



**TAKING ROOT: A GROUNDED APPROACH TO
SCIENCE COMMUNICATION FOR SEALINK
CURAÇAO**

By Tabita Houtman

Supervisor: Dr. Dries Hegger

Second Reader: Dr. Carel Dieperink

Sustainable Development - Earth System Governance

Faculty of Geosciences

Utrecht University

Master's Thesis

28/09/2022

Word Count: 22.899

Cover Photo: This photograph is of one of the many murals I encountered throughout Curaçao. The artwork is by Sander van Beusekom, and can be found in an old parking lot along Bitterstraat, where all walls are covered with art. This particular piece shows a boy and his father with fishing equipment looking toward the ocean, toward the future. There is a fish motif throughout the mural, and it uses various shades of the colours of the Curaçaoan flag. The mural is meant to represent the close relation between man and the marine environment on Curaçao, positioning the ocean as the future to which father and son are looking. On the horizon, the sun rises to bring another day, full of hope. (*Own photograph, 2022*).

Acknowledgements: I would not have been able to conduct this research the way I did without the help of several important people. I'd like to thank my supervisor, Dr. Dries Hegger, for advising and encouraging me throughout the process. Without his support, I probably would have had a mental breakdown. I also want to thank Danick Trouwloon, who advised me in a similar capacity, even though it wasn't her responsibility. My thanks to Fanny Alberto, who took the time to help me with the street interviews and showed me parts of Curaçao that I otherwise would not have reached. And to Dr. Frank van Laerhoven, who arranged for my travel expenses to be covered so that I could conduct fieldwork on Curaçao, a truly unforgettable experience. To all the friends I made along the way, who made sure I didn't just spend all my time working. And of course to all the participants in my research. Finally, I'd like to thank my family and friends for putting up with me during the months of stress, and for never doubting my ability to do well.

ABSTRACT

Communicating research findings to a lay public comes with a range of challenges, as can be seen in the considerable literature on Science Communication (SC). Part of the issue is a lack of an empirically-based understanding of the communication context, such as audience characteristics or situational barriers. There is literature available on the necessary considerations for SC, but this is fragmented, with different authors mentioning different components and strategies. What is needed is a concrete grounded, empirically based approach to SC. This is the theoretical gap this research aims to fill, with a main research question of: *What good practices can be identified for a grounded approach to science communication?* First, a conceptual approach is composed based on components identified in existing literature. To illustrate the usefulness of such an approach, and to provide a methodological example, a case study is utilised. The case chosen here is the SEALINK project. SEALINK is an interdisciplinary research project studying the ways in which various inputs affect the growth and survival of reefs in the Dutch Caribbean. This case was chosen due to the lack of prior research on this topic both within the project and within the region. The novelty necessitated an in-depth empirical analysis, providing a comprehensive methodological example. Discussion of findings and theoretical implications lead to theoretical learning, ultimately answering the main research question. Methodologically, key findings include the value of interviewing individuals from multiple actor categories, and the value of conducting street interviews and some form of participant observation. Both allow for an enrichment of findings. Theoretically, it was found that the composed grounded approach seemed to provide a comprehensive understanding of the communication context. However, the sub-component ‘opportunities’ in the main component ‘situational factors’ requires further development, both theoretically and methodologically.

Key terms: science communication; grounded approach; SEALINK; communication strategies; laypersons

The following page contains a schematic overview of the grounded approach and the learning outcomes and future recommendations.

Schematic Overview

A Grounded Approach to Science Communication

Main Components	Sub-components	Explanation
Producers	Goals	Project and communication goals as described by project members
	Target Audience	Target audience for communication as described by project members and practitioners
	Actors	Actors involved in the project and communication, including potential partners
Audience	Attitude & Concerns	Attitude and concerns of audience members related to project topic
	Informational Needs	Informational needs of audience members as identified by the audience, project members, and practitioners
	Information Sources	Trusted and preferred sources of information by audience members
	Preferred Format	Preferred format of informational content by audience members
Situational Factors	Barriers	Barriers to communication as identified by project members, practitioners and audience members
	Opportunities	Opportunities for communication as identified by project members, practitioners and audience members

Learning Outcomes & Future Recommendations

Learning and recommendations	
Good Practice	Involving multiple actor categories in empirical analysis
	Conducting street interviews and a form of participant observation
Theoretical Learning	Further analysis is necessary of the 'informational needs' sub-component
	Reconsideration is necessary of both the theoretical definition and operationalization of the 'opportunities' sub-component
Future Research	Further study into the 'opportunities' sub-component
	Application for different audiences
	Actor network analysis
	Linking the grounded approach to the rest of the SC process through empirical analysis

TABLE OF CONTENTS

1. Introduction	7
1.1. Background	7
1.2. Knowledge Gap	8
1.3. Research Aims, Case Study, and Questions	9
1.4. Research Framework	10
2. Theoretical Background	12
2.1. Literature Review	12
2.1.1. Science Communication	12
2.1.2. Understanding the Audience and the Context of Communications	14
2.2. Conceptual Approach to Grounded Science Communication	16
3. Methodology	20
3.1. Literature Review and Conceptual Approach	20
3.2. Case Study Analysis	20
3.3. Data Collection	22
3.3.1. Sampling	22
3.3.2. Researcher Interviews	23
3.3.3. Conservationist Interviews	23
3.3.4. Survey	24
3.3.5. Street Interviews	24
3.3.6. Participant Observation	25
3.4. Data Analysis	25
3.4.1. Coding	25
3.4.2. Analysis	26
3.5. Research Ethics	26
4. Results	27
4.1. Producers	27
4.1.1. Goals	27
4.1.2. Target Audience	29
4.1.3. Actors	30
4.2. Audience	34

4.2.1. Attitude and Concerns	34
4.2.2. Informational Needs	40
4.2.3. Information Sources	41
4.2.4. Preferred Format	44
4.3. Situational Factors	46
4.3.1. Barriers	46
4.3.2. Opportunities	53
4.4. Synthesis.....	55
5. Discussion of Results	59
5.1. Reflections on a Grounded Approach to Science Communication.....	59
5.1.1. Methodology	59
5.1.2. Applicability of Results.....	61
5.2. The Question of Informational Needs and Opportunities	63
6. Conclusion.....	67
References	69
Appendix A	73
Interview Guide Researchers [English].....	73
Interview Guide Conservationists [English]	74
Audience Analysis Survey [English]	75
Appendix B	79
Survey Results.....	79

List of Figures

Figure 1: Research Framework	10
Figure 2: Preferred information sources. Aggregated data from survey and street interviews	41
Figure 3: Responses to survey statements	79

List of Tables

Table 1: Components of a grounded approach to science communication, based on a synthesis of literature	17
Table 2: Overview of learning outcomes and recommendations for future research	67

List of Images

Image 1: Poverty and waste pollution. What was once the most popular restaurant in the area is now closed down, and the platters that used to hold freshly caught fish are now full of garbage (own photograph, 2022)	37
Image 2: Water pollution. Sewage from land is deposited directly into the sea along the North Coast without filtering (own photograph, 2022)	37
Image 3: An article in local Papiamentu-language newspaper èxtra about the Queen Conch research and conservation project (own photograph, 2022).....	42
Image 4: On a 1,5 hour dive, the team I was with collected 14,5 kg of waste, which included 91 plastic cups (own photograph, 2022)	51

TAKING ROOT: A GROUNDED APPROACH TO SCIENCE COMMUNICATION FOR SEALINK CURAÇAO

1. INTRODUCTION

1.1. Background

Modern life is saturated with the products of science. From the seemingly ordinary, such as electricity and cars, to the extraordinary, such as climate change, vaccines, and genetically modified crops. It is the extraordinary in particular that is often subject to controversy, with public debate being marred by misinformation (Cormick, 2019). Nevertheless, most people will at some point be faced with decisions regarding such topics. Understanding the science behind such issues can thus become an important aspect behind making informed decisions. In this way, science communication (SC) can help build capacity for citizenship (Davies & Horst, 2016). In high stakes cases, such as medical or environmental risk, or looming referenda on leaving large unions, failure to convey information to the public can have profound consequences (e.g. Wyss et al., 2021; Dillar, 2022). Failure to communicate does not only have consequences for society, but for science as well. Science is reliant on public support in order to maintain funding and guide policy (Fischhoff & Scheufele, 2013). For example, Tonin & Lucaroni (2017) describe how public perceptions, influenced in part by accumulation of knowledge, can have a considerable impact on conservation success. Effective communication may not be able to forestall misunderstanding and misinformation entirely, but it can be used as a tool of capacity building for citizenship (Davies & Horst, 2016). Yet this raises a variety of new questions regarding the definition of ‘effective’ communication, the nature of the public and relevant information, to name just a few. These are some of the central questions in SC literature.

Science communication does not have one commonly agreed upon definition, beyond the obvious characteristic that it involves communicating science. Or in other words, all forms of communication focused on scientific knowledge and work, including its production, contents, use and effects (Bonfadelli et al., 2017). Cooke et al. (2017) describe effective SC as the sharing of science-related knowledge in such a way that it has an impact on knowledge users. This indicates a goal of SC, namely to have impact. What that impact entails depends on the science that is to be communicated and the purpose that communication serves in that instance. Gunn et al. (2022) are more explicit, stating that effective SC advances research understanding, builds stakeholder awareness, and fosters trust in the scientific process. Gottschling & Kramer (2020) describe a similar facet of SC as a way to strengthen trust in

science, in particular when the process of communication is participatory. One of the most concrete definitions of SC is that presented by Fischhoff (2013), who states that adequate SC (1) contains information the audience needs, (2) in places they can access, (3) in a form they can comprehend. The content of these factors will also differ from case to case. It is difficult to provide a singular definition of SC because there is no one-size-fits-all SC strategy. Each case is context-dependent (Cormick, 2019). Unfortunately, this makes it difficult to identify instances of good practice. What worked well in one situation, might not work as well in another. In practice, these differences are not always accounted for (Nisbet & Scheufele, 2009). This can lead to mismatch of strategies, in such a way that communication goals are not met (Salmon & Roop, 2018). Literature on the shortcomings of and barriers to SC highlight several ways in which SC can fail due to inadequate consideration of the communication context, such as unclear goals (e.g. Gunn et al., 2022), insufficient audience understanding (e.g. Rogers, 2000), or lack attention to the impact of situational factors (Gottschling & Kramer, 2020). An overview of the most important aspects to consider before constructing an SC strategy could work toward minimizing these oversights. Utilizing such an approach in various contexts would then provide researchers and practitioners insights into ways in which to apply such an approach. In some cases, there may be significant audience research or actor constellation overviews already available to draw on. In others, there may not be any formalized research conducted relevant to SC. Both cases can utilise the same components, although their methodologies will differ. These components present a grounded approach to SC, as they encourage researchers and practitioners to conduct certain groundwork before engaging in SC, to ensure that the ultimate communication strategy has a strong empirical basis.

1.2. Knowledge Gap

Based on the previous observations, the identified theoretical knowledge gap is the lack of a coherent approach to the groundwork necessary for effective science communication. Literature on science communication is somewhat fragmented when discussing which factors need to be considered before the formulation of a communication strategy. The issue is not that the knowledge does not exist, but rather that it has not been synthesized into a clear approach. Salmon & Roop (2018) study various ways in which such oversights can lead to communication strategies that have trouble with achieving their goals. Similarly, Nisbet & Scheufele (2009) note that communication strategies are too often based on intuition or prior experiences, rather than on an empirical understanding of communication contexts. Among existing frameworks for SC that do suggest forms of groundwork, the empirical analysis suggested is often limited, with different authors suggesting different components for analysis.

1.3. Research Aims, Case Study, and Questions

To address this knowledge gap, this research aims to compose a grounded approach to science communication by synthesizing existing literature. Additionally, this research aims to illustrate the use of such a grounded approach through a case study analysis. The case selected was that of SEALINK Curaçao. SEALINK is an interdisciplinary research project in the Dutch Caribbean region which studies substances fluxes from land to sea, and the ways in which these impact coral reef health. This case was chosen primarily because it offers the opportunity to showcase a grounded approach to its fullest extent. At the start of this research project, SEALINK had only just been launched. As such, no prior analysis existed related to the communication of SEALINK. Additionally, the region the project focuses on has not been extensively studied. This includes a lack of audience profiles and related topics. To answer all questions thus requires an extensive empirical analysis. Development of such a method will provide a comprehensive example of research methodologies using the a grounded approach.

Based on the primary research aim, the main research question is:

What good practices can be identified for a grounded approach to science communication?

To help answer this question, several sub-questions were formulated.

- 1. Which analytical components for a grounded approach to science communication can be derived from the literature?*
- 2. How can the derived grounded approach be operationalized for empirical analysis?*
- 3. Which good practices for a grounded approach to science communication can be derived from an empirical study for SEALINK Curaçao?*
- 4. What theoretical recommendations can be made based on the findings of the empirical case study?*

The case study analysis will also result in preliminary recommendations for SEALINK Curaçao.

1.4. Research Framework

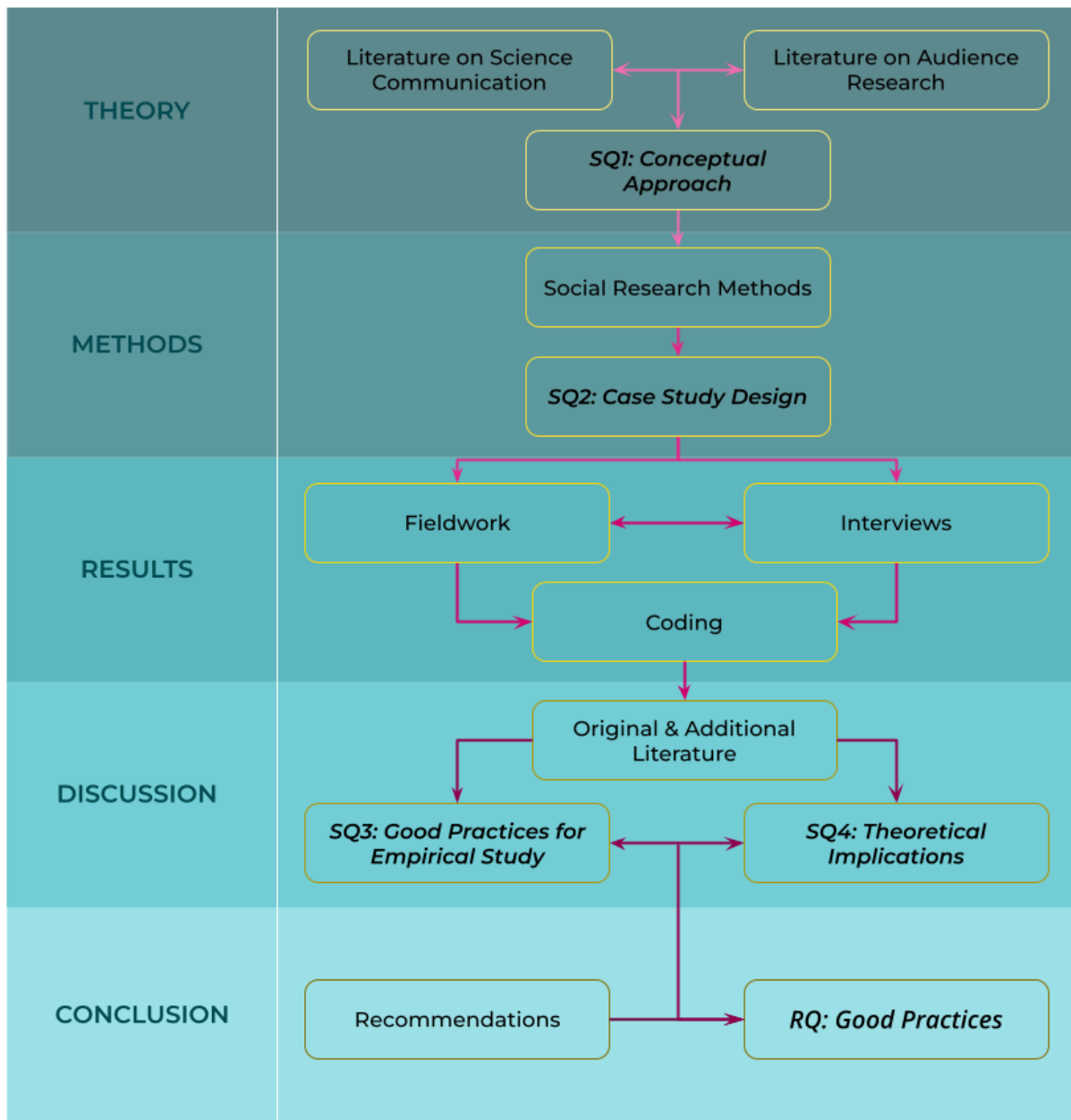


Figure 1: Research Framework

The research framework (Figure 1) is constructed on the basis of the main research question and three sub-questions. The separate phases are both colour and number coded to indicate research progression. The framework utilises several confrontations in order to achieve the main research objective and sub-goals. Verschuuren & Doorewaard (2010) describe confrontations in a general sense as placing an object or observation in relation to something else.

Theory (Ch. 2). Starting at the top, theory on SC and audience research were confronted in order to inform a conceptual approach for grounded SC, answering SQ1: *Which analytical components for a grounded approach to science communication can be derived from the*

literature? The conceptual approach served as foundation for the case study. Additionally, construction of a literature-based approach allowed for methodological and theoretical reflection upon conclusion of the research.

Methods (Ch 3). The grounded approach was operationalized to fit the case study context by consulting literature on social research methodologies. Operationalization included the formulation of interview and survey questions, and selecting sources and participants. This answered SQ2: *How can the derived grounded approach be operationalized for empirical analysis?*

Results (Ch. 4). The results section presents the findings gained from an empirical application of the grounded approach to SC. The case study design was implemented in the form of fieldwork and interviews. The two are mentioned separately to clearly indicate that this case study relied heavily on interviews, but many of them were conducted as part of fieldwork on Curaçao, such as in the form of street interviews. This allowed for additional observation of contextual factors. Interview findings were coded and analysed based on the framework formed by the grounded approach.

Discussion (Ch. 5). In the discussion section, the results are addressed to highlight good practices for an empirical application of a grounded approach to SC. This answers SQ3, *Which good practices for a grounded approach to science communication can be derived from an empirical study for SEALINK Curaçao?* Based on the analysis, additional literature was consulted to increase potential for practical and theoretical learning. Findings were also compared to previously identified literature for theoretical and methodological learning. The analysis of findings in combination with previously identified and relevant additional literature led to the formulation of theoretical insights, answering SQ4: *What theoretical recommendations can be made based on the findings of the empirical case study and confrontation thereof with the literature?*

Conclusion (Ch. 6). All these steps together served to answer the main research question: *What are good practices for a grounded approach to science communication?* Recommendations were made for further research related to a grounded approach to SC.

2. THEORETICAL BACKGROUND

2.1. Literature Review

The literature presented here aims to answer SQ1: “*What does the literature teach us about a grounded approach to SC?*” The literature discussed in this section was chosen to provide a wide range of approaches to SC to learn from. Further details on the search and selection criteria can be found in the methods section. This section has a funnel structure, beginning by exploring SC as a whole, and thereafter delving into specific features as highlighted by various authors.

2.1.1. Science Communication

According to Jensen & Rosengren (1990), communication is at its core constructed of three parts: the message, the audience, and the social system in which the process is embedded. It is by addressing all three aspects that a suitable strategy can be created. Over time, different models have been used that put emphasis on different parts. To better understand the field of SC, it can help to broadly define the different models. The term models is one used by authors that have written on this subject and refers here to the different ways in which science communication is approached. Trench (2008) differentiates between three core models: the deficit model, the dialogue model, and the participation model. The deficit model is considered the oldest and is described as a monodirectional transmission (Gottschling & Kramer, 2020). It functions on the assumption that there is a deficit of knowledge among the audience, and that this gap must be filled (Lewenstein, 2003). Science is shared by experts to a public that is perceived to lack awareness and understanding. Little attention is given to the context, and to what is considered useful by the audience itself. Lewenstein (2003) states that there seems to be no real reduction in the perceived problem in areas where communication campaigns have been carried out along the lines of the deficit model. Next is the dialogue model. Variations of this include the context, consultation, and engagement models. Science communication in this instance takes place between scientists and other groups, either to find out how science could be more effectively shared, or for consultation regarding particular applications. Trench (2008) describes the orientation towards the public as recognising the diverse needs and views and expecting the public to talk back and take on the issues in question. Although this model does involve the public more clearly, conversation is still shaped and guided by the scientific community. The participation model is further oriented toward the public. There is an emphasis on working together with diverse groups and joint contributions. This encompasses issue shaping, agenda setting, and the negotiation of meanings. All groups involved are considered to have a stake in the outcome of discussions and deliberations. Despite the neat theoretical

categorisation, in practice activities often involve a combination of elements from different models (Lewenstein, 2003). A schematic overview of the different models can be found in Table 1 below.

Beyond these theoretical models, there have also been more application-oriented approaches proposed. These prescribe how to structure an SC strategy. One such model is the mental models approach described by de Bruin & Bostrom (2013). This approach recognises that people interpret new information in light of existing beliefs, which in turn are shaped by situational factors. The goal of SC is described as improving the audiences' understanding of an issue and thus their ability to make informed decisions. De Bruin & Bostrom prescribe four steps necessary to construct communication materials. First, a communicator needs to identify what the audience needs to know in order to make informed decisions, which can be done through a literature review as well as an expert panel. Second, a communicator must identify what people already know, and how they make their decisions. This can be achieved through semi-structured interviews and follow-up surveys. Third is the actual design of communication content. The content must address the common gaps and misconceptions determined earlier. Finally, the communication strategy must be tested for effectiveness, which they define as the facilitation of understanding and informed decisions. This approach utilises the same categories as suggested by Jensen & Rosengren (1990). A practitioner must study the situational factors which shape the audience, and construct the message accordingly. Grorud-Colvert et al. (2010) suggest a similar approach, although the mental models do not take precedent. To start, communicators must know the audience. This includes understanding who is asking for information, identifying a target audience, and assessing their knowledge, skills and values. The next step is identifying the main messages, which should be based on the communication goal. Communicators should establish the problem context and why the information they provide is beneficial for the audience to know. Having thoroughly analysed the matter, a communication strategy is chosen depending on the audience and the capacity of communicators. The authors suggest that an external review of communication materials takes place to ensure there are no gaps. Finally, communication strategies must be evaluated, leaving room for adaptation if need be. Both the approach by Grorud-Colvert et al. and that by de Bruin & Bostrom can be seen as contextual approaches, in which communication content is designed on the basis of audience needs and situational factors.

Gunn et al. (2022) present the Triton Framework for SC, which takes a more participatory approach. Unlike the previous two strategies, this framework starts by explicitly identifying the project purpose and communication goals. Communicators must also establish

metrics for success in order to prepare for future evaluations. Next, key audiences need to be identified and assessed. The case study described here does this through data sharing with an organisation that had previously compiled relevant information. Target audiences are then invited to participate in the SC process by providing input and feedback on communication strategies. Based on feedback, channels for communication are selected and content is designed. The strategy must be evaluated and adjusted throughout the process. This study is project-specific, and leans more toward marketing and public relations theory for its methods. The framework was “designed specifically to target key audiences in the marine energy industry” (p. 2). There is no explicit mention within the framework of studying contextual factors. The included survey is aimed at an audience with considerable experience in the field. Although other potential audiences are mentioned, including a larger non-scientific audience, the framework does not seem to be directly applicable to studying layperson audiences, based on the recommendations of other authors. For example, there is no clear mention of studying attitudes or perceptions. The latter is mentioned to indicate that evaluative surveys could be made to assess a change in perception, despite perception not being considered in the initial analysis. According to Torin & Lucaroni (2017), audience perceptions can make a big difference in conservation efforts, making understanding of such perceptions crucial. Additionally, understanding perceptions is an important part of identifying strategies for encouraging behavioural change (Kiley et al., 2017). Turning back to the main communication components as outlined by Jensen & Rosengren (1990), the Triton Framework considers the message and the audience, but not the situational factors.

The three described approaches, aside from all paying close attention to audiences, have one outstanding commonality. All three indicate that there is significant groundwork to be done before a communication strategy can be designed. In other words, some degree of empirical analysis of the communication context should take place before the communication strategy is devised. What this groundwork entails differs per approach. The authors do agree that it must involve a form of audience analysis, although the factors to be considered in this differ as well.

2.1.2. Understanding the Audience and the Context of Communications

Rogers (2000) states that the weak link in SC is a lack of audience understanding. This manifests in the form of assumed knowledge and lack of provided context. Background information is left out because the audience is expected to possess such ‘basic’ knowledge already. This foreknowledge is not always present. Communicators sometimes leave out the broader context as well, leaving audiences unsure as to how they may utilise the provided information. This can make it more difficult for individuals to process information and decide

upon its relevance. De Bruin & Bostrom (2013) highlight common issues in SC that likewise arise from a lack of audience understanding. Miscommunication can arise when experts present knowledge that they find important without taking into account what is relevant to the audience. In a similar vein, the science that is communicated can be too expansive, including too many details. It is important to focus the message, so as to communicate the core of the findings without causing an information overload. Finally, de Bruin & Bostrom recognise a process of mystification through the use of jargon and needlessly complicated concepts. This is a common critique levelled at the scientific community (Cormick, 2019). All three highlighted issues indicate a lack of prior insight into audience characteristics such as informational needs and preferred formatting. Several authors describe ways to remedy the gap in audience understanding through audience analysis or public perceptions research, focusing on different audience characteristics.

In his descriptions of adequate SC, Fischhoff (2013) states that suitable strategies must (1) contain information that recipients need, (2) in places they can access, and (3) in a form they can comprehend. Or in other words, effective SC strategies must first consider an audience's informational needs, commonly used sources, and preferred formatting. Interestingly, this definition does not give much attention to audience attitudes or perceptions. This stands in contrast to a majority of audience analyses, which tend to focus on psychographic factors such as attitude and perceptions (Metag & Schäfer, 2018). For example, Jefferson et al. (2015) focus on attitudes and values as part of their public perceptions research. They explore different types of public perceptions research as the authors have categorised them. Types include cultural, behavioural, knowledge, and concerns analysis. Jefferson et al. also mention studying education and information, including identifying different preferred communication channels. Easman et al. (2018) study public awareness of marine environmental threats and conservation to understand which gaps need to be filled. The team collected data on concerns, behaviour, information sources, memorable issues, and awareness of threats and conservation efforts. Demographic data was also collected to see whether or not there were correlations between qualitative data and demographic categories. The use of these types of data can be found in different configurations in the literature on AA (Cormick, 2019). Some scholars have tried to condense the different forms into clear categories for AA. When discussing environmental communication, Ross (2013) suggests a method for deep audience analysis, which aims to assess the underlying predisposition of an audience in terms of (1) the sources of information they prefer, (2) their motivations for action, and (3) the commonplaces that impact perception. Commonplaces refer to concepts taken for granted by an individual or a group. Ross further

mentions the importance of identifying representative users in order to increase generalisability, similarly to Easman et al. (2018). Metag & Schäfer (2018) distinguish between a *sociodemographic*, *psychographic*, and *behavioural* data within segmentation analysis. Segmentation analysis is a form of AA in which the general public is divided into subgroups based on analytically relevant criteria. The authors explain the need for all three types of data in order to create a holistic understanding of an audience. Segmentation can help construct communication strategies specific to different groups (Cormick, 2019).

The suggested methodologies study situational factors insofar as these are represented in demographic categories such as level of education and socio-economic background. Whether these categories are expanded upon beyond comparative use is often left unclear. In the mental models approach by de Bruin & Bostrom, there is a clear link between audience analysis and SC. Yet here, too, situational factors are minimally considered. The method focuses on identifying decision-relevant beliefs, gaps and misconceptions in knowledge, and preferred wording. There is little mention of situational barriers that may arise, such as political apathy, distrust of science, or a language barrier. As Gottschling & Kramer (2017) explain, SC is embedded in a wide range of situational factors that can impact how messages are received.

In response to oversights such as these, Nisbet & Scheufele (2009) appeal for a more scientific approach to SC, where communication is based on an empirical understanding of contextual factors such as public values and information environments. Delving more in-depth, Salmon & Roop (2018) conducted a study of various polar education, outreach and communication projects in order to identify the gaps between theory and practice. They categorise their insights into three common themes. First, they identify a need for clear objectives, including goals, audiences and messages. Second, they see a need to acknowledge the influence of different contextual factors, such as various interest groups and general power structures. Finally, they describe the need for training and resources, such as theoretical and practical training in SC methods and resources. Their description goes beyond the three components of communication as described by Jensen & Rosengren. Beyond message, audience and situational factors, Salmon & Roop state that aspects such as goals, actors and actor capacity should also be considered.

2.2. Conceptual Approach to Grounded Science Communication

The conceptual approach for grounded science communication is constructed based on the literature discussed above, thereby answering SQ1: *Which analytical components for a grounded approach to science communication can be derived from the literature?* The theory discussed up to this point has established the various facets of communication that scholars

deem necessary to consider when designing SC content. Different approaches were compared to indicate both overlap and divergence, as well as factors that are often overlooked in practice. This exposition highlighted the need for considerable groundwork to be conducted before the formulation of an SC strategy. In this section, the reviewed literature is synthesized in order to provide a coherent overview of the aspects to be considered as part of the groundwork for SC strategies. This is not a comprehensive approach, as there are far more factors that could be considered before constructing SC strategies, such as information networks or wider actor

Table 1: Components of a grounded approach to science communication, based on a synthesis of literature

Main Components	Sub-components	Explanation
Producers	Goals	Project and communication goals as described by project members
	Target Audience	Target audience for communication as described by project members and practitioners
	Actors	Actors involved in the project and communication, including potential partners
Audience	Attitude & Concerns	Attitude and concerns of audience members related to project topic
	Informational Needs	Informational needs of audience members as identified by the audience, project members, and practitioners
	Information Sources	Trusted and preferred sources of information by audience members
	Preferred Format	Preferred format of informational content by audience members
Situational Factors	Barriers	Barriers to communication as identified by project members, practitioners and audience members
	Opportunities	Opportunities for communication as identified by project members, practitioners and audience members

constellations. Instead, the approach focuses on aspects that are most often mentioned as being necessary to SC groundwork, or that are most often overlooked. An overview of this synthesis can be found in Table 1.

The approach is divided into three main components: *producers*, *audience*, and *situational factors*. The main components are based initially on the three parts of communication as identified by Jensen & Rosengren (1990). However, the *message* category is replaced by *producers*. This choice was made for two reasons. Firstly, the approach suggested here identifies factors to be considered prior to the formulation of an SC approach. As the formulation of a concrete message would not take place until this later step, the inclusion of this component was deemed unsuitable in this synthesis. Instead, and secondly, several works mentioned the necessity of identifying goals and target audiences (e.g. Cooke et al., 2017; Salmon & Roop, 2018; Gunn et al, 2022). Additionally, Fischhoff (2013) notes that adequate

SC requires a collaboration between scientists that are familiar with the topic, scientists who have experience with SC, and practitioners capable of managing the communication process. This requires first identifying who these actors are. These sub-components are brought together under *producers* because all three sub-components are elements to be identified among project members and potentially among practitioners as well. Both are considered producers in this context, as they produce knowledge and communication content. The *audience* category refers to the intended audience for science communication, as identified in the target audience sub-component. This component is sub-divided into attitude and concerns, informational needs, information sources, and preferred content format. All four elements are frequently mentioned in literature on audience analysis related to SC, though rarely altogether (e.g. Fischhoff, 2013; de Bruin & Bostrom, 2013; Easman et al, 2008). The final component of groundwork for SC is *situational factors* (Nisbet & Scheufele, 2009; Gottschling & Kramer, 2020 among others). This component has been divided into barriers and opportunities to indicate those situational factors that are directly relevant to the communication process. In reality, contextual elements are often far more complex, and may influence the communication process in unexpected ways. However, the scope and scale of groundwork must remain viable for researchers and practitioners. An in-depth study of communication contexts for even one region may well fill an entire book. As such, the approach concentrates on directly relevant factors. Situational barriers refer to contextual challenges to communication such as a language barrier, or an outdated policy framework. Situational opportunities refer to factors that provide possibilities for enhancing communication effectiveness as defined based on project goals. Opportunities could include focusing events, political shifts, advancements in technology, or similar instances (Jones et al., 2019; Gottschling & Kramer, 2020).

To further clarify the grounded approach, it is useful to define the mentioned actor categories as they are used in this research, how these categories are differentiated, and why they are used.

Project member: Instead of specifying this actor group to researchers, the term project member is used to describe those directly involved with the project that is to be communicated. This is because although most of the individuals involved in a scientific project will be researchers, this is not a given. Thus for the sake of clarity, the broader term is used.

Practitioner: The term practitioner is used to describe those that are more actively involved in the field of study, such as those that hold jobs in those sectors. Individuals in this actor category are likely to have more practical experience with the object of study. Additionally, they may be

closer to audience members by virtue of their work in the field. This is not always the case, but it does provide a useful source when conducted empirical analysis for a grounded approach.

Audience member: This does not refer to the member of any one particular audience. The generality of the approach means that it can be applied in the case of SC projects with a variety of audiences. Therefore, this actor category is not referred to as something more specific, such as ‘decision-makers’ or ‘laypersons’. The approach is intended to be applicable to a broad set of cases.

3. METHODOLOGY

3.1. Literature Review and Conceptual Approach

The objective of the first SQ was to identify components of a grounded approach to SC based on a synthesis of existing literature. Literature was selected in a purposive manner using Google Scholar and WorldCat with search terms including “science communication”, “science communication process”, “audience analysis”, and “shortcomings in science communication”. Works were chosen that described SC, the process of SC, and factors that must be considered beforehand. The literature review also included snowball sampling, wherein the source material of particularly comprehensive texts was consulted. Texts were compared for both variety and overlap. Consulting works that presented a variety of components served to create a more comprehensive synthesis, as potential gaps in each work were supplemented with material by other authors. Identifying points of overlap worked to ascertain the most commonly mentioned components, allowing for a selection of those that were deemed most important or most often overlooked. Together, these comparisons informed a synthesis of the literature in the form of components for a grounded approach to SC, answering the first sub-question.

3.2. Case Study Analysis

This sub-section describes the empirical analysis that was constructed based on the grounded approach to science communication. Presentation of these methods answers SQ2: *How can the derived grounded approach be operationalized for empirical analysis?*

The research conducted here focuses on groundwork for SC in a case where little prior research has been published related to SC. Such a case was chosen in order to illustrate the way a grounded approach to SC may be carried out in full from the beginning. The chosen project topic was marine science, particularly coral reef science, as coral ecosystems are under increasing threat as a result of human impact. As such, effective SC could make a notable impact, while ineffective SC could have severe consequences. Based on these selection criteria, I chose to study the SEALINK project, which I was introduced to by two of my professors. The SEALINK project is an undertaking to study impacts on coral reef health in the Dutch Caribbean. Coral reefs are among the most biodiverse ecosystems on Earth, providing shelter and resources for over a quarter of all known marine life, despite covering only 0,0003% of the Earth’s surface (Birkeland, 2015). They also provide roughly 500 million primarily impoverished people with various ecosystem services, including food, medicine, tourism, and coastal protection (Anthony et al., 2017). Alarming, these systems are under increasing threat of degradation in the form of coral bleaching, pollution, overfishing and habitat destruction, with total coral populations having been halved since the 1950s (Eddy et al., 2021). This has

made the preservation of coral ecosystems a topic of growing concern among marine (conservation) scientists, and the issue has even begun crossing disciplinary boundaries. The SEALINK Project is one such interdisciplinary undertaking. It consists of a team of researchers studying the ways in which various inputs affect the growth and survival of reefs in the Dutch Caribbean (Vermeij, 2021). The project is divided into five work packages (WPs):

- 1) Land to sea: water and substance fluxes
- 2) Physical and chemical aspects of hydrodynamics over Caribbean reef systems
- 3) Reef biogeochemistry
- 4) Management options for sustainable coastal use under different, uncertain future contexts
- 5) Effective knowledge communication towards various stakeholders

The research presented here falls under WP5, which aims to “identify strategies that maximize the use of scientific findings in complex, environmental decision-making contexts.” (Vermeij, 2021). This work package is led by Dr. Frank van Laerhoven, and is carried out in close consultation with PhD candidate Danick Trouwloon, whose topic of study is research uptake strategies for marine conservation. In the research conducted here, particular attention is given to communication with local laypersons. As explained previously, coral reefs are of great importance to a vast number of people living in coastal areas, such as the inhabitants of the Dutch Caribbean islands. Island economies such as Curaçao depend on tourism for a significant portion of their income. This tourism is in turn largely driven by the island’s natural beauty, including coral reefs. As such, the health of corals is relevant to the local population beyond the wish to preserve the reef for its own sake. Locals have a stake in the future of reef health. But in order to make informed decisions accordingly, local laypersons must first understand the issue, and which actions are open to them. This is where science communication comes in.

This research utilises a holistic single-case design, with Curaçao as its unit of analysis and the SEALINK project as part of the case context. The study takes an interpretivist approach, aiming to explore the case within its given context. The broad strokes of this case study were structured based on the work of R. K. Yin (2009). Particulars were informed by relevant literature as was identified beforehand. Although SEALINK aims to study the entire Dutch Caribbean region, this research chose Curaçao as unit of analysis due to existing links to the island. Attention of researchers is currently focused on and around Curaçao. Much of the research is conducted out of CARMABI, the Caribbean Research and Management of Biodiversity foundation located on Curaçao. Additionally, different islands will have different

communication contexts. Including all these contexts in one research project would have stretched the scope beyond what is feasible within the timeframe set for a thesis project.

3.3. Data Collection

3.3.1. Sampling

The decision to contact researchers, conservationists and local laypersons was based on the recognised benefit of consulting multiple actor categories as identified in the theoretical section and resulting conceptual approach. Within these actor categories, participants were sampled in different ways. Researchers were contacted in a purposive manner, by sending out individual emails to known SEALINK researchers. This list was provided to me by Danick Trouwloon. Of the 28 emails sent, I received 15 positive responses. Unfortunately, one respondent did not reply to my follow-up email, and another interview was terminated after six minutes. This left 13 interviews, representing work packages 1-4. I did not officially interview researchers for WP5, as I was already working with them and was in frequent contact.

Conservationists were contacted in different ways. Initially, I only contacted one organisation which I knew would be relevant to my research. I was able to interview two of their members. The others were encountered in a more incidental manner once I had arrived on Curaçao, in a form of snowball sampling. One conservationist was a friend of someone who had gotten in contact with me via Couchsurfing, which is a website for meeting people and/or finding a place to stay during ones travels. Later, it was recommended to me to visit the Seaquarium, where I was able to contact staff and secure another interview. While I was conducting this interview, another person walked in from an organisation I had failed to get in contact with, who was also willing to be interviewed. Finally, the last conservationist I interviewed was one who was suggested to another student who I collaborated with. This student's research covered communication surrounding RAMSAR areas on Curaçao. As we saw some overlap, we decided to conduct some of our interviews together.

Sampling of audience members differed between the survey and street interviews. Street interviews were conducted randomly, although with the intent to form a representative sample. That meant that although we stopped interviewees in the street semi-randomly, we did so looking at age and gender. For example, if we had interviewed three older men in a row, we would look for a younger man, an older woman, or a younger woman to maintain representative diversity.

Survey respondents were sampled randomly. Initially, the plan was to print posters with a QR code that redirected to the survey landing page, and to hand these posters in busy places. However, it was eventually decided that the effort necessary to set this up would not be worth

the expected limited response. Instead, it was decided that the survey would be posted on the *Durf te vragen Curaçao* Facebook page. This page was chosen because it has a large member base, and the goal of the page does not relate to any environmental topics. Members can post requests or offers on the page for a variety of goods and services. The page is in Dutch, but the link was posted with explanatory text in Dutch, English, and Papiamentu. Alternative platforms were considered and pursued, but were rejected either due to lack of access, or due to an increased potential for bias.

3.3.2. Researcher Interviews

The primary goal of researcher interviews was to ascertain individual project goals and ideas on audience and communication. The interviews were semi-structured, guided by seven stages of interview inquiry by Kvale & Brinkmann (2009), and descriptions of interview techniques by Rowley (2012). Researchers were encouraged to share their own perspectives, and so sometimes questions were asked in a different order based on the direction of conversation. Initial questions were open, with follow-up questions being more probing. The necessity for probing questions was noted alongside the answers. For example, if a researcher only mentioned laypersons as an audience after being asked about them directly, a note was made which was in turn reflected in the results. This model was chosen because the goal of researcher interviews was to gather perspectives and hear from individual researchers what they see and expect. What was not mentioned was considered important as well, as it reflected researchers' opinions more fully. Generalizability was not considered relevant. Later, interviews were transcribed for the sake of coding. Details on the coding process can be found in the [Coding section](#).

3.3.3. Conservationist Interviews

An interview guide was constructed for conservationists using similar methods as those for research interviews, but it was not as closely adhered to. Conservationists all had distinct roles, and asking them the same questions was not always helpful. Questions for local conservations were shaped based on their position as bridge between science and society. This includes questions on local attitudes toward science and past communication strategies that have either succeeded or failed. The general themes of the questions, informed by the components of the conceptual approach, were adhered to. Only two interviews were recorded and transcribed. Analysis of the others relied on my own notes written during the interviews, as well as the voice memos I made as recap for myself afterwards.

3.3.4. Survey

The survey was constructed primarily to assess the audience characteristics outlined in the conceptual approach. It began with a series of word associations, going from general to topic-specific. Answers were used to assess the primacy that marine issues hold, as respondents were able to reply in their own terms, with whatever came to mind first (Gelcich et al., 2014). For the following set of questions, inspiration was taken from the methodology provided by Ross (2013), although the final contents were altered. The most notable change was to the question format. The template made use of open-ended questions. However, for ease of comparison and minimization of effort for respondents, these were changed to Likert scales (Clark et al., 2021). Respondents were asked to elaborate on each Likert scale, in case they did want to provide a more in-depth answer, but these questions were not categorised as required and so could be left blank. The survey was constructed in English and translated to Dutch, Papiamentu and Spanish. The Papiamentu and Spanish versions did not include the opportunity to elaborate on the Likert scale questions, as this would have required the assistance of a Papiamentu and Spanish speaker to translate the answers. The translations were made into separate Google Forms, and all four were made available via a [landing page](#). This landing page also included an About section and a contact form.

3.3.5. Street Interviews

Initially, the idea was to use a variation of the survey as an interview guide for street interviews. The main variation was a shift from use of Likert scales to open questions. However, within the first few days of my time on Curaçao, it became apparent that such a formalised approach would not be a suitable option in this particular research context. It seemed that on Curaçao, people were far more likely to engage in a conversation on a topic than answer a set list of questions. People seemed to want to share their story and their opinions, and sometimes that meant that conversations progressed differently than planned. While this made comparison between responses more complicated, it did allow for novel insights to arise that might otherwise not have been mentioned. The questions on the survey were utilised to guide the conversation in a semi-structured way. The interviews were not recorded, as ambient noise created too great a disturbance. Instead, after every interview I took the time to make a personal voice recording recalling what had been said. These voice notes were then transferred to writing at the end of the day. I added sketches of each interviewee to my notes to encourage recall when going over findings at a later point in time.

A recurring obstacle during my field research was the language barrier. Not everyone understood Dutch, and of those that did many were not comfortable speaking it around me. To

address the issue, I was accompanied by Fanny Alberto for most of my street interviews. She is a Curaçao native with a background in social research, and has considerable experience conducting surveys on Curaçao and elsewhere. This made her the ideal interview partner. For those who wished to speak in Papiamentu, she would translate my questions and the respondents' answers. Although this limited opportunities for analysis, it was deemed the most suitable option given the circumstances.

3.3.6. Participant Observation

Conducting interviews in the field allowed me to make additional observations as well, which I recorded in a research journal. These observations were supplemented by information provided to me by key informants, such as Fanny Alberto and Frensel Mercelina. Both have a vast knowledge of the island and its culture, as well as experience in communicating with laypersons. They each showed me different parts of the island, all of which highlighted different situational factors. These observations are woven throughout the results section, as they at times highlight or supplement interview findings. Although the conceptual approach focuses primarily on situational factors directly relevant to the future communication strategy – in the form of barriers and opportunities – studying the wider societal context in a such a way allowed for a deeper understanding of the context in which SEALINK is taking place.

3.4. Data Analysis

3.4.1. Coding

The coding of collected data was informed by the methodologies presented by Kvale & Brinkmann (2009) and Clark et al. (2021). Transcriptions, interview notes and survey responses were initially coded inductively, but further categorisation was guided by the components of the conceptual approach. In the initial phase, meaning units were inductively identified by going through all collected data in Word. The meaning units were then streamlined into codes using comments. All meaning units and codes were exported to Excel, where the codes were deductively sorted into sub-categories based on the conceptual approach. The sub-categories were already divided into primary categories as part of the approach, meaning categorization was complete upon division into sub-categories.

When referring to the coded meaning units in the results, respondents are indicated using a letter to denote their group (R = Researcher, C = Conservationist, AI = Audience Interview, AS = Audience Survey), along with a number based on the chronological order of interviews and survey responses. In total, there are 13 researcher interviews (R1 – R13), 6 conservationist interviews (C1 – C6), 31 audience interviews (AI1- AI31), and 19 survey responses (AS1 – AS19).

3.4.2. Analysis

The coded data was compared to show instances of overlap and disagreement. These instances were then discussed both in terms of their relevance to the case, and for methodological and theoretical implication. The latter was done by referring back to the original grounded approach. Based on the process and findings of the empirical analysis, recommendations were made for alterations of the approach, as well as suggestions for future research.

3.5. Research Ethics

When conducting research in a setting different to one's own circumstances, such as a different cultural and economic context, it is important to be aware of these differences and how they may impact perceptions and positionality. This is particularly relevant when research is conducted by a single person, as potential biases may be overlooked without the presence of additional voices to add their perspectives (Dean et al., 2018). In this case study, a key factor to take into account is the shared history of Curaçao and The Netherlands. Curaçao is a former colony, and remains a constituency of the Kingdom of the Netherlands. As an ethnically Dutch person coming to the island to conduct research, I must be cognizant of the ways in which this could influence how I am perceived, and the way colonial structures continue to shape science and science education (Boisselle, 2016). Before arriving on the island I spoke with two local conservationists and asked them for practical suggestion on how to approach the general public. They provided valuable insights into how to handle interactions. Once I got to the island, I decided to take the first few days to acclimate so that I may be better prepared to conduct myself in the new environment. I spent those first few days with someone who had been living there for a while. He showed me around the island and introduced me to some of his friends and acquaintances. Observing daily life and interactions on Curaçao helped me to better understand local norms and values. This was how I came to the conclusion that structured interviews were not suitable to the context. I also observed the importance of communal public spaces and the forms communication takes within such spaces.

4. RESULTS

This section presents the findings generated by the empirical analysis of a grounded approach to science communication conducted for SEALINK Curaçao. Findings from all sources as described in the methods section are synthesized to provide a holistic overview. Some sections rely heavily on one particular data source, depending on the sub-component it relates to, but in general results are presented in an aggregated manner. This means that, for example, certain researcher assumptions about audience characteristics are directly complemented by and/or contrasted with local layperson responses on the same topic.

4.1. Producers

4.1.1. Goals

As is to be expected in an interdisciplinary project, interviewees described a variety of aims and expected outcomes. These can be divided into three categories: knowledge production, communication and engagement, and environmental action.

Knowledge Production

In the most direct sense, researchers aim to contribute to the existing body of literature in their field. For the PhD candidates, this comes with the added task of obtaining their degree. All researchers primarily aim to enhance insights into the phenomena and processes they will be studying. According to several interviewees, the insights of each WP should together help foster a holistic understanding of the system and its components. The interdisciplinary nature of the SEALINK project is described as a great asset in this endeavour.

“Well, I think it’s very cool that we have this very interdisciplinary team in that, if it was me by myself then I would see many many barriers because I think it would be very difficult for me to translate things to into more social sciences and then to local people. I think in that way we have an advan- that it’s very useful. That we have people working in different areas and that we can use each other’s information to get to people or to reach people.” (R6)

A few researchers also pointed out the need for a balanced temporal perspective when it comes to management.

“I think that’s the important thing. Connecting in a systemic way, all the different elements, how they interact together and then balance the short term perspective for long term perspective.” (R1)

Communication & Engagement

Certain researchers also expressed an aspiration toward community engagement in their research, both to gain local knowledge and to communicate findings. This intent was mentioned by researchers from all work packages (WPs), although not all researchers saw possibilities for such engagement. The individuals involved in WP1 went so far as to say they were looking to create a citizen science network.

“So on the one hand it has a sort of scientific goal, because then over a greater time and area we get more data. But also because it is fun, I think, to just involve people in the research. So in the end it also has a sort of educational feedback. That is something that we are going to work out further.” (R9)
[Translated from Dutch]

“Dus enigszins heeft dat een soort wetenschappelijk doel, omdat we dan meer over de tijd en de ruimte meer data krijgen. Maar ook omdat het leuk is, vind ik, om gewoon mensen erbij te betrekken bij het onderzoek. Dus het heeft uiteindelijk ook een soort van educatieve terugkoppeling. Dat is iets wat we nog verder gaan uitwerken.” (R9) [Original]

Three described achieving societal impact in a more abstract sense, stating that they wish to contribute to (community) empowerment.

“we need to empower people so that people feel that they have something to say about the development of the island” (R1)

Environmental Action

Others hope that their findings will inspire behavioural change, such as in the form of environmental action.

“you also want it to be contributing to the society there and the local people also get this information and hopefully act on it in one way or another.” (R10)

However, one researcher that saw behavioural change as a potential outcome did note that they are



“not doing science communication to recruit people to become activists. That's not like the explicit goal. The main goal is more, first to raise awareness about coral reefs and climate change. So, why should someone care about coral reefs to begin with? Then raising awareness for the fact that they're really in danger” (R2)

In short, interviews with researchers made it apparent that the goals within the SEALINK project vary greatly. Not just in terms of content, which is varied due to the nature of the different WPs, but also with relation to the contributions they hope to provide. Some focus primarily on furthering scientific knowledge for its own sake, while others indicated that they want their work to have a social impact as well. Some of the following sub-components are divided into these same three goals, as answers were given for all three and this distinction provides clarity when reading.

4.1.2. Target Audience

The range of goals identified by researchers is also reflected by the variety in prospective audiences as seen by the same group. Where some saw local laypersons as their primary audience, others explained that this group was either a secondary audience, or not a direct audience for their research at all. This seems to correlate primarily with the ‘distance’ of research to local laypersons’ everyday lives. For example, researchers studying coral calcification or hydrological flows saw less opportunity or need to communicate with local laypersons than those studying well water quality or land management practices. Many researchers instead pointed to political and industry decision makers as their primary audience, as they are the ones with the power to implement change.

“I think it's important to- for this research to be communicated to the government officials, because government officials have, and stakeholders have the power to make changes in environmental conservation policies.” (R11)

Nevertheless, interviewees did point out that local laypersons could influence decision makers through voting or other forms of public pressure. Therefore, even when local laypersons are not considered to be a directly relevant audience, they are not dismissed by those aiming to provide a societal contribution.

“But by being able to vote, you actually also have political power, right? And it- for coral reefs, it makes a difference whether you vote a

politician who, let's say, wants to do something about climate change or who wants to improve water quality.” (R2)

Lastly, a few researchers stated that their primary audience was the scientific community. However, they did reflect on the potential of other groups as their audience. In general, different facets of the research were described as being relevant to different audiences. None of the interviewees identified a singular prospective audience.

Conservationists reiterated the large variety of audiences, but they were more emphatic about the fact that everyone should be involved in some form. Not just decision-makers and other high-level stakeholders, but all locals as well. The conservationists I spoke with all work towards this goal in some form. In general, researchers and conservationists agreed that the audience depends on the content of the findings to be communicated, while simultaneously the content that is communicated will depend on the targeted audience.

4.1.3. Actors

Knowledge (Co)production

Beyond the SEALINK team itself, researchers and conservationists also identified locals as potential contributors to knowledge production. Two researchers mentioned that local archives and older inhabitants could provide a much needed historical perspective on reef development, something that is scarcely documented in the Dutch Caribbean region (R1 & R2). Other researchers also explained that local fishermen can provide a lot of knowledge in terms of which locations would be valuable to conduct research at. They are also able to provide a clearer overview of changes in fish stock, among other things.

“I listen very carefully when they say oh here we never find fish because they- there's this current and then you cannot go with the boat. So for me that's extremely important to know because we don't have that much data about currents or about bathymetry or stuff like that, so they- and they know very well like OK, we cannot go here with the boat because it's only four meters deep and we can go here because it's 200 meters deep. So of course they have a lot of experience, and a lot of knowledge that when we go with them like we always of course listen to them and take that into account.” (R6)

In addition to knowledge sharing, some researchers also floated the possibility of citizen science, as mentioned previously. A potential barrier was lack of capacity for this type of

research on the island. One of the interviewees stated that in the long term, capacity building and empowerment should lead to marine research being conducted by locals themselves, rather than by outside researchers as is mostly the case at the moment. Stichting Uniek, a local nature organisation, already works closely with the University of Curaçao. They encourage students to engage social and economic projects, among other things. Although conservationists stressed the relevance of local knowledge, they maintained that outside knowledge was crucial to further environmental action.

“I think foreign knowledge is very important. Because if you’re sealed off from the world, you won’t know what the developments are outside. Things that could be done much more efficiently, information maybe.” (C5) [Translated from Dutch]

“Ik vind buitenlandse kennis heel belangrijk. Want als je afgesloten bent van de wereld, weet je niet wat de ontwikkelingen zijn. Dingen die veel efficiënter gedaan worden, informatie misschien.” (C5) [Original]

Communication

Actors for communication has both an external and an internal component. The internal component refers to communication actors as seen by SEALINK researchers themselves. There was a notable variation in answers regarding this responsibility. Some researchers stated that WP5 is set up specifically for communication, and should therefore be the ones engaging in it.

“But I do very much see, my own goal is the main one, so to really generate that knowledge, and the best thing would be if it would then go to someone who could bring it to policymakers. But I think that I myself am not the right person to be doing that now.” (R5) [Translated from Dutch]

“Maar ik zie wel heel erg mijn eigen doel is het grootste dus om die kennis echt te verwerven en het mooiste zou zijn als het dus naar iemand zou kunnen die het wel naar de policymakers zou kunnen brengen. Maar ik denk dat ik daar zelf niet de persoon ben om dat nu in ieder geval te doen.” (R5) [Original]

One researcher also explained that this could be due to a lack of capacity, as researchers are already submerged in their own research full-time, and therefore do not have time to engage in communication. Additionally, some researchers indicated that they have little to no

experience with science communication and therefore did not feel up to the task. Others stated that they were open to actively collaborating with WP5, to ensure that findings were both accurately represented and effectively communicated. Others emphasised that results should be communicated as a whole. That is to say, all of SEALINK together, rather than as individual projects.

“I see myself with everybody, with the rest of the SEALINK project, being a part of the group and showing all of our research together, I feel like, showing a big project, showing all the different aspects that we have done is more about, is- can become more valuable and stronger and can speak more than maybe just one type of research.” (R11)

One of the ways this could be encouraged would be through recurring workshops and update meetings, in which researchers are encouraged to share their progress with the rest of the group. Another suggested strategy was to involve the communications expert in the research of other members of the SEALINK project.

“I think maybe even involving the person into some of the experiments or research or field work that the scientist is doing can be important. Because then the person who is communicating the research has a bit more of an insight and an idea, because they did go to the field work or they were in the lab or they did help in this area. So I think getting them involved is also important and not just, here's the data and just communicate it.” (R11)

In a way, researchers from other WPs would still be involved in communication, as they are actively engaging with the communicator to ensure a strong result.

The external element of communication refers here to the identification of relevant actors by conservationists and audience members. Conservationists saw themselves as key communicators, as they are already embedded in society and have a lot of experience communicating to this particular audience. However, they did not see themselves as communicators for SEALINK in particular. One conservationist did note that SEALINK should



be communicated as a whole, once it has been completed, to avoid miscommunication. Before doing so, results should be discussed with a variety of stakeholders to ensure that there are no gaps (C5). Among audience members, opinions differed on who should conduct communication. This refers to communication of marine conservation content in general, not of SEALINK in particular. One audience interviewee thought that parents should be responsible for educating their children, and that external organisations should not be burdened with this responsibility. When asked who should communicate the information to parents, they mentioned the government, but did not provide any particulars (AI20). Most named the government as having primary responsibility in this area, but some also mentioned experts and nature organisations. Experts should also be the ones communicating to the government, to improve environmental awareness and provide policy advice (e.g. AI12, AI21).

Environmental Action

Researchers also did not agree on the extent of the role of local laypersons when it comes to environmental action and related behavioural change. Two researchers explained that they do not expect significant changes from the population.

“it’d be nice for certain things to see a behavioural change, but I think that might be a bit of a too high expectations.” (R4)

“Not sure if I expect the inhabitants of Curaçao to do something physically.” (R3)

Most researchers, conservationists and audience respondents seemed to agree that the bulk of responsibility for environmental action lays with decision-makers, particularly those in government. Discussing the government’s role did uncover a great deal of negative sentiment, with audience interviewees almost invariably saying that the government was not doing enough. They expressed feelings of powerlessness in this regard, stating that they did not see what they could contribute when the government does nothing (e.g. AI4, AI5). Many stated that this was because they only pursued their own interests (e.g. AI9, AI21, AI25). Despite this, the government was still seen as responsible for policy and overall management. Nature organisations were seen by some as having a supporting role in this (e.g. AI18), with research findings guiding both of them. Nevertheless, most audience interviewees did acknowledge a public responsibility. One respondent likened it to keeping the ‘bario’ clean. If everyone cleans their own house and the area outside of it, then the ‘bario’ cannot be dirty. It is the same way with the sea, which the respondent referred to as something like a second home (AI8). The

extent of personal and public responsibility differed greatly between interviewees. The first person I spoke with during my street interviews was of the opinion that people should be marching in the streets to demand the government to do better (A11). A more direct and structural form of public support is through donations to and sponsorships of nature organisations. For example, the Sea Aquarium has a programme that allows schools from disadvantaged neighbourhoods to visit the aquarium free of charge as part of their educational strategy. This programme is funded in part through donations by local businesses.

In short, potential actors involved in SEALINK and its various goals spans a variety of groups. In particular in interviews with conservationists it became clear how interconnected all actors are. The way they described their work, past and present, no element of communication, knowledge (co)production, or environmental action seemed to have only one actor category. Conservationists rely on researchers to produce state of the art knowledge, and on decision makers to make suitable policies. In turn, researchers need conservationists to carry out suggested conservation strategies, and decision makers to create relevant policies. In all of this, public support is necessary for conservationists to obtain funding and volunteers, for researchers to successfully communicate their recommendations, and for new policies to be supported.

4.2. Audience

4.2.1. Attitude and Concerns

Attitude Toward Science

Seeing as this empirical study analyses local laypersons as primary audience for SC, I wanted to establish whether said researchers knew what local laypersons' attitude was to science. Most indicated that they were as of yet unsure what the general attitude is. Instead, they speculated based on previous research and prior knowledge of the region. The ones that did have some idea were those that had already interacted with the population to some extent during the initial phase of their research. These researchers seemed to agree that responses were mixed, but most people were positive or at least curious. Locals seem to be interested primarily in what the research can mean for them, and the potential practical implications rather than the larger scientific debate.

“most people are not really busy with keeping up with the latest scientific developments or what is going on, so I guess most people know somewhere that certain things are not good for the environment or for



marine- for the marine environment etc. But in their everyday life they don't really- they're not really busy with those topics I guess.” (R10)

One researcher described a recurring hesitancy among local laypersons that they interacted with. This hesitancy comes from a number of related issues. Some locals feel that local knowledge is undervalued. According to conservationists, many locals feel that when scientists show up, they intend to teach exclusively, ignoring local perspectives. This is seen as devaluing local knowledge and condescending to laypersons. In addition, locals often assume an environmental researcher is there to ban practices outright without consideration for societal impacts, leaving locals hesitant to interact with the scientific process.

“If you make them feel as if you're the one that knows everything, then you will experience a negative and sometimes hostile attitude. You have to take into account that your research is not meant to take away one's daily bread. It is very important that you indicate that your research is in fact to guarantee they make a living.” [Translated from Dutch]

“als je hen laat voelen dat jij eigenlijk de gene bent die alles weet, dan krijg je te maken met een negatieve en soms vijandige houding. Je moet er rekening mee houden, dat je onderzoek niet bedoeld is om hun brood van de plank te halen. Het is heel belangrijk, dat je aangeeft, dat je onderzoek juist is om hun brood op de plank te garanderen.” (C6) [Original]

The latter part also points to the financial insecurity that many locals fear or actively face. This can make them hesitant to interact with the research process, as they are afraid things will be banned outright, leading to further economic hardships. Another contributing factor is

that past research has not led to any meaningful changes, leaving locals sceptical of the potential of new projects.

“they said that in past research the post research results did not come, or get a place in new policies so that's why they were afraid that this research would not be adopted either.” (R12)

When asked directly, willingness to participate in the scientific process varied among locals. Some respondents actively keep up to date with marine research, or at least try to. They expressed an inherent interest in the topic, and had an in-depth understanding of marine science issues. There were also those that stated they would be willing to engage with research, but did not see any clear ways to do so. A majority of survey respondents do not feel like they are part of the scientific process (Figure X). However, only two expressly stated that they disagreed with the statement “I would like to be (more) involved in the scientific process” (Figure X).

“If local research would need volunteers (to dive etc) I would be more than happy to take a supporting role.” (AS3)

Attitude and Concerns Regarding Environmental Issues

“anyone would be- I guess everyone is likely to have- to have a sense of the environment that you live in, right? (...) How can you not care about your direct natural environment?” (R3)

To researchers in environmental sciences, it can be difficult to imagine that a person could be disinterested in related issues. Nevertheless, many researchers did concede that laypersons may have other things to worry about, such as their health or job security. Conservationists reiterated that many people are likely to be in this position, especially at the moment. Many people, especially following the COVID-pandemic, have a hard time getting by on Curaçao. Food and gas prices continue to increase, while unemployment is on the rise (CBS, 2020). As such, local laypersons may be less concerned with environmental matters, prioritising short time survival instead. One interviewee described environmentalism as a privilege (C1).

I initially interpreted this rather bleak outlook as meaning that laypersons might not even be aware of environmental issues on and around the island. In reality, although the level of awareness differs a great deal from person to person, nearly every respondent mentioned some type of environmental concern. Levels and objects of concern differed, but everyone seemed to be in agreement that things did not look to be going well. Concerns expressed by



Image 2: Water pollution. Sewage from land is deposited directly into the sea along the North Coast without filtering (own photograph, 2022)

Image 1: Poverty and waste pollution. What was once the most popular restaurant in the area is now closed down, and the platters that used to hold freshly caught fish are now full of garbage (own photograph, 2022)

laypersons include drastic reduction in fish stock, water pollution (Image 1), destructive fishing methods, pollution by tourists, loss of biodiversity, degradation through development, coral degradation, decrease of fish size, waste pollution (Image 2), ocean warming, invasive species, ecosystem fragility, climate change, and general environmental degradation. There seemed to be a distinction in answers between those I spoke to in the city, and those I spoke to closer to the beach. When asked what concerns they had in relation to the marine environment, the majority of interviewees in Punda and Otrobanda were mainly concerned with waste pollution (AI1 – AI13). Very few mentioned reef ecosystems or parts thereof. This was made particularly noticeable when one interviewee pointed out that people do not pay attention to life under the sea (AI13). This extends to the government, they said, because when the government gets involved, they only seem to clean for tourists on the land, either forgetting or simply not caring about what happens under water. In contrast, people interviewed near Marie Pompoen, a coastal neighbourhood, consistently brought up topics such as coral degradation, and the harm done by large scale development. Most of the people interviewed in the city also indicated that they rarely if ever swim, while near Marie Pompoen people were more likely to swim, snorkel, and even dive. The sample size was not large enough to draw any conclusions from this discrepancy, but it may be a valuable avenue worth pursuing at a later date. Only a few interviews were conducted near St. Willibrordus and Tera Kora, hindering any type of correlation. Respondents to the survey showed a more in-depth understanding of life below sea compared to city respondents. The majority had a bachelor degree or higher. Beyond this, no noticeable patterns could be discerned between concerns and sociodemographic categories.

“Due to global warming the environments of the sea have been changing a lot, and I myself have been noticing it with later and later seasonal changes.” (AS3)

The reefs are pretty badly endangered. Pollution, but also by exotics, which don't belong in the region. Think of the lionfish/koraalduivel. Exotic tube worms and other dangers. Anchoring and shipping. Large parts of the reef damaged or turned up. Sickness amongst sea urchin. To conclude: very threatening for the coral.” (AS12) [Translated from Dutch]

De riffen worden vrij ernstig bedreigd. Vervuiling, maar ook door exoten, die niet thuishoren in de regio. Denk aan de lionfish/koraalduivel. Exotische kokerwormen en andere gevaren. Ankeren en scheepvaart. Grote delen van het rif beschadigd of omgewoeld. Ziekte onder zee egels. Samenvattend: zeer bedreigend voor het koraal.” (AS12) [Original]

Attitude Toward Environmentalism

Despite the acknowledgement of environmental concerns, and general agreement that these issues need to be addressed, the idea of environmentalism or environmental activism was regarded disfavouredly by most. When responding to the statement “I do NOT see myself as an environmental activist”, the same people that provided the previous two quotes agreed, elaborating that:

“Activism is usually associated with trying to [pressure] others to behave different. While I live an environmentally friendly lifestyle. I do not shove it down others' throats.” (AS3)

“I definitely do not see myself as an activist! I am [however] concerned with nature, and as diver definitely with marine issues” (AS12) [Translated from Dutch]

“Ik zie mezelf zeker niet als activist! Ik ben wel betrokken bij de natuur en als duiker zeker bij maritieme zaken.” (AS12) [Original]

In fact, one respondent, who indicated that they frequently went diving and kept up to date on marine research, said:

“I’m not a climate whacko or activist” (AS9) [Translated from Dutch]

“Ik ben geen klimaat wappie of activist” (AS9) [Original]

Two other layperson respondents indicated that the reason they do not see themselves as environmental activists stems partially from shyness, but that it is important that action is taken (AI10 & AI12). Very few respondents were engaged in environmental action.

One conservationist responded that they do not see themselves as an environmental activist, as *“for that I would need to change my concept of life”* (C1), including removing all plastic from their life, and similar actions. This conservationist stated that activism requires one to fulfil an example position, which they did not find they did sufficiently. Another conservationist, who does see themselves as an activist, explained how this led to a negative perception of them as a person.

“There are many areas they’re not allowed to touch, I think, but I’m the only one here. But I’m the one that started yelling, and I’m ‘that’s that crazy lady from the store!’ I’m not crazy, I was born here! I know the story!” (C4) [Translated from Dutch]

“Er zijn veel gebieden die ze niet mogen aanraken, vind ik persoonlijk, maar ik ben hier de enige. Alleen ik ben de gene die ging schreeuwen, en ik ben ‘das die gekke vrouw van de toko!’ Ik ben niet gek, ik ben hier geboren! Ik ken het verhaal!” (C4) [Original]

Where this animosity toward environmental activism comes from is unclear, and would require future research to uncover. When discussing the concept of environmental action in more neutral terms, many local respondents expressed a feeling of hopelessness or disillusionment. A common refrain went along the lines of ‘the government does nothing, so what can we do?’. Overall, the attitude of local laypersons toward science, environment, and environmentalism differs, as predicted by conservationists. However, some attitudes are more prominent than others. Firstly, many laypersons do seem open to the idea of participating in the scientific process, given that methods to do so are made clear. Secondly, most laypersons do have some degree of environmental concern, even if they may not act on it and the extent of their concern differs greatly. Finally, a majority of respondents seem to agree that although action should be taken in regards to environmental issues, “environmental activism” is not desirable.

4.2.2. Informational Needs

Regarding informational needs, conservationists suggested that researchers should focus on providing alternatives to harmful behaviours, rather than merely suggesting restrictions. Suggesting alternatives is more likely to motivate cooperation, while focusing on restrictions often fosters resentment (C5 & C6).

“And people always want to hear alternatives. So don’t say ‘you can’t do this’ but ‘you aren’t allowed to catch the shark anymore, but these are the alternatives’ with which that person can still put food on the table.”

(C5) [Translated from Dutch]

“En mensen willen altijd alternatieven horen. Dus niet ‘je mag dit niet doen’ maar ‘je mag de haai niet meer vangen, maar dit zijn de alternatieven daarvoor’ waarbij de persoon nog steeds voedsel op tafel kan zetten.” (C5) [Original]

Researchers and conservationists alike stated that local laypersons would likely be interested in practical information, rather than the full scientific story. Indeed, some laypersons I spoke with did indicate that this was the case, with one person saying that without practical knowledge, they would not know how to contribute (AI15).

Informational needs in terms of specific content did not become clear from interviews or observations. It was noted that such needs do vary greatly, as some individuals hold far more knowledge of the marine environment than others (e.g. AI7 & AI17). Additionally, both researchers and conservationists indicated that preferred content will differ between different groups with the layperson public. Fishers may benefit from knowledge on sustainable fishing practices, while well owners will pay attention to water quality improvement schemes. It is therefore crucial to know the audience before beginning communication efforts so that an effective strategy can be constructed.

4.2.3. Information Sources

Both survey respondents and interviewees were given the option to mention multiple sources of information. Combining these two data sources, the most commonly used platforms are news websites (14 people), social media (13), the newspaper (9), word of mouth (9), and television (8). (Figure 2).

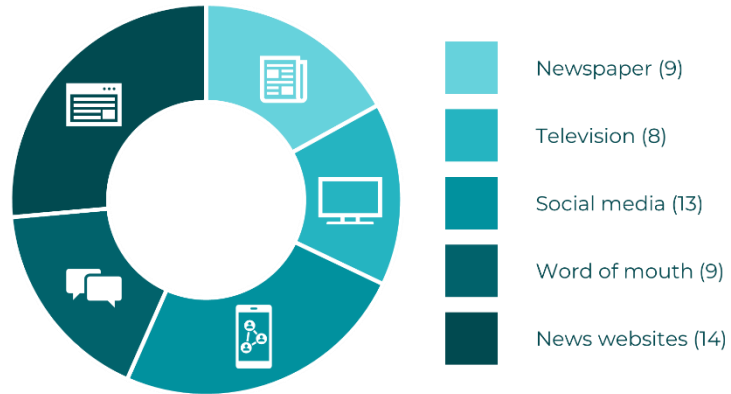


Figure 2: Preferred information sources. Aggregated data from survey and street interviews

In line with this diversity of sources, conservationists and researchers emphasised the need for variety of platforms, with different segments of society preferring different platforms. One researcher, who had engaged in conversation with a number of local laypersons, suggested that there is still a distinct place for the newspaper.

“I think we would like to be in a newspaper. So we encountered quite some people that ask us why there was no announcement of our research in the local newspaper. Some of them were even a bit, well, they first were a bit afraid of- about letting us onto their property as they said, oh, but I didn't see anything in the newspaper about it, so who are you actually?” (R12)

Specifically local newspapers in Papiamentu can reach a lot of people that would not otherwise hear of marine research. For example, when communicating about the Queen Conch Hatchery, a collaborative project with CARMABI and the Sea Aquarium, an article was published in Papiamentu in the newspaper *èxtra*, a popular local newspaper (Image 3). The article includes a QR code that people can scan for more information. Among respondents, young people were less likely to mention the newspaper as their primary source of information. Nature documentaries are also very popular on Curaçao, and are a good way to communicate more complex stories. One conservationist explained that it was a nature documentary that positively changed popular opinion on the Sea Aquarium, which is a key marine educator on the island (C2).



Image 3: An article in local Papiamentu-language newspaper *èxtra* about the Queen Conch research and conservation project (own photograph, 2022)

“People are crazy about things like nature documentaries, they also think they’re very good. David Attenborough is very popular on the island.”

(C5) [Translated from Dutch]

“Dingen als natuurdocumentaires zijn mensen dol op, ze vinden ze ook heel goed. David Attenborough is heel populair op het eiland.” (C5)

[Original]

It was also suggested that community events can work to bring people together to bring attention to a topic. It helps if people receive something in return, such as a free meal (AI29). But whether community events work also depends on the neighbourhood in question. Some neighbourhoods are very active and hold regular council meetings and host clean-ups. Others may not have any active events (C4). Similarly, it was noted that word of mouth is an important way of spreading awareness. One researcher pointed to the value of personal communication in

the form of one-on-one conversations and public events. This is also something I noticed while doing field research. Public spaces, such as food courts, beaches, game rooms, etc., are key places for locals to hang out. In my first few days on the island, someone took me to the food court at the van den Tweel, where I met a variety of people that came there to sit and chat. One of the people I met explained that when he moved to Curaçao, he spent a considerable time at that court, and it was how he made friends and got to know people on the island. He was on a first name basis with all the staff there. During one of my visits, I even happened to run into someone who works with CARMABI. These are social spaces where people come to interact with others, maybe play a game of dominoes, and eat together.

In the past decade or so, social media has also become a prominent platform for communication. For example, the Facebook page “Durf te vragen Curaçao”, on which I posted the survey, boasts 37.000 members. One conservationist noted that as a whole, the local layperson audience has become far more vocal due to the prevalence of social media (C5). This allows anyone that wants to the opportunity to voice their opinion, further overwhelming the informational landscape. Communicators must therefore be prepared to speak to an audience that can talk back outside of the confines of communication channels set up by researchers or communicators themselves. Which websites are used seems to differ somewhat between age groups. Younger interview respondents were more likely to mention Instagram as an information source, while older people that spoke of social media seemed to favour Facebook. The use of social media did not seem to decrease significantly with age. However, extent of social media use was not measured, so there is considerable room for variation. One researcher said about the use of social media for SEALINK that

“I get the feeling that at the moment we’re still a bit reserved. And I hear that from others as well. And that, it’s not like our kick-off on Curaçao appeared abundantly on social media. Something that you would definitely do normally.” (R9) [Translated from Dutch]

“op dit moment zijn we nog wat terughoudend heb ik het idee. En dat hoor ik ook van anderen wel. En dat, ja het is toch niet zo dat we onze kick off zeg maar op Curaçao uitbundig op de social media is gekomen. Wat je normaal juist wel zou doen.” (R9) [Original]

In summary, preferred sources of information span a wide variety of both modern and traditional platforms. This study did not identify a clear discrepancy based on age, although

some conservationists and audience members did suggest that there was a difference (e.g. C6, AI30 & AI31).

4.2.4. Preferred Format

As with information sources, preferred format also differed between individuals. However, interviewees did identify several strategies that they felt would be effective regardless. Commonly mentioned strategies include communication in Papiamentu, simplification of findings, and a non-judgemental approach. According to one conservationist, understandable language also includes using relatable examples.

“You should actually use examples to let people understand what you’re doing, why you’re doing it. Because most people don’t understand scientific language. (...) if you explain it with a good example, with which they are familiar, they immediately understand what it is I’m doing. Then they’ll stand by you, because they’ve understood. That is very important.”

(C6) [Translated from Dutch]

“Je moet dus eigenlijk voorbeelden gebruiken om mensen te laten begrijpen wat je aan het doen bent, waarom je het doet. Want de meeste mensen begrijpen de wetenschappelijke taal niet. (...) als je het uitlegt met een goed voorbeeld, waarmee ze bekend zijn, begrijpen ze het meteen waarmee ik bezig ben. Dan gaan ze aan je zijde staan, want ze hebben het begrepen. Dat is heel belangrijk.” (C6) [Original]

Communication in Papiamentu and use of relatable examples extends to the filling of example positions. Several audience interviewees stated that there should be a local in an example position to inspire others to follow. Conservationists were of the same opinion. Two respondents explained that when people come to raise awareness of environmental issues, either in schools or in other settings, this is generally done by Dutch or American individuals (AI13, AI14).

Education programmes were also mentioned as a key form of communication, not just by researchers and conservationists, but by audience members as well. Children are regarded as a crucial audience for environmental communication. Starting young can teach them to be responsible citizens before their harmful habits can become entrenched (C3). Furthermore, children share the things they have learned with their parents, further disseminating knowledge. Hearing their children talk about it is also more likely to convince parents to change their own

views or habits, which tend to be far more deeply rooted. Several organisations already offer an array of educational programmes, both in Dutch and Papiamentu. Several researchers also mentioned that they participated in a presentation and Q&A for school children on the island.

Another aspect that was brought up repeatedly was the use of visuals, including images, videos, and visual experiments. Researchers mentioned different reasons for this, including visualisations being more engaging and easier to understand. This does not cover only the use of images, but also practical demonstrations of complex processes.

“we do some experiments, for example with dyeing water. So we have a colour, we colour the water, for example in yellow, and then we see how the water moves in certain parts of the of the water mass. So things like that, that are super visual and help seeing that the water is in constant move (...) So stuff like that, I think we can come up with stuff that are very visual and can really catch your attention and make you understand it.” (R6)

Images and videos can also be easily shared on social media in order to reach a larger audience. They also make for engaging educational material. An audience interviewee was able to give a detailed recap of several videos they had seen on Instagram. They indicated that seeing the extent of the plastic soup problem in one of those videos made a particular impact (AI13). Some respondents also mentioned that there should be signs on beaches to inform people (e.g. AI16, AI18, AI22).

As with the rest of the results thus far, recommended communication approaches, platforms and formats span a variety of options. Some of the most commonly mentioned were a non-judgemental approach, communication in Papiamentu, and use of visuals. Communication in Papiamentu could be argued to not be relevant to all segments either, as there are a wide variety of languages spoken on the island, but Papiamentu remains the most common one. Additionally, as mentioned by conservationists, there seems to be a discrepancy between Papiamentu-speaking and Dutch-speaking children in terms of environmental knowledge, where Dutch-speaking children tend to have a greater environmental awareness (C2 & C3). This could indicate that currently the Papiamentu-speaking segment of the population is less catered to in terms of environmental communication.



4.3. Situational Factors

4.3.1. Barriers

Communication

Researchers and conservationists alike mentioned language as a barrier to successful (science) communication. Firstly, there is the direct language barrier. Although the language of primary education on Curaçao is Dutch, a large portion of the population is not comfortable speaking it. The main language on the island is Papiamentu. According to the 2011 census conducted by the CBS, 118.141 people speak Papiamentu, while only 13.014 people indicated that they spoke Dutch. Even less people speak English, with 4610 on the census. Spanish is more prominent, at 8321 (CBS, 2011). Of the researchers involved with SEALINK, only two speak Papiamentu. More than half speak Dutch, a few speak Spanish, and the rest speaks English as well as their native language. Those who do not speak Papiamentu, Dutch, or Spanish experience this as a significant challenge.

“we've been talking a little bit to people, but I guess my limitation in that is that I moved to the Netherlands only like 2 years ago. So my Dutch is still very limited and I don't speak Papiamentu either. And so there has definitely been, you know, that's been a problem in talking to people when we happen to run into them.” (R2)

One of the locals I spoke with provided an example of this. On Curaçao, there is a person commonly known as the Kunukuman. This person organises clean-ups every Saturday, with volunteers often collecting over 150kg of waste at a time. However, the Facebook page that serves as main form of communication on all of this is in Dutch. The interviewee I spoke with is now working to translate content into Papiamentu, in the hopes of reaching a larger audience (AI22).

Secondly, there is the barrier of scientific language. Several interviewees noted that scientific topics and writings on them tend to be complex, making use of jargon. For researchers, it can be difficult to translate this themselves, as they are used to their field-specific terms.

“Was actually really hard to try to explain it to a kid what I do without using all my terms like metagenomics, metabolomics, expecting that people know what I'm talking about or even if I then explain the term I still

recognize that I try to do it very scientifically. Yeah, that was a real challenge.” (R4)

Both of these language barriers can lead to a sense of distance from the subject matter. Similar barriers become apparent in education programmes. As mentioned previously, several conservationists I spoke with are involved in environmental education programmes for children. In working towards this educational goal, several conservationists have noticed a discrepancy between Dutch children and their classmates of Afro-Caribbean or Latin descent. Levels of environmental awareness seem to be higher among Dutch children. One interviewee suggested that this might be because the environmental movement in the Netherlands is in much later stages than on Curaçao. However, they could not definitively explain the reason for this discrepancy. A more straightforward discrepancy is that between public and private schools. A teacher for Green Kidz – an environmental education programme for children on Curaçao – explained that children in private schools tend to know more about environmental topics, making educational programmes easier to implement (C3). Programmes for public schools require some adaptation, as there is less knowledge to begin with. Whether this reflects a wider societal gap is assumed, but is difficult to confirm, and has not been conclusively studied by the conservationists I interviewed.

In a more practical sense, communication and outreach can also be inhibited by a lack of interest. This can simply be a lack of interest in the topic as is, but it can also be caused by a greater concern for other issues such as health and income, as mentioned in previous sections. One audience interviewee noted that on Curaçao, image matters a lot. According to them, people do things because it is fashionable and Instagram-able, and things like snorkelling are not fashionable (AI30). Additionally, some researchers pointed to colonial ties as a potential challenge. Most of the research being conducted is done by researchers affiliated to Dutch institutions, and findings are often analysed in Dutch labs as well. This can engender a feeling of resentment, as

“they feel a bit like OK, here they come, these people from Europe just to teach us how to do things, when we’ve been here forever, I know how this thing works.” (R6)

However, this was contradicted by a conservationist who has lived on Curaçao their whole life.

“People on Curaçao accept foreigners. So that shouldn’t be an issue. Depending on the attitude of the researchers, people here on Curaçao grew up with plantation owners, but there are plantation owners who intermingled with the local population, they don’t have a problem with that. But the ones who have kept themselves separate from the population and feel superior to the population, those are the kinds of people they tend to have issues with.” (C6) [Translated from Dutch]

“Mensen op Curaçao accepteren buitenlanders. Dus dat zal geen rol spelen. Afhankelijk van de houding van de onderzoeker, mensen hier op Curaçao zijn met plantage-eigenaren opgegroeid, maar er zijn plantage-eigenaren die zich gemengd hebben met de lokale bevolking, daar hebben ze geen problemen mee. Maar degenen die zich hebben afgezonderd van de bevolking en zich verheven voelen boven de bevolking, met dat soort mensen hebben ze meestal problemen.” (C6) [Original]

This indicates that the problem is not so much that the researchers are European, but rather whether or not they conduct themselves with a superior attitude when doing research and communicating findings. The impact of researcher attitude relates not just to communication, but to knowledge co-production as well, and the extent to which locals are willing to participate in this.

Knowledge (Co)production

Among the laypersons I spoke with when conducting my analysis, none seemed to find it an issue that I am a white European. As indicated by the previously quoted conservationist, it is attitude that makes a difference. Several respondents commented that it was a good thing I was conducting research, and asking locals the way I was. Too often, one respondent noted, researchers do not value local knowledge or experience (AII14). The respondent provided examples from their own life, where outside experts had been brought in to conduct research or start a project, only for a local to have to show them around and explain to them how things work. As one environmentalist put it:

“After all, why would you listen to the inhabitants who have lived in this area for hundreds of years? Who live together with nature, use the area to live and not to pollute the way it’s happening now?” (C4) [Translated from Dutch]

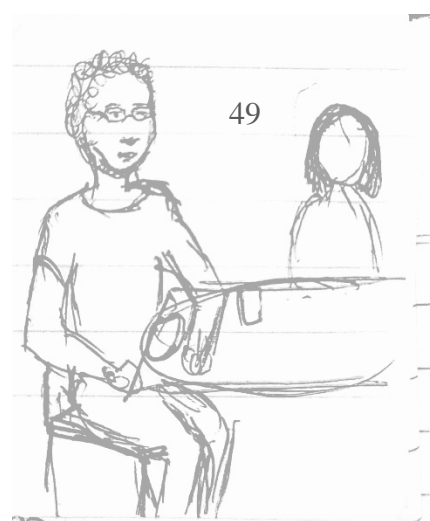
“Waarom zou er ook geluisterd worden naar de bewoners die al honderden jaren wonen in het gebied? Die samen wonen met natuur, het gebied gebruiken om te leven en niet vervuilen zoals dat nu gebeurt?” (C4) [Original]

This does not mean that SEALINK researchers held such dismissive beliefs regarding local knowledge. Many pointed to the importance of local knowledge for their research. One researcher explained that locals may have a lot of knowledge, without having necessarily linked it to science or environmentalism. For example, they may have noticed changes in the reef, but they may not have understood where those changes came from, or what they mean (R2). Not consulting this knowledge base is seen as researchers de-valuing local knowledge and treating locals as less intelligent, as described previously. It certainly does not help that scientists have a less than stellar reputation. According to two conservationists, this is not just a result of actions by researchers themselves, but also because politicians have repeatedly used scientists as scapegoats to maintain their own approval ratings.

“You need to take into account that there’s a lot of political games. And often if something doesn’t go well, scientists are thrown under the bus. It’s easier for people to be against certain science. (...) Then CARMABI is thrown under the bus, and people go along with it. Then they receive the wrong information.” (C5) [Translated from Dutch]

“Je moet er rekening mee houden dat hier veel politiek spel is. En vaak als iets niet goed gaat, worden wetenschappers onder de bus gegooid. Voor mensen is het makkelijker om tegen bepaalde wetenschap te zijn. (...) Dan wordt CARMABI onder de bus gegooid, en mensen gaan daar in mee. Dan krijgen ze de verkeerde informatie” (C5) [Original]

Respondents held a diversity of opinions regarding CARMABI, but the majority had a negative disposition towards the organisation. Some said they do not do enough to maintain nature, and that they restrict



local access to natural areas. The latter is seen as both greedy and insulting, as respondents saw it as a way to make money off of nature, and as a paternalistic endeavour to keep the ‘uneducated’ population out (e.g. C4, AI9). On the other side of the spectrum, some believe that CARMABI does too much to restrict development and other economic opportunities (e.g. AI19). The ones with a neutral or positive attitude toward CARMABI were primarily those that were already following marine research in some way. I happened to speak to a local who went diving frequently, and was involved with an amateur research group of sorts. For the past few years, they had been monitoring coral health and fish stocks around Curaçao. They are not affiliated with any organisation, nor is their research published. However, the person I spoke with stated that they had reached out to CARMABI, to see if there was room for a more formal collaboration, or if CARMABI would be interested in their research. The interviewee stated that CARMABI has not responded or reached out. These attitudes and experiences can present a barrier to knowledge (co)production, as SEALINK is directly affiliated with CARMABI. More generally, locals may be hesitant to engage because previous research has brought little change, as mentioned in the section on audience attitudes.

On a more practical level, technically complex research is often not conducted locally due to a lack of capacity, such as advanced lab equipment. This means that samples gathered through fieldwork in the Dutch Caribbean will end up being analysed in Dutch labs. This spatial fragmentation of the research process also proves a logistical challenge to knowledge co-production, as it is difficult to involve locals in the analysis.

“we do come back here to the Netherlands and we analyse everything here. So it's very hard to kind of engage or do that together because we are in a- we are literally on the other side of the world.” (R6)

Environmental Action

Where barriers to communication and knowledge (co)production primarily considered a local layperson audience, barriers to environmental action were considered more broadly. In part, this is because barriers to action set by one actor are likely to impact another. Layperson respondents also noted a variety of different barriers to action, from a personal to a national scale. One of the identified barriers is that of the ‘struggle for survival’, which has already been discussed previously. One conservationist provided examples of some of the financial burdens



Image 4: On a 1,5 hour dive, the team I was with collected 14,5 kg of waste, which included 91 plastic cups (own photograph, 2022)

associated with environmentally conscious actions, such as waste separation, or even just proper waste collection. They separate three different waste streams at their company, but they cannot afford to expand on this because the costs for renting bins and having them emptied is too high. To further complicate the waste issue, plastic is ubiquitous on Curaçao (Image 2 & 4). The conservationist went on to explain their own struggles in becoming plastic free. Whenever they bring their own cup for drinks, or their own Tupperware for food, it is disregarded, and disposable containers are used anyway (C1). Another interviewee stated that during the pandemic, sales of spear guns for fishing increased. This is despite a ban on their use. The seller explained that this was because

people were trying to fish to survive (C5). Some locals were of the opinion that it was not only a question of money, but also of a ‘lazy mentality’. These respondents indicated that people know very well that actions such as littering are harmful, but that they do it regardless because proper waste disposal would require greater effort (e.g. AI24, AI26, AI27).

There were also several organisational level barriers discussed. One respondent explained that due to the small population of Curaçao, there is no financial capacity for a state-wide, government-organised waste collection programmes (AI12). Another issue is outdated policy, and a simultaneous lack of enforcement of existing policy. Several conservationists and laypersons mentioned that in terms of environmental policy and regulations, Curaçao is behind on neighbouring islands like Aruba and Bonaire (e.g. C5, AI17). However, one conservationist

pointed out that this is not necessarily the greatest cause of problems. Instead, the issue lies more with the lack of enforcement. Even where environmental policy does exist, administrators often choose not to pursue it (C6). Most laypersons I spoke with blamed ‘the government’ at large for the lack of action on Curaçao. Several laypersons stated that the government only took action to clean touristic areas, such as Jan Thiel and Mambo Beach, while other locations are left dirty (e.g. AI8, AI11). This is in line with the commonly uttered sentiment of the government acting out of self-interest and/or economic interest, rather than the interest of the people (e.g. AI9, AI25). Researchers, conservationists and local laypersons alike recognised alternative interests as a barrier to environmental action. For example, a politician may be more concerned with maintaining approval ratings than with creating environmentally sound policy.

Another organisational challenge is that of fragmentation. There are many environmental organisations on Curaçao, and they do work together. There are even some official partnerships between them. Yet one conservationist noted that in reality, collaboration is mostly incidental rather than structural. An example of this that I encountered relates to two organisations that have an official partnership, as listed on both of their websites. One of the board members of Organisation A encouraged me to get in contact with Organisation B. I was given contact information of the chair of Organisation B, and sent a message trying to get in contact. When the message was read but not responded to, the board member of Organisation A stated that the chair may be busy. When I mentioned it to the person helping me with interviews a week later, she stated that the chair was in the Netherlands, and so I may need to contact them via video. Later still, when I spoke with someone from Organisation C, I learned that the contact I had been given was no longer involved with organisation B at all, and had not been for a while. Although this is only one anecdote, it may be indicative of the more informal nature of collaboration. Not everyone I spoke with experienced this as negative, and several people told me that this was simply how it was done on the island. Others noted that this informality leads to a degree of fragmentation that can make it difficult to streamline communication and education strategies. One conservationist noted that it was important that someone act as connector, or “*spider in the web*” to structuralise collaboration (C2).

A variety of barriers to communication, knowledge (co)production and environmental activism were identified, with the latter also discussing audiences beyond local laypersons. Central barriers include the language of communication, a feeling of dismissal regarding local knowledge, and the presence of competing interests in various forms.

4.3.2. Opportunities

Opportunities turned out to be a more difficult component to assess. The potential reasons for this difficulty are examined in the discussion section. One researcher mentioned the existence of neighbourhood groups, which could be a useful platform for knowledge dissemination and engagement (R1). However, one of the conservationists made it clear that there is a large discrepancy in activity between neighbourhood groups (C4). This corroborated observations I had made on Curaçao. In communities like that near Playa Marie Pompoen, inhabitants seem to be quite active, with two residents mentioning beach cleaning initiatives as an example (AI15 & AI16). In contrast, many of the community centres along Westpunt were closed, and some had fallen into disrepair, which could be the result of a less active community group.

In a similarly practical sense, all conservationists I spoke with emphasised the importance of a proper approach by researchers towards local laypersons when trying to engage with them. Foremost among this is that researchers should have a non-judgemental attitude. This relates to the perceived undervaluing of local knowledge.

“you really, you need to respect the audience. You can actually teach, but you need to respect the audience.” (R8)

Similarly, conservationists caution that researchers should not be quick to vilify environmentally harmful behaviour, instead working to understand locals' motives. An example of this is harmful fishing practices. Fishers likely know that the method they employ is harmful, but they may not have any other means of providing for themselves or their family. Vilification or outright criminalisation is also seen as a matter of inequality. Large scale developers and industrial fishing companies appear to be able to act without restrictions, destroying large parts of the reef in the process. A local fisher, meanwhile, might be publicly shamed for catching a shark. Many experience this as a targeted attack fuelled by environmentalists and scientists, with a commonly named actor being CARMABI. This leaves the fishers resistant to interactions with scientists.

“Because people whom you could have won over for nature conservation fall back again because ‘only the little guy has to protect and the rich man is allowed to destroy everything’. I think that’s the most important reason why the little guy obstructs, the inequality he sees around

him. That is something that needs to be solved.” (C6) [Translated from Dutch]

“Want mensen die je over de streep had kunnen halen voor natuurbescherming, vallen weer terug want ‘alleen de kleine man moet beschermen en de rijke man mag alles kapot maken’. Dat is denk ik de belangrijkste reden waarom de kleine man dwarsligt, de ongelijkheid die hij om zich heen ziet. Dat is iets wat opgelost moet worden.” (C6) [Original]

As indicated previously, this may be more a matter of recommendation than a distinct opportunity. However, it does highlight the potential creation of an opportunity. The comparatively simple act of maintaining an open attitude and engaging laypersons in the process of knowledge production or communication can help build trust between producers and the audience. This in turn would increase the likelihood of positive engagement with the community, making it easier to reach communication goals and laying the groundwork for potential environmental action.

Another potential opportunity mentioned by interviewees is that of citizen science. As with the open approach, this is not such the existence of a situational opportunity as it is the possibility to create an opportunity. The potential for citizen science has been mentioned in several prior section, as the implementation of such a project could impact multiple components. For instance, a well-planned citizen science project could work towards streamlining actor collaboration, by having several actors work together toward a clearly identifiable goal, using a pre-determined approach. It could also form a informational source, with participants receiving information through direct engagement with the research process. However, one of the researchers that suggested citizen science as an option did stipulate three requirements for this potential network. First, it must have a purpose. If such an initiative is set up, only to find out that the data collected by participants is not useful, it will simply have been a waste of everyone’s time, which would also sour relationships with local participants. Second, a CS initiative must be feasible within the limits of the project and wider context. Third, people



should be motivated to participate. If no one is interested in engaging with the project, there will be no citizens available to do science.

Further identification of opportunities required more on an in-depth interpretation of the data rather than direct mentioning by participants. For instance, several laypersons mentioned recent occurrences that sparked wider community discussion, but these seemed to be primarily negative. A key example is the discussion surrounding CARMABI management of a nature reserve. Photographs circulated online that suggested that a short period of mismanagement by CARMABI had undone the decades of successful community management that had gone before it (“Vragen Mangrovepark Onbeantwoord”, 2022). These images quickly took root and sparked a wave of criticism against the organisation, accusing it of gatekeeping and fortress conservation. A situation such as this could present an opportunity to shift the debate to the necessities of nature preservation, or the ways in which community members can contribute. Unfortunately, there was insufficient evidence available to indicate that the discussion had been successfully pivoted. Beyond such forms of meta-analysis of acquired data, it was difficult to clearly distinguish situational opportunities as opposed to opportunities that are part of other components. This issue is addressed further in the discussion section.

4.4. Synthesis

Findings from the empirical analysis showed a clear variation in opinions on the different components used in the conceptual approach. Disagreement was not just noted between different sample groups, such as between researchers and local laypersons, but within sample groups as well. This is not to say that these are active disagreements, but rather that participants had different ideas about the producers, audience and situational factors components which require addressing.

Producers

This diversity in ideas already begins at the formulation of project and communication goals. Where some aim only to advance scientific knowledge, others also describe goals of fostering engagement through SC. Yet others fall somewhere in between. The three primary goals identified earlier are knowledge production, communication and engagement, and environmental action. Aside from project goals, respondents also had diverging views in which actors should be involved in fulfilling the three identified project goals.

To start with, researchers had different ideas on which actors should be involved in knowledge production. Some explained that there was not much room for public participation, while others went so far as to suggest the construction of a citizen science network for knowledge co-creation. In between these groups were those that did not see a way to directly

involve the public in the research process, but did see local knowledge as a valuable resource. Most researchers in the latter category mentioned fishers as key source. Amongst local laypersons, participation in research was rarely mentioned outright as an option, although a few did mention that researchers should use local knowledge. The exception to this were individuals that indicated they were already involved in knowledge production in some form. The only group to unanimously agree on the need for public involvement were conservationists. The variation in expected role division among actors as described by researchers and conservationists seem to align with their goals. Researchers who sought mainly to contribute to scientific understanding saw little to no room for public participation. Those that mentioned societal impacts were the ones to suggest use of local knowledge and citizen science. Conservationists described public engagement and education as part of their explicit goals. As such, to them public participation is a requirement.

Such variations can be seen in opinions on target audience as well. Although everyone saw laypersons as an audience to some degree, thoughts varied on how important they are. Differentiations followed a similar line as those on public involvement in knowledge production. Some researchers only mentioned local laypersons as a potential audience for SC after I asked them directly how they saw the role of laypersons. Interestingly, some of the researchers that did not see laypersons as a primary audience seemed to relate this to actor agency as well. These were the ones to state that they did not expect behavioural change. They either implied or stated outright that, after the scientific community, their target for communication would be decision makers, as they are in a position to make policies and should be informed by research when doing so. Those that did see local laypersons as key audience also often did so based on actor agency, explaining that the public has the power to drive change through public pressure and forms of behavioural change. Conservationists were more likely to mention normative rather than instrumental motivations, saying that the general public should be an audience for communication so that they can know their island better. In fact, the motto of Stichting Uniek is “konosé bo isla”, which is Papiamentu for “know your island”. Similarly, Sea Aquarium focuses on local species and education about them, and has separate entrance fees for residents which are far lower than those for tourists. They do all this to encourage local visitors to learn about marine ecosystems around the island. Among local layperson interviewees, views on communication audiences were less explicit, but still present. Several interviewees indicated that science should be communicated with the general public so they know what to do.

In terms of communicators, findings showed that opinions on who should engage in communication also varied. Suggestions included SEALINK as a whole, researchers from WP5, individual researchers, journalists, nature organisations, and the government. Interestingly, although researchers disagreed on who in particular should be communicating, most remained focused on potential communicators within, or directly tied to, SEALINK. Journalists were mentioned by some, with the caveat that researchers should get a say in what is published to avoid misrepresentation. This aligns with one of the barriers Ashwell (2012) found to public SC. The author found that scientists can be reluctant to engage with journalists due to prior bad experiences, such as misrepresentation. Existing nature organisations were not explicitly mentioned as potential communicator by researchers. In contrast, conservationists see themselves as key communicators, not just because of their goals, but because they are already embedded within society, providing a stronger foundation in terms of practical experience and built relationships.

Finally, opinions also differed on who should take environmental action and, in the case of researchers, whether environmental action should be a goal within SEALINK to begin with. Variation runs along the same lines as that for knowledge production and communication. Some believe that decision-makers hold the most responsibility, as they have the ability to drive change. Others say that it is primarily the public that holds responsibility, as the government will do what is popular. Most saw a mixture of roles for a range of actors, including companies and nature organisations. Among local laypersons, some expressed the same sentiment as conservationists regarding knowing your island, saying that this was their island, and therefore they should care for it.

Audience

Among audience members, there were substantial variations in all four sub-components. Despite nearly all audience members having some form of concerns regarding the marine environment, the degree of concern and the form it took varied greatly. Where some were concerned with the directly visible, primarily the waste pollution, others went into depth on the dangers of ocean warming and invasive species. As such, identified informational needs varied greatly. Preferred information sources and formatting also covered a broad spectrum. Use of social media was mentioned frequently, but the newspaper emerged as commonly used source as well.

Situational Factors

Of the barriers and opportunities discussed, not all of them were strictly situational. Nevertheless, it was made apparent that there are a wide range of factors to take into account.

The formulation of barriers in particular can provide a useful guide for communicators when constructing communication strategies in the future.

To summarise, empirical analysis based on a grounded approach to science communication showed notable heterogeneity in all components. What this means both in practice and for the theory is discussed below.

5. DISCUSSION OF RESULTS

5.1. Reflections on a Grounded Approach to Science Communication

This sub-section reflects on the implementation of the empirical analysis and what can be learned from it. The reflection answers SQ3: *Which good practices for a grounded approach to science communication can be derived from an empirical study for SEALINK Curaçao?*

5.1.1. Methodology

From a methodological perspective, the use of the grounded approach to SC provided a clear guideline by which to conduct empirical analysis. An overview of important components and sub-components helped steer participant sampling and the construction of the interview guides and survey. It also worked to structure the results in a coherent manner, allowing for comparison of findings within components and sub-components. The process of empirical analysis also highlighted several methods that could serve as good practice examples for future analyses. Two key insights are discussed below.

Actor Groups

The first of these is the inclusion of stakeholders involved in different parts of the communication process. One aspect of communications that is generally not discussed explicitly is the role of knowledge producers and communicators. In many groundwork studies for SC, only the audience itself is regarded as a subject of research (e.g. Ross, 2013; Easman et al., 2018). Yet as Salmon & Roop (2018) point out, not taking such factors into consideration can lead to inadequate communication strategies.

In the process of my own research, it became clear that an effective strategy could not be constructed without first speaking with knowledge producers and communicators, in addition to an audience analysis. Interviews with researchers and conservationists offered key insights into topics such as the state of research, and the capacity for communication. While audience members did indicate several barriers to communication and conservation, conservationists themselves had a far more in-depth understanding of these barriers based on years of experience. And where audience members named methods of communication they believed would work, these recommendations were greatly supplemented by conservationists and some researchers with prior experience in SC. Researchers mentioned use of local knowledge with the potential for citizen science. Such strategies could have been suggested regardless, but then there would be no clear picture of the capacity for CS, or the willingness to pursue it. Certain pre-existing tensions among knowledge producers and communicators came to light as well. Such tensions were not discussed in this report, as the thesis will be a matter of public record upon submission. Nevertheless, the information is important to the SC process

for SEALINK. Ignorance of existing friction could mean that actions are taken that lead to escalation. Internal dissonance could in turn be to the detriment of outward communication.

Similarly, an empirical analysis reliant on researchers and conservationists without audience input would make results less reliable. Unless conservationists or researchers have conducted an audience study of their own, they cannot always accurately state what attitudes and concerns the audience may hold. As mentioned in the results, interviews with researchers and conservationists left me somewhat pessimistic regarding the awareness of marine environmental issues among laypersons. Yet conversations with laypersons indicated that although levels of awareness may differ between individuals, nearly all respondents had some degree of environmental concern. Answers to follow-up questions suggested that many people are primarily concerned about the issues that they can directly see. The latter is in line with the work of Kolandai-Matchett & Armoudian (2020) who state that one of the challenges in marine science communication is that the marine environment may seem distant to people, making it more difficult for them to relate to it. Without the survey and audience interviews to supplement statements made by researchers and conservationists, this would not have become as clearly apparent. Not interviewing conservationists would have left out a lot of location-specific experience, among other things. And relying on existing project descriptions rather than interviewing researchers would not have shown the differences in goals and target audiences, nor would their knowledge on marine SC have been utilised. Each set of participants made a crucial contribution to the empirical analysis, providing a more holistic understanding of the case. More to the point, it ensured data-rich groundwork for future SC strategies.

Not every SC project will have the exact same actor groups of researchers, conservationists, and audience members. However, these three categories are likely to be present in a broader sense. First, this includes project members, who will be involved in the project to be communicated. Second, there are likely to be practitioners who are involved in something related to the project topic. Third, there will always be an audience for SC, even if the audience may differ between studies. To illustrate this, imagine research is being conducted into the effects of a new diet for Type 1 diabetes patients. Project members would be those conducting research and running trials. Practitioners might be dietitians, or doctors that regularly treat diabetes patients. The audience would be a specific subset of society, namely those living with Type 1 diabetes. In order for the groundwork to be as comprehensive as possible, all three actor groups would need to be consulted. This is not just to enhance the breadth of data collected, but also to improve reliability. By asking different actors questions

related to the same components, comparison of results can confirm or challenge statements made within one group by highlighting supporting or opposing statements within another.

Street Interviews and Participant Observation

The second key methodological good practice involves the manner of audience analysis and related observation. When conducting my audience analysis, I could have chosen to create and send out surveys, and relied solely on those results for the audience component of the grounded approach. Instead, I travelled to Curaçao to conduct audience interviews in person, and to try to immerse myself in the island context. This fieldwork approach yielded a much richer and more in-depth data set than an equal number of surveys would have. For one, I was able to hold conversations with participants, which allowed for more in-depth questioning. This in turn led me to unexpected insights. Not all of these were mentioned in the results section, as it was already quite long, but some of them did lead to discussions with other SEALINK researchers. Furthermore, my exploration of the island, much of it guided by key informants, helped sketch a clearer picture of what life is like on Curaçao, and how this may benefit future communication projects. Not all of these factors were mentioned by conservationists or audience members, likely because they seem so normal to locals and thus not worth mentioning. An example of this is the importance of communal spaces. Even complete strangers can strike up a conversation and interact in communal spaces, such as at a food court or on the beach. Being present in these spaces could prove a good opportunity to engage someone on the topic of the marine environment. Conversations in the field also made it clear that many people are eager to share their opinion once asked. One respondent began an impassioned explanation on biodiversity loss on the island without much prompting. They explained that they were not an expert, but that their father loved the outdoors in his day, and that he taught them everything he knew. Such details would not have emerged had the case study relied on survey responses alone. SC projects may not always have the capacity to conduct fieldwork in such a way, but even a few days in the field would go a long way to enriching audience and situational understanding.

5.1.2. Applicability of Results

The results of the comparison illustrated the practical use of a grounded approach as it relates to SEALINK. It highlighted that opinions differed regarding the project and the communication thereof. This shows the need for coordination within the project, to ensure a coherent communication strategy. It also became clear that there are a variety of actors that could play a role in knowledge creation, communication, and potential environmental action. Such a diversity of actors require a coordinating actor in order to ensure a coherent strategy. Whether this role would be filled by an individual or an organisation, and who that individual

or organisation should be, calls for further research and discussion between actors. Additionally, findings showed that there are a variety of attitudes and concerns regarding marine issues, and large discrepancies in the degree of awareness and knowledge of related topics. This indicated the need for a varied approach to SC in the SEALINK case. Respondents also gave preference to different sources and format of communication. Some suggested that sources such as the newspaper and television would be effective sources through which to reach older segments of the population, while social media would be better suited to younger groups. Unfortunately, the sample size was not large enough to confirm whether this statement is true. Finally, enquiry into situational factors uncovered a number of barriers to SC, as well as a few opportunities. Listing the barriers in such a way forms a useful list of ‘points of attention’ that communicators should take into account when designing communication strategies. The depth of findings highlights the heterogeneous nature inherent to the communication process, further illustrating the need for a grounded approach.

Eco-Powerlessness

One of the identified barriers that seems to be particular to the layperson audience is the feeling of powerlessness many respondents identified. This was linked to government inaction, as well as a ‘struggle for survival’. The latter point refers to the feeling of powerlessness that many local laypersons expressed, as well as the idea of a ‘struggle for survival’ that was mentioned by interviewees in all groups. Kennedy & Givens (2019) found that people of a lower social class are indeed more likely to feel powerless, while people of a higher social class see being sustainable as good and achievable. They refer to the former groups as “eco-powerless”, and the latter “eco-habitus”. The “eco-powerless” are not necessarily uncaring in the face of environmental crises, but feel marginalized and threatened both by the environmental issues at play and government or other efforts to address them. One of the identified concerns is the idea that decision makers and environmental activists focus on environmental issues without paying heed to the social impacts of the issue and their subsequent actions. Perhaps this is part of the reason that ‘environmental activist’ is considered an undesirable thing on Curaçao, but this is speculation. According to Kennedy & Givens, the reason those in lower social classes experience eco-powerlessness is because “green consumption” is seen as the gold standard for environmentalism. This means that those who are not able to afford the more expensive “eco-friendly” options may feel as if they cannot contribute. In this vein, Easman et al. (2018) suggest that actions should fit into people’s daily routine and lifestyle, with no negative financial impacts. When it comes to marine science and conservation, members of the public may also feel a sense of powerlessness because marine

ecosystems are highly complex and interwoven, distant to those who do not swim and dive, and full of unfamiliar biota (Kolandai-Matchett & Armoudian, 2020). The issue of distance was observed in this case study as well, where those in the city and those that did not swim or dive seemed to be less aware of life under the sea, focusing instead on the more visible forms of waste pollution. For these reasons, it would be useful to provide practical recommendations for actions that laypersons can take. This informational need was one that was identified by individuals in all actor groups.

5.2. The Question of Informational Needs and Opportunities

This sub-section discusses the approach itself, and the theoretical implications of empirical analysis, answering SQ4: *What theoretical recommendations can be made based on the findings of the empirical case study?* Instead of recapping the entire grounded approach, attention is given to the aspects I recommend should be altered based on my findings over the course of this research.

There were two components in the framework where the findings were not as clearly identifiable, namely those of informational needs and opportunities. Although a number of informational needs were suggested by researchers, conservationists and laypersons, the content was somewhat limited. In retrospect, the reasons for this seem apparent. On the producer side, research is still in early stages, and it is difficult to indicate which knowledge may emerge. This makes it difficult to suppose which parts of the findings may be most relevant to communicate. Similarly, conservationists are not deeply familiar with the project, and do not know what its results will be. As such, both can only suggest that a layperson audience is likely to prefer practical and directly applicable information. Audience interviews and survey results confirmed that most laypersons do indeed want to receive practical information, showing them which direct actions they can take. In terms of content, informational needs are far more diverse. This was not concluded based on audience statements about preferred content; after all, it is difficult to ask for something they do not currently know. Instead, this observation is based on the divergence in awareness and knowledge about topics related to the marine environment. Where some did not know much more than that the beaches are polluted, others were engaged in their own amateur research group. This indicates that some people may require considerable background information, while others might be looking for more in-depth knowledge. Despite the brevity of findings regarding informational needs, this section provides valuable insights. Firstly, it highlights the need for practical knowledge. This is in line with findings by Jacobs et al. (2015), who recommend that informational campaigns should include concrete possible actions. When messages focus on raising awareness and concern without addressing practical

options, the communications effort becomes ineffective, because individuals are less likely to feel as if they can make a difference. Second, it became clear that content-wise informational needs are diverse. In this regard, Rogers (2000) cautions against assumed knowledge. Not everyone has the same degree of background knowledge, and this should be taken into account when designing communication content. Both are important matters for consideration when moving to the next step in the communication process. As such, it does not seem necessary to alter this sub-component. More research is required to assess whether the lack of findings is a matter of approach, or a result of the newness of the SEALINK project.

Another component that presented some analytical difficulty was that of opportunities for SC, although the difficulties were somewhat different from those encountered with the informational needs component. Many suggested opportunities were not situational, but rather recommendations related to other components. Few situational opportunities were identified. Multiple implications can be derived from this absence. The most straightforward explanation is that no clear situational opportunities were identified because there are none present. Yet considering the multitude of contextual factors that are or could be influencing marine conservation and communication thereof, this seems unlikely. It is also unlikely that none of the interviewees held relevant knowledge. Therefore, it must be concluded that the issue lies with the conceptual approach, methodology, analysis, or a combination thereof. The conceptual approach described the opportunities sub-components as “opportunities for communication as identified by project members, practitioners, and audience members”. Based on the literature, opportunities for communication were defined as situational factors that facilitate science communication, such as focusing events, technological advancements or political shifts (Jones et al., 2019; Gottschling & Kramer, 2020). These are notably large shifts, which would certainly stand out. Yet the more subtle changes and resulting opportunities are not clearly mentioned. Subtle changes may also be more difficult to observe, as the resulting opportunity is not always obvious. This has methodological implications as well. The empirical design derived from the conceptual approach included asking researchers, practitioners and audience members directly about opportunities for science communication. Of those that could provide an answer, most responded with practical factors such as the use of certain sources or formats. Recognizing less obvious opportunities might require respondents to first identify situations that could be utilised to create opportunities. This requires an extra analytical step, which would require either a longer period for consideration or more specific questions. An example of a more specific question would be: “Consider situation A. Do you see any opportunities for SC arising from this situation? Could you elaborate on your answer?”. However, this could be considered a

leading question, as it already presents situational factors for respondents to assess. This brings us finally to the analytical implications of the opportunities sub-component. Establishing relevant opportunities may be a matter of ‘reading between the lines’, in the sense that answers to other questions could indicate underlying opportunities. This is how the conversation starter regarding CARMABI was identified. It was not mentioned explicitly as being an opportunity, but the fact that several respondents broached this topic signifies that it was a window through which a debate could be had. Yet such a form of analysis raises further complications. Without clear indicators or direct answers, classification of opportunities is largely left up to the discretion of the researcher. In cases where there is only one researcher, such as for this project, could negatively influence the reliability of results. A possible way to address this would be to involve other researchers, so that findings can be discussed and verified. However, this may not always be possible due to limited capacity or other extenuating circumstances. What empirical analysis has made clear, is that the opportunities sub-component needs to be re-considered and developed further in any future iteration of this approach. Identifying opportunities could prove crucial to a successful SC strategy. But without clarification of the approach, along with the resulting methodology and analysis, results are likely to be incomplete and minimally reliable.

As a whole, the grounded approach to science communication yielded a considerable amount of relevant data which can be used by future communicators for the SEALINK project. In terms of broader application, the theoretical basis in SC literature indicates that it can be more widely applied. Empirical analysis did not contradict this notion. However, it was noted that the sub-category of opportunities would need to be reconsidered before conducting further research. Although the sub-component of informational needs did not yield the same quantity of results as other sub-components, the data was nevertheless important to the overall findings. Further case studies would need to test whether the low quantity of results is to do with the approach, the nature of the sub-component, or the nature of the SEALINK case in particular.

5.3. Limitations in Practice

As with any research project, this one faced a number of limitations. The issue that posed the biggest challenge in practice was the language barrier. Although many Curaçaoans do speak Dutch and English, the most common language is Papiamentu. This made it difficult for me to consult sources such as local newspapers. It also meant that I had to rely on someone to help translate during street interviews. I was fortunate enough to receive support of this kind from Fanny Alberto, but it did limit the amount of interviews I could conduct as I had to account for her schedule as well. Additionally, I was limited in terms of scale. This research was conducted in partial fulfilment of my master’s degree. Accordingly, research was primarily

conducted by myself within a six month timespan. This includes the research design and set-up. There were also no funds available for expenses such as postal surveys or flyers. Hence the scale of research remained relatively small. This rules out generalization of findings, as the sample was simply too small. There were also areas that I could not visit either because I had no reliable means of transportation, or because I was advised that entering these areas alone was too dangerous, especially as a woman. This does not render the collected data meaningless. However, it does highlight the need for continued research among a greater portion of the population. Unfortunately, funding for such research is scarce. Nevertheless, if ever there arises an opportunity, expanded social research on Curaçao and the wider Dutch Caribbean region, both qualitative and quantitative, could prove a useful resource for future research and policy making in the area.

The last key limitation relates to sources of information. CARMABI has been mentioned throughout this thesis, both for its role in SEALINK and its regular activities on the island. Unfortunately, I was not able to consult with them. The one interview I did have planned was cut short, and left me disinclined to follow up. When I later enquired whether I would be able to reside on the facility's premises in the hopes of making contacts there, I did not receive a reply, as the email went to the same person I had failed to interview. Once on Curaçao, I did happen to meet a member of CARMABI at a supermarket food court, but at the time I did not feel comfortable asking for an interview. Despite its contentious reputation among the local population, CARMABI remains a key organisation for conservation, education, and communication. They will need to be consulted going forward, especially if a form of citizen science is to be set up.

6. CONCLUSION

The research conducted for this thesis aimed to synthesise existing literature on groundwork for science communication to compose a coherent grounded approach. The three main components to a grounded approach identified were *producers*, *audience*, and *situational factors*. The approach provided a coherent framework based on which a methodology for an empirical analysis was constructed. SEALINK was chosen as a case study, due to the novelty of both the project and the execution of grounded science communication research in the area. This provided ample opportunity to conduct analysis, increasing the potential for methodological and theoretical learning. An overview of learning outcomes and recommendations for future research can be found in Table 2 below.

Table 2: Overview of learning outcomes and recommendations for future research

Learning and recommendations	
Good Practice	Involving multiple actor categories in empirical analysis
	Conducting street interviews and a form of participant observation
Theoretical Learning	Further analysis is necessary of the 'informational needs' sub-component
	Reconsideration is necessary of both the theoretical definition and operationalization of the 'opportunities' sub-component
Future Research	Further study into the 'opportunities' sub-component
	Application for different audiences
	Actor network analysis
	Linking the grounded approach to the rest of the SC process through empirical analysis

Methodologically, the main findings were the value of involving multiple actor categories, and in conducting street interviews and a form of participant observation. Engaging members from multiple actor categories – in this case researchers, conservationists, and local laypersons – enhances the breadth of findings by relying on the knowledge of people with a range of experiences in different parts of the project topic. Additionally, cross-comparison can improve reliability of results. Conducting street interviews and a form of participant observation can further enrich results by providing a better understanding not just of the audience, but the context in which they find themselves. In terms of theoretical implications, the grounded approach seemed to be a suitable framework, providing relevant information for SEALINK. However, the 'opportunities' sub-component does require theoretical and methodological reconsideration. This is then also a recommendation for future research. Future research should

also expand on empirical analysis by applying the grounded approach to studying not just different communication contexts as a whole, but different audiences as well. An assumption has been made that the grounded approach will be applicable to different audiences, but further research will need to prove whether this is the case. Additionally, it may be beneficial to expand of the ‘actor’ sub-component and study actor networks. A network analysis would provide an overview of informational networks, which could be used in later communication strategies. It is not suggested that network analysis is added as a sub-component, as this would broaden the scope of analysis too far. However, studying the possibilities offered by network analysis could provide valuable insights for further development of the actor sub-category. Finally, it is recommended that empirical analysis be conducted to illustrate the ways in which knowledge gained from the grounded approach can be applied when constructing a communication strategy. This would serve to further link the grounded approach to the following steps in the science communication process.

As the products of science subjects of scientific research continue to shape our lives, it is becoming increasingly important that audiences understand the issues at hand, and how to act accordingly. This seems especially true in cases related to the environment, such as climate change or coral reef degradation. To ensure that knowledge on these topics is communicated clearly and effectively, communicators must understand the context in which they intent to communicate, rooting strategies firmly in empirically derived groundwork.

REFERENCES

- Achterberg, P., De Koster, W., & Van der Waal, J. (2017). A science confidence gap: Education, trust in scientific methods, and trust in scientific institutions in the United States, 2014. *Public Understanding of Science*, 26(6), 704-720.
- Anthony, K., Bay, L. K., Costanza, R., Finn, J., Gunn, J., Harrison, P., ... & Walshe, T. (2017). New interventions are needed to save coral reefs. *Nature ecology & evolution*, 1(10), 1420-1422.
- Ashwell, D. (2012). Barriers to the public communication of science: Commercial constraints versus public understanding. *PRism*, 9(1), 1-11.
- Bindoff, N.L., W.W.L. Cheung, J.G. Kairo, J. Arístegui, V.A. Guinder, R. Hallberg, N. Hilmi, N. Jiao, M.S. Karim, L. Levin, S. O'Donoghue, S.R. Purca Cuicapusa, B. Rinkevich, T. Suga, A. Tagliabue, and P. Williamson, 2019: Changing Ocean, Marine Ecosystems, and Dependent Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 447-587. <https://doi.org/10.1017/9781009157964.007>.
- Birkeland, C. (2015). Coral reefs in the Anthropocene. In *Coral reefs in the Anthropocene* (pp. 1-15). Springer, Dordrecht.
- Bonfadelli, H., Fähnrich, B., Lüthje, C., Milde, J., Rhombert, M., & Schäfer, M. S. (2017). Das Forschungsfeld Wissenschaftskommunikation. In *Forschungsfeld Wissenschaftskommunikation* (pp. 3-14). Springer VS, Wiesbaden.
- Bruine de Bruin, W., & Bostrom, A. (2013). Assessing what to address in science communication. *Proceedings of the National Academy of Sciences*, 110(supplement_3), 14062-14068.
- Bryman, A., Clark, T., Foster, L., & Sloan, L. (2021). *Bryman's Social Research Methods*. Sixth ed. Oxford University Press.
- Bucchi, M., & Trench, B. (Eds.). (2014). *Routledge handbook of public communication of science and technology* (p. 274). New York: Routledge.
- Bullock, O. M., Colón Amill, D., Shulman, H. C., & Dixon, G. N. (2019). Jargon as a barrier to effective science communication: Evidence from metacognition. *Public Understanding of Science*, 28(7), 845-853.
- Cormick, C. (2019). Who doesn't love a good story?—What neuroscience tells about how we respond to narratives. *Journal of Science Communication*, 18(5), Y01.
- Davies, S. R., & Horst, M. (2016). *Science communication: Culture, identity and citizenship*. Springer.
- De Clippele, L., Michelotti, M., Findlay, C. R., Cartwright, A., Fang, Q., Wheatley, C., ... & De Meyer, K. (2021). The Future of Our Seas: Marine scientists and creative professionals collaborate for science communication. *Research for All*, 5(1).
- Dean, J., Furness, P., Verrier, D., Lennon, H., Bennett, C., & Spencer, S. (2018). Desert island data: an investigation into researcher positionality. *Qualitative Research*, 18(3), 273-289.
- Dillard, J. (2022, February 16). Does scaring people work when it comes to health messaging? A communication researcher explains how it's gone wrong during the COVID-19 pandemic. *The Conversation*. Retrieved September 26, 2022, from <https://theconversation.com/does-scaring-people-work-when-it-comes-to-health-messaging-a-communication-researcher-explains-how-its-gone-wrong-during-the-covid-19-pandemic-174287>

- Easman, E. S., Abernethy, K. E., & Godley, B. J. (2018). Assessing public awareness of marine environmental threats and conservation efforts. *Marine Policy*, 87, 234-240.
- Eddy, T. D., Lam, V. W., Reygondeau, G., Cisneros-Montemayor, A. M., Greer, K., Palomares, M. L. D., ... & Cheung, W. W. (2021). Global decline in capacity of coral reefs to provide ecosystem services. *One Earth*, 4(9), 1278-1285.
- Fischhoff, B. (2013). The sciences of science communication. *Proceedings of the National Academy of Sciences*, 110(supplement_3), 14033-14039.
- Fischhoff, B., & Scheufele, D. A. (2013). The science of science communication. *Proceedings of the National Academy of Sciences*, 110(supplement_3), 14031-14032.
- Friesen, J., Van Stan, J. T., & Elleuche, S. (2018). Communicating science through comics: a method. *Publications*, 6(3), 38.
- Gelcich, S., Buckley, P., Pinnegar, J. K., Chilvers, J., Lorenzoni, I., Terry, G., ... & Duarte, C. M. (2014). Public awareness, concerns, and priorities about anthropogenic impacts on marine environments. *Proceedings of the National Academy of Sciences*, 111(42), 15042-15047.
- Gottschling, M., & Kramer, O. (2020). Recontextualized Knowledge. In *Recontextualized Knowledge* (pp. 1-14). De Gruyter.
- Grorud-Colvert, K., Lester, S. E., Airamé, S., Neeley, E., & Gaines, S. D. (2010). Communicating marine reserve science to diverse audiences. *Proceedings of the National Academy of Sciences*, 107(43), 18306-18311.
- Gunn, C. M., Amerson, A. M., Adkisson, K. L., & Haxel, J. H. (2022). A Framework for Effective Science Communication and Outreach Strategies and Dissemination of Research Findings for Marine Energy Projects. *Journal of Marine Science and Engineering*, 10(2), 130.
- Jacobs, S., Sioen, I., De Henauw, S., Rosseel, Y., Calis, T., Tediosi, A., ... & Verbeke, W. (2015). Marine environmental contamination: public awareness, concern and perceived effectiveness in five European countries. *Environmental Research*, 143, 4-10.
- Jefferson, R., McKinley, E., Capstick, S., Fletcher, S., Griffin, H., & Milanese, M. (2015). Understanding audiences: making public perceptions research matter to marine conservation. *Ocean & Coastal Management*, 115, 61-70.
- Jensen, K. B., & Rosengren, K. E. (1990). Five traditions in search of the audience. *European journal of communication*, 5(2), 207-238. (Gottschling & Kramer, 2020).
- Jones, J. G., & Simons, H. W. (2017). *Persuasion in society*. Routledge.
- Jones, R., Colusso, L., Reinecke, K., & Hsieh, G. (2019, May). r/science: Challenges and opportunities in online science communication. In *Proceedings of the 2019 CHI conference on human factors in computing systems* (pp. 1-14).
- Josephson, S., Kelly, J., & Smith, K. (Eds.). (2020). *Handbook of visual communication: Theory, methods, and media*. Routledge.
- Kennedy, E. H., & Givens, J. E. (2019). Eco-habitus or eco-powerlessness? Examining environmental concern across social class. *Sociological Perspectives*, 62(5), 646-667.
- Kiley, H. M., Ainsworth, G. B., van Dongen, W. F., & Weston, M. A. (2017). Variation in public perceptions and attitudes towards terrestrial ecosystems. *Science of the Total Environment*, 590, 440-451.
- Kolandai-Matchett, K., & Armoudian, M. (2020). Message framing strategies for effective marine conservation communication. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 30(12), 2441-2463.
- Kouper, I. (2010). Science blogs and public engagement with science: Practices, challenges, and opportunities. *Journal of science communication*, 9(1), A02.

- Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. sage.
- Lewenstein, B. V. (2003). Models of public communication of science and technology.
- Maibach, E., Roser-Renouf, C., & Leiserowitz, A. (2009). Global warming's six Americas 2009: An audience segmentation analysis.
- Metag, J., & Schäfer, M. S. (2018). Audience segments in environmental and science communication: Recent findings and future perspectives. *Environmental Communication*, 12(8), 995-1004.
- Mumby, P. J., Flower, J., Chollett, I., Box, S. J., Bozec, Y. M., Fitzsimmons, C., Forster, J., David Gill, Griffith-Mumby, R., Oxenford, H. A., Peterson, A. M., Stead, S. M., Turner, R. A., Townsley, P., van Beukering, P. J. H., Booker, F., Brocke, H. J., Cabanillas-Teran, N., Canty, S. W. J., Carricart-Ganivet, J. P., Charlery, J., Dryden, C., van Duyl, F. C., Enriquez, S., den Haan, J., Iglesias-Prieto, R., Kennedy, E. V., Mahon, R., Mueller, B., Newman, S.P., Nugues, M. M., Cortés Núñez, J., urse, L., Osinga, R., Paris, C. B., Petersen, D., Polunin, N. V. C., Sánchez, C., Schep, S., Stevens, J. R., Vallès, H., Vermeij, M. J. A., Visser, P. M., Whittingham, E., & Williams, S. M. (2014) *Towards Reef Resilience and Sustainable Livelihoods: A handbook for Caribbean coral reef managers*. University of Exeter, Exeter. 172 pages
- Nisbet, M. C., & Scheufele, D. A. (2009). What's next for science communication? Promising directions and lingering distractions. *American journal of botany*, 96(10), 1767-1778.
- Peters, H. P. (2013). Gap between science and media revisited: Scientists as public communicators. *Proceedings of the National Academy of Sciences*, 110(supplement_3), 14102-14109.
- Rivas, C. (2012). Coding and analysing qualitative data. *Researching society and culture*, 3(2012), 367-392.
- Rogers, C. L. (2000). Making the audience a key participant in the science communication process. *Science and engineering ethics*, 6(4), 553-557.
- Ross, D. G. (2013). Deep audience analysis: A proposed method for analyzing audiences for environment-related communication. *Technical Communication*, 60(2), 94-117.
- Rowley, J. (2012). Conducting research interviews. *Management research review*.
- Salmon, R. A., & Roop, H. A. (2019). Bridging the gap between science communication practice and theory: Reflecting on a decade of practitioner experience using polar outreach case studies to develop a new framework for public engagement design. *Polar Record*, 55(4), 297-310.
- Tonin, S., & Lucaroni, G. (2017). Understanding social knowledge, attitudes and perceptions towards marine biodiversity: The case of tegnùe in Italy. *Ocean & coastal management*, 140, 68-78.
- Trench, B. (2008). Towards an analytical framework of science communication models. *Communicating science in social contexts*, 119-135. McQuail (1997)
- Vermeij, M. (2021). The SEALINK Project. <https://www.sealinkcaribbean.net/>
- Verschuren, P., Doorewaard, H., & Mellion, M. (2010). *Designing a research project* (Vol. 2). The Hague: Eleven International Publishing.
- Wilson, M. J., Ramey, T. L., Donaldson, M. R., Germain, R. R., & Perkin, E. K. (2016). Communicating science: Sending the right message to the right audience. *Facets*, 1(1), 127-137.
- Wyss, R., Rubega, M., & Capers, R. (2021, April 7). Scientists need to become better communicators, but it's hard to measure whether training works. *The Conversation*. Retrieved September 26, 2022, from <https://theconversation.com/scientists-need-to-become-better-communicators-but-its-hard-to-measure-whether-training-works-154628>

- Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5). sage.
- Zorn, T. E., Roper, J., Weaver, C. K., & Rigby, C. (2012). Influence in science dialogue: Individual attitude changes as a result of dialogue between laypersons and scientists. *Public Understanding of Science*, 21(7), 848-864.

APPENDIX A

Translations of the interview guides are available in Dutch, and translations of the survey are available in Dutch, Spanish and Papiamentu. These can be provided upon request

Interview Guide Researchers [English]

Research

How would you describe the goal of your research?

For what reason should your research and its results be communicated?

To whom should your research be communicated?

Why is it important that [they] hear about your research?

How should your research be used?

Audience

What place do local laypersons have in your research/SEALINK in general?

How do you see the relationship between local laypersons of Curaçao and (marine) science?

What parts of your research do you find most important to communicate?

What parts of your research do you believe to be most important to your target audience?

What parts of your research do you believe to be most important to local laypersons?

In which forms can the relevant parts be most effectively communicated to your target audience?

In which forms can the relevant parts be most effectively communicated to local laypersons?

Barriers

What do you think the main challenges are/will be when communicating SEALINK research and results?

How do you think we could address these challenges?

What opportunities do you see for communicating SEALINK findings?

Interview Guide Conservationists [English]

Producers

What kind of work do you do (related to conservation)?

Are you familiar with SEALINK?

If yes, could you describe the project to me?

What would you like to see SEALINK do?

In your opinion, when will the project be a success?

Who do you think the project should be communicated to?

How do you view the role of local laypersons in conservation efforts?

What do you think motivates local laypersons to participate in conservation efforts?

Audience

What attitude do local laypersons have toward marine science and conservation?

How do you view the relationship between (marine) science and local laypersons?

If necessary, how do you think this relationship can be improved?

Do you engage in communication toward local laypersons?

If yes, what form does this take?

What type of information do laypersons need?

What sources do local laypersons consult?

Which forms would be most successful in communicating SEALINK findings?

What recommendations would you make for a science communication project such as SEALINK?

Situational Factors

What barriers do you see to science communication and conservation?

How do you think these barriers should be addressed

What opportunities do you see for advancing engagement with marine conservation science?

Audience Analysis Survey [English]

Introduction

Thank you for taking part in this questionnaire. Your answers contribute to my research on the population of Curaçao as audience for marine science. I'm doing this as part of my master's thesis.

Results from the first part of this survey will be used to understand how people on Curaçao think about certain marine-related topics. Results from the second part of this survey will indicate what type of information sources and formats people prefer. Finally, results from the last part of this survey will serve as comparison to see if attitudes and media usage differ based on certain demographic categories (here: age, education, employment) or whether the difference is random. The last part will help determine whether the data collected from this survey would be generalizable to a larger population or not.

Your participation is fully anonymous.

By continuing to the next section, you acknowledge that you have read this information, and you consent to the use of your response in my research.

Word association

The first few questions will be word association. Please fill in the first word or phrase that comes to mind when you see the given word.

Curaçao
Ocean
Coral reef
Conservation

Opinion questions

The following section contains questions about your opinion on certain topics. The questions will be in the form of statements, and you will be given the opportunity to answer on a scale ranging from "strongly disagree" to "strongly agree". Following each statement, you will be asked to briefly elaborate on your ranking.

I am concerned about the marine environment.

Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree

Could you briefly explain why?

I am NOT concerned about the state of coral reefs.

Strongly Agree
Agree
Neutral

Disagree
Strongly Disagree

Could you briefly explain why?

I find conservation of marine ecosystems important.

Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree

Could you briefly explain why?

I do NOT see myself as an environmental activist.

Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree

Could you briefly explain why?

I see myself as an active part of the scientific process.

Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree

Could you briefly explain why?

I would like to be (more) involved in the scientific process.

Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree

Could you briefly explain why, and if you answered in agreement, how?

Informational questions

The following questions relate to your preferred sources of information.

I consult scientific data before making decisions related to the marine environment.

Always
Sometimes
Never

Could you briefly elaborate on your previous answer?

Whose input do you value most when shaping your own opinion on (marine) science topics?

What sources do you get your news from?

Newspaper
Television
Radio
Social Media
Word of Mouth
News websites
Other, namely...

General information

The following section includes general questions.

How old are you?

18-25
26-35
36-45
46-55
56-65
65+
I'd rather not say

What levels of education have you completed?

Primary school
Secondary school/high school
Vocational training
Bachelor's degree
Master's degree
PhD
I'd rather not say

What sector do you work in?

Tourism
Childcare

Healthcare

Education

Fishery

Legal

Government

Construction

Sanitation

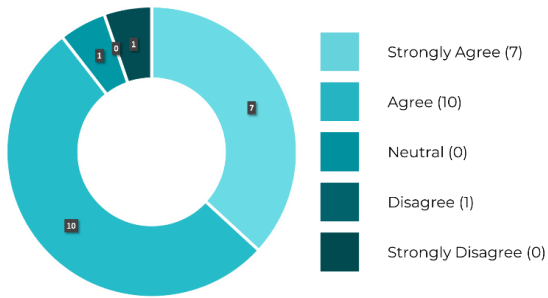
Student

I don't have a job at the moment

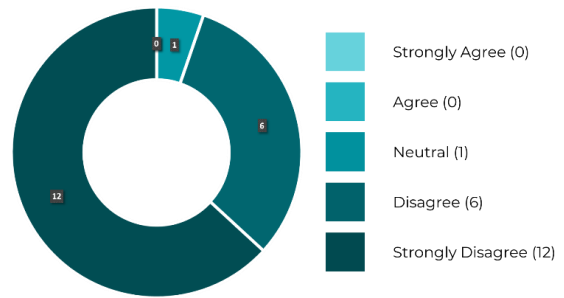
I'd rather not say

APPENDIX B

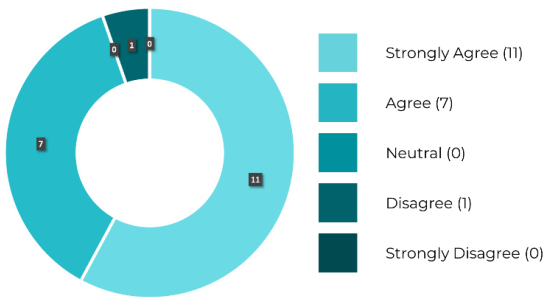
Survey Results



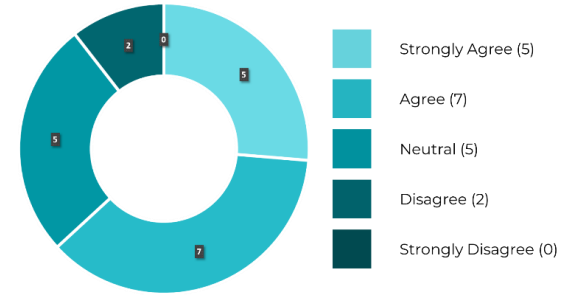
1. I am concerned about the state of the marine environment



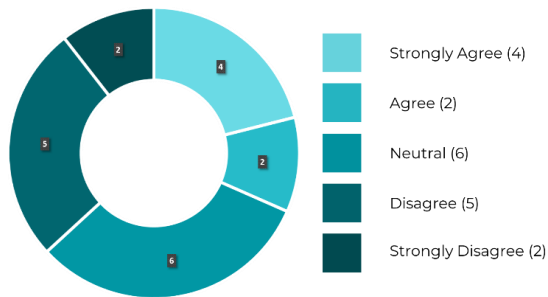
2. I am NOT concerned about the state of coral reefs



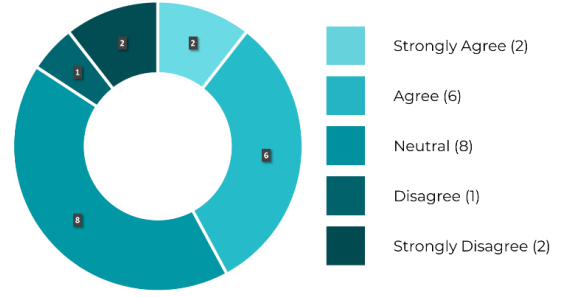
3. I find conservation of marine ecosystems important



4. I do NOT see myself as an environmental activist



5. I see myself as an active part of the scientific process



6. I would like to be (more) involved in the scientific process

Figure 3: Responses to survey statements