenlehrpfad. Warum ist das touristische Interesse an den Dünen so gering?
- 4) Einstellungen im Naturschutz:
 - a) Welche Philosophie oder welche Philosophien stehen hinter dem Naturschutz in den Sylter Dünen?
 - b) (Wenn man ältere Texte über die Sylter Dünen liest, liest man oft, dass es am besten sei, man überlasse die Dünen sich selbst und griffe nicht ein. (Gutachten aus den 60ern, Neuhaus 1995) Waren diese Wildnisgedanken tatsächlich vorherrschend und sind sie es immer noch?)
 - c) (In denselben Texten wurde auch die ästhetische Funktion der Sylter Dünenlandschaft hervorgehoben. Welche Rolle spielt diese Ansicht?)
 - d) Wie passt das mit der FFH-Richtlinie zusammen? Diese ist ja erstens sehr weitreichende Konsequenzen und zweitens einen starken Fokus auf Habitate und einzelne Arten.
 - e) In einigen Teilen Dänemarks, wie etwa dem Nationalpark Thy, sind Anwohner sehr skeptisch gegenüber einer dynamischen Dünenlandschaft? Der Große Sandflug mit seinen zerstörerischen Konsequenzen hat sich dort tief in das kollektive Gedächtnis eingegraben. Welche Rolle spielt das auf Sylt – es gibt ja kaum noch Einheimische auf Sylt?
 - f) Im Februar wurden Kreuzkrötentümpel auf Sylt vertieft. Was waren die öffentlichen Reaktionen darauf?
- 5) Kulturelles Erbe: Plaggen und Brennen sind zwei sehr traditionelle Methoden der Heidenutzung.
 - a) Erleichtert das die Akzeptanz von Naturschutzeinsätzen?
 - b) Wären die Geräte auch in Dünengebieten einsetzbar?
 - c) Werden Heideflächen auch beweidet? (Das wäre auch historisch, wo sind die Probleme auf Sylt?)
- 6) Einstellung zum Küstenschutz
 - a) Was ist die vorherrschende Mentalität der Bevölkerung, wenn es um Küstenschutz geht.
 - b) Jahrhundertlang wich die Sylter Küste zurück – bis in die 1980er. Wie gingen die Insulaner mit dem Küstenrückgang um? Was hat sich seit der Einführung der Basisküstenlinie verändert?
 - c) In Dänemark wird an Küstenabschnitten, an denen von einer zurückweichenden Küste in den nächsten Jahren keine Bedrohung für Bewohner und deren Eigentum ausgeht, der Küstenrückgang zugelassen. Diese Kriterien erfüllt zumindest das Sylter Listland. Ist diese Einstellung mit der Mentalität an der Nordseeküste vereinbar?
 - d) In den Niederlanden wird oft der Konsens zwischen verschiedenen Akteuren gesucht. Der Sandmotor ist ein paradigmatisches Beispiel dafür, wie versucht wird Küstenschutz, Tourismus und die Schaffung von Habitaten in einem Projekt zu vereinen. Gibt es Beispiele für eine ähnliche Zusammenarbeit auf Sylt? Weshalb nicht?
 - e) Außerdem gilt in den Niederlanden der neue Grundsatz, dass Küstendünen nicht mehr künstlich befestigt werden, wo immer das möglich ist. Ist so eine Regelung auf Sylt momentan denkbar?
- 7) Auch das dynamische Dünen-management in den Niederlanden begann mit Pilotprojekten.
 - a) Welche Konstellation von Akteuren bräuchte es, um ein solches Projekt zu initiieren?
 - b) Welche Rolle kann der LKN / Betreuungsverbände / LLUR dabei spielen? Dünen werden oft vor allem mit Küstenschutz assoziiert. Die Küstenschutzbehörde LKN spielt auf Sylt eine große Rolle. Wieviel Vertrauen genießt der LKN in der Sylter Bevölkerung?
 - c) Wer muss denn ersten Schritt tun? Lokale Initiativen mit neuen Ideen oder die externen übergeordneten Behörden (LLUR, LKN)?

B. Summary

[00:40]: Die Naturschutzgemeinschaft Sylt (NSG) betreut zwei Heidegebiete auf der Insel Sylt. Was sind denn die Ziele für die Gebiete?

Die NSG Sylt betreut seit den 70-er Jahre zwei Naturschutzgebiete auf Sylt: Die „Braderuper Heide“ und „Morsum Kliff“. Zu den Schutz- und Entwicklungsmaßnahmen, die seit den 80er-Jahren durchgeführt werden, gehören maschinelles Plaggen, Beweidung und Brennen. Die NSG initiierte den Aufbau einer Wanderschafherde; diese wird vom Land und den Gemeinden finanziert. Brennen ist oft komplizierter: Das Beantragen ist ein langwieriger Prozess und auch die passende Witterung - trockener Ostwind aus Osten – wird seltener. Brennen in der Brut- und Setzzeit wurde verworfen und die Rauchentwicklung beeinträchtigt den Tourismus. Im Vergleich zu Dänemark ist das Brennen in den Geestheiden schwieriger, da das Gebiet dichter besiedelt ist. In den Dünengebieten ist das unter Umständen anders.

[05:55]: Wie war die Resonanz auf die Vertiefung der feuchten Dünentäler zum Erhalt der Kreuzkröte (Bufo calamita) im Februar 2019?

Die Resonanz auf das Vertiefen der Dünentäler war durchaus positiv. Der Erfolg solcher Maßnahmen steht und fällt sicherlich mit der Qualität der Öffentlichkeitsarbeit.

Durch die Kombination aus Brennen, Plaggen und Beweiden sind die beiden Heidegebiete in einem guten Zustand. Diese Erfahrungen werden jetzt im „Heideprogramm 2.0“ auf weitere Sylter Geestheiden übertragen. Auf Sylt finden sich mehr als 50 % der Geestheideflächen, Schleswig-Holsteins. Das Programm wird über den Europäischen Landwirtschaftsfond (ELER) gefördert. Über einen Zeitraum von sieben Jahren sollen jedes Jahr sechs Hektar Heide erst entbuscht und dann geplaggt werden

[09:10]: Wäre maschinelles Plaggen auch in den Dünenheidebereichen machbar?

Klassischerweise unterscheidet man zwischen der Geestheide, einer reinen Kulturlandschaft, die seit Jahrzehnten nicht mehr genutzt wird und dementsprechend Pflege bedarf und der Küstenheide. Diese stellt eigentlich ein Endstadium der Vegetationsentwicklung dar; dementsprechend werden diese Heiden klassischerweise nicht gepflegt. Diese Annahme relativiert sich angesichts der zunehmenden Verbuschung.

Die fortschreitende Sukzession ließ die Dünentäler verlanden, die zudem auch seit Jahren immer mehr trockenfielen. Das führte auch zu einem Rückgang der Moosbeere (*Vaccinium oxycoccos*). Aus diesem Grund wurde seit zehn Jahren über eine Vertiefung der Täler nachgedacht, die jetzt durchgeführt wurde. Zwar haben die Kröten dieses Jahr dort gelaicht, allerdings sind auch die vertieften Täler seitdem trocken gefallen, sodass die Reproduktion dieses Jahr weitgehend ausfällt. Nichtsdestotrotz ist es eine erfolgsversprechende Maßnahme, und wird in den Niederlanden auch durchgeführt.

[14:50]: Die Beweidung dient der Nachpflege auf den Flächen?

Beweidung, Brennen und Plaggen als Möglichkeit, die klassische, unregelmäßige Heidenutzung nachzustellen. Dabei ist natürlich zu bedenken, das Plaggen sehr teuer ist, ein Hektar zu Plaggen kostet ca. 20.000 €. Brennen ist deutlich günstiger, während die Beweidung sogar einen kleinen Nutzen in Form des Fleisches erbringt.

[16:50]: Sind solche Schutz und Entwicklungsmaßnahmen in den Betreuungsverträgen festgeschrieben?

Die Durchführung von Schutz- und Entwicklungsmaßnahmen geht über die klassischen Pflichten eines Betreuungsvereins hinaus, aufgrund der Engagements der NSG ist der Zustand in den beiden Gebieten auch vergleichsweise gut ist. Der Betreuungsverein kann – etwa in den Betreuungsberichten - auf Maßnahmen oder auch EU-Projekte drängen, aber nicht entscheiden. Dabei sind ein langer Atem und direkte Kontakte wichtig. Generell gibt es eine Dreigliederung der Zuständigkeit. Das MELUND ist die oberste Behörde, das LLUR die obere und der in dem Fall der Kreis Nordfriesland die untere Naturschutzbehörde. Das Land ist für die Schutz- und Entwicklungsmaßnahmen zuständig und gibt das Geld, die Ausführung überwacht der Kreis, sodass die Verantwortung letztlich beim Land liegt.

[19:55]: Die Flächen gehören ja nicht dem Betreuungsverein, sondern den jeweiligen privaten oder öffentlichen Landeigentümern. Welche Rolle spielen die Landbesitzer bei den Maßnahmen?

Prinzipiell können Maßnahmen gegen den Willen der Landbesitzer durchgesetzt werden, das ist allerdings nur die Ultima Ratio. In der Regel werden die Landbesitzer mitgenommen. Bei der Überzeugungsarbeit hilft es, lokal verwurzelt zu sein. Die Heidepflege ist jedoch weithin akzeptiert und die Wanderschafherde ein touristisches Highlight. Diese Maßnahmen werden professionell durchgeführt, ausgeschrieben und an Firmen vergeben und vom Kreis in Zusammenarbeit mit dem Betreuungsverein begleitet.

[22:20]: Auch in den Dünenheiden wird eine zunehmende Verbuschung beobachtet. Welche Form des Naturschutzes bräuchten denn die Sylter Dünen?

Großer Handlungsbedarf besteht bei den Neophyten, die sich in vielen Dünengebieten ausbreiten. Für die Kartoffelrose, die auf Sylt am verbreitetsten ist, ist eine Ampellösung denkbar. Diese würde zwischen Roten Gebieten, in denen die Kartoffelrose so stark verbreitet ist, dass eine Bekämpfung aussichtslos erscheint und Gelben Gebieten unterscheiden, wo bislang einzelne Inseln mit Kartoffelrose existieren; dort könnte eine weitere Ausbreitung mit Beschnitt und Verbiss durch Weidetiere gestoppt oder zumindest gebremst werden. In grünen Gebiete, sind die Vorkommen so gering, dass man sie komplett frei von der Kartoffelrose halten könnte. Schwierig ist die Entfernung an Störstellen wie Bunkern.

Maschinen in die Dünen sind nach wie vor umstritten, nicht zuletzt, weil das Genehmigungsverfahren sehr aufwendig ist. Davon abgesehen wird einerseits ein großer Schaden an der Vegetation befürchtet. Andererseits, könnte die Entfernung der Vegetation oder der Maschineneinsatz erhöhte Dynamik als Nebeneffekt haben. Das wäre auch wünschenswert, da die Dünen auf Sylt eine lange Geschichte der gezielten Stabilisierung haben. Im Lauf der letzten 50 Jahre ging auch die touristische Nutzung der Dünen mehr und mehr zurück. Früher liefen Touristen von List quer durch die Dünen zum Weststrand, aber nach und nach wurden die zunehmenden Touristenströme immer mehr kanalisiert: Parkplätze wurden angelegt, befestigte Wege zum Strand ausgewiesen, Trampelpfade bepflanzt und das Betretungsverbot strikt durchgesetzt. Für Küstenschutz Zwecke wurden Dünen wohl auch gezielt aus der Luft gedüngt.

Langsam findet ein Umdenken statt und mehr dynamische Prozesse erscheinen wieder wünschenswert – auch aus Sicht des Schutzes für die Kreuzkröten, denn die Kröten brauchen die Pfade auf dem Weg zu den Laichgewässern. Es reicht also nicht, nur die Laichtümpel zu schaffen oder zu vertiefen.

[29:00]: Wer propagierte den Slogan „Dünenschutz ist Inselschutz“ in den letzten Jahrzehnten?

Die Einstellung „Dünenschutz ist Inselschutz“ stammt aus preußischer Zeit, in der die Dünen massiv genutzt oder sogar übernutzt wurden und in der die Insel noch im Jahr um einen Meter abbrach. Mit befestigten Dünen sollte dieser Prozess gebremst oder gestoppt werden. Dies gelang aber erst mit den Sandvorspülungen seit 1972. An vielen Stellen bilden sich vor dem Dünenkliff neue Dünen und der Ellenbogen wächst weiter nach Norden. Damals spielten die Dünen im Alltag eine größere Rolle, als Weide – auch für Gänse – oder als Spielplatz und standen für jedermann offen. Das lässt sich heute nicht mehr umsetzen, die Insel besuchen teilweise 250.000 Besucher auf einmal. Nichtsdestoweniger kappt das Betretungsverbot in den Dünen die Beziehung zwischen den Menschen, die auf der Insel leben und den Dünen. Dementsprechend sollte man die Dünenlandschaft wieder stärker öffentlich zugänglich machen und das nicht als exklusive Führung anbieten. Aus naturschutzfachlicher Sicht spricht nichts gegen Wege über die Wanderdüne; da brütet nichts, die Amphibien werden auch nicht gestört, und es fördert die Dynamik.

[34:20]: In Dänemark und den Niederlande werden Dünen stärker in das Tourismuskonzept mit eingebunden, dort gibt es Hinweisschilder, Infotafeln, etc. Auf Sylt findet sich kein Dünenlehrpfad. Ist das touristische Interesse an den Dünen auf Sylt geringer?

Die NSG ist mit Lehrpfaden und Informationstafeln sehr zurückhaltend uns setzt stattdessen mehr auf den direkten Kontakt und Führungen im Gebiet. Außerdem ist Sylt größer als z.B. die ostfriesischen Inseln und hat mehr Gäste. Im Lauf der Jahre wurden aus Kurgästen Touristen. Das Bild der Touristen auf Sylt prägt vor allem der Strand mit der Brandung und auch der Nationalpark Wattenmeer spielt eher eine untergeordnete Rolle. Die Werbeprospekte für den Tourismus illustrieren anschaulich, wie sich das Verhältnis zwischen Dünen und Touristen gewandelt hat: Bis in die 80er Jahre zeigten Werbebilder oft attraktive Damen IN den Dünen, danach verschwindet das Motiv. Seitdem sind die Dünen mehr eine Kulisse.

„Dünenschutz ist Inselschutz“ ist mit Sicherheit Teil der kollektiven Identität. Aber es zeichnet sich auch hier ein Wandel ab. Am Morsumkliff, beispielsweise, kam es früher häufig zu Konflikten zwischen traditioneller Nutzung wie dem Sammeln von Rauschbeeren und dem Naturschutz. Heute ist der Naturschutz akzeptiert und das Naturschutzgebiet ein Aushängeschild des Ortes. Das hängt sicher auch mit der Erschließung Morsums für den Tourismus zusammen.

[44:20]: In der Presse wird oft über den „Ausverkauf“ Sylts berichtet. Spielt es eine Rolle, dass es immer weniger Sylter gibt?

Der Mangel an bezahlbarem Wohnraum für Einheimische führt zu sozialen Problemen. Andererseits gibt es große Bemühungen der Gemeinden, neuen Wohnraum zu schaffen. Außerdem stellt sich die

Frage, wer eigentlich „Sylter“ ist? Menschen, die neu nach Sylt ziehen bringen jedenfalls ein anderes Verhältnis zu der Umgebungsnatur mit. Um der Inseljugend wieder einen Bezug zur Natur zu vermitteln, bietet die NSG deshalb drei Jugendgruppen an. Deren Programm ist eine Mischung aus Pfadfindern, Naturerlebnis und Inselerkundung. Außerdem gibt es eine Kooperation mit den Drittklässlern einer Westerbilder Grundschule, wo Kinder auch einmal in der Woche die Natur der Insel erkunden.

Dass das Betreten der Dünen so tabuisiert wurde, hängt auch mit den steigenden Touristenzahlen zusammen, sodass sich eine „Blockwart“-Mentalität herausbildet. Bleiben alle anderen auf den Wegen, verlässt man selbst den Weg auch nicht. Auch weisen Gäste andere Gäste bei Verletzung dieser Regel zurecht.

[53:15]: In Dänemark wird an Küstenabschnitten, an denen von einer zurückweichenden Küste in den nächsten Jahren keine Bedrohung für Bewohner und deren Eigentum ausgeht, der Küstenrückgang zugelassen. Diese Kriterien erfüllt zumindest das Sylter Listland. Ist diese Einstellung mit der Mentalität an der Nordseeküste vereinbar?

Am Morsumkliff lässt man das Kliff erodieren und zurückweichen. Am Weststrand hingegen wäre es wohl möglich, weiter vorzuspülen und gleichzeitig die Dünen weniger stark zu befestigen oder sogar zurückweichen zu lassen. Es käme im Endeffekt zu keinem Landverlust. Nicht mehr vorzuspülen ist dagegen hypothetisch, weil sich die Vorspülungen seit den 80er Jahren stark etabliert haben. Ein Wegfall der Dünenbefestigung an einigen Stellen sorgte gewiss für Widerstand. Ob dem mit sachlichen Argumenten beizukommen ist, erscheint ungewiss, denn oftmals hat der Meinungswandel in der Generation der Entscheidungsträger (noch) nicht stattgefunden. Solche Maßnahmen wurden bislang aber noch nicht öffentlich diskutiert.

[59:30]: In den Niederlanden greift der Mensch oft wesentlich gestaltender in die natürlichen Prozesse ein, um ein gewünschten Zustand zu erreichen. Passt diese Einstellung nach Sylt?

Da kommt der Nationalparkstatus des Wattenmeers ins Spiel, denn dort sind Eingriffe prinzipiell tabu. Zum Beispiel wurde der Sand für die ersten Vorspülungen aus dem Rückseitenwatt beim Nössedeich entnommen. Auf diesen Inseln brüteten jahrelang zahlreiche Vögel, bis der Fuchs kam. Auf dem Norderoogsand bildet sich zwar gerade eine neue Insel, aber mit dem Aufspülen eigener Brutinseln täte man sich schwer. Bereits die Fahrinnenvertiefung zwischen Föhr und Dagebüll weckt Diskussionen. Im Beltringharder Speicherkoog wurde es praktiziert und auch im Rantumbecken wird es überlegt. Aber auch der Nationalparkstatus wird im Lauf der Zeit anders interpretiert. Mittlerweile ist zum Beispiel der Abschuss von Füchsen leichter geworden.

[1:05:00]: Wenn man ein Pilotprojekt starten wollte. Wer muss denn ersten Schritt tun? Lokale Initiativen mit neuen Ideen oder die externen übergeordneten Behörden wie das LLUR oder der LKN?

Bisher lag der Fokus im Naturschutz auf den Geestheiden. Für die Dünen braucht es zuallererst eine klare Zielsetzung, was der Naturschutz erreichen möchte. Die Ausbreitung der invasiven Arten und die Verbuschung werden seit Jahren dokumentiert, allerdings wird oft der Aufwand gescheut, die Kartoffelrose und andere Arten anzugehen, da die Entfernung sehr aufwendig ist. *Rosa rugosa* muss man an den meisten Stellen wohl akzeptieren, denn die Bekämpfung auf ganzer Fläche ist zu aufwendig und das Kaktusmoos ist wohl noch schwerer zu entfernen. Dazu fehlen bislang aber auch Ideen.

Als weitere Ziele des Naturschutzes bleiben noch die Botanik der Dünen, insbesondere der feuchten Dünentäler, Insekten und Amphibien. Brutvögel gibt es fast keine mehr. Lediglich ein paar Lerchen und Wiesenpieper einige Eiderenten und Brandgänse brüten noch in den Dünen, allerdings keine Steinschmätzer mehr. In der Diskussion für den FFH-Managementplan, der aktuell für das Listland geschrieben wird, spielt die Schafbeweidung eine Rolle.

[01:12:25]: Die Probleme kamen ja nicht über Nacht. Wie blieben sie so lange unbemerkt?

Die Sukzession und Verbuschung der Dünen war ein schleichender Prozess, ebenso die langsame, aber stetige Stabilisierung der Wanderdünen. Außerdem beginnen der Paradigmenwechsel im Naturschutz und die Diskussion um einen neuen Naturschutz in den Dünen erst langsam, wie langwierige Debatte um die Laichgewässer für Kreuzkröten zeigt. Dort wird gewissermaßen erstmals vom Prinzip der Käseglocke beim Naturschutz in den Dünen abgewichen. Dieser Prozess geschieht langsam.

[01:20:15]: Was charakterisiert denn die NSG im Vergleich zu den anderen Betreuungsvereinen?

Die NSG betreut mit Absicht nur diese beiden Gebiete auf Sylt, um so eine optimale Betreuung dieser beiden Gebiete zu gewährleisten. Weiterhin ist der Verein in der Jugendarbeit und der Besucherinformation sehr aktiv und bietet Informationen zu vielen, auch überregionalen Naturschutzthemen an und möchte Debatten anstoßen.

XI. SH-02: AWI Sylt

A. Questionnaire

- 1) Wahrnehmung der Küstendünen: Die historische Perspektive beschreibt die Beziehung zwischen den Menschen und den Dünen auf Sylt als ein durchtrenntes Band; Dünen seien zur Kulisse für Badetourismus degradiert worden?
 - a) Welches Bild müssten Insulaner wie Touristen von den Dünen stattdessen erhalten?
 - b) Was bräuchte es außer dem ersten deutschen Küstendünenbuch seit über 100 Jahren, um ein neues Dünenbild zu initiieren?
 - c) Wer hat den Slogan „Dünenschutz ist Inselschutz“ nach dem Zweiten Weltkrieg propagiert?
- 2) Küstenschutz-Mentalitäten: gerade in den Vordünen ist Schutz vor Überflutung das oberste Ziel
 - a) Was ist die vorherrschende Mentalität der Bevölkerung, wenn es um Küstenschutz geht?
 - b) Jahrhundertlang wich die Sylter Küste zurück – bis in die 1980er. Wie gingen die Insulaner mit dem Küstenrückgang um? Was hat die Einführung der Basisküstenlinie geändert?
 - c) Wenn man Dänemark, Deutschland und die Niederlande im Vergleich betrachtet: Gibt es wesentliche Unterschiede in der Küstenschutzmentalität? (Deutschland: Hauptsache, nix bewegt sich nirgends; Dänemark: auf Effizienz bedacht: wo lohnt sich Küstenschutz?; Niederlande: Alles ist möglich)
 - d) In Dänemark und den Niederlanden sieht Küstenschutz in den Dünen anders aus; was passte eher zu Sylt?
 - i) In Dänemark wird an Küstenabschnitten, an denen von einer zurückweichenden Küste in den nächsten Jahren keine Bedrohung für Bewohner und deren Eigentum ausgeht, der Küstenrückgang zugelassen. Diese Kriterien erfüllt zumindest das Sylter Listland. Ist diese Einstellung mit der Mentalität an der Nordseeküste vereinbar?
 - ii) Im Vergleich gilt in den Niederlanden der neue Grundsatz, dass trotz der Basisküstenlinie Küstendünen nicht mehr künstlich befestigt werden, wo immer das möglich ist. Ist so eine Regelung auf Sylt momentan denkbar?
- 3) Building with nature: In den Niederlanden wird oft der Konsens zwischen verschiedenen Akteuren gesucht. Der Sandmotor ist ein paradigmatisches Beispiel dafür, wie versucht wird Küstenschutz, Tourismus und die Schaffung von Habitaten in einem Projekt zu vereinen.
 - a) Der Sandpuffer bei List stellt ein Pilotprojekt für Building with nature auf Sylt dar. Wie kam dieses-bislang einzigartige – Projekt zustande?
 - b) Wer hat die Initiative ergriffen?
 - c) Warum ist es bislang dabei geblieben?
- 4) Pilotprojekte:
 - a) Welcher Akteur ist am ehesten in der Lage, einen Versuch für ein dynamischeres Management anzustoßen?
 - b) Welche Rolle kann der LKN / Betreuungsverbände / LLUR dabei spielen? Dünen werden oft vor allem mit Küstenschutz assoziiert. Die Küstenschutzbehörde LKN spielt auf Sylt eine große Rolle. Wieviel Vertrauen genießt der LKN in der Sylter Bevölkerung?
 - c) Wer muss denn ersten Schritt tun? Lokale Initiativen mit neuen Ideen oder die externen übergeordneten Behörden (LLUR, LKN)?
 - d) Gibt es Pläne für die Nutzung der Schießanlage nach 2019?

B. Summary

Zur Vorbereitung auf dieses Interview fasste der Interviewpartner das historische Zusammenspiel von Mensch und Dünenlandschaft auf Sylt zusammen. Die wichtigsten Punkte werden hier skizziert.

Bis ins 19. Jahrhundert lebten Menschen von und mit den Dünen, indem sie Vieh weideten und Strandhafer verwendeten, Überbeanspruchung initiierte und unterstützte die Bildung von Wanderdünen, Auf ihrem Weg über den Nehrungshaken begruben sie auch Felder und Häuser.

Diese Verbindung zwischen den lokalen Dorfbewohnern und „ihren Dünen“ wurde ab Mitte des 19. Jahrhunderts schrittweise abgebaut. Die neuen preußischen Herrscher leiteten diesen Prozess ein Sie schränkten die traditionelle Nutzung der Dünenlandschaft ein und unternahmen große Anstrengungen, um die Dünen zu stabilisieren und den Küstenrückzug zu stoppen. Später wurden Dünen befestigt, um die neu gebaute militärische Infrastruktur wie Straßen, Bunker und Kasernen, die bis zum Zweiten Weltkrieg auf der ganzen Insel errichtet wurden, zu schützen. Menschen wurden aus den Dünen verbannt, um Schäden an den Plantagen zu verhindern. Ebenfalls ab dem 19. Jahrhundert ersetzte der aufstrebende Tourismussektor zunehmend die traditionelle Nutzung der Dünen. Die ersten Touristen bewunderten die landschaftlich reizvolle, romantische und damals noch hochdynamische Dünenlandschaft, die letztlich als Naturschutzgebiet geschützt wurde. Auch der Naturschutz zielte darauf ab, Menschen aus den Dünen herauszuhalten, um die Natur nicht zu schädigen. Als die Besucherzahlen in den 1960er und 1970er Jahren stiegen, wurde der freie Zugang zu den Dünen endgültig beendet und die Touristenströme über Parkplätze und ausgeschilderte Wege gelenkt.

Keine Menschen in den Dünen bedeuten jedoch auch weniger Störung und fortschreitender Sukzession. Es bedeutet aber auch, dass die alten, traditionellen Verbindungen zwischen Mensch und Dünen, d.h. die Betrachtungsweisen der Dünen, auf Sylt gekappt wurden. Bisher ist kein erfolgreiches Nachfolge-Paradigma in Sicht.

[00:40]: Wenn die alte Verbindung zwischen Mensch und Düne gekappt wurde – wie müsste ein neues Image der Dünen aussehen?

Auf Sylt müsste man wieder Stolz auf die eigenen Dünen entwickeln. Auf Vlieland, in den Niederlanden, zum Vergleich, ist man sich der Tatsache bewusst, darauf, mit 45 m die höchste Düne im Wattenmeer zu haben. Der besondere Charakter der Sylter Dünenlandschaft ist vielen Menschen unbekannt oder egal.

Im Gegenzug ist die starre Küstenschutzansicht „Dünenschutz ist Inselschutz“ in den Köpfen der Sylter tief verankert. Dieses Betretungsverbot wird auch nicht infrage gestellt; die öffentliche Empörung über Verstöße ist stets groß.

Dabei gibt es Unterschiede zwischen der einheimischen Bevölkerung und den Gästen; einheimische Sylter lassen es sich oft nicht nehmen, mit ihren Hunden durch die Dünen zu gehen. Die Tradition des Beerensammelns in den Dünen lässt sich hingegen nur noch selten beobachten, ebenso Kinder, die wie früher in den Dünen spielen und toben. Letzteres mag auch mit einer generellen Naturentfremdung zu tun haben.

[05:30]: Wie ist dieses Betretungsverbot geregelt?

Die Naturschutzgesetze sehen vor, dass Naturschutzgebiete nur auf ausgewiesenen Wegen betreten werden. Davon gibt es durch das Listland allerdings nur einen einzigen und nur das „Erlebniszentrum Naturgewalten“ hat ein Kontingent für Führungen auf den Trampelpfaden.

Zurück zur Ausgangsfrage: Die neue Wertschätzung für die Dünen müssten die auf Sylt ansässigen Naturschutzvereine aktiv verbreiten, zum Beispiel könnte es mehr Führungen geben. Bislang war das Interesse an diesen Führungen eher verhalten. Das wiederum liegt an dem Betretungsverbot, auf das in den letzten Jahrzehnten verstärkt hingewiesen wurde und das weitgehend akzeptiert wurde. Um den Gästen ein Vorbild zu sein, hielten sich auch viele Sylter an diese Regelung. Auch dadurch ist diese Verbindung wohl gerissen.

[13:25]: Auf Sylt findet auf Grund der steigenden Grundstückspreise ein Wandel statt, so dass viele Menschen, die auf der Insel arbeiten, ans Festland ziehen und dafür mehr Ferienhäuser entstehen. Welche Rolle spielt dieser Wandel der Bevölkerung?

Zugezogene Menschen können natürlich nicht mehr die Beziehung zu den Dünen entwickeln, wie sie alteingesessene Sylter haben. Andererseits kann man mittlerweile nur noch schwer zwischen Alteingesessenen, vor langer Zeit zugezogenen und langjährigen Stammgästen unterscheiden. Diese Gruppen oder diese Gruppe, müsste man zunächst erreichen. Dafür braucht es mehr als die

Informationen, die bisher auf Dünen- oder auch Ortsführungen gegeben werden. Stattdessen bedarf es einer konzertierten Kampagne, die bewusst ein anderes, dynamischeres Bild der Dünen vermitteln will. In vielen Führungen überwiegt noch die starre Küstenschutzansicht.

Um dieses Denken aufzubrechen, müssten sich die drei Vereine auf Sylt zusammenschließen, und ein neues, gemeinsames Bild der Dünen entwerfen. Dieses Bild müsste in einer konzertierten Kampagne in Büchern, Vorträgen und vor allem geführten Wanderungen publik gemacht werden. Für eine Buchserie könnte die niederländische Reihe „Duinen en mensen“ Pate stehen. Erreichen kann man damit wohl zunächst nur die neuen Gäste; denen müsste man vermitteln, dass die Teilnahme an einer geführten Dünenwanderung genauso selbstverständlich wird, wie die Teilnahme an geführten Wattwanderungen. Über diese Gäste könnte man die notorisch schwer zu erreichenden Sylter Gastgeber erreichen, die dann wiederum auch ihre Stammgäste darauf ansprechen.

[19:50]: Das heißt, die Akteure, die solch einen Prozess initiieren, sind vor allem die Vereine und weniger die Naturschutzbehörden in Flintbek oder Husum?

Diesen Prozess können die Vereine natürlich nicht alleine stemmen, es braucht die Unterstützung der öffentlichen Hand – allein schon, damit ein solches Buch über Dünen mit einem Preis von circa 20 Euro erschwinglich bleibt. Zum Selbstkostenpreis ist so ein Buch unverkäuflich. In so eine Serie könnten die anderen Dünengebiete an der Westküste auch gleich mit aufgenommen werden. Insgesamt bräuchte so eine Kampagne die Unterstützung aller behördlichen Ebenen bis hinauf ins Umweltministerium.

Trotzdem sind auf Sylt nur die Betreuungsvereine mit ihren Freiwilligendienstlern in der Lage, so eine Kampagne zu verbreiten. Diese müssten für diese neue Aufgabe natürlich entsprechend geschult werden.

[22:50]: Auf Terschelling in den Niederlanden wurden Dünen im großen Stil „wiederbelebt“. Diese dynamische Dünenlandschaft gefällt den Touristen dort sehr. Könnte man solche Versuchsprojekte einer dynamischen Dünenlandschaft gewissermaßen als Katalysator nutzen?

Zu Beginn des 20. Jahrhunderts hatte die Künstlerszene – insbesondere die Landschaftsmalerei – auf Sylt großen Einfluss auf die Unterschutzstellung der Dünen. Diesen Einfluss hat sie heute nicht mehr, aber dennoch kann die künstlerische Auseinandersetzung mit der Dünenlandschaft durchaus an diesem Wandel mitwirken. Die Naturschützer alleine können einen solchen Imagewandel nicht herbeiführen. Auf Langeoog finden zum Beispiel Malkurse in den Dünen statt und an solchen Kursen besteht auch Bedarf. Natürlich bräuchten diese Kurse dafür eine Genehmigung, die Dünen zu betreten.

Auch das Schriftstellerische könnte genutzt werden. Der Sylter Chronist C.P. Hansen aus dem 19. Jahrhundert hat einen großen Schatz an Sagen, Märchen und Beschreibungen der früheren Dünennutzungen geschaffen. Die Dünen nehmen in seinen Geschichten eine sehr prominente Stellung ein.

Dünenführungen, die die neuen Aufgaben des Naturschutzes thematisiert werden, müssen selbstverständlich die verbliebenen Stellen in den Sylter Dünen besuchen, an denen sich Windrisse, overwashes, etc.- befinden. Auf Amrum lässt sich beobachten, wie die Gäste diese ungewohnte Umgebung eines overwashes sehr genießen, auch wenn das Gehen im weichen Sand sehr mühsam ist. Generell kann man sich die für die touristische Erschließung z.B. der Listland-Dünen einiges von Amrum anschauen: Dort ist die Dünenlandschaft mit Holzbohlenwegen erschlossen und es werden archäologische Artefakte und Aussichtspunkte auf dem langen Weg durch die Dünen zum Strand integriert. Die dortigen Holzbohlenwege haben sich dort anscheinend als beste Lösung erwiesen. Denn natürlich kann man mit den derzeitigen Touristenzahlen auf Sylt das Wegegebot nicht mehr aufheben. Geführte Wanderungen in die Dünen stellen – ähnlich wie bei den geführten Wattwanderungen in das eigentlich gesperrte Wattgebiet – keinen zu großen Eingriff in die Ökosysteme dar – es käme nur zu geringem Vertritt. Man könnte auch zwischen den einzelnen Strandübergängen quer Wanderwege oder Bohlenwege anlegen. Es gab auch kurzzeitig Wanderungen von der Listlandstraße auf Trampelpfaden zur Wanderdüne.

[30:45]: Wer ist eigentlich für das Erteilen solcher Ausnahmegenehmigungen für das Betreten der Naturschutzgebiete zuständig?

Die formelle Genehmigung erteilt die Untere Naturschutzbehörde (UNB) in Husum, allerdings gegebenenfalls in Absprache mit den Landeigentümern. Die UNB müsste solchen Führungen dann auch ihren Segen erteilen.

[33:19]: Jahrhundertlang wich die Sylter Küste zurück – bis in den 1980ern die Sandvorspülungen den Küstenrückgang beendeten. Hat sich das Verhältnis der Sylter zum Küstenschutz seitdem geändert?

Dass die Sandvorspülungen den Küstenrückgang gestoppt haben, hat kein Umdenken bei den Küstenschützern einsetzen lassen. Dünenbepflanzungen werden immer noch als notwendig angesehen. An einigen Stellen könnte man sich dynamische Dünen eigentlich leisten. In den 1970er Jahren setzten sich die deutschen Wasserbauer erstmals mit den niederländischen Kollegen in Verbindung, um zum Beispiel über die Integration des Naturschutzes in den Schutz der Marschenküste zu lernen. Dieser Prozess ist für die Dünen überfällig, steht aber bislang noch aus.

Das Ministerium könnte Dienstreisen der zuständigen LKN-Mitarbeiter in die Niederlande anordnen, um mit diesen Konzepten vertraut zu werden. In einer hierarchisch strukturierten Behörde braucht es dafür die Anordnung von oben.

[37:15]: An der jütländischen Westküste (Dänemark) wird an Küstenabschnitten, an denen von einer zurückweichenden Küste in den nächsten Jahren keine Bedrohung für Bewohner und deren Eigentum ausgeht, der Küstenrückgang zugelassen. Diese Kriterien erfüllt zumindest das Sylter Listland. Ist diese Einstellung, dass man die Basisküstenlinie an einigen Stellen aufgibt, mit der Mentalität an der deutschen Nordseeküste vereinbar?

Eine Aufgabe der Basisküstenlinie käme einer 180°-Kehrtwende im Küstenschutz gleich. Eine solche Entscheidung kann nur das Umweltministerium treffen. Das Ministerium wird jedoch nichts gegen den entschiedenen Willen der Sylter Lokalpolitik entscheiden. Was es jedoch machen könnte, wäre einen Diskurs über zukünftigen Küstenschutz zu eröffnen und auch finanzielle Anreize zu setzen. Solche Vorschläge werden nicht aus der Lokalpolitik oder dem Landschaftszweckverband kommen. Das gilt auch für die Anlage eines neuen Wegenetzes, auch dieses müsste wahrscheinlich stark bezuschusst werden – sei es nun aus Mitteln des Landes oder der EU. Auch EU Fördergelder müsste man für ein solches Projekt anzapfen können.

Das Listland zwischen Strandhalle und Klappholttal wäre für Versuche in diese Richtung prädestiniert, da es dort kaum Infrastruktur gibt. Eine Gefährdung der Listlandstraße durch den Meeresspiegelanstieg ist zurzeit nicht abzusehen und das einzige Gebäude in der Randdüne ist das Holzgebäude der Strandsauna und das sollte transportabel sein. Auch die Lister Strandhalle lässt sich versetzen.

[52:45]: Im Vergleich gilt in den Niederlanden der neue Grundsatz, dass trotz der Basisküstenlinie Küstendünen nicht mehr künstlich befestigt werden, wo immer das möglich ist. Ist so eine Regelung auf Sylt momentan denkbar?

Das wäre wohl eine der ersten Maßnahmen des Küstenschutzes. Konkret hieße das, dass man auf den aufwendigen und teuren biotechnischen Küstenschutz an den meisten Stellen verzichten könnte und nur noch in den Ortslagen von Westerland, Wenningstedt, Rantum und Hörnum biotechnischen Küstenschutz betreiben müsste. Auch vor dem Roten Kliff wird auf man den Vordünengürtel nicht verzichten wollen. Insgesamt könnte man dadurch die Randdüne verstärken, was die genauen Effekte sind, kann man allerdings nicht voraussagen.

Es wäre auch möglich, diesen Ansatz mit der niederländischen Praxis der Vorstrandvorspülungen zu kombinieren. Vorstrandvorspülungen finden zurzeit in Hörnum-Nord statt, vor dem Listland bisher noch nicht. Kombinierte man Vorstrandvorspülungen mit dynamischem Dünenmanagement, könnte man sehen, was in der Randdüne passierte. Es bestünde kein Risiko, im Falle, dass es dort zu großen Overwash-prozessen kommt, könnte man die Düne wieder zuschieben – sollte das notwendig werden.

Südlich des Klappholttals werden zurzeit die Kiefern aufwendig entfernt. Diese Landschaftsveränderung stößt im Übrigen bei einigen auch auf Kritik. Solche Eingriffe müssen dementsprechend auch gut kommuniziert werden; das wurde in diesem Fall versäumt.

Dort ergäbe sich ein alternatives Experimentierfeld. Wehte in diesem Abschnitt der Wind mehr Sand ins Hinterland könnte das auch Naturschutzmaßnahmen wie die Entfernung der Kiefern zurzeit im Klappholttal überflüssig machen, da diese einfach zusandeten. Dort grenzt der Kiefernbewuchs bis an den Randdünenwall. Dort könnte man auch durch kräftige Sandvorspülungen eine neue Generation Wanderdünen auslösen. Natürlich würde das mehrere Jahrhunderte dauern, bis die Kiefern überwandert wären.

[01:00:35]: Welche Rolle spielt der Landschaftsschutz bei solchen Projekten?

Die Wertschätzung der offenen Heidelandschaft entstand parallel zu groß angelegten Projekten zur Urbarmachung der Heide im 19. Jahrhundert, als Menschen aus Süddeutschland angesiedelt wurden, um mühsam die Heide in Ackerboden zu verwandeln. Auch wurden damals viele Sandflächen mit Kiefer aufgeforstet, um die Flächen wenigstens für Forstwirtschaft zu nutzen. Literatur und Landschaftsmalerei rückten diese Landschaft auf dem Rückzug ins öffentliche Bewusstsein.

Und heute geraten diese Gebiete aus Sicht des Naturschutzes wieder ins Blickfeld, da sie ein Rückzugsort für viele wärmeliebenden Arten auf nährstoffarmen Böden sind, für die in der industrialisierten Landwirtschaft kein Platz mehr ist. Und auch die Forstwirtschaft lohnt sich an diesen Stellen nicht mehr.

Die Baumpflanzungen in die Heidegebiete auf Amrum sorgten damals auch für großen Unmut unter Pflanzensoziologen, die argumentierten, dass es sich bei dieser Heide um natürlich vorkommende Küstenheide handele und nicht um eine Kulturlandschaft.

[01:08:50]: Building with nature: In den Niederlanden wird oft der Konsens zwischen verschiedenen Akteuren gesucht. Der Sandmotor ist ein paradigmatisches Beispiel dafür, wie versucht wird Küstenschutz, Tourismus und die Schaffung von Habitaten in einem Projekt zu vereinen. Die Sandvorspülung und der mit Sand bedeckte Deich vor dem Alfred-Wegener-Institut (AWI) List stellt ein Pilotprojekt für „Building with nature“ auf Sylt dar. Wie kam dieses-bislang einzigartige – Projekt zustande?

Als Schutz für ihre Anlagen hatte die Reichswehr-Luftwaffe eine Ufermauer errichtet, die in den 1990er Jahren zusehends zerfiel und die Anfang der 2000er Jahre umfangreich saniert wurde. Dadurch kam es zur Lee-Erosion nördlich davon am Gelände des AWI und die Uferschutzmauer sollte bis zum Mövenbergdeich verlängert werden. Das AWI bestand jedoch auf einem natürlichen Übergang zum Meer für Forschung und Lehre. Über die Frage, wie der Küstenschutz an dieser Stelle aussehen sollte, entbrannte Streit. Der Konflikt konnte am Ende durch persönliche Kontakte informell beendet werden. Es handelt sich aber bei der Sanddecke über dem Deich offiziell um ein Sanddepot, das heißt eine taktische Sandreserve für den Küstenschutz.

Diese künstliche Düne als weiches Ufer stellt somit einen Kompromiss zwischen Küstenschutz und Naturschutz dar. Seit dieser Maßnahme ist das Argument für naturnahen Küstenschutz schwieriger abzuweisen und so wurde die verstärkte Ufermauer bei der Siedlung „Sonnenland“ mit dem Sand von der Baugrube des „Landserhofs“ in List bedeckt, um das Deckwerk besser in die Landschaft zu integrieren. Demnächst sind Ufersicherungsmaßnahmen vor der Vogelkoje Kampen notwendig und auch dort ist ein weicher Küstenschutz mittels einer aufgespülten Sandnehrung denkbar. Künstliche Sandnehrungen sind generell eine landschaftsfreundliche Alternative zum Lahnungsbau. Mit ihnen ließen sich auch win-win Situationen erreichen, da sie neben Ufersicherung auch Habitate für Brutvögel sind. Und da dafür auch Nordseesand verwendet würde, ist dann der Übergang zur Dünengestaltung fließend. Das heißt aber nicht zwingend, dass auf Sylt ein Konzept aus den Niederlanden übernommen wird. Es ist wohl eher eine Parallelentwicklung. Das Motto *Building with Nature* hat es wohl auch noch nicht ins Deutsche geschafft.

Es gibt auch südlich von Rantum Bereiche, wo man natürliche Dünenentwicklung zulassen könnte. Für die Generierung einer Wanderdüne ist der Nehrungshaken dort wohl allerdings zu schmal. Das wäre eher im Listland oder vom Klappholtal bis Buhne 16 möglich.

[01:25:25]: In den Niederlanden scheut man beim Dünenmanagement auch nicht vor großen Eingriffen in die Landschaft zurück. Auf Terschelling wurde der Strandhafer zum Beispiel von der Randdüne gemäht. Ist dieser Ansatz mit dem Naturschutz im Nationalpark Wattenmeer vereinbar?

Auch in den Niederlanden sind beide Ansichten vorhanden. Seit ein paar Jahren gibt es das Projekt „De Rijke Waddenzee“. Das Ziel ist, neue Miesmuschelbänke als Ersatz für die verlorenen gegangenen Miesmuschelbänke zu schaffen. Letzten Endes blieb es bei den Experimenten und die Miesmuscheln siedelten sich von alleine wieder an. Aber der Erkenntnisgewinn durch solche Experimente ist auch viel wert.

Dort wird auch noch im experimentellen Maßstab Seegrass (*Zostera marina*) ausgesät. So etwas würde man in Deutschland nicht machen. Der Naturschutz in Deutschland ist sehr viel romantischer und auch stark vom amerikanischen Wildnisgedanken, von der *sublime nature* inspiriert. Diese Idee hinter den Nationalparks fiel im walddiebenden Deutschland auf fruchtbaren Boden.

Im Wattenmeer spielt der amerikanische Nationalparkgedanke eine große Rolle. Es gilt „Natur Natur sein lassen“. Diesen Gedanken auf den Wattflächen umzusetzen, war nicht schwer; die Salzwiesen

des Nationalparks werden aber nach demselben Prinzip gemanagt. Demgegenüber erinnert die Vertiefung einiger Dünentäler für Kreuzkröten zum Laichen bei Puan Klent schon eher an niederländische Praktiken. Oft treffen sich die beiden Ansätze aber auch in der Mitte und es wird ein Kompromiss gefunden. In den Dünen besteht aber eigentlich kein Grund, mit großem Aufwand Strandhafer zu mähen oder auch Vegetation zu entfernen. Große Mengen vorgespülter Sand erzielen letzten Endes dieselbe Wirkung. Natürlicherweise war Sylt eine Wanderdünenlandschaft.

Letzten Endes muss man immer abwägen. Wo die letzten Refugien von Rote-Liste-Arten in Gefahr sind, da sind Eingriffe gerechtfertigt und notwendig. Plaggen zum Beispiel stellt einen großen Eingriff in die Natur dar. Die schönste Düentalvegetation findet sich sogar in den Bereichen, wo bis in die 1950er Jahre geplaggt wurde. Der Wiederaufbau der Schleswig-Holsteinischen Seeadlerpopulation ist ein anderes Beispiel.

Aber auch der Naturschutz kann letztlich nur mit den Menschen und nicht gegen sie erreicht werden. Früherer Naturschutz setzte oft alles daran, andere Gruppen wie Landwirte aus den Gebieten zu verdrängen. Diese Richtung war und ist teilweise noch auf Sylt verbreitet; in den 80er Jahren wurden noch Dünengebiete mit Stacheldraht eingezäunt. Die derzeitige grüne Umweltpolitik in Schleswig-Holstein schlägt seit einigen Jahren einen Weg des Dialogs ein, zum Beispiel in der Agrarpolitik. Das wäre auch für den Naturschutz in den Sylter Dünen wünschenswert, deswegen braucht es eben eine solche konzertierte Kampagne. Denn hier ist die Sache anders. Das Küstenschutzdogma „Dünenschutz ist Inselnschutz“ ist schon so lange überwältigend dominant gewesen, dass es keine Interessengruppen mit anderen Ansichten mehr gibt. Von den Dünenbauern aus dem 19. Jahrhundert lebt keiner mehr.

XII. SH-03: SW

A. Questionnaire

- 1) Die SW betreut auf Sylt mehrere Dünengebiete
 - a) Wo besteht der größte Handlungsbedarf?
 - b) Wie müsste der Naturschutz in den Sylter Dünen folgerichtig aussehen?
 - c) Wie soll dieser erreicht werden?
 - d) Diese Feststellungen sind nicht neu? Warum hat sich so lange nichts getan?
- 2) In dieser Strategie:
 - a) Nach wissenschaftlichen Erkenntnissen bringt ein erhöhter äolischer Sedimenttransport Vorteile für die Klimaanpassung wie auch für die Biodiversität mit sich. Welche Rolle spielt eine erhöhte äolische Aktivität in den Dünen für die NSW?
 - b) Neophyten-Bekämpfung
 - i) Ergebnisse aus Dänemark: Bedarf an großflächigen Rodung um die Wiederbesiedlung zu vermeiden?
 - ii) Radikale Maßnahmen wie großflächiges Abplaggen?
 - iii) Nachpflege durch Beweidung: Kann es auf Sylt umgesetzt werden?
 - c) Ist Heidepflege in den Küstendünen notwendig?
 - d) Erfahrung mit (EU) Projekten? Was sind die Vor- und Nachteile?
 - e) Welche Rolle sollten Pilotprojekte spielen? Was bräuchte es dafür?
 - f) Welche Rolle spielen öffentliche und private Landbesitzer? Gibt es Unterschiede?
- 3) Die SW als Betreuungsverein
 - a) Was ist die Rolle der SW als Betreuungsverein laut Vertrag?
 - b) Was ist die Rolle der SW als Betreuungsverein laut Selbstverständnis?
 - c) Was charakterisiert die SW im Vergleich zu anderen Naturschutzvereinen auf Sylt?
 - d) Welche Rolle spielt das Ziel einer unberührten Natur, in die der Mensch möglichst wenig eingreift?
- 4) Welche Rolle spielt der Landschaftszweckverband?
- 5) Welches Image genießen die Dünen auf Sylt?
 - a) Wie groß ist das öffentliche Interesse an Dünen?
 - b) Welche Resonanz gab es auf die Vertiefung der feuchten Dünentäler?
 - c) Müsste sich etwas daran ändern? Wenn ja, wie?

B. Summary

[00:30]: Die Naturschutzgesellschaft Schutzstation Wattenmeer (SW) betreut mehrere Dünengebiete auf Sylt. Wo besteht denn eurer Ansicht nach der größte Handlungsbedarf und wie müsste ein Naturschutz aussehen, der das erreicht?

Der größte Handlungsbedarf besteht darin, die natürlichen Prozesse wiederherzustellen und ein kleinflächiges Mosaik von Biotopen zu erstellen, um so letztlich auch die Artenvielfalt zu erhalten. Dafür bedarf es einer neuen konsensualen Gesamtstrategie. Diese zu erreichen ist allerdings schwierig, da bisher im Naturschutz die Denkweise vorherrschte, dass die Gebiete umso besser geschützt seien, je weniger direkte menschliche Eingriffe in das Gebiet erfolgen. Deshalb dürfen Dünen nicht betreten werden und deswegen werden auch Trampelpfade rigoros abgesperrt. Credo hierbei ist: Dünenschutz ist Inselnschutz. Die Einsicht, dass diese Form des Naturschutz unter Umständen zu einem schlechteren ökologischen Zustand der Gebiete führt, als ein gewisser Vertritt, ist ebenso neu, wie die Erkenntnis, dass ein gewisses Maß an Dynamik erforderlich ist, um die Artenvielfalt zu erhalten. Beides ist zudem schwer vermittelbar.

[02:50]: Wie könnte man zu einem solchen Konsens gelangen?

Der erste Schritt muss hier eine fachliche Diskussion innerhalb der SW sein, da bereits hier ein Konsens fehlt: auch die SW zäunt nach wie vor Dünengebiete auf der Hörnum Odde ein. Der zweite Schritt ist dann, diese Meinung in Fachkreisen, d.h. etwa mit dem Landschafts-zweckverband zu diskutieren. Eine zentrale Frage dabei ist, wie man mit den großen, von Krähenbeere (*Empetrum nigrum*) dominierten Bereichen verfahren soll? Eventuell, kann man hier mit Maßnahmen, die primär auf die Bekämpfung und Entfernung des Kaktusmooses (*Campylopus introflexus*) abzielen, auch im weiteren Umfeld eine erhöhte Sedimentdynamik initiieren. Möglicherweise bietet sich auch ein Brennen der Heide an, wie es im Nationalpark Thy praktiziert wird.

[05:20]: Wie geeignet wären an dieser Stelle radikale Maßnahmen wie großflächiges Abplaggen, wie es zum Beispiel im Kennemerland in den Niederlanden praktiziert wird?

Beim Brennen der Krähenbeere, wie es in Thy geschieht, müsste erst die Interpretation des prioritärer FFH-Lebensraumtyp (Code 2140) geklärt werden. In Dänemark wird dieser Biotoptyp als kleinskaliges Mosaik mit kleinen Graudünen-Flächen verstanden. Diese Sichtweise müsste zunächst mit regionalen (wie dem LLUR) und nationalen Behörden (z.B. BfN) abgesprochen werden, bevor man zur Taten schreiten darf.

Bei der Kartoffelrose (*Rosa rugosa*) stellt sich zunächst die Frage, inwiefern sie tatsächlich ein zunehmendes Problem darstellt: Für die Hörnum-Odde ergaben zwei vereinsinterne Kartierungen, dass die Bedeckung 1987 und 1997 jeweils bei ca. 4 % lag. Daraus kann man vorsichtig ableiten, dass die Kartoffelrose auf den nackten Sandböden nicht sonderlich gut gedeiht. Auffällig ist sie vor allem entlang von Störfächen wie Wegen, Straßen oder Schuttplätzen. Zudem ergaben die Erfahrungen, die beim dänischen LIFE REDCOHA Projekt gemacht wurden, dass man die Rose wohl kaum endgültig loswird, sondern höchstens eindämmen kann. Wie die endgültigen Erfahrungen im LIFE REWETDUNE Projekt aussehen werden, bleibt abzuwarten. Dort wird die Kartoffelrose erst seit vier Jahren bekämpft.

[09:55]: Welche Rolle spielt der Erhalt der offenen Kulturlandschaft, wie er in Dänemark sehr wichtig ist?

Das Ziel auf Sylt sollte der Erhalt der Artenvielfalt sein, allerdings laufen beide Perspektiven oft auf dieselben Maßnahmen hinaus. Jedoch wären Naturschutz durch sind selbst erhaltende Prozesse, z.B. durch Wiederinitiierung von Auswehung dem Brennen vorzuziehen, nicht zuletzt, weil Brennen negative Auswirkungen auf die Entomofauna haben kann. Beim Brennen besteht die Gefahr, dass einzelne Arten mit flugunfähigen Lebensstadien ganz verschwinden. Andererseits wäre das Brennen in den unbewohnten Dünen der Sylter Sandnehrungen eventuell einfacher als in den Geestheiden der Inselmitte, wo es Konfliktpotenzial mit Anwohnern gibt.

[12:20]: Wären auch EU-geförderte Projekte denkbar, um z.B. den Etat zu erhöhen? Bislang stehen überwiegend Gelder von Ausgleichszahlungen aus dem Windenergiesektor zur Verfügung.

Bisher sprachen zwei Vorbehalte gegen die Beantragung eines solchen EU-Projekts. Zum einen ist für diese Projekte ein sehr hoher Verwaltungsaufwand nötig. Zum anderen erschien die Gesamtsituation auf der Insel bislang zu komplex und die Vorbehalte auf Sylt gegenüber innovativen Naturschutzmaßnahmen in den Dünen als zu groß, um dort Naturschutzprojekte zu beginnen.

Mit Hinblick auf die ersten Erfolge bei der Renaturierung der feuchten Dünentäler erscheinen Großprojekte nun aber attraktiver und durchführbarer, um erstens zusätzliche Mittel zu generieren und zweitens auch ein längerfristigen Naturschutzprozess (4-6 Jahre) einzuleiten, um z.B. die Qualität von Trockenbereichen, dem Habitat von z.B. Steinschmätzer (*Oenanthe oenanthe*) zu verbessern.

[15:10]: Welche Akteure verursachen denn die beschriebene, komplexe Gesamtsituation?

Spekulationen mit Grund und Boden haben in den vergangenen Jahren ein allgegenwärtiges Klima des Misstrauens auf Sylt erzeugt. Dadurch ist es für alle Parteien schwierig, etwas in den Schutzgebieten zu verändern, was mit Baggern zu tun hat. Zudem brauchen Naturschutzmaßnahmen aktive Unterstützung durch das LLUR, etwa durch die Maßnahmen, die das LLUR in die Managementpläne schreibt, die aber noch nicht vollständig sind.

[17:20]: Welche Unterschiede gibt es zwischen öffentlichen und privaten Landbesitzern?

Mit den Gemeinden und dem Landschaftszweckverband, dem Zusammenschluss der Sylter Gemeinden funktioniert die Zusammenarbeit gut. Dort ist auch Verantwortungsbewusstsein für und auch ein gewisser Stolz auf die ihnen anvertraute Dünenlandschaft erkennbar.

Gerade im Listland, das im Familienbesitz ist, ist die Lage viel komplexer. Dort bestätigen sich die Erfahrungen aus Skagen, dass sich die Zusammenarbeit mit vielen Landbesitzern als sehr schwierig gestaltet. Dort blieben immer einzelne Parzellen unbearbeitet. Im Listland ist die Situation anders, da die Erben die Flächen gemeinschaftlich verwalten und im Konsens entscheiden. Somit kann ein Eigentümer allein blockieren, obwohl andere Familienmitglieder die Maßnahmen unterstützen. Bislang scheinen ökonomische Interessen durch den potenziellen Verkauf des Grundwassers als Vetofaktor zu wirken.

[20:20]: Was ist die Rolle der Schutzstation als Betreuungsverein laut Vertrag und laut Selbstverständnis?

In den Betreuungsverträgen sind nur wenige Pflichten, wie die zur Durchsetzung der Schutzgebietsverordnungen, festgehalten; zum Beispiel, das allgemeine Betretungsverbot durchzusetzen. Das Vereinsziel ist ein weiter reichender Schutz.

[21:15]: Mein Eindruck ist, dass die Dünen auf Sylt weitaus weniger intensiv in den Tourismus eingebunden werden als in den Niederlanden oder in Dänemark. Täuscht dieser Eindruck?

Auf Sylt gibt es eben diese lange Tradition von „Dünenschutz ist Inselschutz“: Es sei gut für die Dünen, wenn keiner darin herumläuft. Deswegen ist das touristische Angebot für die Dünen auch sehr gering. Eine Sonderinstitution sind die exklusiven Führungen des „Erlebniszentrum Naturgewalten“ in List zum Fuß der Wanderdüne. Generell müsste die Zugänglichkeit der Dünen verbessert werden, etwa durch mehr Führungen. Bislang gab es dazu Untersuchungen im Rahmen einer Masterarbeit, die aber keine Umsetzung fanden.

[24:20]: Die SW bietet auch Dünenführungen in Rantum und Hörnum an. Wie groß ist das öffentliche Interesse an diesen Führungen?

Generell ist das öffentliche Interesse an speziellen Exkursionen wie ornithologischen oder Dünenführungen eher gering. Das ist beispielsweise auf Amrum anders, weil dort ein anderes Publikum Urlaub macht,

[24:50]: Wie fiel denn die öffentliche Resonanz auf die Vertiefung der Dünentäler aus?

Bisher war die Resonanz positiv: lediglich bei der Vorstellung der Maßnahmen gab es eine Beschwerde, dass hübsche Glockenheide (*Erica tetralix*) der Maßnahme zum Opfer gefallen sei.

[26:00]: Wenn man langfristig einen anderen Zustand der Sylter Dünen erreichen möchte, was müsste sich dafür an ihrem Image ändern?

Es ist fraglich, inwiefern der vorherrschende Gedanke, dass Menschen die Dünen nicht betreten sollen, zu ändern ist. Um Störstellen durch Vertritt zu generieren, könnte man alternativ Beweidung mit Schafen oder größeren Tieren wie Galloways einführen. Diese wären eventuell ein touristisches Highlight. Ungeklärt ist jedoch das Futterangebot in der Heide für die Tiere.

[29:40]: Was charakterisiert denn die SW im Vergleich zu den anderen Betreuungsvereinen auf Sylt, wie der Naturschutzgemeinschaft Sylt oder der Sölring Foriining?

Die SW arbeitet schwerpunktmäßig eigentlich im Wattenmeer und betreut formal nur zwei kleine Dünengebiete im Sylter Süden, kann aber nichtsdestotrotz Expertenwissen über die Küstendünen

mitbringen. Die NSG betreut die Geestheiden und bringt von dort Expertenwissen mit. Generell steht die Zusammenarbeit zwischen den drei Vereinen auf einer guten Grundlage und hat sich durch den gemeinsamen Dünenschutz in den letzten Jahren sehr intensiviert.

XIII. SH-04: LKN-SH

A. Questionnaire

- 1) Welche Rolle spielen Küstendünen in Ihrem Arbeitsalltag?
- 2) Sandersatzmaßnahmen
 - a) Durch die Sandersatzmaßnahmen seit 1983 ist es gelungen den Rückgang der Küste zu stoppen (Kosten ca. 6 Mill. € jährlich). Der LKN ist momentan Herr der Lage.
 - b) In den Niederlanden werden vermehrt Vorstrandvorspülungen durchgeführt. Auf Sylt werden die meisten Vorspülungen als Strandvorspülungen durchgeführt. Was sind die Gründe dafür?
- 3) Klimawandel und vor allem der Meeresspiegelanstieg werden den Küstenschutz langfristig vor neue Herausforderungen stellen. Um dem zu begegnen, wurde die Wattenmeer-Strategie 2100 erarbeitet, die auf wissenschaftlichen Erkenntnissen basiert.
 - a) Rolle der Wattenmeer-Strategie für die Arbeit des LKN?
 - b) In der Wattenmeerstrategie zählen die Inseln explizit zum Betrachtungsraum. Die beiden Haken Sylts haben sich über die Jahrtausende an den Meeresspiegelanstieg angepasst. Wie schätzt der LKN die Bedeutung des landwärts gerichteten Sedimenttransports ein?
 - c) Die Klimaanpassung und Sturmflut eine starke räumliche Komponente. Wo beginnt oder endet die Zuständigkeit des LKN landseitig? (Kann er zum Beispiel bei Flächennutzungsplänen mitwirken?)
- 4) Biotechnischer Küstenschutz
 - a) Die Befestigung von Dünen wurde lange betrieben, um Ackerflächen und Siedlungen zu schützen, später auch um den Rückgang der Westküste zumindest zu verlangsamen. Welche Rolle spielt er heute?
 - b) Die Maßnahmen des biotechnischen Küstenschutzes werden im Fachplan Regiebetrieb festgelegt. Wie werden die Vorgaben
 - c) Gibt es Vorgaben für minimale Abmessungen der Vordünen?
 - d) Biotechnischer Küstenschutz ist viel Handarbeit und muss teuer sein. Der Fachplan erwähnt jedoch keine Kosten. Wie hoch sind die Kosten dafür?
 - e) Dynamisches Dünenmanagement: In den Niederlanden hat sich die Einstellung durchgesetzt, dass der Rückgang der Küste durch Strandvorspülung gestoppt werden kann und man dementsprechend nicht mehr konsequent zu stabilisieren braucht. Außerdem erhöht die Sandauswehung ins Hinterland die Breite der Dünen
 - i) Zulassen von mehr Dynamik, indem die Dünen generell nicht mehr stabilisiert werden außer an besonders schmalen Dünenstellen
 - ii) Förderung dieser Prozesse, z.B. durch Entfernen der Vegetation, Mobilisieren der Vordünenspitzen. Ist dies etwas typisch niederländisches
 - f) Building with nature in den Niederlanden meint mehr, als großflächige Sandvorspülung und Nutzen natürlicher Prozesse wo immer möglich.
 - i) Was waren die Erfahrungen mit dem Sandpuffer bei List?
 - ii) Generell: Gibt es vermehrt Einbindung anderer Interessen in Küstenschutzprojekte?
 - g) Dänische Strategie: Mentalität: billiger und effizienter, nur dort vorzuspülen und Dünen zu befestigen, wo es erforderlich ist. Erosion wird an anderen Stellen zugelassen
- 5) Maßnahmen im Küstenschutz der nächsten 10 Jahre werden im Generalplan Küstenschutz festgeschrieben.
 - a) In zehn Jahren kann sich in der öffentlichen Wahrnehmung und in der politischen Wahrnehmung einiges ändern. Gerade gewinnt z.B. das Thema Klimawandel an Bedeutung. Wie flexibel ist der Generalplan?
 - b) Auch die Sandvorspülungen vor Möglichkeit von Pilotprojekten
- 6) Zusammenarbeit mit anderen Behörden: Dünen und Salzwiesen sind nicht nur wichtige natürliche Helfer im Küstenschutz, sondern auch geschützte, wertvolle Habitate.

- a) Für den Naturschutz in den Salzwiesen ist die Nationalparkverwaltung, also ebenfalls der LKN zuständig.
 - b) Für den Naturschutz in den Dünen ist hingegen das LLUR zuständig. Wie ist die Zusammenarbeit mit dem LLUR geregelt?
 - c) Wäre es wünschenswert, dass der LKN auch für den Naturschutz in den Küstendünen zuständig wäre? (Wäre es möglich?)
- B. Summary

[00:05]: Welche Rolle spielen die Küstendünen in Ihrem Arbeitsalltag beim LKN.SH?

Dünen dienen sowohl dem Hochwasserschutz, d.h. dem Schutz des Hinterlandes vor Überflutung als auch der Küstensicherung, das heißt dem Schutz vor Erosion. Die vorderste Dünenkette wird dabei stets als Randdüne bezeichnet; ohne Sicherung würden die Sylter Randdünen durch den Küstenrückgang von 1 bis 4 m pro Jahr nach und nach abgetragen. Deswegen werden die Randdünen durch Vordünen geschützt.

[01:35]: Mit Einführung der Sandersatzmaßnahmen seit Mitte der 1980er Jahre konnte der Rückgang der Küste gestoppt werden. Man könnte meinen, der LKN.SH ist Herr der Lage auf Sylt.

Die Sandersatzmaßnahmen seit 1972 haben den Küstenrückgang gestoppt. An vielen Stellen konnte vor den Randdünen eine Vordünenkette als Sandpuffer gebildet werden und nur an wenigen Stellen gingen exponiert gelegene Randdünen verloren. An diesen Stellen versucht der LKN.SH nicht, diese Dünen wiederherzustellen, weil es an diesen Stellen weitere Dünenketten im Hinterland gibt und so die Sicherheit gewährleistet bleibt. Dieser Sandpuffer ist notwendig, um die Westküste Sylts bei Starkereignissen schützen zu können und ein Abbrechen der Randdüne zu verhindern. Das ist nur möglich, weil dank der Strandaufspülungen viel Sediment im System ist.

Im Querschnitt von Land her betrachtet, besteht das Küstensystem aus den Dünen, dem Strand, dem Vorstrand mit dem Riff-Rinne-System und dem Seegrund. Durch die Strandaufspülungen ist das Sedimentbudget des Strandes gewachsen. Im Küstenvorfeld ist vielerorts das Gegenteil der Fall; dieses erodiert insbesondere am Nord- und am Südende der Insel zusehends und das Küstenprofil versteilt sich. Vor Westerland ist die Situation ausgeglichener, seit dort Vorstrandaufspülungen stattfinden. Die Wirksamkeit der Vorstrandaufspülungen wird jedoch durch die starken Tideströmungen entlang der Küste zu den Inselenden hin verringert, die einen großen Teil des Sediments schnell verfrachten und dadurch das Anwachsen des Ellenbogens im Norden bzw. eine Vergrößerung des Hangs zum Vortrappief hin beschleunigen.

[07:20]: In den Niederlanden werden vermehrt Vorstrandaufspülungen durchgeführt. Das ist aber auf Sylt aber nur bedingt einsetzbar wegen der starken Strömungen?

Dazu kommen noch andere wirtschaftliche Rahmenbedingungen. In den Niederlanden sind Strandaufspülungen generell günstiger, weil Spülschiffe vor Ort sind und weil dort das Budget deutlich größer ist. Mit Geldsummen wie in den Niederlanden wären auch auf Sylt andere Dinge realisierbar. Maßnahmen wie den Sandmotor bei Den Haag kann man realisieren, wenn man günstig vorspülen kann und auch keine Ausgleichsmaßnahmen finanzieren muss.

[09:20]: 2015 wurde die Wattenmeerstrategie vom Kabinett verabschiedet, denn Klimawandel und vor allem der Meeresspiegelanstieg werden den Küstenschutz langfristig vor neue Herausforderungen stellen. Um dem zu begegnen, wurde die Wattenmeer-Strategie 2100 erarbeitet, die auf wissenschaftlichen Erkenntnissen basiert. Was ist die Rolle der Wattenmeer-Strategie für die Arbeit des LKN.SH in Bezug auf Sylt?

Ein Meeresspiegelanstieg führt zum Ertrinken des Wattenmeers, wenn nicht genügend Sediment in das System transportiert wird. Die Wattenmeerregion inklusive großer Teile des heutigen Festlands wie Dithmarschen / Nordfriesland ist seit der letzten Eiszeit mit dem Meeresspiegelanstieg mitgewachsen. Früher dienten Moränenkerne seeseitig der heutigen Inseln als Sedimentquelle. Diese Quellen sind allerdings mittlerweile nahezu vollständig abgetragen; das führt dazu, dass das Land nicht mehr so schnell mitwachsen kann. Zurzeit wächst das küstennahe Vorland um ca. 1 cm pro Jahr auf, das ist fast das Dreifache wie der Anstieg des Mitteltidehochwassers (MtHw) seit 1900. Sturmfluten steuern den Prozess des Mitwachsens, indem sie mehr Sediment in das Wattenmeer verfrachten. Wenn der seeseitige Hang des Wattenmeers erodiert und gleichzeitig die Marschen vor den Deichen anwachsen, schwindet der Anpassungsspielraum des Wattenmeers.

[14:20]: auch weil die Deichlinie nicht mitwandert.

Die Wegnahme der Deiche würde aber die Probleme nicht lösen, sondern im Gegenteil Weitere schaffen, denn dann würden sich wie vor Jahrtausenden in Dithmarschen und Nordfriesland Moore und Sümpfe hinter sandigen Nehrungshaken bilden. Dieses Gebiet kann man dann nicht mehr nutzen. Dann kann der Mensch das Gebiet gleich aufgeben, dann gibt es auch keine Probleme mehr. Aber man sollte den Menschen als ein positives Element in der Natur sehen.

An den Meeresspiegelanstieg muss man sich natürlich strategisch anpassen. Für den Hochwasserschutz der Marschgebiete wurde der Klimadeich entworfen, aber unendlich lassen sich die Deiche auch nicht erhöhen.

[20:00]: Wie verhält sich die Insel Sylt unter einem steigenden Meeresspiegel?

Im Gegensatz zu den ostfriesischen Inseln oder auch den nordfriesischen Außensänden handelt es sich bei Sylt, Föhr und Amrum um Geestkerninseln. Das heißt, Sylt wandert nicht frei mit steigendem Meeresspiegel mit, sondern der Geestkern wird lediglich abgetragen und das erodierte Sediment verteilt sich durch den küstenparallelen Längstransport. Das Sediment, aus dem die beiden Nehrungshaken, die sich nach Norden und Süden an den Moränenkern anschließen, stammt aus dem erodierenden Sylter Inselkern. Durch die Strandaufspülungen wird dieser Küstenrückgang gestoppt. Bei steigendem Meeresspiegel steigen die benötigten Vorspülmengen.

Gerade die Inselenden sind zurzeit zusätzlichen Belastungen ausgesetzt, denn in den 1960er und 1970er Jahren ist der Tidenhub im Bereich Sylt um ca. 30 cm angestiegen. Dadurch erhöhen sich auch die Tideströmungen. Sediment an den Inseln wird dadurch schneller in die angrenzenden Tiefs und ins Wattenmeer transportiert. Im Vergleich bleibt das Sediment, das bei Stürmen in der Inselmitte abgetragen wird, länger dem Sedimentbudget der Insel erhalten. Aus diesem Grund wird 2019 zum zweiten Mal nach 2017 bei Hörnum Sand in den Vorstrand eingebracht.

Die Dünen sind das jüngste geologische Element auf Sylt und bilden sich durch Auswehung von feinem Sediment am Strand und ermöglichen so das vertikale Aufwachsen des Nehrungshakens. In vergangenen Jahrhunderten stellte Sandflug eine existentielle Bedrohung für die Bewohner der Insel dar.

[29:50]: In den Niederlanden hat sich die Einstellung durchgesetzt, dass der Rückgang der Küste durch Strandvorspülung gestoppt werden kann und man die Dünen dementsprechend nicht mehr überall konsequent zu befestigen braucht. Außerdem erhöht die Auswehung von Sand ins Hinterland die Weite der Dünen

Zunächst einmal ist auch in den Niederlanden der Sand in der Brandungszone am wichtigsten, damit er dort die Energie der Wellen abfangen kann. Und auch dort, wo keine Infrastruktur oder Bebauung durch Flugsand beschädigt werden kann, kann man sich diese Auswehung nur deswegen leisten, weil in den Niederlanden wesentlich mehr vorgespült wird. Diese Situation ist auf Sylt nicht gegeben, denn erstens beginnt die Bebauung – das Listland vielleicht einmal ausgenommen, oft sehr dicht hinter der Düne. Zweitens existiert auf Sylt nur eine Randdüne, die oft sehr steil ist und recht schmal ist und dementsprechend gesichert werden muss. Den Sandpuffer für solche Experimente hat Sylt einfach nicht!

Es ist letztlich also eine Frage des Geldes. Wenn man sich dafür entscheidet und es auch finanziert, deutlich mehr Sand vorzuspülen, um zum Beispiel neue Habitate zu schaffen, dann ist das prinzipiell möglich. Auch wenn das natürlich Habitate am Meeresboden schädigt oder zerstört. Aber bis dahin ist der biotechnische Küstenschutz noch genauso wichtig wie im 19. Jahrhundert.

[39:25]: Biotechnischer Küstenschutz ist viel Handarbeit und muss teuer sein.

Teuer ist in diesem Zusammenhang relativ. Durch den biotechnischen Küstenschutz werden bis zu 10 m³ Sand pro Strandmeter gebunden und enden nicht in der Randdüne, sondern bleiben dort, wo sie die Energie der Wellen wirkungsvoll dämpfen.

[42:00] An der Westküste Jütlands in Dänemark wird folgendes praktiziert: Dort wird nur an den Stellen vorgespült und nur dort werden Dünen zu befestigt, wo Bebauung oder Infrastruktur gefährdet sind. An den anderen Stellen lässt man der Natur und auch dem Küstenrückgang freien Lauf. Wäre das in Abschnitten wie dem Listland, die diese Bedingungen erfüllen, auch möglich?

Theoretisch ist das möglich aber realistisch kann man die Küstenlinie auch im Listland nur stellenweise zurückweichen lassen. Und das würde neue Probleme durch Lee-Erosion an den Flanken dieser Gebiete nach sich ziehen. Die gleichen Probleme ergeben sich auch bei der partiellen Rückverlegung von Deichen, weil es zu Buchteneffekten kommt. Und diese grundlegenden physikalischen Prozesse werden sich auch unter einem steigenden Meeresspiegel nicht ändern.

[48:55]: *Dünen sind ja auch aus Sicht des Naturschutzes wichtig. Wie sieht denn die Zusammenarbeit mit dem Naturschutz aus?*

Der Schutz der Dünen ist Aufgabe des Landschaftszweckverband und der Gebietsbetreuer bzw. des staatlichen Naturschutzes. Die Zusammenarbeit ist gut; meistens geht es um Fragen wie Lagerplätze für Material. Der LKN.SH ist für den Küsten- und Hochwasserschutz der Insel im Rahmen des gesetzlichen Auftrages gem. Landeswassergesetz zuständig, den Rest machen die Gemeinden.

XIV. SH-05: Untere Naturschutzbehörde (UNB) des Kreises Nordfriesland

A. Questionnaire

- 1) Allgemein:
 - a) Welche Rolle spielen die Sylter Küstendünen in Ihrem Arbeitsalltag?
 - b) Wo besteht der größte Handlungsbedarf?
 - c) Wie müsste der Naturschutz in den Sylter Dünen folgerichtig aussehen?
 - d) Wie soll dieser erreicht werden?
- 2) In dieser Strategie:
 - a) Nach wissenschaftlichen Erkenntnissen bringt ein erhöhter äolischer Sedimenttransport Vorteile für die Klimaanpassung wie auch für die Biodiversität mit sich.
 - i) Welche Rolle spielen die drei letzten, ergrünenden Wanderdünen?
 - ii) Welche Rolle spielt eine Wiederbelebung der Dünen für die SF?
 - b) Neophytenbekämpfung
 - i) Ergebnisse aus Dänemark: Bedarf an großflächigen Entfernung um die Wiederbesiedlung zu vermeiden?
 - ii) Ergebnisse Niederlande: Radikale Maßnahmen wie großflächiges Abplaggen des Oberbodens zeigen Wirkung. Ist so etwas denkbar?
 - iii) Beide: Nachpflege durch Beweidung: Kann es auf Sylt umgesetzt werden?
 - c) Integration anderer Sektoren wie Tourismus, Küstenschutz
 - d) Ist Heidepflege in den Küstendünen notwendig?
 - e) Finanzierung: Die EU als Geldgeber. Erfahrung mit EU Projekten? Was sind die Vor- und Nachteile?
 - f) Welche Rolle sollten Pilotprojekte spielen? Was bräuchte es dafür?
 - g) Welche Rolle spielen öffentliche und private Landbesitzer? Gibt es Unterschiede zwischen den beiden?
- 3) Was sind die Zuständigkeiten einer UNB in Schleswig-Holstein?
 - a) Was sind die Aufgaben der UNB im Vergleich zur ONB (LLUR)?
 - b) Im Verhältnis zu den Betreuungsvereinen?
- 4) Welches öffentliche Image haben die Sylter Dünen?

B. Summary

[00:05]: *Was sind denn die Aufgaben der Unteren Naturschutzbehörde [UNB] allgemein und konkret im Naturschutz der Dünen auf Sylt?*

Die eine große Aufgabe ist vor allem die Bauleitplanung für die Gemeinden im Landkreis, einschließlich der 380 kV Hochspannungsleitung der Seekabel zu den Offshore-Windparks durch das Wattenmeer. Außerdem ist die UNB zuständig für die Genehmigung für Befreiungen vom gesetzlichen Biotopschutz. Das betrifft neben dem Küstenschutz in Dünengebieten, den Dünen, auch Eingriffe in Magerrasen oder Wertgrünland. In den letzten Jahren kam weiterhin die Regelung von Drohnenflügen dazu. Zudem werden die Artenschutzbemühungen des Landes Schleswig-Holstein fachlich flankiert.

Daneben agiert die UNB auch, indem sie Schutz und Entwicklungsmaßnahmen im Natur- und Landschaftsschutz durchführen lässt, Ökokonten einrichtet. Dafür stehen momentan finanzielle Mittel aus den Ersatzgeldern vom Bau der Windkraftanlagen zu Verfügung.

In den Sylter Dünen wurde bislang hauptsächlich Heidepflege betrieben und so lag der Fokus vor allem auf den mit Heide bestandenen Dünen. Dort wurde geplaggt und entkusselt. Durch das Artenschutzprojekt für die Kreuzkröte (*Bufo calamita*) rücken nun die feuchten Dünentäler mehr in den Vordergrund. Dort besteht großer Handlungsbedarf; auch hier müsste entkusselt werden, da sie momentan mit hoher Vegetation bestanden sind. Allerdings muss dann auch die anschließende

Offenhaltung gewährleistet werden. Andernfalls wären die öffentlichen Gelder in die Entkusselung schlecht investiert. Außerdem ist die derzeitige Trockenheit aufgrund der Dürre 2018 ein Problem.

[05:35]: Neben den feuchten Dünentälern gibt es noch zahlreiche andere streng geschützte Habitats auf der Insel, wie Graudünen. Welche Rolle spielen diese Habitats?

Aus naturschutzfachlicher Sicht hat Sylt eine sehr befestigte Küstendünenlandschaft, in der es kaum noch dynamische Bereiche gibt. Da die Dünen ein wichtiger Erosionsschutz sind, sind dem Wunsch nach Dynamik dort natürlich Grenzen gesetzt. Die Frage ist also: Wieviel Dynamik verträgt der Küstenschutz?

Ungeachtet dessen bräuchte es mehr Offenstellen, denn es gibt auch kaum noch Brutvögel, was in Dünen eigentlich normal ist und auch die Insekten und Amphibienzahlen nehmen ab. Im Gegenzug sind invasive Arten wie die Kartoffelrose (*Rosa rugosa*), das Kaktusmoos (*Campylopus introflexus*) oder die Cranberry (*Vaccinium macrocarpon*) auf dem Vormarsch.

Generell braucht es also mehr Übergangsbereiche wie vom dauergefluteten Düentalbereichen hin zu Bereichen mit schwankenden Wasserständen, hin zu Magerrasen und Borstgrasrasen und in die Heideflächen. Dieselben Probleme sind auch in den Dünen von Amrum und St. Peter-Ording zu sehen

Bislang entstehen Freiflächen vor allem als Nebeneffekt anderer Maßnahmen wie Entkusseln oder bei der Gestaltung der Krötenlaichgewässer auf Sylt. Bei letzteren wurde der Aushub aus den Vertiefungen nicht teuer abgefahren, sondern an Ort und Stelle als freie Sandfläche modelliert. Zum einen brauchen Kröten solche Offenflächen, zum anderen konnte so kleinskalig Raum für Pionierhabitats geschaffen werden.

[10:50]: Welche Rolle spielen denn die drei letzten Wanderdünen im Listland in der Naturschutzstrategie?

Im Zusammenhang mit den Wanderdünen im Listland beschränken sich die Aufgaben der UNB vor allem auf das Ordnungsrecht, indem Genehmigungen für geführte Dünenwanderungen des Erlebniszentrum Naturgewalten oder für wissenschaftliche Arbeiten erteilt werden. Im Naturschutz spielen sie keine Rolle, Informationen über die Habitatqualität in der Auswehungsfläche hinter den Dünen kommen vom zuständigen Betreuungsvereinen, der Sölring Foriining.

[13:50]: In Dänemark und den Niederlanden gibt es Bestrebungen, Neophyten mit großem Aufwand durch Plaggen oder kontinuierlichem Beschneiden ein für alle Mal aus der Landschaft zu verbannen. Ist das für Sylt im Gespräch oder überhaupt wünschenswert?

Wünschenswert wäre es auf jeden Fall, um so die Qualität dieser Habitats auf Dauer zu erhalten. Damit wären solche Maßnahmen auch theoretisch sinnvoll, andererseits ist es praktisch unmöglich. Die stellenweise Dominanz der Kartoffelrose ist quasi akzeptiert. Die Cranberry und das Kaktusmoos sind noch nicht so weit verbreitet, es werden dort aber zurzeit keine Ressourcen investiert, um diese auch loszuwerden. Außerdem ist die Insellage ein Problem, das Material kann nicht abgefahren werden. Das recht humose Pflanzenmaterial vom beginnenden Geestheideprojekt geht an die Landwirte und sonst wird viel auch beim jährlichen Biikebrennen verwendet.

[18:20]: Ist die Nachbeweidung auf Sylt eine realistische Möglichkeit, die Landschaft offenzuhalten?

Auf Sylt beweiden Schafe noch immer Listland und Ellenbogen. Im Zuge der Managementplanung stellt sich dabei momentan die Frage, inwieweit eine Beweidung nur mit Schafen noch zeitgemäß ist, oder ob einige Ziegen dazu genommen werden könnten. Auch ein Einsatz der vom Land finanzierten Wanderschafherde kommt in Betracht. Zurzeit hat diese Schafherde einen Zugplan über die Geestheide des Flugplatzes und der Braderuper Heide hin zum Morsum Kliff. Auch für Amrum müssen Pflegemaßnahmen ergriffen werden; dort denkt man über eine Beweidung mit Islandpferden nach.

Pferde haben eine Reihe von Vorzügen vor Rindern. Auf Amrum findet sich das artenreichste Grünland auf Pferdeweide; außerdem erzeugen ihre Trittsiegel offene Stellen auf der gesamten Fläche und nicht gesammelt um Tränken. Die Nachteile der Pferdebeweidung wie Latrinenbildung lassen sich durch extensive Beweidung und Zugplanung verringern.

[23:00]: Im Naturschutz ist Geld meistens knapp. In Dänemark versuchen Naturschützer, ihr Budget durch EU-Mittel aufzustocken. Sind solche Gedanken im Gespräch?

Das „Heideprogramm 2.0“ für die Geestheide sollte über den Europäischen Landwirtschaftsfond (ELER) Projekt bezuschusst werden. Dazu wird es allerdings erst in der nächsten Förderperiode

kommen. LIFE Projekte sind bislang keine ernsthafte Option, solche großen Projekte müssen politisch vorbereitet werden. Die Insel muss bereit dafür sein, es braucht mehr dazu als die naturschutzfachliche Notwendigkeit.

[25:30]: Heißt das, die Landeigentümer sind noch nicht soweit oder ist das öffentliche Bild der Dünen noch nicht reif dafür?

Zunächst einmal gibt es fachliche Vorbehalte, die geklärt werden müssen um zu wissen, was die Ziele in der Fläche sind. Außerdem gibt es Vorbehalte der Landeigentümer, die persönliche, finanzielle Nachteile befürchten. Es gibt auf der Insel aber auch ganz klare politische Haltungen. Kleinere Eingriffe in die Gebiete sind in der Regel unproblematisch, größere Maßnahmen hingegen umstritten. Da es zum Beispiel im Listland noch Trinkwasserbrunnen gibt, kommt auch die Frage der Versorgungssicherheit auf.

Dementsprechend müssen sich die Landeigentümer ernst und mitgenommen fühlen und die Maßnahmen müssen ihrer Haltung entsprechen und für sie zumutbar werden. Konkret bedeutet das, dass Sachverhalte immer wieder mit den Landeigentümern besprochen werden. Zwar kann man rechtlich die Duldung von Maßnahmen erzwingen oder sogar Eigentümer enteignen, aber das wird auf Sylt nicht gemacht und wäre taktisch höchst unklug.

[29:10]: Gibt es Unterschiede zwischen privaten und öffentlichen Landeigentümern?

Die Vorbehalte privater Flächeneigentümer inklusive der Kirchengemeinden sind oftmals größer. Das liegt zu einem Teil oft daran, dass der Austausch mit den privaten Eigentümern nicht so intensiv ist wie mit den lokalen Gemeinden. Die Zusammenarbeit dort beruht auch auf einem gegenseitigen Behördenverständnis. Außerdem sind die Maßnahmen auf öffentlichen Flächen für die Zukunft gesichert und auch rechtlich einfacher. Somit lassen sich Pilotprojekte lassen eher auf öffentlichen Flächen durchführen, auch um der Öffentlichkeit zu zeigen, wie Naturschutz in den Dünen aussehen kann.

[31:35]: Ist es also auch das Ziel von Pilotprojekten wie der Vertiefung der Dünentäler, das öffentliche Image der Dünen zu verändern?

Das ist nur ein sehr unterschwelliges Ziel und auch nicht das Ziel der Kooperationspartner auf der Insel. Der Vertiefung der Dünentäler gingen schwierige Diskussionen voraus, da es eine starke Küstenschutzlobby gibt, die mehr Dynamik als mit den vertieften Dünentälern zurzeit nicht akzeptiert. Denn vermeintlich geht mehr Dynamik in der Dünenlandschaft mit weniger Sicherheit einher, darum wird alles, was von dieser Norm abweicht, kritisch und genau geprüft. Teilweise werden auch Informationen über Auswirkungen von Maßnahmen auf beispielsweise den Grundwasserstand gefordert, die so nicht zu liefern sind.

Auf Sylt beginnt gerade erst ein Diskurs über die Zukunft der Dünen. Dass die ökologische Vielfalt und Bedeutung der Dünen abnimmt, wird erst jetzt realisiert. Die Wertschätzung für den Lebensraum Dünen ist bei den Besuchern zurzeit noch nicht stark ausgeprägt, das sollte aber ein Ziel sein.

Solche Maßnahmen helfen, dieses Image aufzubrechen. Aus diesem Grund boten die Betreuungsvereine auch während der Arbeiten Führungen in dem Gebiet an, um die Besucher aufzuklären, was in der Heide eigentlich passiert. Es geht auch darum, das Bild, das die Naturschutzvereine jahrzehntelang vermittelten, nämlich, dass man die Dünen nicht stören darf, so abzuwandeln, dass gewisse Störungen erfolgen müssen.

[39:20]. Was sind die Aufgaben der UNB im Vergleich zur Oberen Naturschutzbehörde, dem LLUR in Flintbek?

Aus einer rechtlichen Perspektive regelt das die Naturschutzzuständigkeitsverordnung. Konkret für die Dünen auf Sylt sieht es so aus, dass das LLUR die strategische Ebene inklusive der Erstellung Managementpläne übernimmt und auch mithilfe des Ministeriums Naturschutzgebiete ausweist oder bei Rückfragen zu Biotoptypen klärt. Die UNB ist in diesem Zusammenhang vor allem ausführendes Organ, das sich in dem vom LLUR abgesteckten Rahmen bewegt. Das LLUR kontrolliert die Einhaltung und den Erfolg der FFH-Managementpläne, die von der UNB umgesetzt werden. Da die UNB allerdings über wesentlich mehr lokales Wissen verfügt, ist ein enger Austausch letztlich unverzichtbar. Bei großen Projekten, wie jetzt dem Heideprojekt 2.0 sind jedoch nicht nur ein enger Austausch und der Segen der übergeordneten Stellen unverzichtbar, sondern auch Engagement der übergeordneten Behörden. Somit liegt die Verantwortung je nachdem bei der Unteren oder der Oberen Naturschutzbehörde; im Prinzip ist es eine gemeinsame Verantwortung, die nur in guter Zusammenarbeit getragen werden kann.

XV. SH-06: LLUR-SH

A. Questionnaire

- 1) Allgemein:
 - a) Welche Rolle spielen die Sylter Küstendünen in Ihrem Arbeitsalltag?
 - b) Wo besteht der größte Handlungsbedarf?
 - c) Wie müsste der Naturschutz in den Sylter Dünen folgerichtig aussehen?
 - d) Wie soll dieser erreicht werden?
- 2) In dieser Strategie:
 - a) Nach wissenschaftlichen Erkenntnissen bringt ein erhöhter äolischer Sedimenttransport Vorteile für die Klimaanpassung wie auch für die Biodiversität mit sich. Welche Rolle spielen die drei letzten, ergrünenden Wanderdünen??
 - b) Neophytenbekämpfung
 - i) Ergebnisse aus Dänemark: Bedarf an Großflächigen Entfernung um die Wiederbesiedlung zu vermeiden?
 - ii) Ergebnisse Niederlande: Radikale Maßnahmen wie großflächiges Abplaggen des Oberbodens zeigen Wirkung. Ist so etwas denkbar?
 - iii) Beide: Nachpflege durch Beweidung: Kann es auf Sylt umgesetzt werden?
 - c) Integration anderer Sektoren wie Tourismus, Küstenschutz neben dem Biotopschutz?
 - d) Ist Heidepflege in den Küstendünen notwendig?
 - e) Finanzierung: Die EU als Geldgeber. Erfahrung mit EU Projekten? Was sind die Vor- und Nachteile?
 - f) Welche Rolle sollten Pilotprojekte spielen? Was bräuchte es dafür?
 - g) Welche Rolle spielen öffentliche und private Landbesitzer? Gibt es Unterschiede zwischen den beiden?
- 3) Zuständigkeiten
 - a) Was sind die Aufgaben der UNB im Vergleich zur ONB (LLUR)?
 - b) Im Verhältnis zu den Betreuungsvereinen?
- 4) Welche Rolle spielt der Geotopschutz? (Aufgabe des LLUR?)
- 5) Welches öffentliche Image haben die Sylter Dünen?

B. Summary

[00:10]: Was ist die Rolle des LLUR beim Naturschutz in den Sylter Dünen?

Am Naturschutz in den Sylter Dünen sind mehrere Dezernate (Biotop- und Artenschutz) des LLUR beteiligt, die mögliche Maßnahmen fachlich begutachten. Diese Maßnahmen werden in der Regel von der Unteren Naturschutzbehörde umgesetzt und vom Land Schleswig-Holstein finanziert.

Gewisse Maßnahmen, wie den Wegebau führt der Landschaftszweckverband Sylt auf der Insel durch. Allerdings erscheint das aktuelle Wegekonzept aus den 1980er Jahren aus heutiger Sicht kontraproduktiv, war aber damals und auch heute notwendig, um eine großflächige Zerstörungen der Vegetationsbestände durch Tritt zu verhindern (Gratwanderung). Im Rahmen des Wegekonzeptes sind vorhandene Wegetrassen zwischen Strand und Parkplätzen festgelegt worden. Bis in die 60er Jahre wurden Parkplätze vielfach noch mit *Rosa rugosa* umpflanzt.

Lange galt naturschutzfachlich die Einschätzung von Ernst-Wilhelm Raabe aus den 1960ern, dass die Küstenheiden auf der Geest der Insel Sylt, anders als die Binnenheide ein natürliches Endstadium darstellt und dementsprechend keine Pflegemaßnahmen nötig seien. Dies galt auch für die Küstendünen auf den Nehrungshaken im Norden und Süden der Insel. Dünenwälder kommen an der Schleswig-Holsteinischen Westküste nur sehr kleinflächig vor. Da aktuell in vielen Gebieten an windgeschützten Stellen eine starke Gehölzentwicklung – teilweise mit standortfremden nicht heimischen Gehölzen – u. a. als Folge des hohen atmosphärischen Stickstoffeintrags stattfindet, wird dieses Paradigma zusehends infrage gestellt.

Nachdem im vergangenen Jahrhundert Dünen mehrfach aktiv durch Bepflanzung festgelegt wurden, sind nur noch 3 vegetationsfreie Dünenfelder verblieben. Die letzten drei vegetationsfreien Flächen werden zunehmend durch die Sukzessionsabläufe festgelegt. Gefördert/ beschleunigt wird diese Entwicklung u.a. durch die geringe Flächengröße der Offenflächen, durch fehlenden Sandnachschub, durch Nährstoffeinträge usw. . Außer der Beweidung mit Schafen am Ellenbogen und im nördlichen Listland – findet keine Nutzung der Küstendünen statt. Bis auf das Zurückdrängen von Gehölzen

werden keine Pflegemaßnahmen durchgeführt. Im Klappholttal werden zurzeit Bergkiefer (*Pinus mugo*)-Bestände entfernt. Bei der Schafbeweidung (Standbeweidung) wird momentan außerdem zugefüttert, was die Nährstoffbilanz der Dünen auch verschlechtert. Die Schafe weiden außerdem in den Salzwiesen und tragen Nährstoffe in die Dünen, da sie dort häufig lagern.

Momentan stellt sich vor allem die Frage, wie der zukünftige Naturschutz in den Dünen aussehen soll. Dazu ist es erforderlich, sich der Ziele bewusst zu werden. Diese lassen sich u.a. ableiten aus den vorkommenden Lebensgemeinschaften, da die Flächen entsprechend zu erhalten sind (ges. Biotopschutz) bzw. den FFH-LRT mit Idealzustand EHZ „A“. Eine intensivierete Beweidung wäre eine mögliche Maßnahme, andererseits braucht es prinzipiell Nachschub an kalkreichem Sand vom Strand und von jüngeren Dünen, sodass die Frage eigentlich ist: Was kann der Küstenschutz an der Westküste zulassen? Weitere Maßnahmen, wie das kontrollierte Brennen oder die (Schlegel-) Mahd wären ggf. weitere geeignete Maßnahmen.

[12:55]: Das heißt die künstliche Schaffung von freien Sandflächen sollte im zukünftigen Naturschutz in den Sylter Dünen eine große Rolle spielen?

Was es eigentlich anstelle künstlicher Freiflächen braucht, ist der Nachschub an frischem, kalkreichem Sediment vom Strand.

[15:10]: In Dänemark werden Neophyten großflächig entfernt, um die typisch dänische, offene Küstenheide zu erhalten. Was soll mit den Neophyten auf Sylt geschehen?

Prinzipiell ergeben sich in der Flächenpflege drei Möglichkeiten:

In der Binnenheide findet Beweidung mit Wanderschafen statt. Die Beweidung ist nicht das Ziel, sondern das Ziel der Beweidung ist es u.a. die Kartoffelrose zu verbeißen und entsprechend zurückzudrängen. Die Beweidung wäre demnach ein Ansatz zur Neophytenbekämpfung auch in den Küstendünen. Der Erfolg hängt allerdings stark von der Herdenführung ab? Außerdem stellt sich die Frage: Wie intensiv kann beweidet werden? Es muss genügend Futter für die Tiere vorhanden sein. Beweidung im Hüte-/Pferchsystem führt auch zu Nährstoffentzug und einer Ausmagerung der Böden, Das wäre auch in der Küstenheide eine Option und wäre entsprechend zu prüfen.

Neben dem Verbiss von Kartoffelrose ist es ggf. wichtig, Vegetationsschichten zu reduzieren, die Streu abzubauen und vegetationsfreie Pioniersituationen zu schaffen. Erforderlich ist es dabei die verschiedenen Dünenstadien zu berücksichtigen und als entsprechende Ziele zu verfolgen.

Die beiden nachfolgenden Absätze haben nichts mit der Fragestellung zu tun:

Im NSG „Dünen auf dem Roten Kliff“ fehlen ebenfalls Pionierstadien. Dort gab es früher große *Arnica montana* Bestände. Plaggen, d.h. die Entfernung der Streuauflage ist nur eine Option, wenn denn eine solche Streuschicht über dem Sand vorhanden ist. Außerdem kann man Brennen: bestimmte Arten, wie die Drahtschmiele (*Deschampsia flexuosa*) lassen sich allerdings nicht brennen.

Außerdem spielt die Hydrologie eine sehr wichtige Rolle; wenn in trockenen Sommern viel Vegetation abstirbt, könnten sich periodisch Wasser führende Dünentäler vertiefen. Unter dynamischen Verhältnissen können auch neue Dünentäler entstehen. Wenn man neue feuchte Dünentäler aktiv anlegt, müssen diese flach sein, damit sie im Sommer auch trockenfallen können. Bei allen Überlegungen/ Maßnahmen muss immer der Gesamtlebensraum betrachtet werden; Einzelarten müssen immer zurückstehen.

[23:15]: Wo finden sich Unterschiede zwischen der deutschen und der niederländischen Naturschutzmentalität?

In den Niederlanden ist man experimentierfreudiger. Generell findet dort auch Beweidung statt, um Streuschichten abzubauen und die Vegetation zurückzusetzen. Für Sylt wäre ein selbsterhaltendes System wünschenswert und dem Schutz von Einzelarten vorzuziehen. Mentalitäten haben auch immer viel mit Gesetzen zu tun: In Schleswig-Holstein macht es das Landeswaldgesetz zum Beispiel sehr schwer Wälder zu beseitigen. Das war bei der Entfernung der Kiefern im Klappholttal allerdings kein Problem. Ähnliche Gesetzgebungen existieren wohl auch in den Niederlanden. Dänemark ist wesentlich weniger dicht besiedelt, dort ist die Waldentfernung einfacher.

[31:25]: Das LLUR ist auch für den Geotopschutz zuständig. Welche Rolle spielt denn der Geotopschutz?

Viele Dünen auf Sylt sind als Geotope eingestuft, allerdings ist Geotop ein Prädikat, aus dem sich kein rechtlicher Schutzstatus ableiten lässt. Allerdings sind viele geologische Formationen Bestandteil des gesetzlichen Biotopschutzes gem. Landes- und Bundesnaturschutzgesetz. Auch

Vegetationsbestände fallen unter den gesetzlichen Biotopschutz. Weitere wichtige Regelungen, die im Falle der Sylter Dünen greifen, sind für Teilflächen die EU-Vogelschutzrichtlinie, die FFH-Richtlinie oder Naturschutzgebiets-Verordnungen.

[34:05]: Wie verhalten sich der gesetzliche Biotopschutz und der Schutz nach der FFH-Richtlinie

Der gesetzliche Biotopschutz und die FFH-Richtlinie zielen auf Verschiedenes ab. Während die FFH-Richtlinie den günstigen Erhaltungszustand bestimmter Habitats auf regionaler Ebene sicherstellt und ein generelles Verschlechterungsverbot aufstellt, sind bestimmte Biotope geschützt. Eingriffe in die Biotope müssen dementsprechend kompensiert werden. *[37:10]: Welche Rolle spielen die Landeigentümer bei der Umsetzung der Naturschutzmaßnahmen? Gibt es Unterschiede zwischen privaten und öffentlichen Landbesitzern?*

Generell ist die Einstellung der Landbesitzer entscheidend. Öffentliche Landbesitzer verspüren nicht die öffentliche Betroffenheit, wie das bei privaten Landbesitzern, wie z.B. im Listland ganz anders, es ist oft den Leuten wichtig, auf ihrem Grund und Boden selbst entscheiden zu können. Natürlich müssen die Landbesitzer informiert, ernst genommen und mitgenommen werden. Auch das ist bei öffentlichen Eigentümern einfacher

[39:20]: Im Naturschutz ist Geld notorisch knapp, da sind EU Projekte eine Möglichkeit, das Budget aufzustocken. Ist das für Sylt eine Option?

Auf Sylt ist EU-Unterstützung für die Geestheiden für die nahe Zukunft angedacht. Für eine EU-Förderung muss man beachten, dass es sich dabei nicht um Pflegemaßnahmen handeln darf, sondern um investive Maßnahmen. Weiterhin bringen EU-Projekte einen großen Verwaltungsaufwand mit sich und die Zustimmung der Landeigentümer muss von vornherein geklärt sein. Das heißt, es bräuchte mehrere Schritte:

1. Was soll erreicht und dementsprechend getan werden?
2. Die Eigentümer müssen den Maßnahmen zustimmen
3. Eine Institution müsste den Antrag stellen und auch in Vorleistung gehen

Wer diese federführende Institution ist, ist nicht festgelegt; in diesem Fall käme z. B. die Untere Naturschutzbehörde, der Landschaftszweckverband Sylt oder auch eine Stiftung infrage. Das LLUR leitet in der Regel keine Projekte, weil es keine Maßnahmen durchführt.

Auch in einem solchen Projekt sollte gewährleistet bleiben, dass nicht nur einzelne Arten gefördert werden, sondern der Biotopschutz im Vordergrund steht. Allerdings sind Biotopschutzmaßnahmen aufwendiger und bedürfen eines separaten Antrags, deswegen sind Naturschutzmaßnahmen, die auf Einzelarten abzielen, oft beliebter. Damit die Ziele des Biotopschutzes gewährleistet bleiben, wurde für die Vertiefung der Dünentäler auf Sylt ein Teilmanagementplan geschrieben. Das Ziel hier war es, ein Düental, sich momentan nicht bilden kann, zu imitieren. Weiterhin muss man alle Ansprüche einer Art berücksichtigen. Es muss gewährleistet werden, dass Kröten nicht überfahren werden.

XVI. SH-07: WWF Wadden Sea Office

A. Questionnaire

- 1) Welche Rolle spielen Dünen für das WWF Wattenmeerbüro?
- 2) Derzeitiger biotechnischer Küstenschutz in den Vordünen auf Sylt:
 - a) Wo besteht Handlungsbedarf?
 - b) Wie sollte der Küstenschutz in den Sylter Vordünen nach Meinung des WWF aussehen?
 - c) Welche Konstellation von Akteuren bräuchte es für die Umsetzung?
- 3) Klimawandel und vor allem der Meeresspiegelanstieg werden den Küstenschutz langfristig vor neue Herausforderungen stellen. Um dem zu begegnen, wurde die Wattenmeer-Strategie 2100 erarbeitet, die auf wissenschaftlichen Erkenntnissen basiert.
 - a) Welche Rolle spielt die Wattenmeerstrategie im derzeitigen Küstenschutz?
 - b) Inwiefern hat sie Auswirkungen auf den biotechnischen Küstenschutz Sylts? Dünen werden darin ja nicht erwähnt.
- 4) In der KliGlobWatt Studie haben der WWF und das Ministerium verschiedene Modellbeispiele für alternativen Küstenschutz vorgestellt. Darunter sind auch viele Beispiele aus den Niederlanden und Dänemark.
 - a) Mentalitäten Dänemark:

- i) Worin unterscheidet sich die Mentalität im Dänischen und im Schleswig-Holsteinischen Küstenschutz?
 - ii) Wie wirkt sich das auf die Pflege von Küstendünen aus?
 - iii) Dänische Strategie ist es, nur dort vorzuspülen und Dünen zu befestigen, wo es erforderlich ist. Erosion wird an anderen Stellen zugelassen. Passt das nach Sylt?
- b) Niederlande:
- i) Dynamisches Dünenmanagement: In den Niederlanden hat sich die Einstellung durchgesetzt, dass der Rückgang der Küste durch Strandvorspülung gestoppt werden kann und man dementsprechend nicht mehr konsequent zu stabilisieren braucht. Außerdem erhöht die Sandauswehung ins Hinterland die Breite der Dünen. Inwiefern passt diese selbstbewusste, kontrollierende Haltung
 - ii) Building with nature in den Niederlanden meint mehr, als großflächige Sandvorspülung und Nutzen natürlicher Prozesse wo immer möglich. Generell: Wie steht es um die Einbindung verschiedener Interessen an der Westküste?
 - iii) Was sind eure Erfahrungen aus der Zukunftswerkstatt zum Dockkoog?
 - iv) Worin unterscheidet sich die Mentalität im Niederländischen und im Schleswig-Holsteinischen Küstenschutz?
- 5) Welches Image haben die Sylter Dünen?
- a) Wie groß ist das öffentliche Interesse an den Sylter Dünen?
 - b) Müsste oder sollte sich daran etwas ändern?
 - c) Ist das Image der Dünen in den Niederlanden und Dänemark anders?
- B. Summary

[00:16] Welche Rolle spielen Dünen für das WWF Wattenmeerbüro - auch im Hinblick auf die Einführung alternativer Ansätze im Küstenschutz?

Dünen sind zunächst ein wichtiger Bestandteil der Naturlandschaft des Wattenmeeres, wenn sie auch nicht überall zum Nationalpark gehören. Weiterhin sind sie Lebensraum für Tiere und Pflanzen, und waren in der Vergangenheit starken menschlichen Einflüssen ausgesetzt. An vielen Stellen besteht Handlungs- und Verbesserungsbedarf aus Sicht des Naturschutzes besteht. Bebauung, Zergliederung, Befestigung, Bepflanzung haben die Dünen stärker vielleicht als andere Teile des Wattenmeers beeinflusst. Mit Blick auf Klimaanpassung sind Dünen vom Meeresspiegelanstieg direkt und als erstes betroffen.

[02:30] Wo besteht denn der größte Handlungsbedarf? Wie sollten Dünen gepflegt oder gemanagt werden, verglichen mit der jetzigen Praxis?

Die Küstendünen sind oftmals bebaut, besiedelt, zergliedert und bepflanzte, wie zum Beispiel in St. Peter. Dementsprechend befinden sich die Dünen meist in einem ökologisch nicht ursprünglichen, teilweise auch stark verbesserungswürdigen Zustand. Auf Sylt sind die Probleme ähnlich: Bebauung, Nutzung, Bepflanzung, Festsetzungen als Maßnahmen des Küstenschutzes.

Dünen sind oft als Naturschutzgebiete bzw. FFH-Gebiete ausgewiesen, deshalb werden auch Managementpläne geschrieben und Pflege- und Entwicklungsmaßnahmen sollen durchgeführt werden, um so den Zustand der Dünen aufzuwerten. Typische Probleme sind die Überalterung der Dünen, Befestigung, Bewuchs mit invasiven Arten. Damit sind offene Standorte, sandige Flächen und feuchte Dünen selten geworden. Letztere sind oft von Grundwasserspiegelsenkung durch Entwässerung und Wasserentnahme betroffen. Dagegen muss etwas unternommen werden, etwa durch Freischieben und Anhebung des Grundwasserspiegels.

Es besteht also großer und dringlicher Handlungsbedarf an vielen Stellen. Die bisherige Arbeit in den Dünen ist oftmals kleinteiliges „Stückwerk“. Z.B. versucht die Schutzstation Wattenmeer auf Sylt Dünentäler zu renaturieren und Vegetation zu entfernen. In St. Peter-Ording wird jedes Jahr entkusselt und viel Vegetation rausgenommen. Es passiert schon etwas, in kleinem Maßstab. Dünen sind allerdings eher wie ein „vergessener“ Lebensraum, der sich ökologisch nur auf den zweiten Blick erschließt und im Vergleich zu den Wattflächen und Salzwiesen eher etwas zurücktritt. Es wird jedoch versucht – z. B. in St. Peter-Ording – auf eine offenere Dünenlandschaft hin zu arbeiten und mehr offene, sandige Flächen zu schaffen und weniger standort-untypische Pflanzen in den Dünen zu haben.

Es geht nach wie vor eher um das Erhalten des aktuellen Zustandes, mit Veränderungen wie mit dem Freischieben eines Dünentals tut man sich schwer. Bei solchen Maßnahmen gibt es viele Auflagen

und Formsachen. Die Anlieger und Nutzer und deren negative Auswirkungen werden geprüft und sind sehr wichtig.

Es ist schade, wenn man sieht was in anderen Ländern so passiert, zum Beispiel in Dänemark. In Jütland gibt es einen anderen Umgang mit Dünenlandschaften und selbst wenn dort vieles nicht vorbildhaft ist, kann man von ihrem Dünenmanagement einiges lernen.

[06:30] Der zukünftige Meeresspiegelanstieg ist zentrales Element in der Wattenmeerstrategie, die 2015 veröffentlicht wurde. Darin gibt es keinen direkten Fokus auf Dünen, jedoch umfasst er das Wattenmeer als Ganzes. Welche Rolle spielt diese langfristige Strategie im aktuellen Küstenschutz?

Die Wattenmeerstrategie 2100 ist eine handlungsleitende Strategie für Akteure im Küsten- und Naturschutz. In der Wattenmeerstrategie werden keine konkreten Schritte aufgezeigt, sondern Handlungspunkte, Ideen, Bereiche in denen man aktiv werden sollte. Das heißt nicht, dass alle Handlungsfelder darin stehen. Aus ihr sollen Maßnahmen abgeleitet werden, auch für andere Pläne wie FFH Managementpläne, sofern sie das Wattenmeer betreffen.

Eine dynamische Verlagerung der Küstenlinie steht so explizit da nicht drin, aber das passt zum Punkt „Wachsen mit dem Meer“. Damit kann sie ein wertvolles und leitendes Instrument für das Dünenmanagement sein. Noch ist das jedoch nicht in allen Teilen der Verwaltung angekommen.

Bislang ist aus der Wattenmeerstrategie das Forschungsprojekt „BaseWad“ hervorgegangen. Darin wird die Sedimentdynamik im Vorfeld von Sylt und die Verlagerung der Sandvorspülungen untersucht. Nach Meinung des WWF Wattenmeerbüros sollte mehr passieren.

[11:25]: Wo gibt es unterschiedliche Mentalitäten in Dänemark und Deutschland?

In Dänemark gibt es eine stärkere Tradition in der Nutzung von Naturgebieten wie Fischerei, Beweidung. Man muss dann entscheiden, welche Ansätze man sich anschaut und abschaut. In den Niederlanden und Dänemark ist man forscher mit Beweidung. Die Umgestaltung der Landschaften ist dort im Vergleich mit Deutschland mehr akzeptiert und gewollt. Hier wird viel auf Erhalten und Landschaft bewahren gesetzt.

Dynamisches Dünenmanagement ist in den Niederlanden Küstenschutzpolitik. In Deutschland ist der Ansatz ein anderer. Hier könnte ein Besuch deutscher Dünenmanager in den Küstendünen der Niederlande etwas bewirken, um sich anzuschauen, wie dort Dünen als Schutzelement verwendet werden. In Schleswig-Holstein werden Dünen nicht offiziell als Küstenschutzelement bemessen, übernehmen aber natürlich trotzdem eine Küstenschutzfunktion. Generell ist die Bemessung von Dünen offenbar schwieriger als bei Deckwerken oder Deichen. Das ist in den Niederlanden genauso, trotzdem werden dort Dünen und künstliche aufgeschüttete Dünen ganz gezielt als Küstenschutzbauwerke genutzt.

[15:45] In den Niederlanden und Dänemark werden Küstendünen anders gemanagt. In den Niederlanden herrscht das dynamische Dünenmanagement vor. In Dänemark dagegen wird Küstensicherung nur stellenweise betrieben und die zurückweichende Küste eher akzeptiert. Diese Bedingungen erfüllt das Listland auch, aber Land Verluste in Kauf zu nehmen, erscheint in Schleswig-Holstein noch sehr schwierig.

Landverlust wird auf Sylt an der Hörnum Odde auch toleriert. Im Unterschied zu Sylt ist Dänemark natürlich deutlich dünner besiedelt, und zweitens ist an vielen Stellen kein flaches Marschland im Hinterland. Deshalb kann man wohl da den Küstenrückgang einfacher hinnehmen und akzeptieren.

In den Niederlanden wird sehr aktiv aufgespült und man toleriert, wie in Deutschland auch, keinen Küstenrückgang. Im Prinzip bringen die Niederlande mehr Sand in das System ein und spülen ihre Inseln stärker auf. Dementsprechend kann man es leichter tolerieren, wenn ein Teil des Sandes vom Strand auch auf die Düne weht oder wieder erodiert wird. Dieses dynamische Küstenmanagement ist einfacher für jemanden zu akzeptieren, der solchen Veränderungen kritisch gegenübersteht. Trotzdem sollten im Nationalpark Wattenmeer die natürlichen Prozesse wie der Küstenrückgang dort, wo dadurch niemand zu Schaden kommt, akzeptiert werden. Das erodierte Sediment lagert sich anderswo wieder an und lässt z.B. eine Sandbank wachsen.

[19:12]: Die Delta-Kommission in den Niederlanden versucht verschiedene Landnutzungsinteressen zusammenbringen. Der WWF hat für den Dockkoog einen integrierten Entwicklungsprozess angestoßen. Was kann man in dieser Hinsicht von den Niederlanden lernen?

Vor allem Dialogfähigkeit; in den Niederlanden werden Ideen im Allgemeinen gut kommuniziert und verkauft. Zum einen werden Projekte gut vermittelt, aber man redet auch untereinander viel. Im Vergleich wirkt die deutsche Diskussion oft kleinteilig; geplante Maßnahmen werden länger und

intensiver geprüft; es dauert länger, bis eine Maßnahme anläuft. Das hat aber oft auch Vorteile für den Naturschutz.

Außerdem folgt der niederländische Naturschutz eher einem Managementgedanken. Und betätigt sich eher als Landschaftsgestalter. In Deutschland möchte man eher den Status quo erhalten. Natürlich gibt es auch in den Niederlanden Rückschläge, aber man hat den Eindruck, als würden Pilotprojekte in den Niederlanden schneller umgesetzt werden. Anscheinend führt der Dialog eher zu Kompromissen, und diese Ergebnisse werden dann zügig umgesetzt. Das heißt nicht, dass alles naturschutzfachlich sinnvoll ist oder vor Gericht Bestand hätte, aber es wird eben probiert.

[23:05] Wie groß ist denn das öffentliche Interesse an Dünen an der Westküste allgemein? Ein anderer Interviewpartner meinte, dass die Dünen lediglich zur Kulisse für den Weg zum Strand geworden sind.

Sie sind ein Element, das zur Küste gehört und einfach schön ist. Kommunen und Gemeinden, wie Sylt oder St. Peter-Ording oder Amrum, müssen zusammen mit dem Kreis allerdings noch mehr aus ihrem Naturraum Düne machen und schützen und vor Siedlungseinflüssen bewahren.

Tatsächlich werden Dünen, auch von Touristikern langsam wieder stärker wahrgenommen. Man entdeckt diese Landschaft wieder neu und vielleicht in diesem Zusammenhang auch, dass das Bepflanzen und Festlegen doch nicht das non-plus-ultra ist und man stattdessen Offenstellen schafft und vom Menschen eingebrachte Vegetation wieder entfernt. In St. Peter-Ording bildet zum Beispiel das Kaktusmoos (*Campylopus introflexus*) Teppiche über den Dünen und sorgt für den Verlust sandiger, dynamischer Lebensräume.

[27:05]: In Dänemark versucht man, Neophyten mit hohem Aufwand, ein für alle Mal aus der Landschaft zu entfernen. Haltet ihr das auch im deutschen Wattenmeer für wünschenswert?

Im Unterschied zu Deutschland versucht man in Dänemark tatsächlich, Gebiete ganz von der Kartoffelrose zu befreien. Man fängt dort einfach mal an. Die Schutzstation Wattenmeer (NSW) versucht auf Sylt, die Cranberries (*Vaccinium macrocarpon*) zu entfernen. An große Projekte, wie auf einer Insel die Kartoffelrose komplett zu entfernen, geht man tatsächlich bislang nicht ran.

Die Nationalparkverwaltungen bzw. die Naturschutzbehörden gehen das bislang nicht an und akzeptieren diesen Zustand, wie er ist und versuchen keine Veränderung. Das kommt auch daher, dass die Nationalparkverwaltungen traditionell Organisationen sind, die dafür sorgen, dass möglichst wenig Nutzung erfolgt und wenige Eingriffe stattfinden. Sie sind nicht dafür aufgestellt, um zu entscheiden, wie man so eine Düne aktiv managt. Das lässt sich auf den Ostfriesischen Inseln beobachten, wo die Nationalparkverwaltungen zumindest teilweise für den Naturschutz in den Dünen zuständig sind, vor allem auf den Ostseiten der Inseln. Dort wird versucht, die Dünen möglichst nicht zu beeinflussen, da ja natürliche Entwicklung stattfinden soll. Und natürlich ist es am schönsten, wenn Dünenverjüngung über Sturmfluten oder andere natürliche Prozesse stattfindet und nicht durch den Eingriff des Menschen.

[29:50] Das heißt es wäre wünschenswert in Deutschland zumindest zu versuchen, wie man invasiven Pflanzenarten beikommen könnte?

Man könnte sich als Ziel setzen, eine Wattenmeerinsel oder ein Gebiet von der Kartoffelrose oder der Spätblühenden Traubenkirsche (*Prunus serotina*) zu „befreien“ und dann mit einer Insel oder einer Inselecke beginnen.

Auf Sylt muss der Gedanke erstmal durchsickern, dass der Sedimenttransport vom Strand ins Hinterland gut für die Insel ist. Dort ist bislang die Tradition vorherrschend, alle Windrisse zu schließen und einen stabilen Dünengürtel zu schaffen. Das sind die Ausgangsvoraussetzungen für die derzeitige Diskussion.

[32:15] Dass Wanderdünen eine Gefahr darstellten, gab es auch in Dänemark und den Niederlanden. Trotzdem scheint es, als hätten die Menschen dort einen anderen Bezug zu ihren Dünen. Was sind Deine Erfahrungen?

Es scheint so, dass Dynamik öfter akzeptiert wird. Es gibt auch aber dort stellenweise Proteste, z.B. auf Terschelling. Dort konnten dann ebenfalls nicht alle Teile des Projekts umgesetzt werden. Es stellt sich die Frage, warum diese Ideen in Deutschland noch nicht angekommen sind. Es fehlen bislang oft die Akteure in den Verwaltungen, die solche Ideen in den Verwaltungen voranbringen. Der WWF versucht das zu ändern. Aber z. B. die Naturschutzakteure auf Sylt fühlen sich ebenso dem Erhalt ihrer Kulturlandschaft verpflichtet. In dem Zusammenhang hat die NSW eine progressive Sonderrolle inne, aber auch sie stößt an die Grenzen des Machbaren und Akzeptierten.

Die Sichtweise „Dünenschutz ist Küstenschutz“ im Sinne einer fixierten Düne und das Bestreben, alle Dünen zu bepflanzen, stammt aus dem Küstenschutz und ist mental tief verankert. Dass es nicht schlimm ist, dass eine Düne einen Windriss hat, passt damit nicht zusammen. Diese Mentalität scheint auf Sylt besonders verbreitet zu sein. In Dänemark ist dieser Gedanke auf jeden Fall deutlich weniger verbreitet.

In den Dünen bedarf es einer aktiven Rolle des Naturschutzes. Dort ist manchmal ein aktiveres, direktes Management nötig, wenn der Zustand der Dünen zuvor durch menschliche Aktivitäten verschlechtert wurde. Da Dünen in Schleswig-Holstein oft außerhalb des Nationalparks liegen, sind Managementmaßnahmen dort einfacher möglich und wünschenswert.

XVII. SH-08: Sölring Foriining

A. Questionnaire

- 1) Die SF betreut auf Sylt mehrere Dünengebiete
 - a) Wo besteht der größte Handlungsbedarf?
 - b) Wie müsste der Naturschutz in den Sylter Dünen folgerichtig aussehen?
 - c) Wie soll dieser erreicht werden?
- 2) In dieser Strategie:
 - a) Nach wissenschaftlichen Erkenntnissen bringt ein erhöhter äolischer Sedimenttransport Vorteile für die Klimaanpassung wie auch für die Biodiversität mit sich. Welche Rolle spielt eine Wiederbelebung der Dünen für die SF?
 - b) Neophytenbekämpfung
 - i) Ergebnisse aus Dänemark: Bedarf an großflächigen Entfernung um die Wiederbesiedlung zu vermeiden?
 - ii) Ergebnisse Niederlande: Radikale Maßnahmen wie großflächiges Abplaggen des Oberbodens zeigen Wirkung. Ist so etwas denkbar?
 - iii) Beide: Nachpflege durch Beweidung: Kann es auf Sylt umgesetzt werden?
 - c) Wie sieht die Zusammenarbeit mit anderen Interessengruppen (Tourismus, Jagd, Küstenschutz?) aus?
 - d) Welche Rolle spielen öffentliche und private Landbesitzer? Gibt es Unterschiede?
- 3) Die NSW als Betreuungsverein
 - a) Was charakterisiert die SF im Vergleich zu anderen Naturschutzvereinen auf Sylt?
 - b) Welche Rolle spielt das Ziel einer unberührten Natur, in die der Mensch möglichst wenig eingreift?
- 4) Welches Image genießen die Dünen auf Sylt?
 - a) Wie groß ist das öffentliche Interesse an Dünen?
 - b) Was sind die Reaktionen auf die durchgeführten Naturschutzmaßnahmen?
 - c) In Dänemark und den Niederlande werden Dünen stärker in das Tourismuskonzept mit eingebunden, dort gibt es Hinweisschilder, Infotafeln, etc. Auf Sylt findet sich kein Dünenlehrpfad. Ist das Interesse an Dünen auf Sylt geringer als anderswo?

B. Summary

[00:10]: Was sind die Aufgaben der Sölring Foriining als Betreuungsverein in den Sylter Dünengebieten?

Die Sölring Foriining ist ein Verein mit 1700 Mitgliedschaften, was in etwa 2600 bis 2700 Mitgliedern entspricht. Er hat verschiedene Aufgaben: In seiner ersten Rolle als Naturschutzverein betreut die Sölring Foriining auf Sylt sechs Naturschutzgebiete, davon 4 Dünengebiete entlang der Westküste. Das naturschutzfachliche Ziel ist eine Erhaltung der traditionellen Dünenlandschaft. Der Referenzzustand entspricht dem Zeitraum 1700-1800. Zurzeit lassen sich folgende Prozesse in den Dünen beobachten: Obwohl die klassische Lehrmeinung davon ausgeht, dass das Klima auf den Küstenheideflächen zu harsch sei, als dass sich Neophyten wie die Kartoffelrose (*Rosa rugosa*) oder das Kaktusmoos (*Campylopus introflexus*) dort etablieren könnten ist die Zuwanderung an Neophyten zurzeit hoch. An Stellen, wo Küstenschutzmaßnahmen wenig intensiv stattfinden, gibt es kleinskalige Auswehungsprozesse.

Weiterhin ist die Sölring Foriining ein wichtiger Kunst- und Kultur- und Heimatverein, der sich der Denkmalpflege und der Bewahrung des Söltrings verschrieben hat, eine Trachtengruppe hat und 4 Museale Einrichtungen betreibt. Nicht zuletzt ist die Sölring Foriining ein Lobbyverein für

Küstenschutz, der in den 70er Jahren auf Kommunal-, Landes- und Bundesebene erfolgreich stark für die Einführung der Sandvorspülung warb

Aus dieser Perspektive sind geschlossene Dünenketten wünschenswert und sind Windrisse und Overwashes unerwünscht. Dies gilt insbesondere an den drei bis vier Erosions-Hotspots auf der Insel, wo es aufgrund der Strömungsverhältnisse immer wieder zu Erosion kommt. Auch die Kartoffelrose ist aus dieser Sicht weniger kritisch, stabilisiert sie doch Dünen sand ähnlich gut wie Strandhafer (*Ammophila arenaria*).

Das Thema Dünenpflege ist demnach auch innerhalb des Vereins kontrovers.

[08:45]: Welche Rolle spielt die Rolle der Sölring Forining als Kultur- und Heimatverein in der Dünenpflege?

Als Kultur- und Heimatverein ist der Sölring Forining sehr am Erhalt des althergebrachten Landschaftsbildes gelegen. Das lässt sich anschaulich an den Salzwiesen der Inselrückseite erläutern. Die dortigen Salzwiesen waren seit jeher Allmendeweiden und wurden bis in die 90er Jahren beweidet. Danach kam die Beweidung für fünf Jahre zum Erliegen. Seitdem wird versucht die Beweidung wieder aufzunehmen, was aber aufgrund nicht vorhandener Genehmigungen und im zweiten Schritt an fehlender Bereitschaft der Landwirte ((freilaufende Hundeproblematik) derzeit nicht gelingt. Die Sukzession zum Schilfmeer und dann Birkenwald soll unterbunden werden findet aber derzeit statt.

Der gleiche Gedanke steht auch hinter der Pflege der Atlantischen Heide an der Westseite: auch dort besteht aus Sicht der Sölring Forining Handlungsbedarf. Die zuständigen Behörden sahen dort bislang oft weniger Anlass zum Eingreifen.

Folglich kommt der Erhalt der Landschaft auch in Dünengebieten zum Tragen. Als einziges Dünengebiet auf Sylt wird das Listland nach wie vor mit Schafen beweidet, momentan zur Hälfte. Möglicherweise ist diese Beweidung der Grund, dass sich im Listland weniger Kartoffelrose findet. Auch in den angrenzenden Salzwiesen zeigt die Beweidung subjektiv betrachtet Erfolge, da dort mehr Wiesenvögel brüten, ein gewünschtes Szenario. Die Beweidung hält die Vegetation hält die Wiese kurz. Mit Beweidung wurden also gute Erfahrungen gemacht.

[13:10]: Wäre auch eine Pflege mit größeren Weidetieren (Galloways, Highland-Rinder) denkbar?

An manchen Stellen in SH werden auch Konikpferde zur Beweidung von Dünenlandschaften eingesetzt. Auf Sylt NICHT. Die Diskussion über eine intensivere Beweidung findet zurzeit statt. Momentan gibt es auf der Insel eine Wanderschafherde; diese wird vom Landschaftszweckverband und dem Land SH finanziert. Der Landschaftszweckverband, ein Zusammenschluss der Sylter Gemeinden, kümmert sich zudem um die Pflege der Gemeindeflächen außerhalb der bebauten Ortslagen (Wege und Küstenschutz).

Diese Herde könnte aufgestockt werden oder aber auch um eine Herde mit anderen auch andere Tiere, wie Ziegen oder Robustrindern ergänzt werden. Die Stimmen, die eine zunehmende Beweidung fordern, werden lauter. Andererseits, gibt es auch Befürchtungen, dass dann die Trampelpfade in den Dünen durch Vertritt wieder breiter werden könnten und möglicherweise auch wieder von Menschen genutzt würden. Im Fall von Robustrindern sind massive und damit teure Zäune nötig, um die Tiere von den unzähligen Rad- und Autofahrern – vor allem während der Hochsaison - zu separieren.

[15:55]: Die Bekämpfung von Neophyten ist ein kontrovers diskutiertes Thema. In den Niederlanden und auch Dänemark werden große Anstrengungen unternommen, um Neophyten ein für alle Mal loszuwerden.

Die bisherigen Versuche *Rosa rugosa* zu entfernen, waren nur kurzfristig erfolgreich. Schließlich muss das gesamte Wurzelwerk mit entfernt werden. Anstelle von ein- oder zweimaligem Beschneiden bräuchte es große Anstrengungen, die Pflanzen müssten lange Zeit abgedeckt werden. Eine Alternative wäre Schnitt und anschließende Beweidung, die zum Verbiss der Pflanze führt. Da *Rosa rugosa* stellenweise sehr dichte Bestände bildet, ist eine flächendeckende Entfernung momentan unrealistisch. Einzelne Herde, wie auf dem Ellenbogen, lassen sich eher kontrollieren.

Bei der Spätblühenden Traubenkirsche (*Prunus serotina*) ist die Situation ähnlich: Bloßes Schneiden bringt keinen Erfolg; die Pflanzen treiben erneut aus. Ringeln der Stämme wurde auf Sylt noch nicht probiert. Auch bei dieser Art muss das gesamte Wurzelwerk mit entfernt werden.

Allerdings kommt diese Art bisher eher auf den Geestheiden denn in den Dünengebieten vor. Das gleiche gilt für Eberesche (*Sorbus aucuparia*) und auch die Felsenbirne (*Amelanchier ovalis*) wächst zurzeit nur vereinzelt von der Heide in die Dünenflächen.

[20:55]: In den Niederlanden wird seit Mitte der 1990er Jahre Dynamisches Dünenmanagement betrieben. Dort stoppten die großen Mengen vorgespülten Sandes den Küstenrückgang und Auswehung eines Teils des Sandes in die Vordünen wird zugelassen. Wäre dieses Konzept auf Sylt auch denkbar?

Es ist durchaus vorstellbar, dass diese Methode auch auf Sylt Erfolg hätte. Die Sedimentmengen, die der Wind umlagern kann, lassen sich während langer Ostwindperioden beobachten. Vermutlich werden größere Mengen Sand aus Kostengründen nicht vorgespült. Möglicherweise könnte eine Exkursion der zuständigen Behördenmitarbeiter in die Niederländischen Dünen ein Pilotprojekt mit anstoßen.

[24:05]: Die äußerste Dünenkette ist ja in vielen Fällen als Naturschutzgebiet geschützt, wird aber auch vom LKN gepflegt. Wie sieht die Zusammenarbeit aus?

Zwischen den Küstenschutzabteilung des LKN und der Sölring Forining gibt es Kontakt. Der Verein nimmt zum Beispiel an Deichbeschauungen und Strandbefahrungen teil. Da sich die Behördenstrukturen professionalisieren, nimmt der Kontakt allerdings sukzessive ab.

Formell ist die Zusammenarbeit unterschiedlich, da die seeseitigen Naturschutzgebiets-Grenzen unterschiedlich verlaufen. Im Naturschutzgebiet „Nord-Sylt“ ist es das Mitteltidehochwasser, in den Gebieten „Baakdeel“ und „Rantum-Süd“ jedoch die Dünenkante.

[27:55]: Welche Rolle spielen die Landbesitzer bei der Durchführung von Naturschutzmaßnahmen?

Im Naturschutzprojekt zur Vertiefung der Dünentäler südlich von Rantum war der Landschaftszweckverband Partner. In diesem Gebiet ist besonders deutlich, wie der „Überschutz“ in den vergangenen Jahrzehnten zu einer „Verschlechterung“ des Gebiets aus einer naturschutzfachlichen Perspektive geführt hat. Dieses Projekt war zudem ein gelungener „Übungslauf“ für weitere Projekte, an dem viele (auch dänische) Partner beteiligt waren. Eine Hürde, die es zu bewältigen galt, war der „A“-Status der Projektflächen nach der FFH-Richtlinie. Eigentlich sind in solchen Gebieten keine weiteren Pflegemaßnahmen nötig.

[30:10]: Gibt es Unterschiede zwischen privaten und öffentlichen Landbesitzern?

Zunächst muss man dabei den Schutzstatus des Gebietes berücksichtigen: Handelt es sich um streng geschützte Flächen oder ist es „ungeschütztes“ Land? Außerdem können auch die Eigentümer von geschützten Flächen wirtschaftliche Interessen haben, etwa durch die Förderung von Grundwasser. Diese kollidiert mit-Naturschutzzielen.

Eigentümergeinschaften sind ebenfalls komplizierter als einzelne Eigentümer, aber auch die Herkunft der Landbesitzer ist entscheidend. Erfahrungsgemäß erhält man von Landeigentümern, die dauerhaft auf der Insel wohnen, eine klare Antwort, während Landeigentümer, die sich nur zeitweise auf der Insel aufhalten, oft weniger Interesse am Naturschutz auf der Insel haben. Dementsprechend sind Verhandlungen mit Eigentümern, die nicht von der Insel stammen, in der Regel schwieriger.

[32:05]: Welches Image haben die Dünen auf Sylt, bzw. wie groß ist das Interesse an den Dünen?

Das Interesse an Wattführungen ist oftmals größer als an Veranstaltungen in den Dünen. Dafür gibt es zwei Gründe: erstens hat sich das Motto: „Dünenschutz ist Inselschutz“ tief in das kollektive Gedächtnis von Gästen wie Einheimischen eingebrannt. Dementsprechend betritt niemand mehr ohne schlechtes Gewissen die Dünen.

Weiterhin ist das Angebot an touristischen Veranstaltungen in den Dünen vergleichsweise gering. Die einzige regelmäßige, kommerzielle Führung abseits der Wege bietet zurzeit das Erlebniszentrum Naturgewalten in List an. Weitere Führungen bedürfen einer begründeten Ausnahmegenehmigung. Allerdings wäre es durchaus denkbar, das Wegenetz auszubauen und so die Landschaft erlebbarer zu gestalten. Nicht zuletzt, um auch den Bewohnern von Sylt und deren Kindern die Inselnatur wieder näher zu bringen. Vorbild könnten hier die großen Dünengebiete entlang der Ostseeküste Litauens sein.

XVIII. Seminar Talk: Functional restoration of bogs and dunes. Lessons from 25 years of practice and research

Nijssen, Marijn (Bargerveen Foundation)

A functional approach restoration of habitats is based on the ecological traits of the fauna as well as on conditions and processes. This is explained by the role of the red-backed shrike (*Lanius collurio*)

for the restoration on habitat restoration. During the 1990s, the Dutch breeding population of red-backed shrikes collapsed in most parts of the country due to the intensification of agriculture. However, numbers increased around the restored peat bog Bargerveen. Examinations revealed, that the landscape there, provided enough open patches, where in turn lives the variety of insects that red-back shrikes depends on for feeding their chicks. The animals retreated from the central part of the restored bog during the following decades as the emerging conditions got unfavourable for them.

In coastal dunes, red back shrikes and wheatears (*Oenanthe oenanthe*) heavily rely on sandy patches such as blowouts as they harbour the necessary abundance of insects as well. By restoring the necessary morphological processes, these species can be supported.

XIX. Seminar Talk: Cattle on loan - enabling private cattle herds to be built without investment costs

Lindholm, Sisse (Municipality of Fredrikshavn)

The LIFE-REWETDUNE Project took great effort to restore the open dune heath at Hulsig Hede and elsewhere by removing non-native shrubs and trees. However, without aftercare, the area will be encroached by these species again. Besides the wild Roe and Red deer that feed on the seedlings and trees and the partially restored hydrology of the area cattle long-term grazing should be introduced to suppress succession.

As a voluntary landowner association having the same goal failed a couple of years ago due to a lack of commitment and accountability, this time a different approach was chosen. The basic idea is that the aftercare is already planned and funded during the actual project. This encompasses money for developing an aftercare management plan for the responsible municipality of Fredrikshavn and to by both the Galloway cattle and the necessary equipment, such as fences and a trailer.

The plan intends that the cattle can be loaned by private landowners for five years for grazing on their property. During this time two inspectors guide and help the landowners, which may not have dealt with cattle before to ensure the welfare of the animals and the goals of nature conservation. After the 5 years, the landowner has to return the same number of animals in the same condition. In turn, he may keep any excess calves that have been born during these five years. Then these cattle might be loaned again to another landowner. This task is done by the municipality of Fredrikshavn.

Landowners have indeed interest in loaning cattle, however, there also remain challenges to the grazing. The advices of the two inspectors might be contradictory, for instance for the well-being of the cattle, a lower grazing intensity might be needed in some place, because of the low nutritional value of the grasses. For nature conservation, however, a higher grazing intensity might be desirable. From an economic point of view, it is still difficult to sell the meat of the animals.

XX. Different approaches to remove *Rosa rugosa* at the LIFE REDCOHA and the LIFE REWETDUNE Project

Frisk, Karsten (Naturstyrelsen) & Lindholm, Sisse (Municipality of Fredrikshavn)

At the REDCOHA LIFE Project along the Jutish west coast, different methods to remove the invasive shrub *Rosa rugosa* were tested and compared. There, the most efficient method turned out to be digging down and costs about 2 €/m². Shredding *R. rugosa* with a biorotor applied to a tractor two to three times achieves a similar result and costs about 0.8 to 1.5 €/m². Further methods were used, but did not turn out to work that well: Chemicals have to applied several times and add up to 2-2.5 €/m². Covering the cut down stubs with a light absorbing tarp costs 12 to 13 €/m².

At the LIFE REWETDUNE Project *R. rugosa* was removed at a large scale at Grenen, the northernmost part of Skagen. The goal was to eradicate the rose on about 7 ha. There, the rose was cut down manually or with a specialised robot first. Then, every rose has been cut down manually every fortnight for four years now. Every season, fewer plants come into bud. Eventually, the small, weakened plants are dug out. Presumably, after another six years all plants will have been gone.

XXI. Test of methods to combat *Prunus serotina*

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Within the LIFE WETHAB Project, 5 different methods were tested to remove the invasive American black cherry (*Prunus serotina*). The effect of the different methods was monitored with the help of four questions: Has the plant survived the treatment? Has the plant survived the treatment and

created new shoots from the roots? Has the plant survived and produced new shoots from the stub? Has the plant re-rooted itself?

First, some trees were ringed over a length of 50 cm along the trunk to remove the cambium, i.e. the inner and outer bark of the tree. After one year, it resulted in vigorous development of new shoots from the stub. Second, small plants were covered with thick black plastic bucket, which in turn were fixed with three tent pegs of each 40 cm length. However, one year of coverage did not seem to be long enough. Third, also larger plants were covered with a bucket after being cut at ca. 10cm above ground. Also these buckets were covered with three tent pegs. Fourth, small plants were uprooted were pulled up, turned around and stick into the ground upside down. Fifth, plants are just cut down and the cut part is not removed from the place but just left at the place.

XXII. National Park 2.0. A new standard for Dutch National parks: scale, international exposure, new combinations

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The Dutch national Parks have a particular history. Whereas the idea of national parks of sublime, untouched wilderness originated in the US in the 19th century and was imitated in the course of the 20th century in many places in Europe like Sweden or Germany, a different path was chosen in the Netherlands. Because of the lack of untouched wilderness, the Dutch national parks should represent the country's most typical landscapes and should support nature, recreation, education and research. Compared to other countries, the Dutch national parks are rather small, as they must cover a minimum size of at least 1,000 ha. The first national park in the Netherlands was founded in the 1930s.

However, when the Dutch nature conservation policy was decentralised in 2012, the national parks were simply forgotten, i.e. nobody really felt responsible for them. Then, the 20 small national parks did not match with international expectations, were not well-known in the public and - differing from their former aim – were mostly restricted to nature reserves instead of featuring typical landscapes.

To overcome that state, a future, integrated perspective for 2030 was developed. Therein, the national parks should be turned into natural gems showcasing the natural and cultural history of the area that also serve as destination for sustainable tourism and recreation. To achieve that goal, zoning plans that combine functions wherever possible are an important tool. This strategy also reflects typical elements of the Dutch national mentality, which includes to make the best use of the limited space, with a focus on recreation. The national parks are thus seen as a motor for the regional economy. Nature conservation is done thoroughly and with a strong sense for responsibility. New insights are incorporated quickly and with a will to experiment.