

Master thesis

An investigation of sailing activities as a possible pathway for marine
plastic litter in the southern North-Sea region

Double Degree M.Sc. Water and Coastal Management

M. Sc. Environmental and Infrastructure Planning

Markus Merten

Markus.Merten@uni-oldenburg.de

M.Merten@student.rug.nl

University of Oldenburg: 5039507

University of Groningen: S3837912

1st Supervisor - Femke Niekerk

f.niekerk@rug.nl

Faculty of Spatial Sciences

University of Groningen

2nd Supervisor - Peter Schaal

Peter.Schaal@uni-oldenburg.de

Institute of Biology and Environmental Sciences

University of Oldenburg

"No one will protect what they don't care about;
and no one will care about what they have never experienced"

Sir David Attenborough

Abstract

Over eight million metric tons of plastic end up in the world's oceans annually, threatening ecosystems and leading to environmental degradation. In order to develop strategies that can limit the amount of plastic ending up in the environment and minimizing the consequences for numerous receptors, it is necessary to identify possible sources and pathways. The sailing sport is considered a large industry operating in the southern North-Sea region. Numerous policies and regulatory measures have already been implemented, legally prohibiting plastic and other types of trash entering the marine environment through sailing activities. Responding to the increasing number of new pathways and sources for marine litter, this research investigates to what extent the sailing sport along the coastline of Lower-Saxony Germany contributes to the problem of plastic pollution in the marine environment and how possible points of entry can be managed. This research applied a deductive approach, using semi-structured interviews with relevant stakeholders and observations as method of data retrieval. The results reveal that the possible points of entry for plastic entering the marine environment through sailing activities are rather limited. The problem perception was identified as the main driver for considering the sailing sport as possible pathway for marine litter. The results highlight that the problem perception regarding plastic pollution has changed over past decades to an increasing pro-environmental behavior across the sailing community. However, this change has not reached everyone within the sailing community. The sailing clubs along the coastline entail a unique position of initiating a change in the sailors' problem perception and pro-environmental behavior.

Key Words: Marine Litter, Plastic Pollution, Sailing Sport, Problem Perception

Table of Contents

| | | |
|-----------|--|-----------|
| 1. | Introduction | 1 |
| 1.1. | Scientific and Societal Relevance | 2 |
| 1.2. | Presentation of the Research Questions | 3 |
| 1.3. | The Outline of the Thesis | 5 |
| 2. | Theoretical Framework | 8 |
| 2.1. | Sources of Marine Litter | 10 |
| 2.2. | Plastic | 11 |
| 2.2.1. | Primary Microplastics | 11 |
| 2.2.2. | Secondary Microplastics | 12 |
| 2.3. | Sea-based Sources | 13 |
| 2.3.1. | Fishing Industry..... | 13 |
| 2.4. | Land-based sources | 14 |
| 2.4.1. | Agriculture | 14 |
| 2.4.2. | Ship Maintenance | 15 |
| 2.4.3. | Tourism and Recreation | 15 |
| 2.4.4. | Rivers as Pathway | 16 |
| 2.5. | Receptors and Consequences | 17 |
| 2.5.1. | Impacts on the Environment | 17 |
| 2.5.2. | Impacts on the Society | 18 |
| 2.5.3. | Aesthetic and Economic Impacts | 18 |
| 2.6. | Plastic Pollution: Transition Theory | 19 |
| 2.7. | Formal and Informal Institutions..... | 21 |
| 2.8. | The Notion of Complexity | 24 |
| 2.9. | Conceptual Model | 25 |
| 3. | Methodology | 27 |
| 3.1. | Methods of Data Retrieval | 27 |
| 3.1.1. | Semi-Structured Interviews..... | 28 |
| 3.1.2. | Observations..... | 31 |
| 3.1.3. | Explanation of the Coding-Tree..... | 32 |
| 4. | Results | 34 |
| 4.1. | Problem Scope: Points of Entry during Sailing Activities..... | 36 |
| 4.1.1. | Recreational Sailing Activities on the Sea | 36 |
| 4.1.2. | Activities and Life in the Marina & the Impact of Waste Infrastructure | 38 |

| | | |
|-------------|--|-----------|
| 4.1.3. | Dominant Maintenance Practices..... | 41 |
| 4.1.4. | Synthesis: Problem Scope | 43 |
| 4.2. | Problem Perception | 43 |
| 4.2.1. | Attitude towards Sustainability and Plastic Pollution..... | 43 |
| 4.2.2. | Perspective of Board Members (Sailing Club Representatives)..... | 46 |
| 4.2.3. | Perspective of a Members and Non-Members | 49 |
| 4.2.4. | Synthesis: Problem Perception..... | 49 |
| 4.3. | Managing Problematic Points of Entry | 51 |
| 4.4. | Synthesis..... | 53 |
| 4.5. | Discussion and Critical Reflection of this Research | 54 |
| 5. | Conclusion..... | 58 |
| 5.1. | Windows of Opportunity for further Research | 60 |
| 6. | References | 61 |
| 7. | Appendix | 66 |
| 7.1. | Interview Guidelines | 66 |

List of Figures

| | |
|---|----|
| Figure 1: Thesis Outline: Chapter 1 and 2 | 5 |
| Figure 2: Content of the Theoretical Framework..... | 5 |
| Figure 3: Thesis Outline: Chapter 3 and 4 | 6 |
| Figure 4: Thesis Outline: Chapter 5 | 7 |
| Figure 5: Source-Pathway-Receptor-Consequence Model, by Authors Own..... | 8 |
| Figure 6: Box: Primary Microplastic and Secondary Microplastic..... | 11 |
| Figure 7: Reinforcing Coghweel, based on Loorbach, 2002..... | 20 |
| Figure 8: Four Phases of a Transition, based on Loorbach, 2002 | 20 |
| Figure 9: Multi-Stage Concept and Interplay in a Transition, based on Geels, 2005 | 21 |
| Figure 10: Influential Network of the Macro-, Meso- and Micro-Level, Authors Own..... | 23 |
| Figure 11: Conceptual Model..... | 26 |
| Figure 12: Derivation of the three Dimensions of Knowledge onto the Questionnaire..... | 29 |
| Figure 13: Coding Tree | 33 |

| | |
|---|----|
| Figure 14: Map of Observations Sites, Authors Own, based on Esri, HERE, Garmin, FAO, METI/NASA, USGS..... | 34 |
| Figure 15: Pictures Nordenhamer Yachtharbour Information Boards, Authors Own | 38 |
| Figure 16: Different Scales within the Sailing Community..... | 48 |
| Figure 17: Application of the Conceptual Model onto Research Findings..... | 52 |
| Figure 18: Transition of the Problem Perception | 54 |
| Figure 19: Domains influencing the Problem Perception | 55 |

List of Tables

| | |
|---|----|
| Table 1: Formal Institutions on a Macro-Level, created by author..... | 22 |
| Table 2: Interviews conducted during this Research | 35 |
| Table 3: Observation Sites | 36 |

1. Introduction

It is evident that human action has created a variety of environmental problems such as climate change, pollution and deforestation. One part of the Environmental degradation is the plastic pollution of the planet ecosystems.

Plastic pollution and marine litter have been discussed widely and are generally accepted in our society. With many land- and sea-based sources, plastic travels with ocean currents to distant, isolated, and unpopulated regions harming ecosystems and their wildlife (ICES, 2018; Li, Tse, & Fok, 2016; Mengo, 2017). Recent studies have shown that small particles of plastic (microplastics) have been found in human digestive systems exposing that plastic pollution has reached our own food-chain with unforeseeable consequences for the human health. Plastic consumption is increasing and so is the amount of plastic trash, which is accumulating in recycling facilities or landfills, resulting in more plastic possibly entering the environment with unpredictable consequences (Li et al., 2016).

The scientific community has mobilized a lot of effort to identify the current scope of plastic pollution and its various land- and sea-based sources. Sea-based litter contributes to about 20 percent of the total amount of debris in the ocean (Li et al., 2016). Industries such as fisheries, offshore windfarms and recreational cruises are among the major contributors of sea-based litter (ICES, 2018; Li et al., 2016; Mengo, 2017). A large portion of debris that is washed up on the coast, has its origin in fishing activities. Over 6600 fishing vessels from nine different European nations are active in the greater North-Sea area of which Germany accounts for 220 fishing vessels in their fleet (ICES, 2018). The fishing industry intentionally and unintentionally discards fishing gear such as nets, pots, ropes, dolly rope and nylon netting which results in a large quantity of plastic accumulating in the sea (ICES, 2018; Li et al., 2016; Mengo, 2017). As the sailing sport is another big industry operating in the sea and entails a close connection to immediate marine environment, this research will investigate to what extent sailing activities contribute to plastic pollution in the North-Sea area.

Nonetheless, one should note that it is difficult to determine the exact number of active sailing vessels in comparison to fishery vessels in the North-Sea as a registration of sailing vessels in Germany is only necessary if the vessel for open sea is longer than 15 meters (Amtsgericht Bremen, n.d.). It is to be investigated if sailing activities contribute to the problem of plastic pollution and if so, to what extent.

In order to minimize the impact of plastic pollution, global, international, national, regional and local measures have been taken in order to prevent litter from entering the environment. These policies and initiatives aim not only for prevention but also mitigation and remediation of plastic entering the marine environment. However, these measures require a tailor-made and context dependent implementation settings in order to work in a most effective way. These measures can be distinguished among different scales from a macro-level, such as environmental policies established by the European Union over a meso-level to a micro-level perspective where the communication and behaviours of and between individuals play a major role. While formal institutions such as rules, and legislation aim for reduction of plastic litter with a legislative execution of power. Informal institutions implemented in societies and cultures aim for interaction of people and their communication with each other. Both kind of institutions are powerful tools as instruments for changing people's behaviour and to limit the amount of plastic entering the marine environment.

The result of the investigation of recreational sailing activities and perception of sailors about plastic pollution give implications for prevention and minimization strategies that could decrease the impact of plastic pollution onto the marine environment. The proposed measures will be based both on the findings of this research and on the theoretical debate of recent published scientific papers and reports with a focus on formal and informal regulatory instruments that can be applied and implemented to limit an environmental impact by human activities.

1.1. Scientific and Societal Relevance

The research project “*Macroplastics*” conducted by the University of Oldenburg has been investigating the geographical distribution of plastic pieces in the southern North-Sea and its possible sources. Scientific researchers have already identified a great number of sea-based sources for marine litter such as fisheries and recreational cruises (Li et al., 2016). However, the sailing community and its activities have been neglected within this research so far. Therefore, the research group formulated the leading assumption, that with the operation of sailing vessels and marinas at the coast and around the islands, a significant source of plastic has largely been overlooked in the investigation of pathways of plastic pollution. This research focuses on this knowledge gap and aims to identify another possible source and pathway for marine littering in the geographical frame of the coastline of Lower-Saxony, Germany. By doing so, specific sailing activities such as the life in the marina, life at sea and the maintenance

of sailing boats will be investigated in order to identify possible pathways that allow plastic to enter the marine environment.

With the help of the collected scientific data, new minimization and prevention measures and strategies are formulated. These strategies might help the operators of sailing vessels and marinas to minimize their impact on plastic pollution.

1.2. Presentation of the Research Questions

This research aims to identify additional sources of plastic marine litter. Therefore, this research entails a threefold research objective: (1) the problem scope will be identified, (2) the problem perception of the relevant stakeholder will be analysed, and (3) outlines the identified knowledge gaps and the derivation of minimization strategies and prevention measures. Therefore, two primary research questions have been formulated:

To what extent do recreational sailing activities on the coast of Lower-Saxony and its surrounding islands contribute to the problem of plastic litter entering the marine environment?

How can problematic entry points for plastic entering the marine environment be managed?

The secondary research questions fulfill their purpose by being able to answer the primary research question. They specifically aim to identify possible sources that allow plastic to enter the marine environment during sailing activities. Moreover, communication patterns of relevant stakeholders within the sailing industry shall be derived as well.

Secondary research question being answered by findings of the theoretical framework:

What role do informal institutions play in terms of communication about pro-environmental behavior and the prevention of plastic entering the marine environment?

Secondary research questions being answered by the empirical findings of this research:

What are possible sources (points of entry) for marine litter entering the marine environment during different recreational sailing activities?

How are organizational structures, such as provision of information of the marina and sailing clubs, influencing the sailing community in terms of plastic pollution?

How is the problem of plastic pollution being perceived by relevant stakeholder within the sailing community?

How are technical structures and measures such as waste management by the marinas influencing the sailing community in terms of plastic pollution?

Secondary research questions that create a synthesis of the findings in the theoretical framework and the empirical findings:

What are possible, effective prevention measures?

What are possible, effective minimization strategies?

The next chapter will outline the structure of this thesis and research explaining the line of thought of the chapters of the theoretical framework, the methodology, the results and discussion.

1.3. Outline of the Thesis

In order to create a coherent and structured line of thought the chapters and their context will be outlined. Chapter 1 will first give a general description of the specific context of this research outlining the used scientific methods.

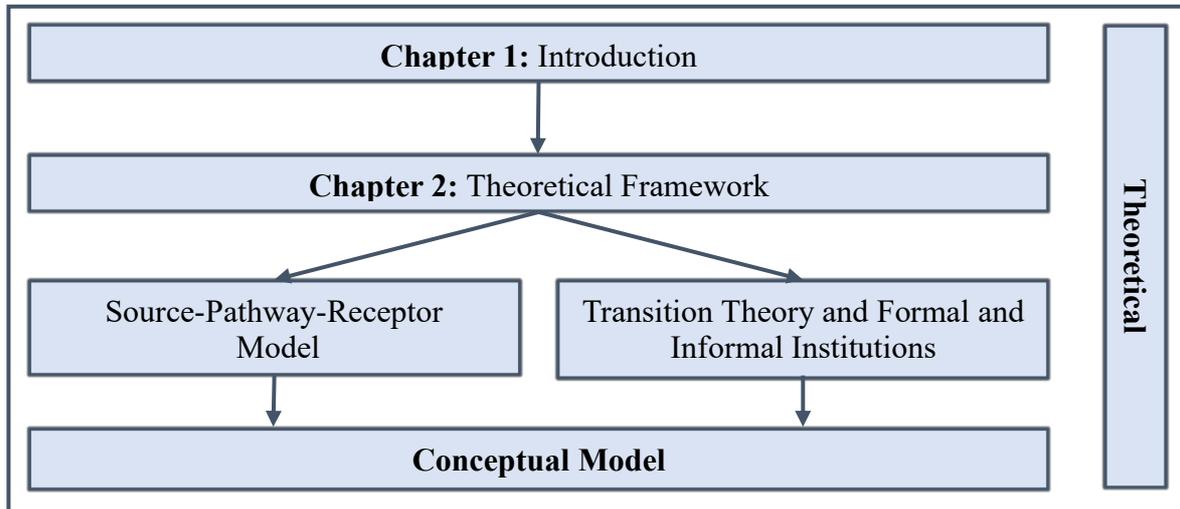


Figure 1: Thesis Outline: Chapter 1 and 2

Chapter 2 will elaborate the current state of research discussing various sources and pathways for plastic litter entering the marine environment by using the Source-Pathway-Receptor-Consequence model as an instrument to frame the problem of plastic pollution. Furthermore, the transition towards a more pro-environmental consciousness and behavior of people will be explained and illustrated

using a variety of scientific literature focusing on instruments that limit environmental degradation in both formal and informal ways on different scales (see figure 2). Both foci of the theoretical framework will result in a conceptual model combining the

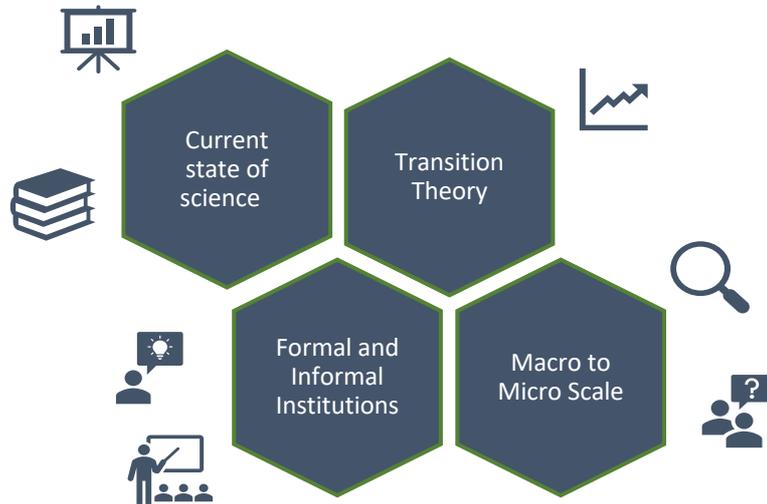


Figure 2: Content of the Theoretical Framework

management of points of entry of plastic litter and the identification of the context specific measure or strategy for minimization purposes.

The third chapter will elaborate on the method of data retrieval concerning semi-structured interviews with relevant stakeholders for this research and observations of the selected marinas and shipyards. Therefore, a data triangulation with semi-structured interviews, observation and an extensive critical literature review will be applied in order to create a pool of information.

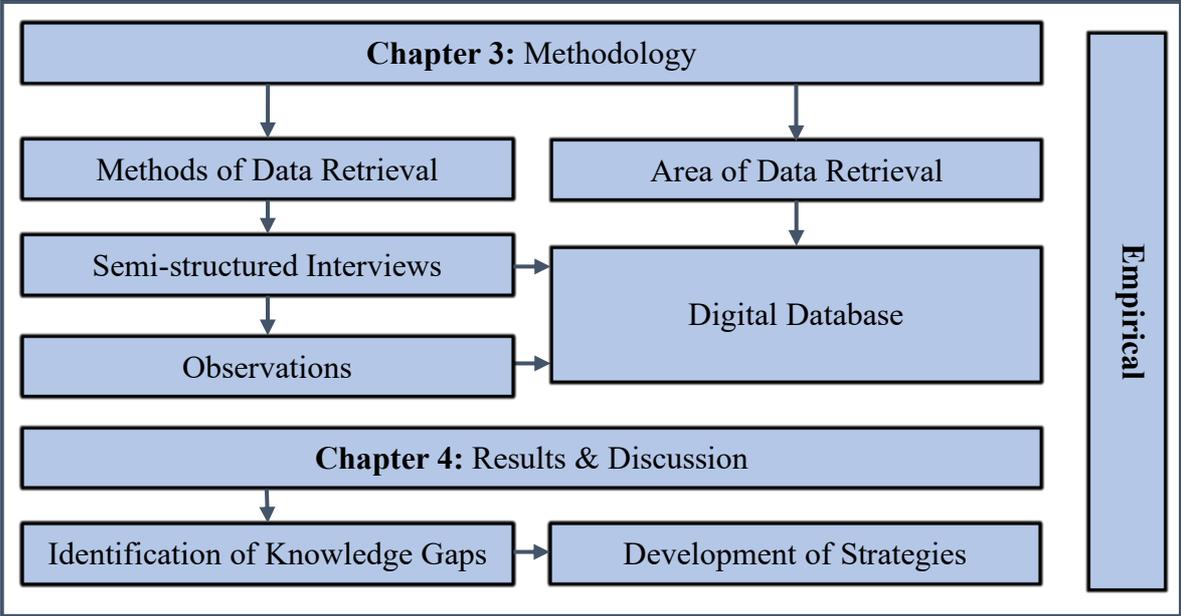


Figure 3: Thesis Outline: Chapter 3 and 4

All collected data will then be summarized and put into a case study database, being stored and related to each other and put into one conclusion, it will create a clear line of thought. This database will be digital. The conducted interviews will be summarized and put into categories in order to create a detailed and structured database of the collected data. In addition, the data gathered by method observation will be documented in protocols and processed and implemented into the digital database. This will contribute to the creation of a coherency of all the collected scientific data in order to identify interrelations, connections and interactivities of the gathered information with the different methods of data retrieval.

The fourth chapter of this thesis will summarize the findings of the three data collection methods by using a tailor-made category system for the specific context discussed during the interviews and observation of relevant sites. By relating the collected data to each other, knowledge gaps during recreational sailing activities will be identified and specific minimization and prevention measures developed and the specific context for the implementation identified.

The last chapter of this thesis will create a synthesis of this research while addressing recommendations for planning practices concerning the topic of plastic pollution within the sailing community.



Figure 4: Thesis Outline: Chapter 5

2. Theoretical Framework

The threefold research objective of this research tries to grasp to what extent the sailing community contributes to the problem of marine litter within the spatial boundaries of Lower-Saxony, Germany. In order to understand the theoretical background of marine litter with a focus on plastic litter, this chapter will explain and determine, based on current research, reports and scientific literature, the sources of marine litter. These sources include the release and pathway of marine litter and its receptors and consequences. Furthermore, the problem of plastic pollution will be put into the context of transition theory. In line with this field or research, informal and formal institutions as regulating instruments for minimizing plastic pollution will be explained and their interaction with each other taken into consideration.

Marine plastic pollution can be described as a complex system that represents an interrelated web of multiple stakeholders of various sectors including the economy, society and the environment (Gago et al., 2016). In order to create a comprehensive and holistic basis of this research, the interrelatedness of the various sectors will be applied on the Source-Pathway-Receptor-Consequence (SPRC) Model and related to recent studies and scientific literature.

According to Mendenhall (2018), it is important to identify knowledge gaps of a system in order to develop possible counter measures and implement these strategically. Uncertainty and knowledge gaps in research of sources and pathways can limit and restrict the effectiveness of a certain measure or a regulatory instrument. Therefore, a full assessment of the complex system of plastic pollution is needed while taking the local context into consideration, in order to create a comprehensive basis to develop instruments (Mendenhall, 2018) that serve as a tool to limit the amount of plastic entering the environment. To create a comprehensive theoretical background of plastic pollution, the SPRC-Model is being adopted, which serves as a structured frame in understanding the complexity of marine plastic pollution.

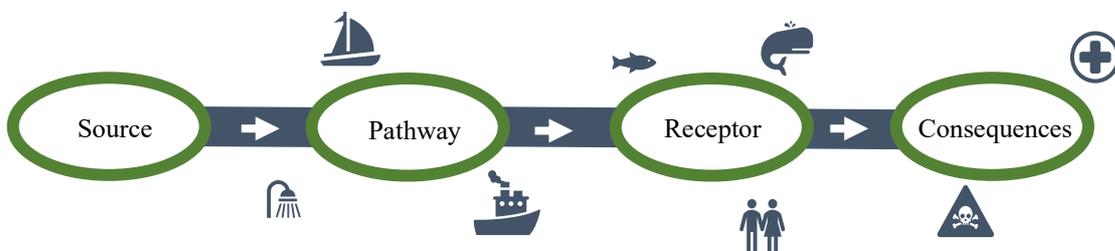


Figure 5: Source-Pathway-Receptor-Consequence Model, by Authors Own

The SPRC-Model has often been adopted by scientific scholars in order to understand the complexity physical processes of pollution (Holdgate, 1980). The model can determine various sources, pathways, and consequences from a toxic element reaching destinations where it does not originate from (Holdgate, 1980). It can, furthermore, serve as tool for environmental impact assessments and to minimize the environmental impact of harmful activities (Mendenhall, 2018). The SPRC-Model helps to frame the complex problem of plastic pollution by connecting the points of entry of plastic litter and the pathway through which various species are being impacted, e.g. rivers. Lastly, the model illustrates consequences for the receptors of marine plastic litter.

The application of the SPRC-Model frames the problem of plastic pollution. However, the threat of marine plastic litter is a global one including a vast number of industries, economic sectors, the society and the environment. Thus, it can be considered a wicked problem, relating to the notion of the plastic industry being a complex system with a nearly endless number of interrelated sectors and factors. However, this research focuses only on how plastic can reach the marine environment, and not actively considering exterior factors such as the plastic industry itself, or larger societal landscapes such as politics, and the economy. These factors are certainly acknowledged but play a subordinate role in this research. Therefore, using the SPRC-Model as instrument of framing the problem of plastic entering the marine environment fulfils its specific task on focusing only on the research objectives.

The following section will first illustrate the various sources of marine plastic litter and its pathways while briefly discussing the receptors and consequences for the environment, society and economy. This outline will create a basis of understanding the complexity of plastic pollution. Furthermore, the informal and formal instruments for plastic entering the environment will be discussed to determine how pro-environmental behaviour is being communicated and influenced on macro-to micro-level. This will form the groundwork for the development of minimization strategies and prevention measures in order to identify sources of plastic litter of sailing activities.

2.1. Sources of Marine Litter

The term marine litter includes all pieces and elements that have once been processed by industrial activities and have at some point been intentionally or unintentionally discarded into the environment at different stages of a product's lifecycle (Gago et al., 2016). Marine litter summarizes a variety of materials, from cigarette butts to lumber and plastic particles (Gago et al., 2016; Li et al., 2016). However, in this research the focus rests on macro- and microplastics which display a large quantity of marine litter. Both, micro- and macroplastic pose a threat to ecosystems, the economy and society (Gago et al., 2016; Ploetz et al., 2015; Richardson, Gunn, Wilcox, & Hardesty, 2018).

Scientific scholars have agreed on two types of sources for marine litter, which again contain a variety of sources and pathways in which litter can enter ecosystems. These two sources are either sea-based or land-based (Gago et al., 2016; Li et al., 2016; Mengo, 2017; UNEP, 2016). The marine litter entering the ecosystem through these pathways varies in its quantities, which are related to the geographical differences in population density (Ríos et al., 2018) and fluctuational seasonal dynamics of usage and industrial activity near the coast and water bodies (UNEP, 2016). Furthermore, these two pathways deliver both micro- and microplastic to the natural environment. Land-based Industries such as recreation, agriculture and ship maintenance are just a few sources of plastics entering aquatic ecosystems (Gago et al., 2016; Mengo, 2017). Plastic with a land-based origin can come from different sources: from industrial facilities, to agriculture and everyday utensils such as washing machines (from washing synthetic fabric), tyre wear off, cosmetics but also spilling of industrial plastic pellets during transportation (UNEP, 2016).

Therefore it is important to answer the question of whom is littering and why items or fragments are being discarded from these systems into the environment (Gago et al., 2016). In addition, it is important to determine where items are being discarded in order to establish effective counter measures (Gago et al., 2016).

2.2. Plastic

Plastic pieces are in general being categorized between macro- and microplastics. This categorization is built upon their order of magnitude. The general differentiation of plastic in the environment are as follows:

- Macroplastic > 5mm in diameter
- Microplastic > 5mm in diameter

However, a piece of plastic such as a water bottle, will not always be categorized into one of these categories as it will eventually change its structure due to a variety of impacts. Once macroplastic materials enter the environment, they are being exposed to a variety of natural occurring processes, such as radiation leading to the degradation and mechanical crushing of the initial product. While macroplastic can already harm the environment, which will be discussed in chapter 2.6, these materials will eventually be categorized as microplastics due to its change in diameter.

Figure 6 explains the differences between the development and emerges of different kinds of microplastic.

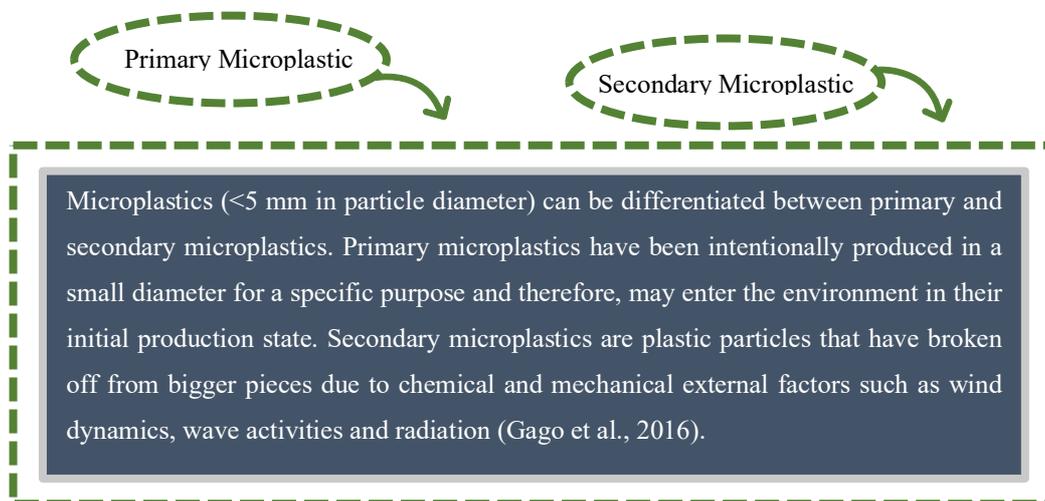


Figure 6: Box: Primary Microplastic and Secondary Microplastic

The following section will discuss the difference between primary and secondary microplastic in detail.

2.2.1. Primary Microplastics

Primary microplastic has been fabricated as such and serve individual product demands. Plastic in a microscopic size is often used as a base for further production processes (Li et al., 2016).

In order to form plastic into a desired product design, industrial plastic pellets are required. Industrial plastic pellets are smaller than 5 mm in diameter and are therefore categorized as microplastic and more specifically primary microplastic. These are being primarily produced for companies to form into the desired product. However, the pellets can enter the environment as a consequence of wrongful handling and spilling during transport (Gago et al., 2016). In addition, shredded plastic waste can enter the environment during recycling- and waste separation processes through physical processes such as wind or simple wrongful handling by human activities (Gago et al., 2016).

Often, in cosmetic products microplastics are used with the aim of enhancing the product's effectiveness in personal care and hygiene. These personal care products are among others, facial scrubs, shower gels and sunscreen. The products use nanoparticles that often find their way into water systems during hygiene processes such as showering or recreational bathing. However, primary microplastic accounts only a relatively small amount of plastic entering the environment in direct comparison to other sources of microplastics (UNEP, 2016).

2.2.2. Secondary Microplastics

The determination of the geographic origin of secondary microplastics compared to primary microplastics is more problematic as there is not much evidence of what kind of initial plastic product this type of microplastics are derived from. Secondary microplastic can originate from a variety of different sources, pathways and product types (UNEP, 2016).

The fragmentation of larger pieces of plastic is one consequence of physical terrestrial process such as weathering from land towards the sea. In combination, fragmentation processes by light, ultraviolet light, the availability of oxygen and mechanical processes such as wave activity facilitate for plastic to break off (Li et al., 2016). These degradation processes are intensified when happening in the marine environment due to the combination of chemical and mechanical processes. The combination of direct exposure to radiation of sunlight, which initiates oxidation processes resulting in a chemical bond breakage of the polymer matrix and mechanical abrasion due to wave action and turbulences, enhances the degradation and fragmentation of plastic items (Li et al., 2016).

Another significant input of secondary microplastics are tyre wear off and inadvertent disconnection of synthetic fibres from textiles during washing processes can both enter the marine environment (Li et al., 2016; UNEP, 2016). In European countries such as Norway and the Netherlands, plastic dust from tyre wear-off has been identified as a major source of microplastic contamination in the marine environment. Fibres from tyres can accumulate on

roads and be moved by water and wind into the drainage system eventually ending up in the sea. In Germany alone, 110.000 tonnes of fibres are released from rubber tyre wear off into the environment every year and transported by river systems (UNEP, 2016).

2.3. Sea-based Sources

Sea-based sources are being referred to as litter that is discarded by marine activities such as recreational boating, fishing or offshore installations or simply dumping (Gago et al., 2016). Sea-based litter contributes to about 20 percent of the total amount of debris in our ocean (Li et al., 2016). The next section will discuss the fishing industry as one of the biggest industries in the North-Sea and its plastic input into the marine environment. By pointing the lens of observation onto the fishing industry a linkage to the sailing sport is created as both sectors are operating in the North-Sea region and its aquatic ecosystem.

2.3.1. Fishing Industry

The commercial fishing industry plays an important role due to its large industry in the larger North-Sea area (Li et al., 2016). Over 6600 fishing vessels from nine different European nations are active in the greater North-Sea area, of which 220 fishing vessels account for Germany (ICES, 2018). Most of the German fishing fleet are beam trawlers focussing on brown shrimp in the southern North-Sea area and play an important role in the marine plastic pollution due to their use of dolly rope, one of the most littered items by the fishing industry (ICES, 2018; Mengo, 2017; Richardson et al., 2018).

The fishing industry intentionally and unintentionally discards fishing gear such as nets, pots, ropes, dolly ropes and nylon netting, which result in a large quantity of plastic floating at a fishery specific depth in the sea (ICES, 2018; Li et al., 2016; Mengo, 2017). In addition to this operational fishing waste, domestic waste such as fish boxes (which are made out of polystyrene) and other forms of plastic products such as buckets or gloves are being discarded as well (Mengo, 2017). By creating a feedback mechanism, this results in “ghost fishing” where the catch can contain a large portion of plastic including the discarded fishing gear, which can lead to economic losses for the fishing industry and poses hazards for marine and terrestrial wildlife (Li et al., 2016; Richardson et al., 2018). Studies have found that there is a significant relationship between the type of marine debris found on shores and the fishing industry activities as the gear is easily traceable and put into the context of fishing activities due to the specific equipment characteristics (ICES, 2018; Li et al., 2016). This relationship is influenced by multiple interacting factors, such as the number and size of vessels, the number

of crewmembers onboard, space for waste storage, the type of gear being used but also factors that affect littering such as weather that could lead to unintentionally littering due to loss of gear (ICES, 2018; Li et al., 2016). Within the OSPAR area (North East Atlantic) it is estimated that around 130.000 and 550.000 tonnes of plastic have been littered by the fishing industry since the 1950s. However, as the quantification of marine litter is rather difficult to determine, these numbers are just approximations based on multiple assumptions and might therefore not represent a reliable number (Mengo, 2017). Nevertheless, this estimate can give a first impression on the impact the fishing industry has on the environment and habitats of the North-Sea.

The fishing industry is just one of many sea-based sources for plastic marine litter. The problem of plastic pollution is a complex one with lots of sectors involved. While the fishing industry plays an important part of plastic entering the marine environment specifically in the North-Sea regions, other sectors must be considered worldwide. Other industries such as recreational cruises, offshore windfarms, and commercial shipping play also an important role in plastic entering the marine environment directly (Gago et al., 2016). In the next section, the land-based sources for plastic litter will be outlined while elaborating on the importance of rivers as conveyor belt for plastic entering the North-Sea.

2.4. Land-based Sources

Land-based sources are being referred to as litter that is directly being discarded along the coast by activities such as beach tourism but also litter from distant regions such as towns or major industrial areas located further inland is considered (Ploetz et al., 2015). It amounts to around 80 percent of the entire amount of debris in the ocean (Li et al., 2016). Multiple major industries such as recreation, agriculture, ship maintenance and industrial production are often located in close proximity to the coast or waterbodies (Li et al., 2016; UNEP, 2016). The industrial generation of products, the consumption and waste management are considered the main producers of marine litter (Gago et al., 2016). Within a product's lifecycle, an item goes through different stages of production, consumption and post-consumption, which all contain possibilities for the product or its components to leave the economic cycle and enter the environment through human activity (Ploetz et al., 2015).

2.4.1. Agriculture

The agricultural sector is often located within proximity to coastal regions or river systems. In order to provide an effective water distribution system for crops, irrigation pipes made from

plastic are used (UNEP, 2016). In addition, plastic-based protective meshes, sheets and planting containers are used for agricultural activities. All these items may be littered at some point of their lifecycle. The items can later be transported to aquatic ecosystems through rivers or being moved by winds near inland waterbodies and coastlines (UNEP, 2016).

However, as the impact of agriculture on marine plastic pollution is yet to be investigated, the extent to which the agricultural sector is part of the plastic pollution remains unknown (UNEP, 2016). More research is required in order to identify the industries extent of plastic pollution.

2.4.2. Ship Maintenance

In order to prevent biological growth of ship hulls to exceed a certain threshold, maintenance is needed during which the ship hulls need to be cleaned on a regular basis (UNEP, 2016). In order to clean the ship hulls, the method of air blasting is applied to relieve the ship of unwanted biological growth and degradation (UNEP, 2016). Often air blasting uses sand grains to effectively remove this biological growth. However, due to the durability of plastic, nowadays, plastic particles are often used instead of sand (UNEP, 2016). These particles can be washed towards the waste water treatment works, where not all plastic particles can be filtered out leading to particles entering the environment (Li et al., 2016). Another possible leak of microplastics is the ship hull paint. This type of paint is often based on polymers and when treated with air blasting, the particles can break off and enter the wastewater treatment in the same way as the plastic particles do (Li et al., 2016; UNEP, 2016). Wrongful ship maintenance such as using a sanding machine without an effective suction system can lead to micro particles being transported via wind into the environment.

2.4.3. Tourism and Recreation

The tourism sector is largely located in densely populated coastal regions (UNEP, 2016) and the variety of activities entails a great quantity of possible pathways for plastic to enter the marine environment. The recreational sector encompasses not only housing like Airbnb's and hostels but also a variety of activities such as cruises, water-sports, hiking, bike-tours, shopping, and beach tourism (Ploetz et al., 2015; UNEP, 2016). All these activities and many more, account for a large portion of the land-based marine litter input. Overall, packaging, playing an important role in the tourism sector, accounts for around 40 percent of all plastic being littered with its majority being food-packaging, which plays a subordinate role in the tourism sector. Often, as it is of convenient that packaged food is being bought. It is already prepared, provides a means for transporting and keeps the food fresh until consumption. However post

consumption, these food-packages might be littered because of e.g. the absence of effective waste management opportunities, laziness or anti-environmental behaviour (UNEP, 2016). The effects of formal institutions and pro-environmental behaviour will be discussed in the following chapters. In some cases, touristic activities take place in isolated and especially vulnerable places as these might be more popular due to the attraction of nature-based activities (Carić & Mackelworth, 2014).

Especially the cruise ship industry, which accounts for around 13 percent of the global shipping fleet, contributes around 24 percent of globally floating debris (Carić & Mackelworth, 2014). Cruise ships often have their destinations in remote areas where sufficient waste management for ships is absent which leads to a huge issue in terms of waste management on board. Approximately 2.6 to 3.5 kg of waste per person is being generated on ships everyday which leads to a huge accumulation of waste onboard. While biological waste can be dumped overseas after 12 nautical miles offshore, plastic trash must be stored until it can be disposed properly (Carić & Mackelworth, 2014; Gago et al., 2016).

The above-mentioned industries have a major impact on pollution with macroplastic items. Another, smaller kind of plastics is referred to as microplastics which often derive from different sectors and different stages of product lifecycles and has already been discussed in the previous chapter.

2.4.4. Rivers as Pathway

Even though regions or industries might not be within close proximity to the sea, there are means and mechanisms of transport litter and particles, such as wind and rivers that carry the polluting items towards the sea (Gago et al., 2016; Li et al., 2016; van der Wal, van der Meulen, & Gijsbert, 2015). River systems and wastewater treatment works function as a transport mechanism that carries debris to river estuaries (Li et al., 2016).

In addition, extreme weather events such as hurricanes or major flooding can increase the amount of debris transported towards the sea via rivers (Li et al., 2016; UNEP, 2016). Municipal landfills, densely populated areas, major industrial areas and recreational activities that are located alongside freshwater river systems, are major contributors to plastic pollution (Gago et al., 2016; Reifferscheid, Bänisch-Baltruschat, Brennholt, Breuninger, & Hatzky, 2016).

2.5. Receptors and Consequences

The outlined sources and pathways for debris entering the environment entail a large complexity with interrelated actors, sectors and furthermore its many receptors suffering numerous consequences. This complexity is being mirrored by the scientific community's frequent findings of negative impacts and consequences of plastic entering the marine environment for the interrelated web of the economy, society and the environment. There are still numerous knowledge gaps that the scientific community is aware of, whilst other still must be identified.

The negative impacts of plastic for the environment, economy and society can be derived from the advantages and benefits plastic has in comparison to other materials such as high durability and flexibility, due to its structural integrity. Due to this resistance against physical and chemical processes such as degradation, it may have a variety of consequences on numerous receptors. In order to create a holistic view on the receptors and consequences, the following section will discuss the impact on the environment, society, and the aesthetic and economic impact of marine plastic debris.

2.5.1. Impacts on the Environment

Macro- and microplastic fragments that have found their way into the environment can harm ecosystems in numerous ways. Often, macroplastic pieces, originating from commercial fishing activities such as fishing nets, ropes (Gregory, 2009), or from coastal tourism, e.g. six pack rings (Sheavly & Register, 2007), can harm the local wildlife through the impairment of the movement abilities. Among others, sea turtles, sea birds and marine mammals reportedly suffer from entanglement through fishing gear and other macroplastic pieces (Sheavly & Register, 2007).

The deterioration of the ability to move freely often leads to starving, can inflict wounds or cause suffocation eventually leading to death (Gregory, 2009; Sheavly & Register, 2007). Next to the superficial impacts of microplastic, often being focused on by the mainstream media of entangled animals, microplastics pose a far-reaching threat to the wildlife. Plastic pellets and other small pieces of plastic can be mistaken for food or fish eggs while larger pieces of plastic such as plastic bags can be mistaken for jelly fish (Sheavly & Register, 2007). These pieces, once swallowed by a marine species, can become tilted in their throat or digestive system or even give the false impression or sense of saturation (Gregory, 2009; Sheavly & Register, 2007) eventually leading to suffocation or starvation (Sheavly & Register, 2007).

Next to harming the wildlife itself, plastic can have a major impact on habitats and entire ecosystem and pose as a physical threat (Beaumont et al., 2019). Marine plastic can be seen as an attractive alternative to commonly colonised sea debris such as lumber. Thus, plastic can host entire bacterial communities and transport them to distant areas and potentially suppress native species (Kirstein et al., 2016).

2.5.2. Impacts on the Society

Until recent scientific research the plastic pollution has been documented on all trophic levels (Li et al., 2016; Ploetz et al., 2015; Seltenrich, 2015; Sheavly & Register, 2007). From microplastic entering the marine environment through wastewater systems such as hygiene and medical products (Sheavly & Register, 2007), to the decay into smaller pieces and being mistaken for food by animals, the threat of microplastic has reached our own food chain (Seltenrich, 2015). Research on the consequences from e.g. exposure to numerous chemicals through sea food consumption is still at an early stage and the long term effect on the human health is yet to be investigated (Seltenrich, 2015). In addition, tourists and local beach visitors e.g. can be exposed to bacterial contamination or sharp pieces of sea debris resulting in infections and wounds (Sheavly & Register, 2007).

2.5.3. Aesthetic and Economic Impacts

The visibility of plastic pollution can also have negative consequences through the damage of ecosystem services and to the recreational ability of ecosystems (Beaumont et al., 2019; Sheavly & Register, 2007). Especially local communities that rely on sectors such as fishery or tourism may suffer from the degradation of ecosystem services such as the provision of local fish (Beaumont et al., 2019). As mentioned earlier, marine plastic debris can lead to “ghost fishing”, decreasing the productivity and profitability of fisheries and aquaculture (Beaumont et al., 2019). It can furthermore entangle propellers and rudders, leading to immense costs in repairs, time and can put fishermen and boaters at risk (Beaumont et al., 2019).

Next to the direct influence on the productivity of an industry such as fisheries (Beaumont et al., 2019), plastic can have an indirect influence on sectors such as tourism and recreation (Sheavly & Register, 2007). Accumulated plastic trash along shorelines and beaches attracts the media and receives public attention through the visual picture of trash discarded into the environment (Gregory, 2009; Sheavly & Register, 2007). Thus, by creating an unattractive landscape, it forces the local industry and community to clean-up the immediate environment on their own costs (Sheavly & Register, 2007). Furthermore, the unattractiveness of

contaminated landscape might result in emotional issues of local beach users and tourists deciding to spend less time at the localities, which results in a decrease of the revenue for this sector (Gregory, 2009; Sheavly & Register, 2007).

In order to prevent plastic trash from entering the marine environment, many policies have been implemented by different scales of authority such as global policies that have been agreed upon by many countries, laws by the EU that ban e.g. plastic bags and national or regional bans of certain materials in products (Xanthos & Walker, 2017). Many of these policies are created by a central authority or government for the purpose of minimizing the consequences of plastic pollution. Many of these measures, strategies and policies are of formal nature. NGOs and companies have introduced informal strategies for mitigation, prevention and remediation such as the certification of eco-labels for sustainable tourism activities e.g. the blue fleet (Critchell et al., 2019; Schuep, Gasser, Haarman, Brown, & Giotto, 2016). The blue flag is an eco-label specifically feature certain marinas that try to be as environmentally conscious as possible (Deutsche Gesellschaft für Umwelterziehung [DGU] & Foundation for Environmental Education [FEE], 2019).

How to differentiate formal and informal institutions and what kind of measure is most appropriate in the context of the sailing sport as possible source or pathway for marine litter will be discussed further.

2.6. Plastic Pollution: Transition Theory

The previous chapter has conceptualized the complex nature of plastic pollution by the application of the SPRC-Model. This conceptualization has illustrated the diffuse, non-linear, multi-scalar and multi-sectoral dire nature of marine plastic litter (Critchell et al., 2019). Thus, plastic pollution can be categorized as wicked problem. Horst Rittel (1973) describes the term “wicked problem” as something that is difficult or impossible to solve due to incomplete, contradicting information and changing elements including a multitude of interrelated factors that makes it near to impossible anticipating changes (W. J. Rittel & M. Webber, 1973).

Loorbach (2002) has developed a theory combined with a management approach to deal or manage such wicked problems and to manage and influence its development into a specific direction.

The concept of transitions tries to encompass and detangle the complex interaction patterns between individuals, organizations and networks in order to achieve a stable condition of a system (Loorbach, 2010). Loorbach (2002) describes this transition as a “long-term process of

change in which a society or a subsystem fundamentally changes” (Loorbach, 2002, p. 3). These fundamental changes are developing over long periods of time and on different stages, e.g. a large-scale demographic change such as birth and death rates of a population or major changes in cultural norms or belief systems (Loorbach, 2002). Thus, two concepts are being joined together and creating the concept of transitions. These two concepts are the multi-phase concept, development by Loorbach (2002) and the multi-stage concept, development by Geels (2004).

The multi-phase concept explains these fundamental societal changes through a model of phases. Driven by three distinctive but connected domains, of which these fundamental changes are being influenced and enhanced (see figure 7).

Loorbach describes these as cogwheels due to interconnectedness and influential network capabilities (Loorbach, 2002).

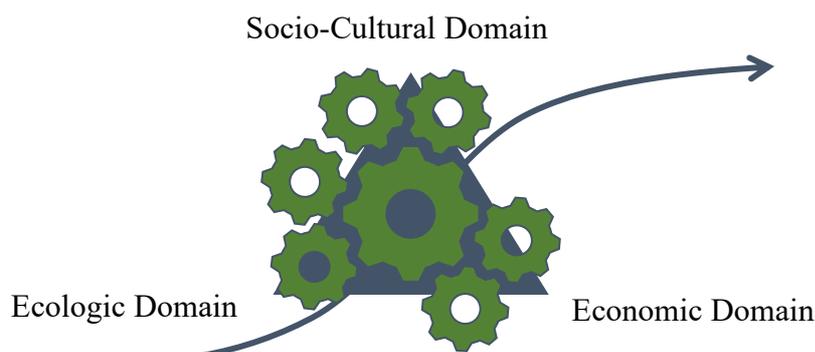


Figure 7: Reinforcing Cogwheel, based on Loorbach, 2002

The three domains enhance the process of transition which moves through four phases. The predevelopment phase where nothing really changes yet with close to no visible effect, the take-off phase where the process of change begins, the acceleration phase where the actual structural

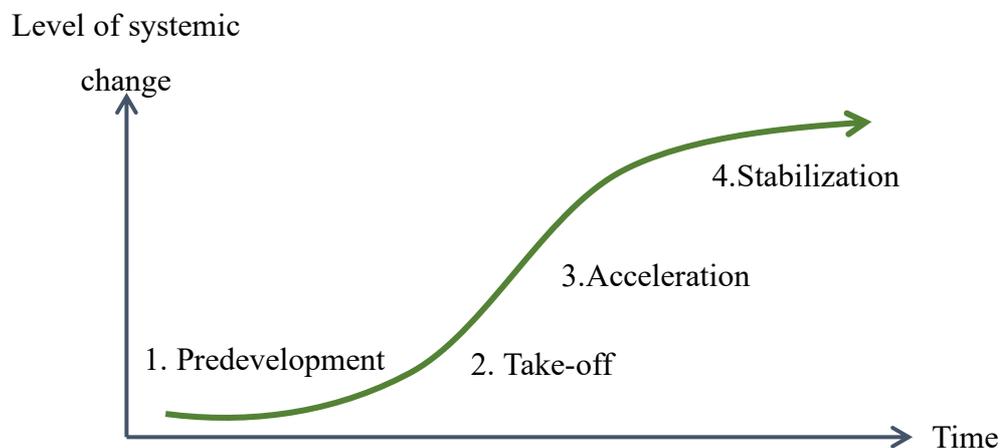


Figure 8: Four Phases of a Transition, based on Loorbach, 2002

change gains momentum through the interaction of the three main domains on different stages, and the stabilization phase, where the process of changes slows down and coming to a stable condition. This process is forming an s-curve which is being illustrated in figure 8.

The multi-stage concept on which the multi-phase concept is based, describes three different stages in which changes occur describing the process of “regime-change” (Loorbach, 2002, p. 4). The macro-level describes the societal landscape of large-scale domains such as the economy, society or entire industry sectors and major belief systems. The meso-level describes the regime of organisations, social norms and unwritten rules and processes and stands between the macro-level and the micro-level. The micro-level contains individual innovation that challenge the regime (Geels, 2005).

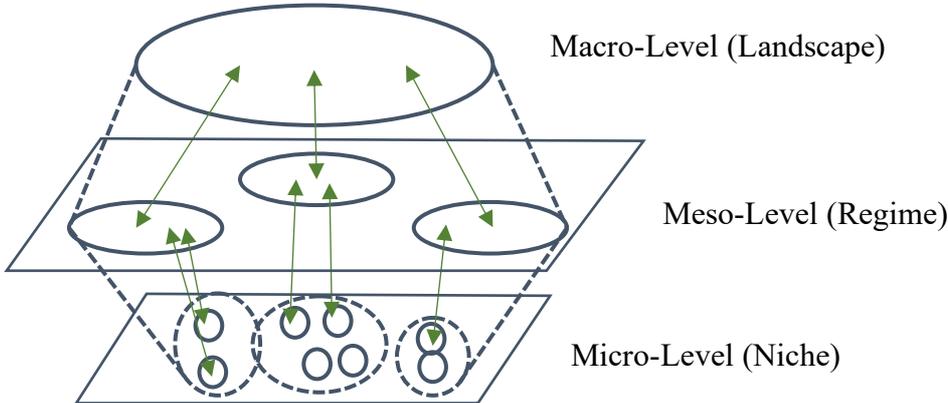


Figure 9: Multi-Stage Concept and Interplay in a Transition, based on Geels, 2005

When combining the concept of the multi-phase and the multi-stage the transition is only possible involving a specific requirement. This requirement is the interaction between all three levels. By an interaction on all levels, from local innovations on a micro-level that influence social norms to dominant practices on a meso-level, macro-level changes are being enhanced. Thus, creating large-scale societal changes (Loorbach, 2002) again influencing meso-level and micro-level. This influence can be affecting new policy on the other scales.

2.7. Formal and Informal Institutions

There are numerous instruments, processes, and tools that can be used to intercept the pathway in which plastic is being transported into the marine environment. These instruments and processes can be categorized in formal and informal institutions which require considerable attention on all three stages that were defined by Geels, 2005. While sources and pathways may play a significant role on a local level, the problem of plastic pollution is a global one. Thus,

both kinds of institutions must be considered in the process of the determination of a new instrument that minimizes or prevents plastic litter entering the marine environment.

Formal institutions according to Lauth (2015), describe a set of rules such as legislation, laws and regulation, that if being violated by certain action have to be punished with various measures (Lauth, 2015). Therefore, formal institutions can be ranged from a macro- to meso-scale depending on the governmental level of the authority which had implemented the law or regulation. Numerous laws, and regulations are already in place that influence the amount of debris entering the marine environment which monitor and if necessary penalize wrongful behaviour (Lauth, 2015). These are among other issued by International, national and regional governmental bodies and authorities such as the UN, the German federal government and regional authorities. By implementing formal institutions, the societal landscape and the regime, including dominant practices are being influenced in three ways: by preventing plastic trash from entering the marine environment, by mitigating plastic trash reaching the marine environment and lastly the remediation of plastic litter out of ecosystems (Critchell et al., 2019). Table 1 summarizes a variety of international and national laws and regulations that have changed dominant practices of sectors operating at sea such as sailing sport. These policies, laws, and regulations address problems such as dumping harmful substances or garbage into international, national, regional and local waters (Carić & Mackelworth, 2014; Critchell et al., 2019). Other laws, issued by the German federal government prohibit the use of specific paints and antifouling that contain harmful substances for the environment and human health (ChemVerbotV, 2017).

Formal Institutions on a Macro-Level Scale

| | | |
|------------------|---------------|-------------------------------------|
| Agenda 21 | International | United Nations |
| UNCLOS | International | United Nations |
| MARPOL Annex V | International | International Maritime Organization |
| MARPOL Annex III | International | International Maritime Organization |
| ChemVerbotsV | National | Federal Ministry of Justice |

Table 1: Formal Institutions on a Macro-Level, created by author

However, formal institutions cannot always fully comprehend the entire extent of the problem. Scientific scholars such as Helmke & Levitsky (2003) identified a gap, which ignores the existence of informal institutions also influencing norms and practices (Helmke & Levitsky, 2004; Lauth, 2015). Informal institutions are not enacted by a formal authority or fixed in legal

documents. Informal institutions are based on social interaction, habits, dominant practices and cultural norms (Dahl & Pedersen, 2004; Lauth, 2015). Thus, they form clusters of a geographical concentration of a group of socially connected people (Dahl & Pedersen, 2004), common interest or shared social identity (Reid, Sutton, & Hunter, 2010). These informal institutions are related to the notion of the meso-to micro level of Geels, 2005. While individual sailors can be considered on a micro-level, sailing clubs and umbrella associations of sailing clubs form a group of socially connected individuals with a common social identity on a meso-level. Within this social network, knowledge, dominant practices are being mediated, shared and communicated (Dahl & Pedersen, 2004; Helmke & Levitsky, 2004; Lauth, 2015). For instance, this knowledge can describe recycling processes or other forms of plastic prevention or mitigation measures during recreational sailing activities.

Furthermore, informal institutions can help to bridge macro-level changes or introduced policies with meso- and micro-level activities (Lauth, 2015; Reid et al., 2010). Reid et al. (2010) emphasises the importance of the meso-level as a mediating tool between local innovations, activities, and practices and major societal changes on a macro-level (Reid et al., 2010). On a macro-scale, problems are being abstracted and generalized concerning themselves with the overall system neglecting the specific context in the search of a solution serving the assumption of “one size fits all” (Reid et al., 2010). Thus, macro-level policy-making neglects the local context (Reid et al., 2010). The meso-level can therefore, serve as a mediating tool to foster

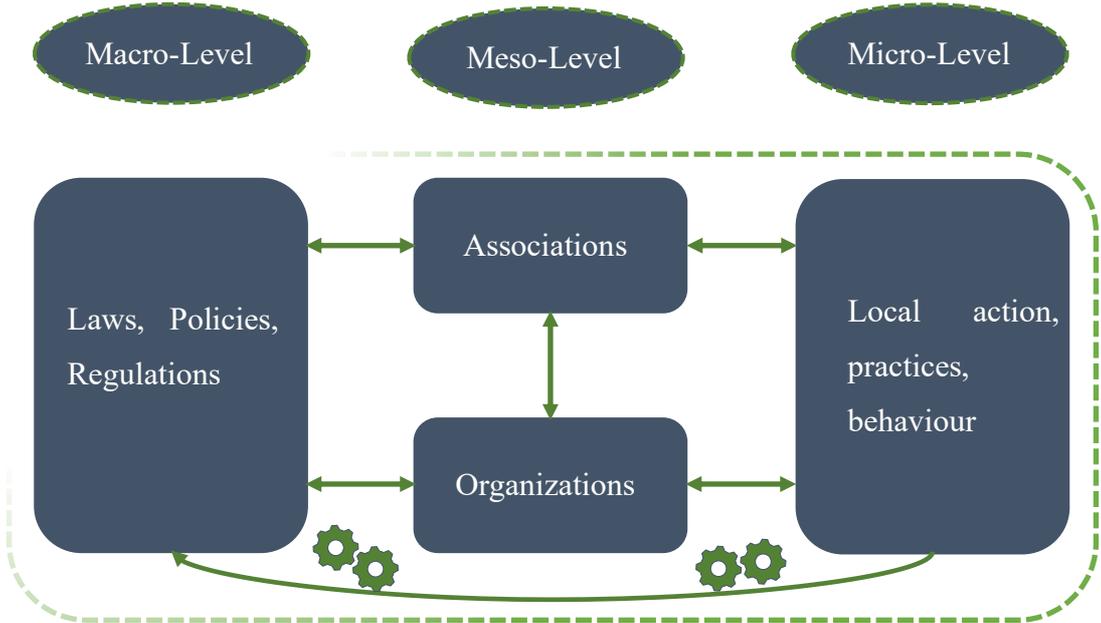


Figure 10: Influential Network of the Macro-, Meso- and Micro-Level, Authors Own

local innovation and can create windows of opportunity macro-level policy-makers (Geels, 2005; Reid et al., 2010).

This process is based upon an intersubjective interaction which changes the regime gradually as new practices are being introduced. Thus, the scale on which the change occurs, gets widened and eventually influences the societal landscape (macro-level). Hence, a structural change in our society is possible as dominant practices from a local level are being mediated through the meso-level, resulting in major societal changes. However, as informal institutions are increasingly dominant within the meso- to micro-level, one should not neglect that informal institutions are also present within the macro-level. The dotted line in figure 10 illustrates the intensity of informal institutions on all three levels, being intensified on a micro- to meso-level, and getting less intense at the macro-level. This emphasises that informal institutions are present on all three levels but in different intensities on each level. The long arrow following the path from the micro-level to the macro-level resembles the influencing cogwheels which were mentioned in figure 7 displaying the three major domains influencing the acceleration of a transition by local innovation impacting major societal landscape changes on a macro-level.

2.8. The Notion of Complexity

The problem of plastic pollution is complex. There are numerous interrelations concerning the society, economy and the environment. The application of the SPRC-Model has framed the problem in terms of a socio-cultural and ecological landscape and has only briefly discussed the economic factors. It is necessary to acknowledge that the problem is larger than discussed in this research. By framing the problem onto the SPRC-Model numerous factors and sectors are not being mentioned and only a small number of sources, pathways, receptors and consequences were discussed to create a minimal framework for this research in order to focus on the relevant factors and the specific context. Therefore, by limiting the context, a clear picture emerges in which it is easier to navigate this research. This limitation of variables gives furthermore, a clear structure to this research and thesis while simultaneously focusing on the most relevant aspects.

2.9. Conceptual Model

Chapter 2 has outlined the problem of plastic pollution and the need for more research on the identification of sources and pathways to formulate, develop and implement new strategies for minimizing the countless consequences. Therefore, a conceptual model (see figure 11) has been developed seeking to identify possible pathways during recreational sailing activities. As a consequence, new minimization strategies can be implemented which minimize the impact on the receptors and the consequences (illustrated by the green dotted line in figure 11).

The first step of the model is the acceptance that sailing sport might be another source for marine litter. By determining how big the sailing community and its industry is compared to other industries operating in the southern North-Sea area. The next step of the model is the identification of possible pathways by sailing activities focussing on recreational sailing activities on sea and in the marina, as well as maintenance and repairs of the boat. In addition, the problem perception and communication patterns of the sailing community needs to be investigated in order to determine how the problem of plastic pollution is being perceived and how it is being communicated by the sailing community. In order to pinpoint where the problem lies, the notion of different scales by Geels, 2005 has to be considered. This helps to determine on which scale a new measure or instrument must be implemented that can close a gap for plastic litter entering the marine environment through recreational sailing activities. Thus, the focus of this research lies upon interregional, national and international sailing clubs and umbrella associations of sailing clubs.

The next step is to formulate a tailor-made, context specific instrument that can be strategically implemented. In order to be most efficient, certain steps must be taken such as regular monitoring of the instrument's performance. There, the circle starts again with the realization of a problem which relates to the monitoring of the effectiveness of the new policy.

By creating a continuous flow of monitoring and evaluation, the process of developing new prevention measures and minimization strategies can be adjusted to its changing circumstances and changing context.

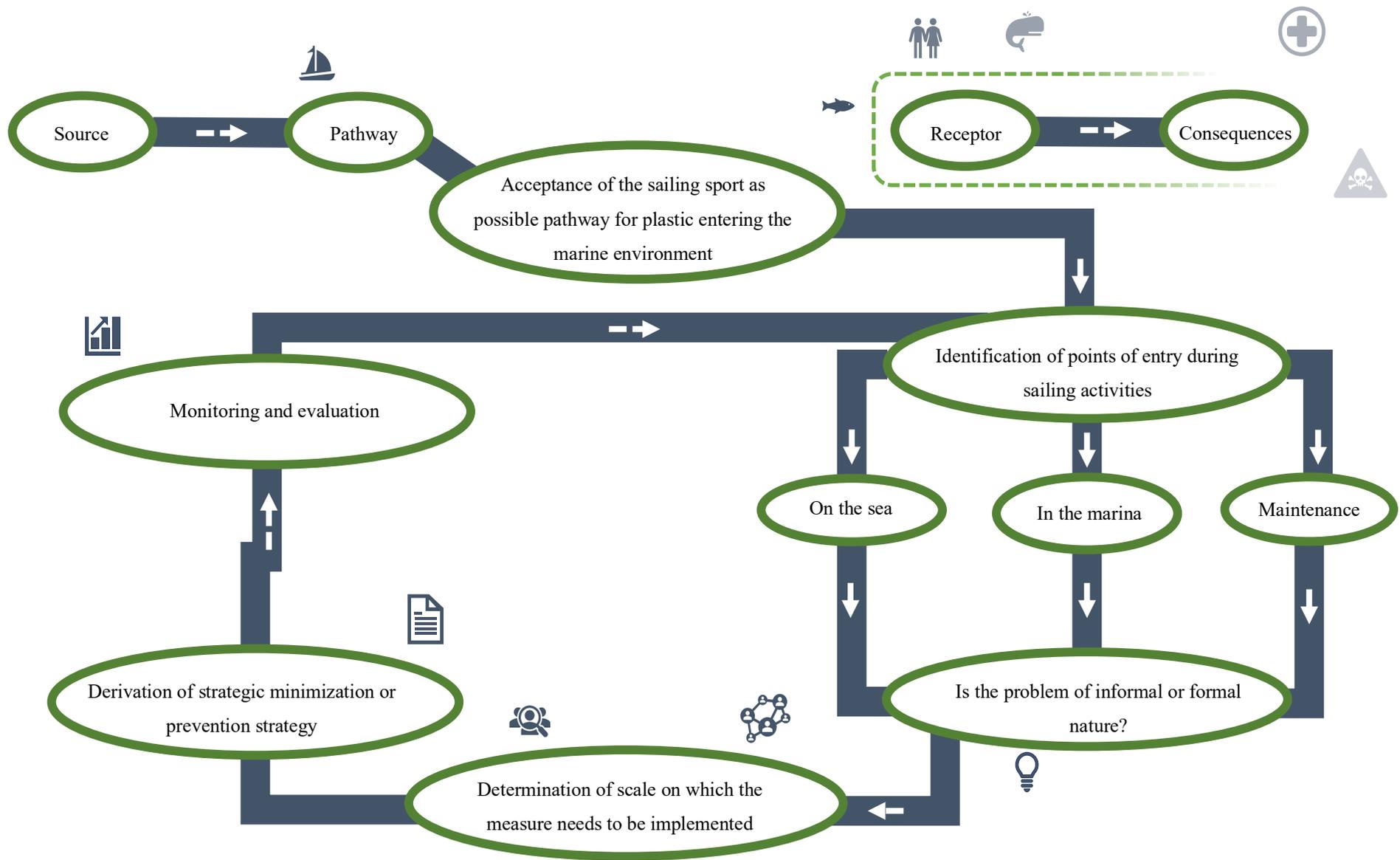


Figure 11: Conceptual Model

3. Methodology

The object of research of this study is to investigate to what extent sailing activities contribute to the marine plastic pollution within the geographical frame of the North-Sea along the coastline of Lower-Saxony, Germany. Thus, this research will be threefold in which the current problem scope, the problem perception of relevant stakeholder will be investigated, and based on these findings minimization and prevention measures will be developed.

In order to answer the remaining formulated research questions, it is crucial to determine organizational structures and to identify communication patterns of and between sailing clubs, their members, and individual sailors which don't necessarily belong to a local sailing club. The method of data retrieval and of the data analysis will be further explained in the following.

3.1. Methods of Data Retrieval

In order to investigate a specific phenomenon within its natural surroundings semi-structured expert interviews give first implications on how this phenomenon or activity unfolds itself in its natural environment (Kaiser, 2014, p. 2). The selected experts are relevant stakeholders which have specific and explicit, inside knowledge of the three stages of usages of sailing boats and on activities that might have a potential for plastic entering the marine environment. These stakeholders are:

- Industry Experts
- Sailing Club Representatives
- Sailing Club Members
- Individual Sailors

Kaiser, 2014 describes an expert as someone who has explicit knowledge about a specific topic. This person does not have to be an expert in terms of scientific knowledge but someone who has explicit knowledge about the research objective and possibly entails a position of initializing change (Kaiser, 2014, p. 41).

Experts are being determined by two factors, their position and their functional knowledge. The industry experts can be considered experts as they have a holistic view on the entire sailing industry including dominant practice and knowledge about large scale changes within the industry and the community itself. Furthermore, they can give insides on organizational and communication structures of sailing clubs and of the larger sailing community of Lower-Saxony. The representatives of sailing clubs can be considered as policymakers (experts) as

they are in a powerful management position creating institutions such as regulations that must be followed by their members that influence dominant practices within the specific sailing club. Furthermore, they can offer, together with members of the sailing clubs and the non-member sailors, an inside view and expert knowledge of everyday activities and operation of sailing boats. In addition, they have an inside view on the organizational structure of sailing clubs and the communication structure with and between sailors and sailing clubs. The individual sailors can give implications on communication patterns of the sailing community without the influence of a local sailing club. All mentioned stakeholder can furthermore give implications on possible points of plastic entering the marine environment at different stages of sailing boat usage such as maintenance, recreational sailing activities and living at the marina.

The selected stakeholders fulfil the criteria mentioned by Kaiser, 2014 of being in a position of initializing change and having specific expert knowledge of the investigated phenomena (Kaiser, 2014, p. 41).

3.1.1. Semi-Structured Interviews

Semi-structured interviews are conducted to obtain data which other forms of data retrieval, such as literature review, are inefficiently or unable to obtain. By using a structured questionnaire which is based on the pre-formulated research questions, interviews can obtain specific data about the investigated phenomenon (Kaiser, 2014). This structured questionnaire tries to grasp three dimensions of knowledge which Kaiser, 2014 describes as (a) Management knowledge (Betriebswissen), (b) Contextual knowledge (Kontextwissen) and (c) Interpretation knowledge (Deutungswissen). Kaiser defines them as follows:

- “Management knowledge – Proficiencies of the expert about processes and routines of about formal rules for solutions to solve societal conflicts” (Kaiser, 2014, p. 44).
- “Contextual knowledge – Proficiencies of the expert about the environment, constraints and interest structures for solutions to solve societal conflicts” (Kaiser, 2014, p. 44).
- “Interpretation knowledge – Subjective relevance, opinions and interpretations of the experts of procedures for solutions to solve societal conflicts” (Kaiser, 2014, p. 44).

These three dimensions are connected to the three main topics of the questionnaire and based upon two main research objectives, the problem identification and perception of the relevant

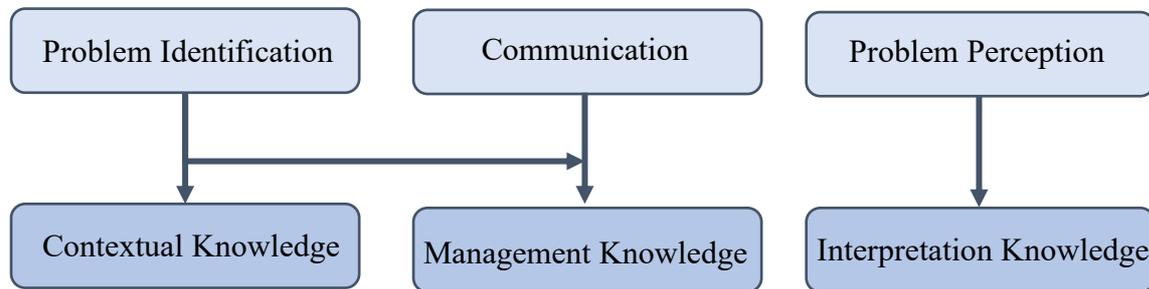


Figure 12: Derivation of the three Dimensions of Knowledge onto the Questionnaire

stakeholders. The contextual- and management knowledge refers to knowledge that identifies problematic points of entry. This thematic block refers to dominant practices at sea, in the marina, and during maintenance processes. In this thematic block, questions will be raised such as:

- How do you minimize your trash accumulation during sailing activities?
- Do you specifically look for environmentally friendly products?
- What kind of equipment do you use when removing antifouling?

In addition, the management knowledge gives implications on communication patterns of and between sailing clubs and their members. The interpretation knowledge specifically aims to identify the problem perception of all investigated stakeholders. Within this thematic block questions will be raised such as:

- How do you implement sustainability in the organizational structure of the sailing club?
- Do you inform your members on how to be more sustainable in their sailing activities?
- What kind of communication ways do you apply?
 - [websites, flyer, information boards]
- Is the topic of plastic trash being explicitly discussed?

The differentiation of the dimensions of knowledge helps to connect the theoretical structure of this research, the identified problem and the methodological required steps to obtain data (Kaiser, 2014, p. 44).

One of the most important components of semi-structured interviews is having a well-structured guideline. The guideline helps to steer the interview in the desired direction and to translate the research questions into answerable questions for the interviewee (Kaiser, 2014, p. 52; Liebold R., 2009, p. 38). In addition, shorter questions and keywords, which are an instrument of

directing the conversation, will help gathering data which the expert did not explicitly emphasised on (Kaiser, 2014, p. 53).

The interviews will be recorded, and relevant data put into a digital database using a category system which is tailor-made for the specific thematic blocks of the questionnaire and research questions/objectives. However, not all data can be captured by using an audio record method. As important gestures of the interviewee or data being presented during the interview cannot be captured by an audio recording, a memory log will be held during the interview. This memory log will capture important information which will be added to the database to fill possible data gaps (Kaiser, 2014, p. 84).

In order to create a coherent picture of the whole sailing sport industry, a detailed questionnaire has been developed for all mentioned stakeholders above. Each questionnaire tries to obtain data from the specific stakeholder to fill knowledge gaps sufficiently and to gain insight knowledge from different perspectives. By obtaining information from different points of view, the research creates a coherent picture of the organizational structures of the sailing club while proving or disproving the obtained data. In addition, the data gathered will evaluate a more holistic picture of not just the organizational structure between sailing clubs, and individual sailors that do not belong to any local sailing clubs, but can also evaluate in general how the information travels within the entire sailing community, which is not bound to a geographical frame but rather by the sailing community as a larger entity. All four questionnaires can be found in the Appendix of this document.

These questionnaires have been tested and adjusted by performing pilot interviews with members of the sailing community without using any recording device. Therefore, no data has been gathered or included in the analysis of this research. The pilot interviews have merely served the purpose of optimizing the questionnaire.

3.1.2. Observations

Kaiser, 2014 emphasizes the importance of different data sources in order to close gaps that might have been left open by another source (Kaiser, 2014). Data gathered by interviews has its limits and can leave questions unanswered resulting in data gaps (Kaiser, 2014). As the number of conducted interviews in this research is limited knowledge gaps might appear. To close these gaps other methods of data retrieval such as the method of observation are included (Kaiser, 2014, p. 2). By observing the phenomenon on-site and collecting data with protocols, the data gathered through interviews can be supplemented.

The method of data retrieval observation allows the observer to learn through a direct exposure to the everyday life from a distance (Weischer & Gehrau, 2017, p. 36). On-site observations can give indications on relationships between people, organizations, and identify communication patterns (Weischer & Gehrau, 2017, p. 83).

The observation sites of this research are selected marinas and repair and maintenance shipyards. These will be conducted simultaneously as the semi-structured interviews with sailors in order to close possible knowledge gaps that might appear during the interviews

The data can, furthermore, underline a statement which was referred to during the interview. By taking a closer look onto the direct environment of sailors, and their everyday activities that happen in the marina, common practices, and communication patterns between sailors, and the sailing clubs can be identified. Furthermore, details that were obtained during the literature review and interviews can be disproved or proved by observing.

Just as the semi-structured interviews, this method of data retrieval will be influenced by a continuous flow of new information that lead to an adaptation of the research method in order to maximize its effectiveness, meaning the process of “learning by doing” helps to increase the efficiency of the data retrieval. The author Schensul, suggest three stages of the method observation (Schensul & LeCompte, 1999). First, the observer needs to familiarise himself with the observation site (environmental description) and creates a detailed description with possible drawings for further illustrations and a richly detailed protocol. Second, the observer selects a more focused view of the environment in order to filter unrelated elements which do not necessarily need a lot of attention. This will help to filter out unneeded information beforehand and to focus on important elements of the observation site. The third step is to record as many details as possible in order to recreate a holistic view of the observation site which will be comparable to other collected data in the analysis. All data is being recorded digitally. The

observation focuses on 5 variables. The environmental description of the observation site, the waste infrastructure, participants (people being observed), their behaviour and activities, and communication patterns and the possible information provision on the website of the specific marina.

During the observation it is rather common to conduct informal interviews (Weischer & Gehrau, 2017, p. 86). These will complement the accumulated data of the protocols and the interviews and will be saved in the digital database.

3.1.3. Explanation of the Coding-Tree

In order to extract the most important data from the expert interviews, it is important to follow pre-structured steps as a form of analysis (Kaiser, 2014, p. 105) . These steps are as follows:

1. Analysis of the data
2. Categorization and filtration of the data
3. Arrangement of the Data into the Code Units

The process of analysing the expert interviews is being done with the program maxQDA2018. The analysed data is subsequently being categorized in an excel sheet that is based upon the coding tree. By creating a category system for the data, the data will get more concrete as it filters all non-relevant information. These categories are being determined by the “Code-unit” which Mayring, 2015 defines as the smallest material which can be analysed (Mayring, 2015).

The code unit of this research includes three main codes with various subcategories (Figure 14). In order to avoid a generalization of any data, the subcategories serve as instrument of categorizing the data into the specific brackets. Therefore, a generalization of any data can be minimized or avoided.

The three main codes are based upon the secondary research questions concerning themselves with the problem scope, looking at possible pathways during recreational sailing activities, the problem perception and communication patterns within the sailing community. The first category of the identification of the problem scope focuses in activities such as recreational sailing activities on the sea, in the marina (including the waste infrastructure) and the maintenance of a sailing boat itself. The second and third category focus on the problem perception within the sailing community, including the attitude and behaviour of stakeholders, reasons for picking up sailing as a hobby and communication patterns within the community. Addressing the code unit of the communication, board members give implications on how they perceive the problem of plastic pollution and how they communicate it with their members

while members give data on how they perceive the information provision by their sailing clubs. The entire coding system is visualized in figure 14. The fourth category concerns itself with data that relates to the notion of behavioural change and a possible identified transition of dominant practices during sailing activities. These codes are based on the understanding of different kinds of knowledge by Kaiser, 2014 and the different set of codes by Kuckartz, 2016. Kuckartz emphasizes on a variety of different codes that serve as an instrument to categorize and structure the specific data obtained into thematic blocks (Kuckartz, 2016, p. 204). While

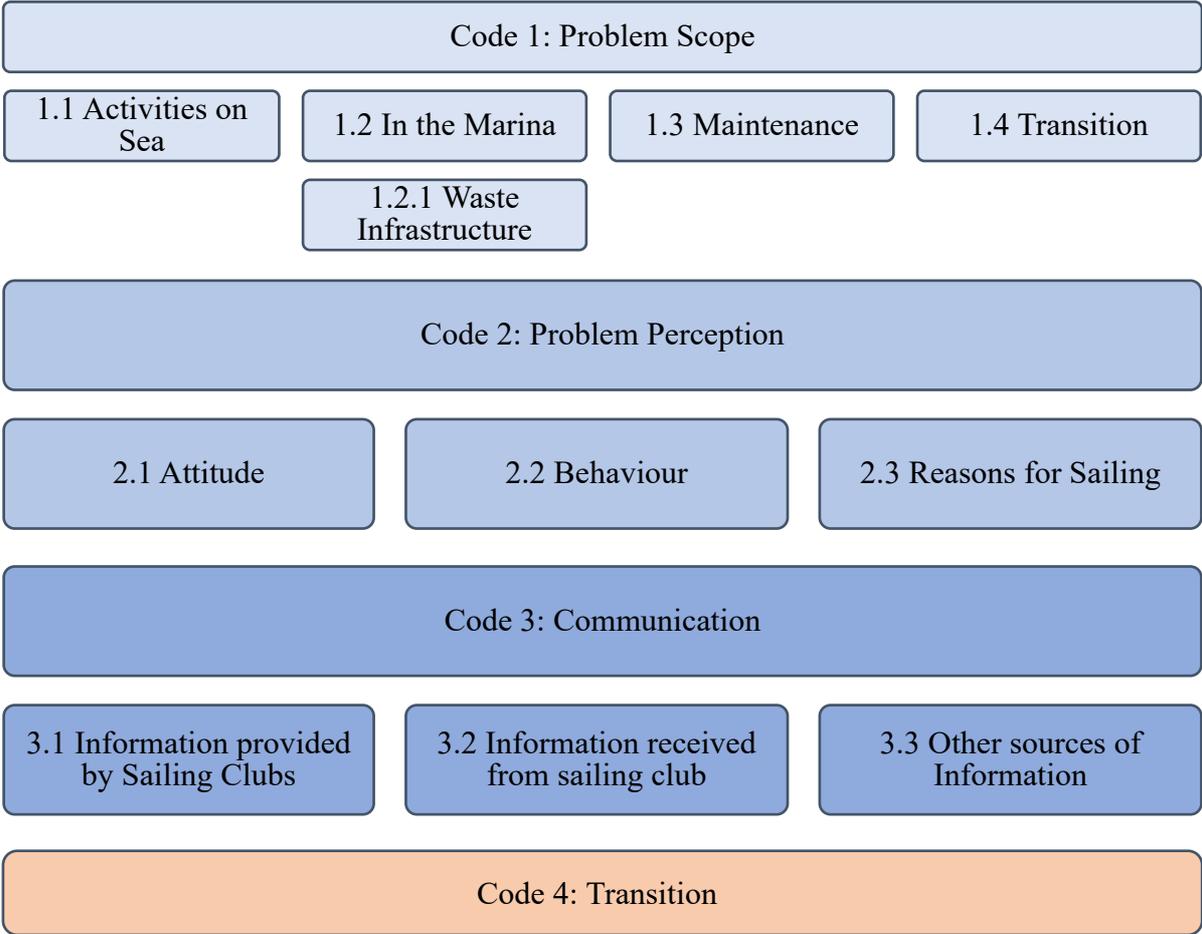


Figure 13: Coding Tree

fact-codes categorize data that relates to specific circumstances, given fact or specific events, thematic-codes relate to data that address a specific topic such as environmental knowledge. A third category addressed by this coding system are evaluative codes which assesses behavioural structures (Kuckartz, 2016, p. 205).

However, it is important to acknowledge that the category system and the analysis of the data has its limit. Some data might not fit into a specific category or is being overlooked. None the less, this category system aims specifically to the research objectives and therefore can extract the most important data concerning this research.

4. Results

This chapter will give insights on the conducted semi-structured interviews with relevant stakeholder as well as on data gathered through observations of marinas, harbours and shipyards along the coastline of Lower-Saxony, Germany. During this research, local sailing clubs were being approached via E-Mail, telephone calls, and sailing club website contact templates. When contacting the sailing clubs, some interviewees have referred to additional potential experts which were being contacted and eventually interviewed as well.

In total, a number of 12 stakeholders were interviewed over a period of 3 months in order gain a significant insight on the problem scope of recreational sailing activities as source of plastic pollution and the problem perception of plastic pollution within the sailing community. In order to acquire different insights and perspectives on the issue at hand individual questionnaires were developed to verify or disprove certain statements of the different stakeholders. A comprehensive list of all stakeholders being interviewed and their position within the sailing community can be found in the table 2.



Figure 14: Map of Observations Sites, Authors Own, based on Esri, HERE, Garmin, FAO, METI/NASA, USGS

In order to fill knowledge gaps that have appeared during the interviews and to verify or falsify certain statements, a total of 8 observations (see table 3) have been carried out at marinas and shipyards along the coastline of Lower-Saxony (see figure 15). In order to ensure the stakeholders privacy, all interviewees are only being identified by their position and background of either being a board member of a local sailing club, a member of a local sailing

club, an individual sailor or an industry expert. All stakeholders have asked to be anonymous except the representative of the Sailing Association of Lower-Saxony

| Number of Interviewee | Interview ID | Position and Background of Interviewee | Date of Interview |
|-----------------------|--------------|---|-------------------|
| 1 | 20190508 | Board Member of a Local Sailing Club | 08.05.2019 |
| 2 | 20190510 | Board Member of a Local Sailing Club | 10.05.2019 |
| 3 | 20190519 | Sailing Industry Experts | 19.05.2019 |
| 4 | 20190522 | Member of a Local Sailing Club | 22.05.2019 |
| 5 | 20190526 | Member of a Local Sailing Club | 26.05.2019 |
| 6 | 20190528 | Board Member of a Local Sailing Club & Harbourmaster | 28.05.2019 |
| 7 | 20190530 | Member of a Local Sailing Club – Sustainability Designee | 30.05.2019 |
| 8 | 20190610 | Individual Sailor | 10.06.2019 |
| 9 | 20190616 | Individual Sailor | 16.06.2019 |
| 10 | 20190620 | Individual Sailor | 20.06.2019 |
| 11 | 20190701 | Member of a Local Sailing Club | 01.07.2019 |
| 12 | 20190712 | Sailing Industry Expert (Sailing Association of Lower-Saxony) | 12.07.2019 |

Table 2: Interviews conducted during this Research

| Marina | Date of Observation |
|--|---------------------|
| Nassauhafen, Wilhemshaven | 08.05.2019 |
| Nordenhamer Sportbootgemeinschaft | 10.05.2019 |
| Nordenhamer Sailing Club Shipyard Hall | 10.05.2019 |
| Dangast Harbour | 21.05.2019 |
| Shipyard Hooksiel | 22.05.2019 |
| Marina Hooksiel | 22.05.2019 |

| | |
|--------------------------|------------|
| Bremerhaven Yachtharbour | 10.05.2019 |
| Cuxhaven Yachtharbour | 28.05.2019 |

Table 3: Observation Sites

The next section of this chapter will elaborate on the findings regarding the problem scope, the problem perception and the communication patters within the sailing community.

4.1. Problem Scope: Points of Entry during Sailing Activities

This section will explain the points of entry during sailing activities assessing specifically the recreational sailing activities on the sea, in the marina and the maintenance process and practices on land. While the interviewees have given first implications on activities that possibly lead to plastic entering the marine environment, the observation of local marinas and shipyards gave implications to verify or falsify certain statements that have been made during the interviews and gave additional data that have not been mentioned during the interviews.

4.1.1. Recreational Sailing Activities on the Sea

The analysis of the semi-structured interviews shows that the majority of sailing trips being done within the southern North-Sea area, are short day trips. These vary from 1 ½ hour trips up to day trips where multiple harbours along the coastline and islands are being visited. Therefore, the trash accumulation on board is rather limited. However, longer distance trips are more difficult concerning the accumulation of plastic trash onboard. Space on sailing ships is limited and at some point, an unpleasant smell can start to affect the crew. Individual plastic trash minimization strategies are being applied in order to limit the plastic trash accumulating on board. Often, the groceries such as cheese and meats are being transferred into Tupperware.

"First, basically, you try to get rid of the garbage once you get ashore. That if you arrive on board, for example, unpack your things first and then dispose of the garbage directly in the marina, separated somehow, and don't necessarily take it on board." (Interviewee 8)

The plastic food wrapping is then being disposed and recycled in the marina waste bins. Thus, the accumulating plastic on board is already being minimized. Furthermore, the majority of the interviewees have stated, that all trash is being collected on board and disposed when reaching a new marina or harbour. The biodegradable waste, however, is often being disposed at sea. Another interviewee (Interviewee 11) has stated that the plastic food wrapping is not the biggest

part of waste accumulating on board during a sailing trip but rather paper. The onboard toilet systems are sensitive to paper and it is therefore collected and disposed with the other accumulating trash. A lot of washing and hygiene products can contain large amounts of microplastic (see chapter 2.5 Plastic). However, most interviewees have stated that they are considering this fact by using for example bar soap instead of shower gels, in order to reduce the production of plastic waste. The washing of clothes is usually being done in the harbour or at home and due to the nature of day trips within the North-Sea area frequent washing of clothes is not necessary. Therefore, no microplastic can reach the environment through the waste-holding-tank of the sailing boat. However, waste-holding-tanks are often being disposed at sea leading to a high nutrient input into the marine environment. These might be individual cases and not represent the behaviour of the entire sailing community.

The sailing sport is a nature-based experience and often exposed to forces of nature such as strong winds, swell and waves. Therefore, it is not uncommon that equipment and smaller items such as glasses, a compass or anything that has not be secured before reaching bad weather conditions or storms, to go overboard. However, this is rather limited and unintentionally.

“Not consciously, but unconsciously, when you're in an oblique position. So, there might be materials that go overboard on the sport boat skipper, but then they are also most urgently missed. So, there is no intention that they really go overboard. And there I would like to say that when heavy weather is announced, the decks are tidied up so far that nothing goes overboard” (Interviewee 6)

The statement above underlines that items are usually being discarded unintentionally caused by accidents relating to the exposure to physical processes and impacts such as wind and oblique position caused by an increasing wave activity. However, other statements clearly state the opposite.

“Oh yes, we have noticed that, a beer can, in back then also plastic garbage... But that is also getting less... We already had a fight on board with some friends because we said you can't throw your garbage overboard and there was a little anti-posture but meanwhile, we have changed something... At least when we are on board, no idea what will happen if we are not on board” (Interviewee 3)

Not one interviewee had stated that they intentionally discard any waste into the environment during sailing activities, recently. However, a few interviewees were able to observe wrongful waste disposal on sea. There seems to be a transition in the behaviour of throwing the trash overboard. In the past, it was a common practice to dispose trash overboard and this behaviour

seems to be decreasing with an increasing environmental conscious and the building of a pro-environmental behaviour across the sailing community. The discard of trash on sea also relates to knowledge gaps of sailors that might be unaware of the negative impacts that litter bears to the marine environment.

"I don't know any reason other than an emergency to throw stuff overboard, who says or believes that may be too badly educated" (Interviewee 7)

This transition is underlined by a learning curve. Common and dominant practices such as the discarding of trash at sea is being individually evaluated leading to a learning by doing process. Sailors are getting more aware of their actions and its consequences to the marine environment and adjust those practices in order to limit their ecological impact. Thus, individual environmental impact assessments are being carried out either intentionally or unintentionally. Another possible point of entry that has been investigated are the marinas along the coastline and specifically its waste infrastructure and information provision about individual minimization and prevention measures and recycling. The findings of this research are summarized in the following section.

4.1.2. Activities and Life in the Marina & the Impact of Waste Infrastructure

Along the coastline of Lower-Saxony around 10.500 berths are available for both sailing club members as well as guests (W. Mell, 2016). The number of berths vary per harbour from 20 up to 300 and so does the possibility for recycling and waste disposal opportunities. Bigger marinas



Figure 15: Pictures Nordenhamer Yachtharbour Information Boards, Authors Own

often have more possibilities and information for appropriate waste management. Bigger Harbours such as the Yachthafen Cuxhaven and the Nordenhamer sport boat harbour entails around 240 berths for both sailing boats and sport boats and with all necessary recycling bins such as paper, plastic, and residual waste and with additional information about how to appropriately recycle waste.

However, information provided in the marina do not include specific prevention and minimization strategies on how to limit the amount on plastic entering the marine environment through recreational sailing activities. In addition, no information on how to properly recycle were provided by local sailing clubs for international guests who might not be familiar with German recycling processes or the German language.

"There are signs, but not in such a way that one could say that a clarification is taking place, that it is important to avoid plastic waste. I haven't noticed that yet." (Interviewee 5)

The interviewees have evaluated the general impression they have gathered over years of experience of sailing activities and time spent at different marinas and harbours along the coastline of Lower-Saxony. Smaller marinas are often associated with poor waste management. Smaller sailing clubs are sometimes located at a small publicly owned harbour.

"We have to do something for members, for guests in our club, we have toilets in the sailing club facilities, and showers here in the hall. We have to do something because N-Ports does nothing" (Interviewee 1)

N-Ports, a German company publicly owned by the state of Lower-Saxony is responsible for some of these harbours in terms of maintenance of the waste-infrastructure, and other facilities such as restroom and shower facilities. However, as these harbours are rather small, the sailing clubs themselves have to take the initiative to provide these establishments for their sailing club members and guests. These are associated with additional costs for the sailing clubs. It is not uncommon that the accumulating trash by members and guests are difficult to manage due to seasonal fluctuation of activities of the sailing community, especially during peak summer month, as the sailing clubs can only provide a limited amount of waste bins. In combination the distances to recycling facilities are long.

"Rather bad, of course there were possibilities, but then it was really so that one had to ask someone where the bins stand now. Often connected with a lot of walking. If you haven't found one who was somehow responsible on site, then you've taken it on board again"
(Interviewee 9)

In general, the waste-infrastructure was evaluated as sufficient but highly dependent on the marina and harbour size. However, this had changed over recent years. In the past, marinas and harbours often only provided one waste bin for residual waste.

“Meanwhile it is quite good, there they have also several bins. But I remember 5 years ago you only had one big waste bin. Here you have cardboard, plastic and residual waste by now, but you often have only the big black bins standing on the chain”; “You will always get rid of your garbage.... You don't have to throw it into the sea” (Interviewee 3)

The observations of the waste infrastructure in selected harbours along the coastline of Lower-Saxony states that the infrastructure is mostly sufficient even in smaller harbours. Recycling opportunities were always present in all 6 harbours that were investigated. In addition, no wrongful behaviour such as intentional littering by sailors has been observed. However, plastic trash and food wrapping was often found around the harbour. These were harbours that were located in proximity to vacation regions such as the Dangast harbour. As these were mostly food wrapping from convenient products such as sandwiches or candy bars, the assumption lies on tourists being the source of the litter and not the sailors themselves as the harbour was relatively clean compared to its surrounding area.

Sometimes local sailing clubs are unwilling to offer their trash bins to guests of the harbour leading to sailing guests having to take their trash back on board until they find a suitable harbour that is willing to utilize their trash.

“They have no desire to dispose the garbage of partly foreign nations, there is partly also such a rage associated and little readiness to say we want to dispose the garbage of other arriving nations” (Interviewee 5)

One interviewee had referred to a specific experience where they had disposed their trash accordingly and found their trash at the end of the night back on their boat as it was apparently unwanted by local sailors. Another interviewee was able to observe how the harbour waste management intentionally discarded the collected trash of the marina at a nearby waterbody. However, this incident was approximately 30 years ago and refers to an individual and particular case that had not been observed again.

During the observations of marinas and yacht harbours along the coastline of Lower-Saxony, the waste infrastructure was always evaluated as sufficient. Even smaller marinas such as the Dangast harbour had a sufficient waste infrastructure with a minimum walking distance to the recycling facilities and with all required recycling bins. However, during the observations,

numerous cigarette butts were thrown overboard and into the harbour by tourists, motorboat operators and once by a sailor.

In general, the waste infrastructure is mostly sufficient leading to the assumption that the lack of the effectiveness of waste infrastructure is not a reason for sailors to discard any kind of waste or material at sea or in the marina.

4.1.3. Dominant Maintenance Practices

During its lifecycle a sailing boat goes through different phases of usages. While the summer months are being used for the actual time of recreational sailing activities at sea, winter months are usually used to take care of certain repairs and maintenance processes. The majority of repairs is being done by the individuals themselves. Many of these processes such as removing paint and antifouling is being done in shipyard halls or designated outdoor areas of a shipyard. Repairing the boat by themselves is often motivated by the urge of getting to know supercriticalities about physical components of the boat or trying to save money and time.

"I basically do the repairs myself, then I also know what's broken, that's just safety thinking for me. If I know my ship and have crawled through every room, then I know that the ship is okay. I have to be able to rely on it, I have no ADAC out there on the water. (Interviewee 1)

"In fact, because I think that I could save money by doing this, actually only as far as working time is concerned." (Interviewee 9)

"What does it cost if we do it ourselves and what does it save us if we do it ourselves? But in most cases, if we do it ourselves, it is cheaper". (Interviewees 3)

The information on how to execute dominant maintenance practices such as the removing of paints below the waterline using a scraper and chemicals or sanding machines with attached suction, are mostly being communicated through informal communication networks and the careful studying of technical and specialist literature such as sailing magazines or even the consultancy of experts in sailing specific hardware stores.

"You know who to ask when you don't know something. Through your own experiences and contacts" (Interviewees 3)

"I bought myself a few books and I am also in a handicraft job and have also interest in it and have read then the necessary know-how for it."(Interviewee 9)

Most sailing clubs privately own halls to give the members the opportunity to execute repairs without polluting the harbour. The motives are not entirely pro-environmental behaviour but

rather the fact that waters pollution caused by sailing club members can lead to economic damages of the harbours ecosystem that is being monitored by the water police. However, most practices are being done without the possibility for harmful substances leaving the maintenance area, that may appear from sanding dust or paint flakes. Through the interviews and observations carried out at the shipyards, no wrongful behaviour could be recorded.

However, according to some of the interviewees, some sailors take advantage of their connections within the sailing community and are able to obtain certain materials from the shipping industry to make the sailing boat haul more robust.

"The most polluting materials are being used by the commercial shipping industry and we have also seen that people get them from commercial shipping or have them get them when someone has access to them." (Interviewee 5)

This paint is allowed within the shipping industry but is not legally obtainable for individual sailors nor is it allowed to be applied onto sailing boats. Thus, some sailors are still using such paints and intentionally harming marine ecosystems. One sailing club in particular is trying to prohibit such behaviour by having their members signing an agreement to not engage in such practices (interviewee 11). Other sailing clubs try to communicate informally to not use such materials.

Some sailing clubs refer their members to local shipyard companies that professionally maintain and repair sailing boats. Certain requests to use more environmentally friendly paint is most likely to be accepted by these companies but none of the interviewees has made such request yet but will most likely in the future if repairs are necessary.

The paint and antifouling have accordingly to the interviewees changed in their chemical's components. Many of these products are more environmentally friendly than in the past. In addition, some practices are being questioned such as the seasonal application of antifouling below the waterline. One interviewee (interviewee 5) emphasized that it is only necessary to remove biological growth and apply antifouling only where necessary instead of the entire ship hull. But this seems to be an individual case where the interviewee had even debated with other sailors about such repair practices.

4.1.4. Synthesis: Problem Scope

This chapter outlines the finding of this research focusing of the following research question:

What are possible sources (points of entry) for marine litter entering the marine environment during different recreational sailing activities?

How are technical structures and measures such as waste management by the marinas influencing the sailing community in terms of plastic pollution?

The findings show that in all three possible points of entry, the amount of plastic and waste entering the marine environment from individual sailing vessels is rather limited. However, as the coastline of Lower-Saxony entails a number of 10.500 sailing boats possibly being active in the North-Sea region (W. Mell, 2016), the amount of plastic being littered can be significant. The largest possibility still is the wrongful and anti-environmental behaviour during recreational sailing activities at sea. Some of the interviewees have stated that there are still people that intentionally discard gear and trash into the sea without thinking of the consequences. The problem scope of the other two possible points of entry are comparable small. The waste-infrastructure of the marinas and harbours is mostly sufficient and plays a significant smaller role in possible littering. However, smaller marinas might have bigger problems with an effective waste management according to the interviewees.

The maintenance and repairs of sailing boats is mostly being done according to legal norms and standards. However, even those legal norms and standards are being questioned by some sailors and individual practices such as the punctual removal of biological growth and a thin application of antifouling being applied.

4.2. Problem Perception

This chapter will illustrate the findings concerning the remaining secondary research question and focus on the problem perception within the sailing community including board members of sailing clubs, members of sailing clubs, experts and individual sailors that are not part of any local sailing club.

4.2.1. Attitude towards Sustainability and Plastic Pollution

When investigating the attitude of sailing community members, it is important to differentiate between sailing club members, individual sailors that don't belong to a local sailing club and

board members of sailing clubs. Thus, different perspectives on how the problem of plastic pollution and sustainability in general is being perceived within the community and how it is being communicated are given. There is a general agreement on including the sustainability aspect within the sailing sport which is largely being influenced by mainstream media such as documentaries, newspapers, and tv news. When asking for the specific reason for choosing the sailing sport as a hobby, family tradition and the nature-based experience, deceleration and exposure to the forces of nature were among the most common reasons. The sailing sport is a recreational outlet and escape from the everyday life. Therefore, a general understanding of protecting the environment in sailors' mindsets is present.

"I think that there is already an awareness and it is being tried not to impact it any further than it already is." (Interviewee 8)

The sensitivity for topics such as sustainability and trying to mitigate harmful substances reaching the environment seems to be comparable larger to other forms of water sports such as motorboating according to interviewee 5 and interviewee 11.

"So that's why we really try to sail while sailing, and we are during the whole season when we are on our way to Copenhagen and back, we consume about 60 litres of diesel during the whole season. That means if I look at what a motorboat or other sportsmen or car drivers consume, it's a fascinating story of what you can do with the wind." (Interviewee 11)

"I would say that through my conversations and encounters the group of sailors consider themselves more environmentally conscious than the group of motorboat drivers." (Interviewee 5)

"Yes absolutely and there are two camps mostly that don't understand each other so well, those are the motorboat drivers and the sailors, the sailors move with a much slower speed with the water and have usually chosen this form as it is more sustainable, because also no fuel is consumed and sailing by the wave is also something harmonious as if a motorboat the wave breaks through by engine power " (Interviewee 5)

The sailing sport is a nature-based experience with a large exposure to natural processes and dynamics such as wind. This close connection implies a considerable sensitivity for caring for the environment and customizing their activities to limit their ecological footprint. However, this sensitivity is not necessarily initiated by the sailing sport but rather with a general sensitivity for minimizing their ecological footprint in their everyday life. The individual pro-environment behaviour starts with specific consumer habits including the avoidance of plastic

wrapped articles or e.g. buying a soap bar instead of using bottled shampoo and thus, is being transferred onto the hobby.

However, while the interviewees all had their own minimization and prevention strategies for plastic entering the marine environment and limiting their ecological footprint during their sailing activities, a few emphasized that it does not translate onto the entire community.

"But that hasn't yet arrived with many people yet"; "That's also funny to understand, for many it's their feeling of freedom next to their everyday life and yet they throw their garbage overboard, that doesn't fit together somehow." (Interviewee 3)

"We have so many discussions, starting with the hair soap. Almost everywhere we come across deaf ears." (Interviewee 4)

As mentioned in the chapter discussing the recreational sailing activities as possible point of entry for plastic entering the marine environment, the interviewees explained exemplary individual cases how they observed wrongful behaviour by members of the sailing community of discarding items at sea. The discussion of plastic pollution has not reached or impacted everyone in the same intensity. This is contradicting with the sailing sport being a nature-based experience and the urge of caring for the environment. Often, the problem seems not to be visible enough for people to change as waste is carried away by wave dynamics and strong winds. In addition, as the sailing sport might function as an escape of the everyday life of people, some might try not to think about negative factors as this would be contradicting with the recreational function of sailing.

"When it comes to hobbies, you probably repress it even more, because you want to have fun and leave the everyday life behind a bit." (Interviewee 9)

The main discussions between sailors seem to follow functions and technical topics related to the sailing boats itself.

"That's actually quite a grey area as far as that goes. There is a lot of talking but plastic waste and how to avoid it is not a topic at all" (Interviewee 9)

In general, there is an agreement within the sailing community that the environmental impact must be considered during sailing activities. This is, however, rather fragmented and not established across the entire community with the same intensity and willingness to change dominant practices or their belief of what might be harmful for the environment.

4.2.2. Perspective of Board Members (Sailing Club Representatives)

One board member pointed out that prevention measures and minimization strategies or the topic of plastic pollution is being negligible discussed within the sailing club mainly because the board member does not consider it necessary to discuss minimization and prevention measures. He emphasized on the members privacy and individual responsibility on how to handle their own waste.

"What do I have to do with other people's privacy?"

"It is their trash not mine";

"We don't need it, they're all reasonable people";

"That is not being discussed there" (Interviewee 2)

The interview with this specific board member was difficult to conduct as there was quite an anti-attitude to the questions and a generally protective behaviour towards the sailing sport itself and the members of the club. The interviewee saw the interview more like an attack at the sailing sport rather than a rational assessment of the sailing sport as possible pathway for plastic entering the marine environment. However, another board member emphasized that it is difficult to inform members in general as the communality of the sailing club members is continuously decreasing leading to a declining feeling of belonging to a community. In addition, the number of young members is decreasing which makes it even more difficult to discuss such topics as the older generation seems to be stuck and locked-in in certain mindsets, and dominant practices regarding the maintenance of the boat and the behaviour at sea.

"In the sailing club it has been like this that the understanding for this whole topic was not yet present with all my older colleagues and was understood faster with the younger ones".

(Interviewee 7)

The younger generation is more accessible to the topic and is willing to discuss and change certain structures of the sailing sport and the community.

Interviewee 12 has stated that there is a general hesitation among the older generation within the sailing club while *"The younger members are committed and engaged "* (Interviewee 12).

In general, minimization strategies and prevention measures are mostly being communicated between individual sailors rather than within sailing clubs. There is a general lack of information provision through the sailing club. Furthermore, when obtaining the sailing or

motorboat driver license, these topics are only being briefly discussed through the rather basic 10 golden rules of water sports.

"That's actually quite a grey area as far as that goes. There is a lot of talking but plastic waste and how to avoid it is not a topic at all." (Interviewee 9)

"Influences of sailing clubs not at all. The sailing club I once belonged to avoided anything but plastic, maybe that had repelled me." (Interviewee 10)

However, no kinds of prevention measures or minimization strategies are being communicated on local- to meso- level by sailing clubs and umbrella associations of sailing clubs. Only particular cases of organizational structures of sailing clubs seem to affect the members attitude and behaviour.

"I think that it has started to move very slowly, it is not the case that it is in all sailing clubs, I wouldn't say that, since it is not structured, that are often initiatives from the individual associations." (Interviewee 11)

Only a few sailing clubs seem to try to mediate and communicate topics such as sustainability and plastic pollution to their members.

"That's an integral part of it." (Interviewee 12)

These sailing clubs try to create a sensitivity for such topics also by obtaining ecolabels for their marina such as the blue flag. While these sailing clubs with a connection to an own marina are usually located on a meso- to micro-scale, there are also national sailing clubs that are not specifically bound to a geographical local location. The sailing association of Lower-Saxony tries to mediate between sailing clubs in order to build a sensitivity to be more environment conscious. Thus, local sailing clubs derive certain information from this national network and are mediating it to their members on a local- to meso-level. With organizing beach clean ups, the sensitivity is being increased among the community and the topic of plastic pollution gains more attention. However, this seems to be a transition following a general acceptance within the society of living more ecological and building a more pro-environmental consciousness.

This also relates to the notion that pro-environmental behaviour starts within the everyday life and is eventually being transferred onto the hobby. Even though the creation of sensitivity to such topics is being mediated through a sailing club, This, does not necessarily have to be connected to the sailing sport itself even though it can play a role in being more environmentally friendly due to the nature-based sailing experience.

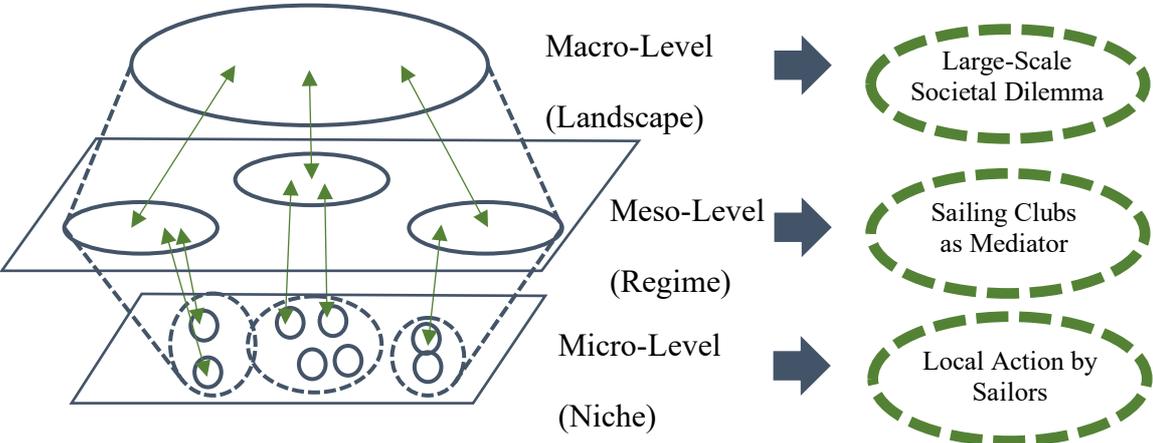


Figure 16: Different Scales within the Sailing Community

This trend can also be observed in the recent 2019 European Parliament elections. While the green political party Alliance90/The Greens have only reached around 10 percent of voting’s in Lower-Saxony in 2014, the votes have increased by over 10 percent with 22 percent in 2019 (Statistisches Bundesamt, 2019, p. 26). This trend is being influenced by recent movements of the younger generation being more environmental conscious. Movements such as “Fridays for Future” advocates and motivates thousands of high school students to be more environmentally conscious while simultaneously trying to motivate the older generation including key actors in industries and politics to adjust and implement new policies to limit the effects of climate change (Fridays for future, 2019). Thus, a large-scale social change is being motivated and influenced by local actions of students.

This trend underlines an acceleration in an ecological movement not only in the sailing community but in society itself.

4.2.3. Perspective of a Members and Non-Members

Most of the information reaching members of sailing clubs and the general sailing community concerning plastic pollution and mitigation of plastic entering the marine environment is either derived from the mainstream media, sailing specific magazines or additional sources such as national sailing clubs, e.g. Soltwaters. As mentioned in the previous chapter, the information provided by sailing clubs is rather limited. However, some interviewees wished to receive more information from their sailing clubs.

“If anyone could do it, it would be the sailing clubs themselves.” (Interviewee 9)

“Especially the group pressure in the sailing club life, can also be a wonderful means for members to pay attention to it” (Interviewee 10)

By being within a community and dominant practices are not only being evaluated by individuals but also by groups and the community. In addition, some interviewees emphasized on the responsibility sailing clubs have for their members and the members behaviour.

“Influences of sailing clubs not at all. The sailing club I once belonged to avoided anything but plastic, maybe that had repelled me.” (Interviewee 10)

Some people might be increasingly drawn to the national sailing clubs that might have implemented sustainability aspects in more detail into their organizational structure. This makes bigger sailing clubs or associations more attractive for people that have already established the sustainability aspect into their everyday life. When smaller sailing clubs do not have implemented the sustainability aspect into their organizational structure in any way or only in small parts, this might be unattractive for people who would wish more effort coming from sailing clubs. However, sailing clubs entail a unique position to mediate information from national scale, e.g. by national sailing clubs, to local individuals. With more effort and willingness coming from the sailing clubs, more people could be reached, and a broader sensitivity build up across the sailing community. Thus, it needs more implementation of the sustainability aspect into the organizational structure of sailing clubs in order to create a sensitivity towards plastic prevention and sustainability in general.

4.2.4. Synthesis: Problem Perception

This chapter outlines the finding of this research focusing of the following research questions:

How is the problem of plastic pollution being perceived by relevant stakeholder within the sailing community?

How are organizational structures, such as provision of information of the marina and sailing clubs, influencing the sailing community in terms of plastic pollution?

The research has shown that there is a general sensitivity within the sailing community when it comes to the plastic pollution and being environmental conscious. Even though most interviewees seem to have a basic understanding on how to avoid plastic entering the marine environment, many were able to observe a contradicting behaviour of members of the sailing community. Many sailors have already implemented individual minimization strategies to prevent a plastic trash accumulation onboard of the sailing ship such as the unpackaging of food and transferring it into Tupperware and the disposal of plastic food wrapping at the marina. The use and application of antifouling is being evaluated by some sailors in order to prevent the harmful substances entering the marine environment. However, the use of less harmful substances seems to be only be justified by the legally binding laws and regulation. An additional request to shipyard companies to use less harmful substances if usually not being made.

The sailing clubs entail a subordinate role when it comes to information provision concerning minimization strategies and prevention measures. The majority of local sailing clubs do not inform their members about specific minimization strategies and prevention measures. However, the sailing clubs are ambitious that their members are using the legal and less harmful substances such as antifouling and paints and behave environmentally friendly. The influence of organizational structures of sailing clubs are rather limited as they do not necessarily make plastic pollution a topic being communicated mainly being justified by the wish to respect the members privacy and the lack of information or willingness of members to change their dominant practices and mindsets.

Larger sailing clubs such as the Soltwaters and the sailing association of Lower-Saxony in which many sailing clubs are members of, advocate minimization strategies and prevention measures while simultaneously trying to build up a sensitivity to plastic pollution across the sailing community. However, not all sailing clubs of Lower-Saxony are part of the association or communicate with larger sailing clubs. This complicates the communication of pro-environmental behaviour from the macro-scale to the micro-scale.

The younger generation of sailing club members and individual sailors seem to be more environmental conscious and trying specifically to limit the environmental impact not only during recreational sailing activities but also with maintenance processes. This behaviour is

also underlined by a larger-scale societal change referred to in the previous chapter of the younger generation being more sensitive towards environmental degradation.

4.3. Managing Problematic Points of Entry

The previous chapters have outlined the problematic points of entry for plastic entering the marine environment through recreational sailing activities and has identified the problem perception of sailors as major driver for plastic entering the marine environment. This chapter will first answer the two remaining secondary and subsequently one of the primary research questions.

Secondary research questions:

What are possible, effective prevention measures?

What are possible, effective minimization strategies?

Primary research question:

How can problematic entry points for plastic entering the marine environment be managed?

Linking the results of this research to the developed conceptual model in chapter 2, the acknowledgement of the sailing sport as possible pathway for marine litter is required in order for a new instrument or strategy to work effectively. As the sensitivity for the topic of plastic pollution has not reached the entire sailing community, it needs to be discussed increasingly and in depth among the community.

The points of entry for marine plastic litter entering the marine environment through the three investigated sailing activities are rather limited and highly related to individual behaviour and attitude towards sustainability and being environmentally conscious. The most common and possible points of entry is the wrongful behaviour of people discarding waste and other items overboard, and the usage of harmful substances such as antifouling. In order to limit plastic entering the marine environment through recreational sailing activities and maintenance processes, it is necessary to create a certain sensitivity to plastic pollution among the sailing community. The literature review already determined numerous laws and regulations (formal institutions) limiting the amount of plastic entering the marine environment through industries operating in the North-Sea region. The obtained data has shown that the issue lies within the problem perception of sailors and their local, individual action.

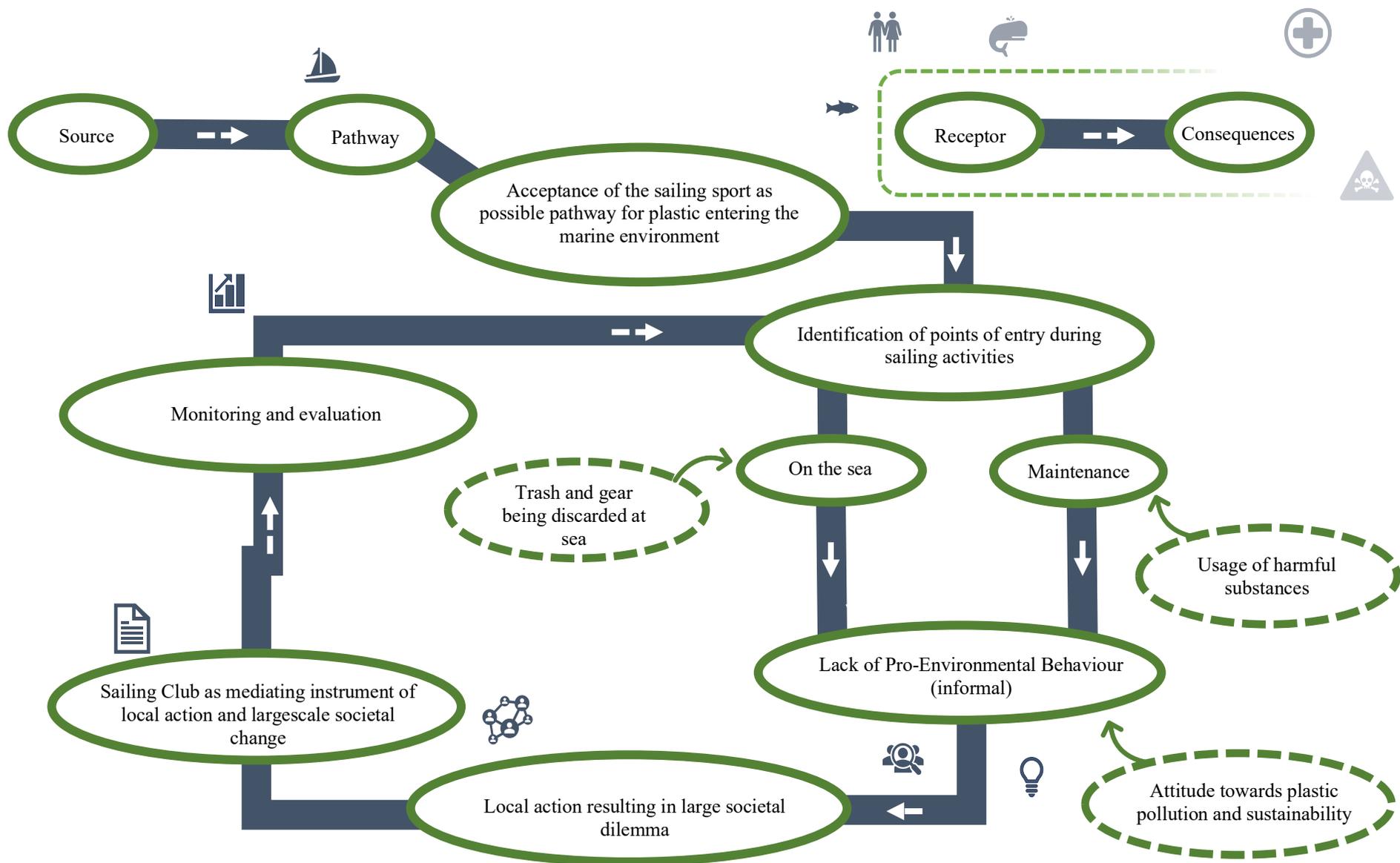


Figure 17: Application of the Conceptual Model onto Research Findings

Applying the findings of this research onto the entire sailing community, the problem ranges from micro-level, individual action results into a large societal dilemma. Sailing clubs entail a unique position of mediating these local actions and influencing this large-scale societal dilemma.

Sailing clubs have to include instruments for creating an environmental consciousness among the sailing organizational structure. By sensitizing the sailing community's mindset, the biggest opportunity for plastic litter entering the marine environment can be minimized. Sailing clubs are able to reach a large number of sailors as around 26.000 members are registered alone in the northern part of Germany (Segler-Verband Niedersachsen, 2019). Dominant practices such as the removal and application of antifouling should be revised and documented if it is necessary to use such harmful substances in an extensive way that is has been used so far. This research has shown through the experience of sailors that only a punctual application of antifouling and the removing of biological growth is enough to secure the integrity of a ship hull.

Larger sailing clubs are already providing a lot of information through workshops, newsletters and beach clean ups and thus, creating a broader sensitivity for topics such as plastic pollution among the sailing community on a larger scale. Sailing clubs should implement such instruments within their organizational structure.

As the younger generation seems to be more accessible for such topics it would be advisable to start with the educational opportunities during the instruction lessons of the sailing license. Therefore, a general sensitivity would be built on which additional knowledge can be added during workshops and information provided by sailing clubs and marinas.

Thus, individual minimization strategies and prevention measures can be applied for a better understanding and acceptance of the sailing sport as possible pathway for plastic entering the marine environment is present.

4.4. Synthesis

The results of this research have pinpointed the actual issue being the problem perception of the investigated stakeholders. According to the Sailing Association of Lower-Saxony, around 26.000 sailors are part of the community in northern Germany, not including guest sailors of the North-Sea (Segler-Verband Niedersachsen, 2019). With 10.500 berths in total along the coastline of Lower-Saxony (W. Mell, 2016), the amount of sailing vessels operating in the North-Sea region is significantly larger than other industries such as fisheries who only account

for 6600 fishing vessels from different nations including Denmark, the Netherlands, Belgium and Germany (ICES, 2018). However, not every member operates a sailing vessel. Many family members are part of a sailing club but operate only one boat. However, as many guest sailors from different nations also use berths along the coastline of Lower-Saxony, it is likely that the entire number of 10.500 berths is occupied during peak season. Referring to the remaining primary research question of this thesis:

To what extent do recreational sailing activities on the coast of Lower-Saxony and its surrounding islands contribute to the problem of plastic litter entering the marine environment?

Even though the points of entry for plastic entering the marine environment are rather limited through the three investigated sailing activities, the numbers might add up. With potentially over 10.500 sailing vessels operating within the southern North-Sea region, during peak season, and a large amount of sailing not being aware on what actions lead to certain consequences, the extent of the sailing sport being a possible pathway can be considered extensive.

4.5. Discussion and Critical Reflection of this Research

This research has investigated to what extent the sailing community and its activities contributes to the increasing problem of plastic pollution within the geographical frame of the coastline of Lower-Saxony, Germany. With the leading assumption, that with the operation of sailing boats and marinas, a significant source of plastic litter has so far been largely overlooked, the problem scope has been identified and the problem perception as major driver for plastic entering the marine environment through sailing activities determined. This research gives first implications to what extent the sailing sport contributes to the problem of plastic pollution.

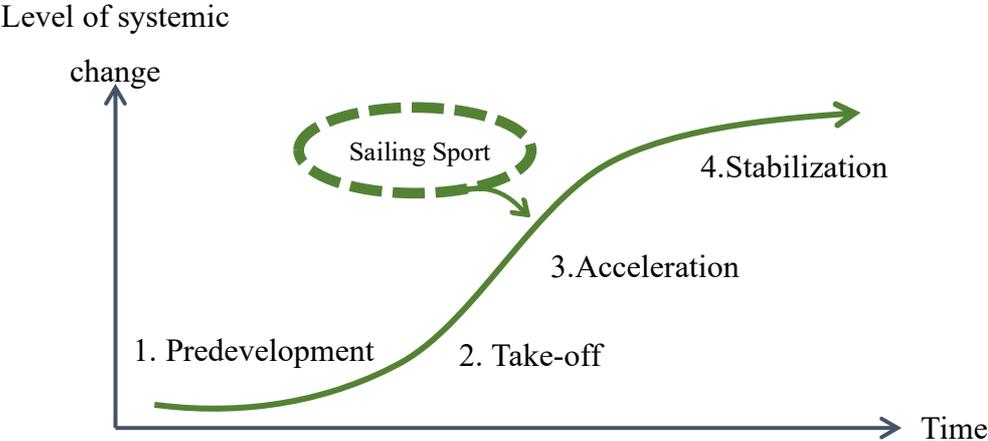


Figure 18: Transition of the Problem Perception

The research has shown that the acceptance is lower with the aging sailing community and that a lot of people are locked-in in their practices that they have been doing for years. However, there seems to be a transition from these less ecological practices towards more pro-environmental behaviour. The younger generation appears to be more sensitive for such topics and accessible for new techniques and practices that might be more beneficial for the environment such as the usage of less harmful antifouling products. In addition, this transition

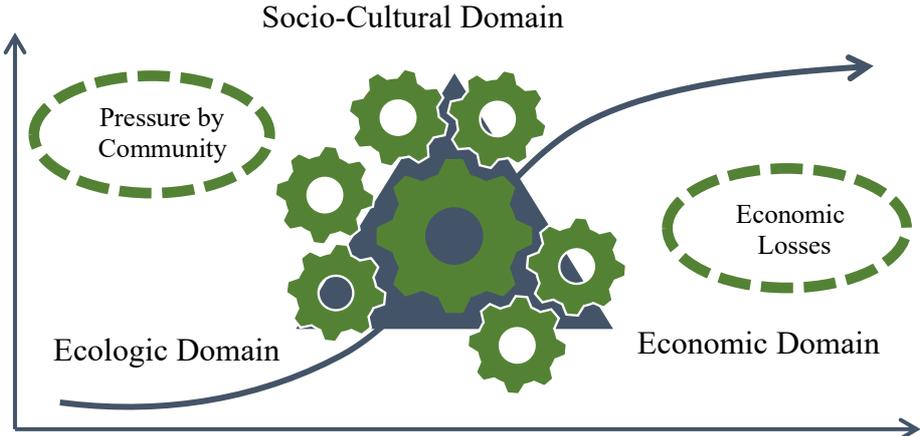


Figure 19: Domains influencing the Problem Perception

can also be observed in the older members of the community. Some interviewees have stated that through their long-time experience they have built an environmental conscious they are trying to transfer onto and share with the community. The sailing sport has already implemented numerous strategies to build a sensitivity across the sailing community for adjusting sailing activities more environmentally friendly. These measures include the minimization of avoiding bringing plastic food wrapping onboard of a sailing vessel, using less harmful antifouling products, and building a sensitivity across the community with workshops and beach clean ups. With the younger generation being more sensitive for such actions and the influence of larger sailing clubs and the inclusion of environmental aspects in the organizational structure of sailing clubs, an acceleration of building a broader pro-environmental attitude is being initiated. Being environmental conscious during maintenance processes leads to less economic losses for the sailing clubs as mentioned in chapter 4.2.2.. Furthermore, plastic debris can damage the ship hulls leading to an economic incentive for people not to litter. Next to economic factors, socio-cultural factors can also motivate people to become environmental conscious. Being within a community, people are being pressured by certain actions of other people and therefore influencing others. By communicating sustainability with others, an awareness for certain actions being not as environmentally friendly as first anticipated is being built. This combines the socio-cultural and ecological domains mentioned by Loorbach, 2002.

These reinforcing cogwheels work towards an acceleration of being more environmentally conscious and individual evaluation of certain practices and actions across the sailing community enhance the transition.

The extent of this research has been limited but has opened a pathway for additional research. The conceptual model has been developed in order to strategically implement certain measures in order to minimize the consequences for the various receptors of marine plastic litter. The findings of this research have shown, that the largest problem lies with the problem perception of sailors and their dominant practices.

However, it seems to be challenging to initialize a large-scale change of the sailing community's behaviour. Most sailing club members and board members belong to an older generation displaying a smaller willingness to change dominant practices. Board members show fewer initiatives of including the sustainability aspect into the organizational structures of the sailing club based on privacy reasons and the impression that their members won't act anti-environmentally anyways. Therefore, the necessity to implement such measures seem not be relevant for certain board members. In addition, older members are locked-in in certain practices and show less ambition to change these.

Furthermore, it is difficult to evaluate the digression or progression of the extent the pathways of sailing activities contribute to plastic litter entering the marine environment. Only a small amount accounts for actual sailing specific gear and equipment. Therefore, it is difficult to trace the input back to the sailing sport itself. It is more likely to observe a gradual change of the problem perception of the relevant stakeholders and to pinpoint the exact position of the transition.

The research approach of this investigation was based on qualitative research using semi-structured interviews and observations. By using observations of marinas and shipyards, certain statements regarding dominant practices during maintenance processes of the ship and in the marina made it possible to verify certain statements that were being made during the interviews. As the most wrongful behaviour mentioned during the interviews was littering waste and equipment at sea, a knowledge gap of this research is being identified. None of the statements about the practices at sea were able to be falsified or verified. However, this appears to be impossible to investigate through the method of observations. In addition, it was difficult to come in contact with the sailing clubs as a large number of the sailing clubs did not answer any emails in regard to the topic of this research. Judging on the impression I got through the

interview of one of the interviewed board members, there was a general hesitation on discussing the sailing sport as a possible pathway for marine litter.

Approximately 10.500 berths are available along the coastline of Lower-Saxony, Germany (W. Mell, 2016). However, an exact number of active sailing vessels operating in the southern North-Sea region is difficult to determine as it is dependent on certain variables such as the occupation of all berths, international sailing guests, the level of activity of some sailing boats, the share of motorboats and the seasonal fluctuation of the sailing sport activities. Some sailors may own a sailing boat, but the recreational sailing activities seem to be limited. Through informal discussions at the marina, it became clear that not every sailing boat operator is actually sailing but is rather using their boat as a second home instead of a sport equipment and mostly spends time at the marina than at sea.

To summarize the critical reflection of this research, the active number of sailing vessels operating in the southern North-Sea region is difficult to determine and so is the actual extent on which the sailing sport contributes to plastic littering. The problem perception of the stakeholders appears to be quite diverse from a very open minded ecological and sustainable attitude to a more contrasting view.

5. Conclusion

Many sources and pathways of plastic litter have already been identified and new strategies and instruments have been developed to prevent plastic entering the environment and to minimize their impact. However, plastic pollution is a problem of global magnitude. Numerous interrelated factors and sectors such as the economy, society and the environment, are resulting in an extensive influential network. Thus, plastic pollution can be considered a wicked problem. Even with the application of the SPRC-Model, this complexity is inherent and must be acknowledged.

The central aim of this research was to determine the extent of the sailing sport as possible pathway for plastic marine litter along the coastline of Lower-Saxony, Germany. Thus, the research objective was threefold, including the problem scope, the problem perception of relevant stakeholders and the development of minimization strategies and prevention measures.

To determine the extent is rather difficult due to numerous variables such as the seasonal fluctuation of sailing activities at sea, the absence of the requirement registration of sailing vessels that are smaller than 15 meters, and a number of berths along the coastline that include motorboats. However, certain sailing activities, such as life on sea, and dominant maintenance practices have shown that the plastic input can be significant.

The problem perception of the relevant stakeholders of this research is quite diverse. Almost all interviewees have already implemented individual minimization strategies and prevention measures for plastic entering the marine environment through sailing activities and have shown an in depth understanding and sensitivity for the topic of plastic pollution. Furthermore, a transition towards more pro-environmental behaviour within the sailing community can be observed. Dominant practices such as the disposal of waste at sea and the usage of harmful paints and antifouling are being evaluated. However, this behaviour is not necessarily be transferable to the entire sailing community.

The analysis leads therefore to the following conclusion:

The problem perception of the stakeholders seems to be the most dominant variable when determining the extent of the sailing sport as possible pathway for plastic entering the marine environment. There are already numerous policies, laws and regulation implemented and in place that limit the amount of plastic and other harmful substances in the marine environment not only aiming for the sailing sport but for all industries operating at sea.

The sailing clubs along the coastline entail a unique position of initializing a change in behaviour across the sailing community as it can mediate between large societal change and small-scale action. Larger sailing clubs and umbrella associations are already trying to build a sensitivity across the sailing community by organizing workshops, events and other forms of information provision. Thus, the local-level action including individual sailors and sailing club members can be influenced by large-scale actors. The sailing clubs can function as an instrument to mediate between these two scales and help to communicate to a vast number of sailors.

There is already a general acceptance and sensitivity in terms of plastic pollution. While the older generation often seems to be locked-in in certain practices, the younger generation is more accessible resulting in a transition of behaviour and attitude. The sailing community entails an acceleration towards a more pro-environmental behaviour. It is, however, not only observable within the community but can rather be seen as large-scale societal change, focusing especially on the younger generation.

The sailing sport is a big industry operating in the southern North-Sea region. Therefore, the environmental impact and input of plastic entering the marine environment through sailing activities can be significant. During this research, the problem scope was identified to be rather limited while the problem perception of the sailors seems to be the most dominant driver for plastic entering the marine environment through sailing activities.

5.1. Windows of Opportunity for further Research

This research has illustrated first results in the investigation of possible pathways for marine litter during recreational sailing activities. With this research a first impression and indicators for further research could be identified. The waste infrastructure had been evaluated by the interviewees leading to the impression that smaller marinas often have an insufficient waste infrastructure. However, the observation of selected marinas has found the opposite to be the case. Therefore, an opportunity for further research would be to investigate on the exact extent the waste infrastructure plays a role of the sailing sport being a pathway for marine litter. In addition, the regional differences of waste infrastructure and recycling systems should be evaluated.

Furthermore, maintenance and dominant practices should be evaluated and tested if it is necessary to apply antifouling the way it has been done in the past and present. New strategies might be just as effective such as the removing of biological growth and the punctual removing and application of antifouling in order to maintain the integrity of the ship hull.

The shipping industry does not have the same regulation as sailing boats in regard to paints and antifouling products. Further research could take place in the industry sector of commercial shipping and evaluate dominant practices.

As the problem perception of the stakeholders has been identified as major driver for plastic marine litter through recreational sailing activities, the attitude towards plastic pollution should be investigated through additional research. Standardized surveys can be quantifiable and statistically analyse people's behaviour. Thus, the problem perception of the different stakeholders should be further investigated using quantitative research methods in order to gather significantly more quantifiable data.

The marinas and harbours do not differentiate between sailing vessels and motorboats. This is also troubling when determining the exact number of sailing boats. However, multiple interviewees have stated that the problem perception of sailors is more accessible than the ones from motorboat operators. Therefore, the motorboat community can also be a considerable pathway for plastic entering the marine environment. As materials such as antifouling do not differentiate between sailing boats and motorboats this pathway is most likely to be the same. However, another starting point for further research would be the problem perception of motorboat operators and if their attitude is as different to the sailors as stated by the interviewees.

6. References

- Beaumont, N. J., Aanesen, M., Austen, M. C., Börger, T., Clark, J. R., Cole, M., . . . Wyles, K. J. (2019). Global ecological, social and economic impacts of marine plastic. *Marine pollution bulletin*, *142*, 189–195. <https://doi.org/10.1016/j.marpolbul.2019.03.022>
- ChemVerbotV 1, Bundesamts für Justiz 27.1.2017.
- Carić, H., & Mackelworth, P. (2014). Cruise tourism environmental impacts – The perspective from the Adriatic Sea. *Ocean & Coastal Management*, *102*, 350–363. <https://doi.org/10.1016/j.ocecoaman.2014.09.008>
- Critchell, K., Bauer-Civiello, A., Benham, C., Berry, K., Eagle, L., Hamann, M., . . . Ridgway, T. (2019). Plastic Pollution in the Coastal Environment: Current Challenges and Future Solutions. In *Coasts and Estuaries* (pp. 595–609). Elsevier. <https://doi.org/10.1016/B978-0-12-814003-1.00034-4>
- Dahl, M. S., & Pedersen, C. Ø.R. (2004). Knowledge flows through informal contacts in industrial clusters: myth or reality? *Research Policy*, *33*(10), 1673–1686. <https://doi.org/10.1016/j.respol.2004.10.004>
- Deutsche Gesellschaft für Umwelterziehung, & Foundation for Environmental Education (2019). 33 Jahre "Blaue Flagge" in der Bundesrepublik Deutschland im Jahr 2019. Retrieved from http://www.blaue-flagge.de/download/DGU_2019_Infoblatt.pdf
- Fridays for future (2019). Wir sind Fridays for Future. Retrieved from <https://fridaysforfuture.de>
- Gago, J., Cronin, R., Sobral, P., Vlachogianni, T., Nilsson, P., Kinsey, S., . . . Werner, S. (2016). *Identifying sources of marine litter: MSFD GES TG marine litter thematic report. EUR, Scientific and technical research series: Vol. 28309*. Luxembourg: Publications Office.
- Geels, F. W. (2005). Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technological Forecasting and Social Change*, *72*(6), 681–696. <https://doi.org/10.1016/j.techfore.2004.08.014>
- Gregory, M. R. (2009). Environmental implications of plastic debris in marine settings--entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions.

- Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 364(1526), 2013–2025. <https://doi.org/10.1098/rstb.2008.0265>
- Helmke, G., & Levitsky, S. (2004). *Informal Institutions and Comparative Politics: A Research Agenda*. Retrieved from Cambridge University Press website: <https://doi.org/10.1017/S1537592704040472>
- Holdgate, M. W. (1980). *A perspective of environmental pollution*. Cambridge: Univ. Pr.
- ICES (November 2018). *Greater North Sea Ecoregion - Fisheries overview*. <https://doi.org/10.17895/ICES.PUB.4647>
- Kaiser, R. (2014). *Qualitative Experteninterviews: Konzeptionelle Grundlagen und praktische Durchführung* (Aufl. 2014). *Elemente der Politik*. Wiesbaden: Springer Fachmedien Wiesbaden GmbH.
- Kirstein, I. V., Kirmizi, S., Wichels, A., Garin-Fernandez, A., Erler, R., Löder, M., & Gerds, G. (2016). Dangerous hitchhikers? Evidence for potentially pathogenic *Vibrio* spp. On microplastic particles. *Marine Environmental Research*, 120, 1–8. <https://doi.org/10.1016/j.marenvres.2016.07.004>
- Kuckartz, U. (2016). *Qualitative Inhaltsanalyse: Methoden, Praxis, Computerunterstützung* (3., überarbeitete Auflage). *Grundlagentexte Methoden*. Weinheim, Basel: Beltz Juventa. Retrieved from http://www.content-select.com/index.php?id=bib_view&ean=9783779943860
- Lauth, H.-J. (2015). Formale und informelle Institutionen in der Vergleichenden Politikwissenschaft. In H.-J. Lauth, M. Kneuer, & G. Pickel (Eds.), *Handbuch Vergleichende Politikwissenschaft* (Vol. 34, pp. 1–13). Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-02993-7_14-1
- Li, W. C., Tse, H. F., & Fok, L. (2016). Plastic waste in the marine environment: A review of sources, occurrence and effects. *The Science of the Total Environment*, 566-567, 333–349. <https://doi.org/10.1016/j.scitotenv.2016.05.084>
- Liebold R., T. R. (2009). *Experteninterview*. In: Kühl S., Strodtholz P., Taffertshofer A. (eds) *Handbuch Methoden der Organisationsforschung*: VS Verlag für Sozialwissenschaften.
- Loorbach, D. (2002). *Transition Management: Governance for Sustainability*.

- Loorbach, D. (2010). Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework. *Governance*, 23(1), 161–183. <https://doi.org/10.1111/j.1468-0491.2009.01471.x>
- Mayring, P. (2015). *Qualitative Inhaltsanalyse: Grundlagen und Techniken* (12., überarb. Aufl.). *Beltz Pädagogik*. Weinheim: Beltz. Retrieved from http://content-select.com/index.php?id=bib_view&ean=9783407293930
- Mendenhall, E. (2018). Oceans of plastic: A research agenda to propel policy development. *Marine Policy*, 96, 291–298. <https://doi.org/10.1016/j.marpol.2018.05.005>
- Mengo, E. (March 2017). *A Review of Marine Litter Management Practices for the Fishing Industry in the North-East Atlantic Area: Report for OSPAR Action 36: to develop best practices in the fishing industry*. Final Report. Lowestoft, United Kingdom. Retrieved from Centre for Environment Fisheries & Aquaculture Science website: https://www.noordzeeloket.nl/publish/pages/122125/a_review_of_marine_litter_management_practices_for_the_fishing_industry_in_the_north-east_atlantic_.pdf
- Ploetz, C., Krauß, O., Betker, F., Höcke, V., Funke, M., Wolf, U., & Krüger, C. (May 2015). *Plastik in der Umwelt Forschung - Quellen, Senken und Lösungsansätze: Mögliche Handlungsfelder für die Forschung*. Düsseldorf. Retrieved from https://www.researchgate.net/publication/329427427_Plastik_in_der_Umwelt_Quellen_Senken_Losungsansatze
- Reid, L., Sutton, P., & Hunter, C. (2010). Theorizing the meso level: the household as a crucible of pro-environmental behaviour. *Progress in Human Geography*, 34(3), 309–327. <https://doi.org/10.1177/0309132509346994>
- Reifferscheid, G., Bänsch-Baltruschat, B., Brennholt, N., Breuninger, E., & Hatzky, S. (2016). *Overview on plastics in European freshwater environments – Results of a survey: European Conference on Plastics in Freshwater Environments*.
- Richardson, K., Gunn, R., Wilcox, C., & Hardesty, B. D. (2018). Understanding causes of gear loss provides a sound basis for fisheries management. *Marine Policy*, 96, 278–284. <https://doi.org/10.1016/j.marpol.2018.02.021>
- Ríos, N., Frias, J. P. G. L., Rodríguez, Y., Carriço, R., Garcia, S. M., Juliano, M., & Pham, C. K. (2018). Spatio-temporal variability of beached macro-litter on remote islands of the North Atlantic. *Marine Pollution Bulletin*, 133, 304–311. <https://doi.org/10.1016/j.marpolbul.2018.05.038>

- Schensul, J. J., & LeCompte, M. D. (Eds.). (1999). *Essential ethnographic methods : observations, interviews, and questionnaires*. Walnut Creek, California: AltaMira Press.
- Schuep, M., Gasser, M., Haarman, A., Brown, A., & Giotto, E. (2016). *Informal approaches towards a circular economy: – learning from the plastics recycling sector in India*. Switzerland.
- Segler-Verband Niedersachsen (2019). Der SVN. Retrieved from <https://segeln-niedersachsen.de/verband/>
- Seltenrich, N. (2015). New link in the food chain? Marine plastic pollution and seafood safety. *Environmental Health Perspectives*, 123(2), A34-41. <https://doi.org/10.1289/ehp.123-A34>.
- Sheavly, S. B., & Register, K. M. (2007). Marine Debris & Plastics: Environmental Concerns, Sources, Impacts and Solutions. *Journal of Polymers and the Environment*, 15(4), 301–305. <https://doi.org/10.1007/s10924-007-0074-3>
- Statistisches Bundesamt. (2019). *Informationen des Bundeswahlleiters, Europawahl 2019, Heft 3: Endgültige Ergebnisse nach kreisfreien Städten und Landkreisen 4*. Wiesbaden. Retrieved from https://www.bundeswahlleiter.de/dam/jcr/5f3be4ff-f16e-4852-938d-9a038adc29cb/ew19_heft3.pdf
- UNEP (2016). *Marine plastic debris and microplastics – Global lessons and research to inspire action and guide policy change*. Nairobi.
- Van der Wal, m., van der Meulen, M., & Gijsbert (2015). *SFRA0025: Identification and Assessment of Riverine Input of (Marine) Litter: Final Report for the European Commission DG Environment under Framework Contract No ENV.D.2/FRA/2012/0025*. Bristol. Retrieved from Eunomia Research & Consulting Ltd website: <http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/iasFinal%20Report.pdf>
- W. J. Rittel, H., & M. Webber (1973). Dilemmas In a General Theory of Planning. *Policy Sciences*, 4, 155–169. <https://doi.org/10.1007/BF01405730>
- W. Mell (2016). Strukturen im Bootsmarkt Update 2016 Zusammenfassung. Retrieved from <https://www.bvww.org/index.php?id=140&uid=563&mode=pdf>
- Weischer, C., & Gehrau, V. (2017). *Die Beobachtung als Methode in der Soziologie*. Konstanz: UTB; UVK Verlagsgesellschaft.

Xanthos, D., & Walker, T. R. (2017). International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review. *Marine Pollution Bulletin*, 118(1-2), 17–26. <https://doi.org/10.1016/j.marpolbul.2017.02.048>

7. Appendix

7.1. Interview Guidelines

| |
|---|
| Interview Guideline - Industry Experts |
|---|

General information

- How long have you been practicing the sailing sport?
- What is the aim of your project?

Problem perception of the stakeholder

- What do you think about sustainability?
 - [Close connection to the environment]
- What do you think is the primary reason for the majority to pick the sailing sport as a hobby?
 - How do you practice sustainability on your boat?
 - How do you inform yourself about prevention measures of producing plastic trash on boat?
 - [Websites, Blogs, Flyer, Literature]
- Do you know if the topic sustainability and trash prevention is being educated in sailing clubs?
- How do you evaluate the waste-infrastructure of marinas in general?
- Do you think that there are enough recycling opportunities?

Problem identification

- What kind of maintenance do you do by yourself?
 - [No self-repair]
 - Do you know how the shipyard company handles the process of dismantling antifouling?
 - Have you ever made specific requests for the use of sustainable materials?
 - What was the reason for choosing this specific shipyard for you boat maintenance?
 - [Self-maintenance]
 - What maintenance processes are being done in water?

- What happens to the accumulating trash happening during maintenance processes done in water?
 - What maintenance processes are being done on land?
 - What kind of equipment do you use when removing antifouling?
 - What happens to the accumulating trash happening during maintenance processes?
 - Do you know any environmentally friendly materials?
- How do you minimize your trash accumulation during sailing activities?
- Do you specifically look for environmentally friendly products?
 - [Hygiene products, laundry detergents, food packaging, maintenance supplies and equipment]
- What do you do with the trash from cooking, etc. on your boat?
- What do you do with biodegradable waste?
- Do you recycle food packaging?
- What do you do with plastic trash on your boat?

Leitfaden – Industrie Experten

Allgemeine Informationen

- Wie lange praktizieren sie bereits den Segelsport?
- Was ist das Zentrale Ziel des Projekts?

Problemwahrnehmung der Stakeholder

- Was halten Sie von dem Prinzip der Nachhaltigkeit?
 - [Verbindung zu Naturbezogener Aktivität]
- Was denken Sie, ist der primäre Grund für die Mehrheit den Segelsport als Hobby zu wählen?
- In welcher Art und Weise praktizieren Sie Nachhaltigkeit an Bord?
- Wie informieren Sie sich über mögliche Vermeidungsstrategien von Plastikmüll?
 - [Webseiten, Flyer, Blogs, Literatur]
- Wissen Sie ob in Segelclubs generell das Thema Nachhaltigkeit thematisiert wird?
- Sind Ihnen in Marinas und Häfen allgemein Hinweise zum Thema Nachhaltigkeit und Müllvermeidung aufgefallen?
- Wie würden Sie die Müll-Infrastruktur von Marinas generell bewerten?
- Sind Sie der Meinung, dass genügend Recycling-Möglichkeiten vorhanden sind?

Problemidentifikation

- Welche Arbeitsschritte der der Instandhaltung ihres Bootes machen Sie selbst?
 - **[Keine Selbst-Reparatur]**
 - Kennen sie die Dominaten Methoden der Werft für die Entfernung von Antifouling?
 - Haben Sie schon mal den Wunsch geäußert besonders Umweltfreundliche Lacke zu verwenden?
 - Haben Sie gezielt eine bestimmte Werft ausgewählt da Sie wussten, dass diese besonders umweltfreundliche Materialien verwendet?
 - **[Selbst-Reparatur]**
 - Welche Reparaturen oder Instandsetzungen machen Sie, während das Boot im Wasser ist?
 - Was passiert mit dem sich ansammelnden Müll, der durch Reparaturen entsteht?

- Welche Reparaturen oder Instandsetzungen machen Sie an Land?
- Welches Equipment verwenden Sie zur Entfernung von Antifouling?
- Wie Verwerten Sie den entstandenen Müll, welcher durch das Entfernen des Lacks und Antifouling entstanden ist?
- Kennen Sie umweltfreundliche Alternativen?
- Was tun Sie, um ihr Müllaufkommen an Bord zu minimieren?
- Achten Sie beim Kauf von Artikeln auf ihre Umweltfreundlichkeit?
 - Hygiene Artikel, Lebensmittelverpackungen, Waschmittel
- Was machen Sie mit Müll, der durch das Kochen entsteht?
- Wie verfahren Sie mit Ihrem Biomüll?
- Wie verfahren Sie mit ihrem Plastikmüll?

Interview Guideline Sailing Club Board Member

General information

How long have you been sailing?

What was the primary reason for choosing the sailing sport as a hobby?

Problem perception of the stakeholder

- What do you think about sustainability?
 - [Close connection to the environment]
- What do you think was the primary reason for your members to pursue the sailing sport as a hobby?
- How do you implement sustainability in the organizational structure of the sailing club?
- Is sustainability being communicated during the process of getting a sailing license?
- Is sustainability being communicated during club meetings?
- Do you inform your members on how to be more sustainable in their sailing activities?
- What kind of communication ways do you apply?
 - [websites, flyer, information boards]
- Are you in contact with the marina operator?
- If yes, is sustainability being communicated?
- Is the topic of plastic trash being explicitly discussed?
- Do you think that the waste infrastructure of the marina is sufficient?
- Do you think that there are enough recycling opportunities?

Problem identification

- Do you refer your members to shipyards for repairs?
 - [No self-repair]
 - What is the primary reason that you refer this shipyard to your members?
 - Do they know the dominant methods of the shipyard for the removal of antifouling?
 - Do you know if the yard also uses environmentally friendly materials such as biological paints?
 - Do you know how many members do their own repairs?
 - [Self-repair]
 - Do you know where most of these repairs take place?

- Do you know what repairs your members do while the boat is in the water?
- Do you know what repairs your members do while the boat is on shore?
- Do you know which equipment is mostly used to remove antifouling?
- Do you know how the waste produced is subsequently recycled?
- Do you inform your members on how the waste produced must be responsibly recycled afterwards?
- Do you inform your members about environmentally friendly alternatives?
- Do you inform your members about ways to minimize the amount of waste on board?
- Do you refer to environmentally friendly products?
 - [Hygiene articles, detergents, food packaging]

Leitfaden – Segelclub Vorstandsmitglieder

Allgemeine Informationen

- Wie lange praktizieren sie bereits den Segelsport?
- Was ist ihr primärer Grund für die Wahl des Segelsports als Hobby?

Problemwahrnehmung der Stakeholder

- Was halten Sie von dem Prinzip der Nachhaltigkeit?
 - [Verbindung zu Naturbezogener Aktivität]
- Was glauben Sie, welcher der primäre Grund war, dass ihre Mitglieder den Segelsport als Hobby aufgegriffen haben?
- Wie binden Sie Nachhaltigkeit in die Organisationsstruktur des Segelclubs ein?
- Wird Nachhaltigkeit während des Segelscheins thematisiert?
- Wird Nachhaltigkeit bei Club-Treffen thematisiert?
- Informieren Sie ihre Mitglieder wie sie ihre Segelaktivitäten umweltfreundlicher gestalten können?
- Welche Informationswege verwenden Sie?
 - [Websites, Flyer, Informationstafel]
- Stehen Sie im Kontakt zu dem Marina Betreiber?
- Wenn ja, wird Nachhaltigkeit zwischen Ihnen kommuniziert?
- Wird das Thema Müll explizit angesprochen?
- Denken Sie, dass eine Müll-Infrastruktur zufriedenstellend gegeben ist?
- Sind genügend Recycling Möglichkeiten gegeben?

Problemidentifikation

- Vermitteln Sie ihre Mitglieder an Werften, wenn Reparaturen anliegen?
 - **[Keine Selbst-Reparatur]**
 - Aus welchem Grund vermitteln Sie gerade diese Werft an Ihre Mitglieder?
 - Kennen sie die Dominanten Methoden der Werft für die Entfernung von Antifouling?
 - Wissen Sie, ob die Werft auch Umweltfreundliche Materialien wie z.B. Lacke verwendet?

- Wissen Sie wie viele Mitglieder ihre Reparaturen selbst erledigen?
- **[Selbst-Reparatur]**
 - Wissen Sie wo diese Reparaturen zum Großteil stattfinden?
 - Wissen Sie welche Reparaturen oder Instandsetzungen ihre Mitglieder erledigen, während das Boot im Wasser ist?
 - Wissen Sie welche Reparaturen oder Instandsetzungen ihre Mitglieder erledigen, während das Boot an Land ist?
 - Wissen Sie welches Equipment zum Großteil verwendet wird, um Antifouling zu entfernen?
 - Wissen Sie wie der entstandene Müll anschließend verwertet wird?
- Verweisen Sie darauf wie der entstandene Müll anschließend verantwortungsvoll verwertet werden muss?
- Informieren Sie ihre Mitglieder über umweltfreundliche Alternativen?
- Informieren Sie ihre Mitglieder über Wege das Müllaufkommen an Bord zu minimieren?
- Verweisen Sie auf umweltfreundliche Produkte?
 - Hygiene Artikel, Waschmittel, Lebensmittelverpackungen

Interview Guideline Sailing Club Members

General information

- How long have you been practicing the sailing sport?
- What was the primary reason for you to choose the sailing sport as a hobby?

Problem perception of the stakeholder

- What do you think about sustainability?
 - [Close connection to the environment]
- How do you practice sustainability on your boat?
- How do you inform yourself about prevention measures of producing plastic trash on boat?
 - [Websites, Blogs, Flyer, Literature]
- How does your sailing club provide information on how to prevent plastic pollution during boating activities?
- Do you receive any information by the marina operator?
- Do you know if the sailing club is communicating with the marina operator in terms of sustainability and waste prevention measures?
- How do you evaluate the waste-infrastructure in the marina?
- Do you think that there are enough recycling opportunities?

Problem identification

- What kind of maintenance do you do by yourself?
 - [No self-repair]
 - Do you know how the shipyard company handles the process of dismantling antifouling?
 - Have you ever made specific requests for the use of sustainable materials?
 - What was the reason for choosing this specific shipyard for you boat maintenance?
 - [Self-maintenance]
 - What maintenance processes are being done in water?
 - What happens to the accumulating trash happening during maintenance processes done in water?

- What maintenance processes are being done on land?
- What kind of equipment do you use when removing antifouling?
- What happens to the accumulating trash happening during maintenance processes?
- Do you know any environmentally friendly materials?
- How do you minimize your trash accumulation during sailing activities?
- Do you specifically look for environmentally friendly products?
 - [Hygiene products, laundry detergents, food packaging, maintenance supplies and equipment]
- What do you do with the trash from cooking, etc. on your boat?
- What do you do with biodegradable waste?
- Do you recycle food packaging?
- What do you do with plastic trash on your boat?

Leitfaden – Segelclub Mitglieder

Allgemeine Informationen

- Wie lange praktizieren sie bereits den Segelsport?
- Was ist ihr primäre Grund für die Wahl des Segelsports als Hobby?

Problemwahrnehmung der Stakeholder

- Was halten Sie von dem Prinzip der Nachhaltigkeit?
 - [Verbindung zu Naturbezogener Aktivität]
- In welcher Art und Weise praktizieren Sie Nachhaltigkeit an Bord?
- Wie informieren Sie sich über mögliche Vermeidungsstrategien von Plastikmüll?
 - [Webseiten, Flyer, Blogs, Literatur]
- Auf welche Art und Weise stellt ihr Segelclub Ihnen Informationen zur Verfügung wie man Müll an Bord vermeiden kann?
- Erhalten Sie auch Informationen darüber von dem Marina Betreiber?
- Wissen Sie ob ihr Segelclub auch mit dem Marina Betreiber über Nachhaltigkeit und Müllvermeidung in Kontakt steht?
- Wie würden Sie die Müll-Infrastruktur der Marina bewerten?
- Sind Sie der Meinung, dass genügend Recycling-Möglichkeiten vorhanden sind?

Problemidentifikation

- Welche Arbeitsschritte der der Instandhaltung ihres Bootes machen Sie selbst?
 - **[Keine Selbst-Reparatur]**
 - Kennen sie die Dominaten Methoden der Werft für die Entfernung von Antifouling?
 - Haben Sie schon mal den Wunsch geäußert besonders Umweltfreundliche Lacke zu verwenden?
 - Haben Sie gezielt eine bestimmte Werft ausgewählt da Sie wussten, dass diese besonders umweltfreundliche Materialien verwendet?
 - **[Selbst-Reparatur]**
 - Welche Reparaturen oder Instandsetzungen machen Sie, während das Boot im Wasser ist?
 - Was passiert mit dem sich ansammelnden Müll, der durch Reparaturen entsteht?

- Welche Reparaturen oder Instandsetzungen machen Sie an Land?
- Welches Equipment verwenden Sie zur Entfernung von Antifouling?
- Wie Verwerten Sie den entstandenen Müll, welcher durch das Entfernen des Lacks und Antifouling entstanden ist?
- Kennen Sie umweltfreundliche Alternativen?
- Was tun Sie, um ihr Müllaufkommen an Bord zu minimieren?
- Achten Sie beim Kauf von Artikeln auf ihre Umweltfreundlichkeit?
 - Hygiene Artikel, Lebensmittelverpackungen, Waschmittel
- Was machen Sie mit Müll, der durch das Kochen entsteht?
- Wie verfahren Sie mit Ihrem Biomüll?
- Wie verfahren Sie mit ihrem Plastikmüll?

Interview Guideline Non-Members

General information

- How long have you been practicing the sailing sport?
- What was the primary reason for you to choose the sailing sport as a hobby?

Problem perception of the stakeholder

- What do you think about sustainability?
 - [Close connection to the environment]
- How do you practice sustainability on your boat?
- How do you inform yourself about prevention measures of producing plastic trash on boat?
 - [Websites, Blogs, Flyer, Literature]
- Do you receive any information by the marina operator or by the local sailing club?
- How would you evaluate the waste-infrastructure in the marina?
- Do you think that there are enough recycling opportunities?

Problem identification

- What kind of maintenance do you do by yourself?
 - [No self-repair]
 - Do you know how the shipyard company handles the process of dismantling antifouling?
 - Have you ever made specific requests for the use of sustainable materials?
 - What was the reason for choosing this specific shipyard for you boat maintenance?
 - [Self-maintenance]
 - What maintenance processes are being done in water?
 - What happens to the accumulating trash happening during maintenance processes done in water?
 - What maintenance processes are being done on land?
 - What kind of equipment do you use when removing antifouling?
 - What happens to the accumulating trash happening during maintenance processes?

- Do you know any environmentally friendly materials?
- How do you minimize your trash accumulation during sailing activities?
- Do you specifically look for environmentally friendly products?
 - [Hygiene products, laundry detergents, food packaging, maintenance supplies and equipment]
- What do you do with the trash from cooking, etc. on your boat?
- What do you do with biodegradable waste?
- Do you recycle food packaging?
- What do you do with plastic trash on your boat?

Leitfaden – Nicht Mitglieder

Allgemeine Informationen

- Wie lange praktizieren sie bereits den Segelsport?
- Was ist ihr primärer Grund für die Wahl des Segelsports als Hobby?

Problemwahrnehmung der Stakeholder

- Was halten Sie von dem Prinzip der Nachhaltigkeit?
 - [Verbindung zu Naturbezogener Aktivität]
- In welcher Art und Weise praktizieren Sie Nachhaltigkeit an Bord?
- Wie informieren Sie sich über mögliche Vermeidungsstrategien von Plastikmüll?
 - [Webseiten, Flyer, Blogs, Literatur]
- Wie würden Sie die Müll-Infrastruktur der Marina bewerten?
- Sind Sie der Meinung, dass genügend Recycling-Möglichkeiten vorhanden sind?

Problemidentifikation

- Welche Arbeitsschritte der der Instandhaltung ihres Bootes machen Sie selbst?
 - **[Keine Selbst-Reparatur]**
 - Kennen sie die Dominaten Methoden der Werft für die Entfernung von Antifouling?
 - Haben Sie schon mal den Wunsch geäußert besonders Umweltfreundliche Lacke zu verwenden?
 - Haben Sie gezielt eine bestimmte Werft ausgewählt da Sie wussten, dass diese besonders umweltfreundliche Materialien verwendet?
 - **[Selbst-Reparatur]**
 - Welche Reparaturen oder Instandsetzungen machen Sie, während das Boot im Wasser ist?
 - Was passiert mit dem sich ansammelnden Müll, der durch Reparaturen entsteht?
 - Welche Reparaturen oder Instandsetzungen machen Sie an Land?
 - Welches Equipment verwenden Sie zur Entfernung von Antifouling?
 - Wie Verwerten Sie den entstandenen Müll, welcher durch das Entfernen des Lacks und Antifouling entstanden ist?
 - Kennen Sie umweltfreundliche Alternativen?

- Was tun Sie, um ihr Müllaufkommen an Bord zu minimieren?
- Achten Sie beim Kauf von Artikeln auf ihre Umweltfreundlichkeit?
- Hygiene Artikel, Lebensmittelverpackungen, Waschmittel
- Was machen Sie mit Müll, der durch das Kochen entsteht?
- Wie verfahren Sie mit Ihrem Biomüll?
- Wie verfahren Sie mit ihrem Plastikmüll?