



**PROMISES, POLITICS AND LIMITATIONS
OF CITIZEN SCIENCE ON THE DUTCH
ISLAND OF TEXEL**

Master thesis Cultural Anthropology:
Sustainable Citizenship

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> Cover Photo of Texel beach taken by Aleysha Korver

Abstract

In this thesis I explore a citizen science initiative on the Dutch island of Texel, this through participant observations and semi-structured interviews. I contribute to the academic debates around science and expertise, knowledge, and democratic participation. I argue that participants of the Strandwerkgemeenschap (SWG) both recognize and contest the three promises of citizen science: the democratization of science, increasing scientific literacy among the public, and citizens contributing to scientific breakthroughs. Moreover, I argue that citizen science challenges the common understanding of expertise. Where both the scientists and non-scientists are viewed as experts. However, the dichotomy between scientists and non-scientists which still persists is not perceived as an issue by the SWG participants. Additionally, I argue that the motivation for participating in citizen science are not only to contribute to gathering data but include: the desire to build and maintain a network, gain knowledge about the coastal flora and fauna, being outdoors, social connections, and contributing to both society and nature. Finally, I argue that the lack of diversity and inclusivity of people of color are barriers to democratic participation in citizen science in the Netherlands.

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Introduction

In the midst of our beach wash up monitoring walk along the coast of Texel, Melissa crouched down and closely examined an intriguing organism she had stumbled upon. With a careful hand, she picked it up, inspecting its intricate details. Sensing her excitement, our group gathered around, eager to witness her discovery. Melissa, with her limited knowledge on the flora and fauna of the Dutch coast, turned to Dirk (scientist at the Royal Netherlands Institute for Sea Research) and Peter (non-scientist volunteer at Strandwerkmeenschap), seeking their expertise to unravel the mystery of her find. Could it be the Common Swimming Crab, the Gray Swimming Crab, or the Shore Crab? It was hard to see the difference since the crab carcass was not complete, but Dirk could tell that it was a Common Swimming Crab by its specific features such as color and head shape. Every 10 meters or so, this would repeat, with one of us finding something that had been washed up on the beach (such as shells, algae, jellyfish, sea anemones, crabs, moss animals or egg cases of sharks and rays) and the rest of the group gathering around to see what it was, discussing its details and significance. Monitoring the coast is part of the Beach Wash Up Monitoring Project by ANEMOON Foundation carried out by the *strandwachters* (beach guards), also known as the *strandwerkmeenschap* (beach work community) (SWG). The SWG members walk a predetermined route along the beach at low tide on a biweekly basis. Along this route they record all stranded organisms or their remains. The observed numbers are then noted on a PDF form or digitally in an Excel sheet after the beach walk. Thereby aiding in increasing the knowledge about the population changes of the species living near the coast (ANEMOON 2023).

As the world is currently experiencing a massive loss of biodiversity, nature conservation requires innovative ways to combat this. Many believe citizen science, such as the beach wash up monitoring discussed above, holds the key. Citizen science may entail the collaboration between

academic professionals and non-professional volunteers, who can help scientists to collect data through observing, monitoring, and recording of the environment. Academic research and international, national, and local policies can use citizen scientists' data (Bonney 2021). There are a variety of names for citizen science, including participatory science, community science, civic science, amateur science, crowdsourced science, volunteer monitoring, community-based monitoring, community-based participatory research, community-engaged research, community-owned and managed research, open science, and street science (Cooper et al. 2021). This broad categorization illustrates the divergence, diversity, complexity, and plurality of the practices of citizen science. Although the definition and history of these terms do not exactly overlap, they refer to practices aimed at including non-professionals in scientific practices (Strasser et al. 2019, 54).

Advocating the bidirectional flow of knowledge between citizens and scientists: citizens contribute their acquired data and knowledge on their environments to scientists, and in turn citizens gain knowledge on different scientific practices and disciplines. In this way, citizen science can be seen as a bridge connecting citizens/communities and scientists/science. Connecting science and the public would mean encouraging non-academic professionals to actively participate in scientific research (Bonney et al. 2015), instead of science as a discipline being exclusive and inaccessible to the public (Strasser et al. 2019). This shift challenges the traditional notion that only scientists have the authority and responsibility to determine research topics, methods, and practices. By actively participating in scientific research, citizen scientists challenge conventional notions of expertise and hierarchical structures in scientific knowledge creation.

The input from citizen science activities like these is of great importance to the policymaking of the European Union's (EU) conservation and nature plans, as well as environmental policy in the Netherlands. Approximately 95% of the Dutch reports on plants and animals for the EU uses data from voluntary observers (Breman, van Vliet, and Vullings 2017). Additionally, citizen science has economic worth, as without the help of citizen science observations on species in the Netherlands, it would be ten times more expensive than if it would have to be done by paid professionals or consultancies in the Netherlands (Breman, van Vliet, and Vullings 2017). Furthermore, if academic professionals were to take over all that what citizen scientists do, there would simply not be enough academic professionals to do so. In the Netherlands alone it is estimated that are 100,000 volunteering participants in citizen science on nature and biodiversity in the Netherlands. Together they help collect more than 6 million observations per year (Breman, van Vliet, and Vullings 2017).

The benefits of citizen science to the Dutch scientific and policymaking institutions are readily apparent, but what do citizen scientists themselves gain from voluntarily putting hours in towards citizen science? It is argued that institutions using and individuals partaking in citizen science bridge the divide between science and citizens, in turn facilitating a greater democratization of science, better scientific literacy, and new scientific breakthroughs (Strasser et al. 2019). The first promise of increased democratization of science can be described as making the process of scientific practice more democratic, which means having more people take part in science, ideally everyone concerned. This will make the creation of scientific knowledge more inclusive though democratic participation of knowledge making. The second promise is better scientific literacy, which involves improving participants' understanding of the scientific process, the nature of science, and the nature of scientific inquiry. The third promise is that partaking in

citizen science means contributing to new scientific breakthroughs. The type of contribution would depend on the level of involvement. For example, certain research is only possible due to large numbers of individuals participating (utilizing crowdsourcing to gather data). On the other hand, if participants are given the power to formulate their own research inquiries on topics which are important to them, the production of more diverse knowledge can contribute to otherwise non-existent scientific breakthroughs (Strasser et al. 2019).

While these three promises of citizen science may appear idealistic on paper, it is crucial to examine their practical implications in real-life settings. How are these promises perceived by individuals engaged in citizen science in the Netherlands? How does the purported bridge between science and citizens manifest itself in practice? How are the interactions and dynamics between scientists and non-scientists? What limitations to citizen science do citizen scientists themselves experience?

To answer these questions, I conducted ethnographic research, from the beginning of February to the end of April 2023, on individuals involved in the citizen science initiative Strandwerkgemeenschap (SWG) on the island of Texel, the Netherlands. Overall, my research asks: How do people involved in citizen science on the Dutch island of Texel experience the promises, politics, and the limitations of citizen science? I argue that citizen science initiatives, such as the SWG, have made significant steps in fulfilling the promises of citizen science but are still constrained by limitations with regard to democratic participation. Making this argument, my thesis contributes to the debates around science and expertise, knowledge production and democratic participation. By researching the individuals involved in the citizen science Beach Wash up Monitoring project on Texel this thesis ultimately seeks to contribute to the ongoing

discourse on citizen science and its role in shaping our understanding of societal issues and environmental challenges.

Academic relevance

Science and expertise

By researching citizen science through the lens of science and expertise, this thesis contributes to the understanding of how citizen science challenges the binary between the academic expert (the scientist) and the non-academic expert (the citizen scientist) from an anthropological perspective. In the realm of science and expertise, citizen science emerges as a unique concept that blurs the traditional boundaries between experts and non-experts. Clarke (2020, 585) states that anthropology of expertise “is concerned not only with making sense of what is seen through the eyes of experts but of how phenomena are seen and of the ideological structures through which these observations are made meaningful”. Thus, the literature on anthropology of expertise will give a conceptual grounding for analyzing citizen science practices. Anthropologist Dominic Boyer (2008), in a review article on anthropology of experts and expertise, delves into the cultural and evolving nature of expertise, suggesting that experts should be defined by their skills, competence, and practical engagement rather than as fixed entities. Viewing experts and expertise from this lens means that every person possesses a form of expertise to some extent, but the value attributed to the various types of expertise varies. For instance, a hairdresser who is an expert at her/his craft is viewed as less of an expert than say a doctor or scientist who is an expert at her/his own craft. E. Summerson Carr (2010), an anthropologist who explores how ideas and values become authoritative in various fields, especially within social work and counseling psychology, has a similar argument to Boyer (2008). Carr (2010) argues that expertise is a dynamic process

involving interactions and ideologies, where expertise is what people do rather than what people acquire. Both Boyer and Carr define an expert as someone who demonstrates skills, competence, and hands-on experience towards a certain craft. These perspectives offer a lens to examine the relationship between scientists and non-scientists, acknowledging both scientists and non-scientists as experts in their specific positions. By bringing these anthropological insights and focusing on practices, they challenge the common understanding of experts. Specifically, I will explore the experiences of both scientific volunteers and non-scientist volunteers who participate in the same expertise but from different positions.

Citizen science acts as a bridge, encouraging public participation in scientific research and challenging the notion of science as an exclusive discipline. However, it also raises questions about power relations and the potential reinforcement of the expert/non-expert dichotomy. If there is a bridge it means that there are two different sides, the expert side and the non-expert side. If the non-scientists in the group are seen as non-experts this has the potential to reinforce the science and public binary. Within citizen science projects a hierarchical structure could take place, where the non-scientists are seen as having less expertise and would therefore not be seen as equals. Would then the bridge between science and the public be a one-way bridge? Having ordinary citizens become more like scientists in order for their ideas and knowledge to be heard? Carr (2010) underlines how expertise is closely intertwined with power dynamics, which can have both oppressive and constructive effects. When individuals express their expertise, they reproduce these power dynamics within society. In other words, experts and non-experts alike play a role in reproducing and maintaining these power relations. Furthermore, in the Netherlands, a country that values expertise in its knowledge-driven economy, citizen science can serve as a means for

citizens to challenge and provoke conventional scientific knowledge, thus questioning the authority of experts.

However, there is a possibility that citizen science initiatives could be co-opted by established scientific institutions or governmental institutions, potentially diluting or redirecting the original goals and intentions of the participants. When co-opted, citizen science projects may be used to reinforce existing scientific paradigms, power dynamics, and agendas, rather than genuinely empowering citizens to challenge and shape scientific knowledge. Therefore, it is crucial to remain alert to ensure that citizen science initiatives retain their independence and maintain a space for critical inquiry and alternative perspectives. The diverse promises and politics of citizen science contribute to its multifaceted nature and potential to reshape the landscape of scientific expertise. To gain deeper insights into these dynamics, my research aims to explore the experiences of academics and non-academics in the practice of citizen science through the conceptual debates discussed in these paragraphs. I argue that one does indeed become an expert by doing, but the division between expert scientists and expert non-scientists continues to shape social dynamics in the SWG group. Nevertheless, this division between scientists and non-scientists is not necessarily perceived as an issue by the SWG members. By examining this divide through the academic debates around experts and expertise, we gain insight into its cultural and historical underpinnings.

Knowledge

Citizen science is a powerful concept that goes beyond its scientific implications, it encompasses the realm of knowledge itself. Citizen science extends into the domain of knowledge as a whole, it has implications for how knowledge is generated, shared, and understood. The three promises

of citizen science (democratizing science, increasing scientific literacy among the public, and empowering citizens to contribute to significant scientific breakthroughs) each highlight the central role of knowledge in this field. For example, making science more democratic means making the production of knowledge more democratic. Increasing scientific literacy among the public means increasing knowledge on how to conduct science / scientific knowledge. Citizens contributing to scientific breakthroughs means having citizens contribute to the creation of significant scientific knowledge.

Fredrik Barth (2002), a social anthropologist best known for his work on an approach to study ethnicity, emphasizes that knowledge is not limited to information and concepts but also encompasses emotions, embodied skills, and attitudes. It shapes our perception of reality and guides our actions. Our stock of knowledge shapes our understanding of reality and guides our actions and coping strategies. Barth emphasizes that knowledge varies greatly among individuals, with significant diversity observed across different populations and throughout developmental stages. Barth pointed out the importance of studying practices through the framework of the anthropology of knowledge, describing knowledge as “what a person employs to interpret and act on the world” (2002, 1). The author focuses on the concept of knowledge and its role in how individuals interpret and navigate the world. He suggests that studying how knowledge is produced within individuals and communities in the context of social relations can greatly contribute to anthropological research. Accordingly, the epistemic systems that have been privileged and dominant (Wayland 2003) shape our understanding of knowledge and reality in significant ways. Scientific knowledge assuming authority and objectivity (Strasser et al. 2019) has a history of being framed as a better and more reliable source of information over other forms of lay knowledge, especially those produced in the global South. This can be described as a Eurocentric

view on knowledge and science, which is still prevalent to this day. This hierarchical positioning of scientific knowledge over other types of knowledge does not only exist in global South countries but also in Western nations like the Netherlands. The Netherlands prides itself on having a *kenniseconomie* (knowledge-based economy), where scientific knowledge is often privileged and considered the authoritative source of knowledge, playing a critical role in political decision making. Scientists and the knowledge they produce are held in high regard by the public, as they are seen as the “experts”. Moreover, having more highly educated academic citizens is of high importance to the Dutch government, since they believe that investing in human capital has increased and will continue to increase the country's economic growth. All these factors combined makes scientific knowledge have a prominent position within the Dutch social hierarchy. I argue that citizen science challenges this dominance by allowing non-scientists to engage with science and question conventional scientific knowledge and the place it holds. By exploring the promises and politics of citizen science, in the so-called global North countries, such as the Netherlands, we can understand the practices and politics of scientific knowledge.

Democratic participation

In addition to being a political system, democracy can also be understood as a way people interact with one another, shaping the written and unwritten rules of society. Accordingly, people make and remake democracy through daily practices, such as participating as a volunteer in a citizen science project. Julia Paley (2002), an anthropologist specialized in the multiple meanings and practices of democracy throughout the world, argues that democracy is not a singular state a country either possesses or lacks but it is a complex set of processes that unfold unevenly over time. In the postwar and postcolonial era democracy was seen and studied by anthropologists as a

universally applicable political system that could be implemented in various contexts. Paley discusses how anthropologists tended to incorporate the discourse of democracy within various contexts and intertwine it with other subjects. These subjects encompass a broad range of topics such as social movements, human rights, legal systems, citizenship, administrative structures, violence, military affairs, postcolonialism, the role of the state, globalization, power dynamics, non-governmental organizations (NGOs), and civil society, among numerous others (2002, 470).

The concept of citizen science implies that citizens, individuals with citizenship, are involved. In popular and scholarly accounts, citizenship is often viewed in relation to nation-states, where citizenship is linked to a specific nation-state where one has rights and obligations towards the nation-state. In this thesis I take a different approach to citizenship. I extend citizenship beyond national boundaries, where one does not only have responsibilities towards a nation-state but towards fellow citizens (be it locally, nationally, or internationally connected) and their shared environment. The rise of the use of the concept and theories around ecological citizenship (Dobson 2006) for example, are said to be a response to the rise in globalization and (global) environmental problems. Where the traditional role of the nation-state in shaping citizenship is not sufficient, transnational problems require transnational forms of citizenship (Wolf, Brown, and Conway 2009).

Additionally, there is the notion of cultural citizenship used in anthropological research by Ong et al. (1996). Ong et al. describe cultural citizenship as “a process of self-making and being-made in relation to nation-states and transnational processes.” (737). Here cultural citizenship is seen as a process that involves both personal agency and external influences. Which takes place within the realm of the nation-state as well as transboundary. The concept of cultural citizenship, as discussed by Ong et al. (1996), intertwines with the idea of citizen science. Both incorporate

the multifaceted nature of civic participation. The notion of citizen science may stem from individuals who believe or are made to believe that they, as citizens, should take up their responsibility towards other individuals and their environment by participating in scientific practices. How this civic duty to participate manifests itself will vary depending on the individual and context. What it means to be a “good” citizen differs per person and culture. Where one may classify themselves as a good citizen who fulfils their duties by not littering, others may find it necessary to also put in hours as a volunteer at a nature conservation organization. Thus, citizen science in a sense can uphold certain ideals or aspirations about being a good citizen. Consequently, how individuals understand and practice one’s own citizenship can also be studied within citizen science participants. Citizenship can also be viewed in relation to other citizens, both being members of the same community. Citizen science initiatives can be a space where a particular sociality of educated and concerned citizens can practice what citizenship means to them.

In this thesis I will be engaging with debates surrounding the notion of democratic participation by ethnographically examining the SWG citizen science project. I will be exploring how citizen science can empower individuals by providing them with opportunities to actively engage in scientific processes. Additionally, I will inquire on the limitations of citizen science in promoting democratic participation with regard to inclusivity and diversity. This will contribute to the broader discussions on citizenship and democratic practices. Since democratization of knowledge, particularly in scientific practices, is framed as crucial for inclusive and accessible scientific knowledge. The concept of democracy serves as a lens through which we can explore crucial questions concerning the distribution of political power, decision-making processes, and the involvement of diverse social groups in democratic systems. Ultimately, assisting in creating

a greater understanding of the practice of citizen science and its implications for making the production of knowledge more or less inclusive.

The field - research location and population

I conducted most of my research on the small Dutch island of Texel (see figure 1), Texel is known for its beautiful nature and coast, which attracts many tourists and nature lovers. Texel is a great place for bird watching and for admiring rare flora and fauna. The island has multiple citizen science initiatives, and it is a place where nature conservation is a priority to different conservation organizations as well as the Dutch government. To the west of Texel is the North Sea and to the east is the Wadden Sea. The Wadden Sea is listed as a World Heritage site by UNESCO as it is the world's largest unbroken system of intertidal sand and mud flats¹. This island is home to not only 13,979 people² but also home to many birds, rare orchids, and seals. In addition, Texel has more than 300 hectares of wet dune valleys, a phenomenon that is almost impossible to find in the rest of the Netherlands. This creates space for other types of flora and fauna that cannot be found in the rest of the Netherlands, increasing the overall biodiversity of the Netherlands. Texel is also a popular tourist destination (mainly for the Dutch), this makes it extra important to protect nature from excessive recreation of tourists.



Figure 1: Map of Texel, The Netherlands (captured via Google Maps on 07-02-2023)

¹ UNESCO World Heritage Centre, n.d.

² Centraal Bureau voor de Statistiek, n.d.

Some parts of Texel are even closed off to the public, to ensure that nature can be protected, additionally during the breeding seasons some paths are closed off to ensure that birds won't be disturbed. The Dutch organization Natuurmonumenten has been working on protecting the nature of Texel for almost 100 years.

Staatsbosbeheer is another large organization focused on nature in The Netherlands, it manages 5,000 hectares of nature on Texel. Another institution active on Texel is The Royal Netherlands Institute for Sea Research (NIOZ), this is how I began to narrow my research to Texel. NIOZ does maritime research in deltas, seas, and oceans across the world, as well as on Texel itself. NIOZ is mainly funded by The Dutch Research Council (NWO) which is “one of the most important science funding bodies in the Netherlands and realizes quality and innovation in science”, another long-term financial partner is Utrecht University (“Nederlandse Organisatie Voor Wetenschappelijk Onderzoek” 2023; “Royal Netherlands Institute for Sea Research,” n.d.). Through NIOZ I was put in contact with one of their employees who is also the coordinator (location Texel) of a citizen science initiative named Strandwerkgemeenschap (SWG). SWG has many locations throughout the Netherlands: Ameland, Petten, Camperduin, Castricum, IJmuiden, Katwijk-Noordwijk, Den Haag, Goeree and Neeltje Jans. This is a citizen science initiative that collects data on marine biology, and in particular of flora and fauna on the Dutch coast. SWG does monitoring walks along the coast to collect data for the ANEMOON Foundation³ which SWG falls under as one of the many citizen science projects ANEMOON has. The SWG monitoring walks on Texel are conducted on the west coast and take place every other week. During my research I was able to join three of the five walks in the period of me being at my research location.

³ Abbreviation for ANalysis, Education and Marine Oecological Research.

Most of my interlocutors within the SWG were 50+, both men and women. My interlocutors are familiar with Texel, as most either live on Texel, have a second residence on the Island or are frequent visitors. My interlocutors were all Caucasians (with the exception of 1 person) and from what I observed could be classified as part of the upper-middle class. The SWG Texel had eleven members, with different duos leading the monitoring walks each time, and the other joining now and then. The group was a mix of scientists and non-scientists, but everyone was a volunteer (not paid).

Research methodology

During my time in the field (February-April 2023) I have conducted multiple semi-structured interviews, informal conversations, and most importantly participant observations. Triangulation of these different research methods was used so that “the data from each can be used to illuminate the other” (Hammersley and Atkinson 2006, 102). My participant observations mainly consisted of joining the bi-weekly beach wash up monitoring walks along the coast of Texel with SWG. The partakers of this citizen science initiative gave me insights into how the everyday activities of participation in citizen science are experienced. I conducted semi-structured interviews with a few of my interlocutors I met through participant observation, establishing a level of trust with them prior to conducting the interviews. During my three months on Texel, I was able to conduct in total, three semi-structured interviews and one interview via email. Furthermore, I was able to join three bi-weekly monitoring walks, volunteer at the National Shell Counting Day and get a tour of NIOZ by one of my interlocutors.

Ethics and positionality

As part of my commitment to ethical research, I took certain measures. Firstly, I asked for oral consent to ensure that they agreed to be my interlocutor. In addition, I was transparent about the research objective and the role I held as a researcher during my interaction with my interlocutors. Furthermore, I anonymized my interlocutors, to the best of my extent, to safeguard their identity. This was done by using pseudonyms and disguising any details of the interactions which may reveal their identity or the identity of people they speak about. The pseudonyms I have chosen are common Dutch names that are not linked to my interlocutors whatsoever. This is especially important in the case of Texel, as it is a relatively small island with only 13,979 inhabitants. After careful consideration, I have chosen not to anonymize the research location in my thesis. By deliberately mentioning Texel as the specific research site, I aim to show the distinctive characteristics and context that this island provides to my research on citizen science in the Netherlands. I believe that including Texel's name will contribute to a more comprehensive understanding of the research findings due to being able to convey the essence of the research location. Texel's geographical identity offers a valuable perspective on the outcomes and implications of my research. It enhances the relevance of the research by acknowledging the specific environmental, cultural, and social aspects that shape the island's context. As a consequence, even though I have made use of pseudonyms for my interlocutors, it is still possible that my interlocutors will recognize each other. However, I do not view this as a problem since I do not disclose any sensitive information about my interlocutors that could harm their interactions with each other.

Bernard Russel (2006) discusses how it is important to be aware of your biases as it forms your positionality as a researcher and person in the field. He argues that objectivity is a skill that you can develop if you work at it. Even though I do not believe being fully objective is possible, I do believe it is possible to be conscious of your own biases, personal identities, experiences, opinions and values in order to be as objective as possible. Therefore, I will discuss my positionality. I have wanted to be a “protector of nature” / “conservationist” since I was very young and have continued this path throughout my education choices. I did a bachelor’s in International Development Studies and in Forest and Nature Conservation at Wageningen University & Research. First and foremost, my education and life experiences have taught me the importance of taking care of the earth and its nature. Nevertheless, it has at the same time made me critical of development and conservation efforts, especially how eurocentrism is intertwined in both development and conservation practices. Therefore, I continue to question eurocentrism within science and citizen science.

Additionally, learning and reading about citizen science has excited me about the potential it has for conservation and bringing people closer to nature. However, it was important that my positive opinion about the role of citizen science in conservation did not cloud my research. This so that I could be open that citizen science, just as everything else, has its downsides and should be questioned. However, during my fieldwork and writing process this was less of an obstacle than I expected, I felt like I was able to have an open mind towards citizen science and how others experienced it. Furthermore, I needed to be aware of my ethnicity and gender. Gender is an important variable when it comes to data collection, it can limit access to certain information, and it can influence how you perceive others (Russel 2006). As a woman this could have meant that during fieldwork, I may have gotten more information from my female interlocutors than my male

interlocutor. Additionally, I need to be aware of my position as a Caucasian researcher from the Netherlands doing research in the Netherlands, since it gives me a privileged position, as I am familiar with the language and culture. This proved to be a valuable factor to my research as it helped to understand the nuances communicated verbally and nonverbally, for instance Dutch expressions and body-language. Furthermore, by avoiding the need for translation, it allowed my interlocutors to feel more comfortable communicating their thoughts with me and minimized the loss of information. However, it's worth noting that my upbringing in Southern Africa (specifically Zimbabwe and Mozambique) sets me apart from the majority of Dutch individuals and contributes to a different perspective on life.

Thesis outline

In the first chapter of my thesis, I explore how my interlocutors experience, view and contest the three promises of citizen science: the democratization of science, increasing scientific literacy among the public, and citizens contributing to scientific breakthroughs. This approach of capturing my interlocutors' firsthand experiences allows for a deeper understanding of citizen science as it is actually practiced, rather than merely discussing its idealistic aspirations.

In the second chapter I argue that there is a persistent dichotomy between scientists and non-scientists and a shifting perception of expertise. That this dichotomy, while not devoid of complexities, continues to shape social dynamics and perceptions with the people involved with the Strandwerkgemeenschap (SWG). By examining both the binary between scientists and non-scientists in contrast to the shifting perception of expertise through an anthropological lens, I aim to gain a deeper understanding of its cultural, social, and historical underpinnings.

In the last chapter I explore what it means for my interlocutor to be a citizen scientist, emphasizing the participatory nature inherent in citizen science. I take a look at their reasons for participation, illuminating the intrinsic motivations that drive individuals to engage in citizen science initiatives. I examine the role of volunteering and social involvement in the context of citizen science, illustrating how these activities foster a sense of community and collective purpose among participants. Additionally, I discuss the crucial themes of inclusivity and diversity within citizen science.

Together, these three chapters paint a comprehensive anthropological picture of what it means to be involved in the citizen science initiative known as SWG on Texel. Through the exploration of experiences, practices, and viewpoints these chapters provide a complex understanding of how citizen science is actually practiced within this specific context. By delving into the realities of SWG members, we gain valuable insights into the lived experiences and dynamics of citizen scientists, illuminating the essence of their engagement with the initiative.

Chapter 1 - Science for the Public: Politics of Knowledge

Saturday 18 February 2023 - It was an overcast morning when Dirk, the newly appointed coordinator of this Strandwerkgemeenschap (SGW) location, arrived at the designated meeting point to pick me up. Dirk works for the Royal Netherlands Institute for Sea Research (NIOZ) and has chosen to be the coordinator of SWG in his free time. As we embarked on our 15-minute drive to the coast, we made a quick stop to pick up Peter, one of the older members of the group. Our destination was a specific beach pole where our monitoring walk was scheduled to commence. Prior to the excursion, I was instructed to wear rain boots due to possible wet areas along the shoreline. Upon arrival at the beach, we encountered Melissa, a middle-aged woman joining us for

the monitoring walk. Dirk, somewhat disappointed, mentioned that due to the windy weather conditions, our findings could be limited. He wanted to be able to show me as much biodiversity as possible, such as various species of shells, crabs, jellyfish, and algae, which we could commonly find would the weather have been better.

Nevertheless, at 11:00 am, half an hour before low tide, we commenced our journey. Slowly but steadily, we walked along the coastline for 2 kilometers, starting at the ebb line. Our gaze intently focused on the ground. As I had little to no knowledge regarding the classification of beach wash up, Dirk, Peter, and Melissa took turns sharing their knowledge with me of the shells and other sea creatures that had washed ashore. One piece of knowledge that especially stuck with me was our practice of exclusively counting the intact "doublet" shells, those that still retained both halves firmly attached to one another, while disregarding the single shell valves (for the form that would be filled in later). This approach stemmed from the fact that when a double shelled shell has lost one of its halves, it becomes challenging to determine its age accurately. It would be hard to tell if the shell is a year old or half a century old. By focusing on the shells where both sides remained attached, we could determine that it had only recently washed up ashore from the ocean floor. This deliberate selection allowed us to capture a more accurate representation of what lives in the ocean through our monitoring efforts.

Halfway through our walk, Dirk diligently recorded the approximate quantities of each species we had observed. Curiosity piqued; I inquired about the purpose of the data we were collecting. Dirk informed me that NIOZ, the organization he worked for, did not utilize the data due to its lack of precision. The varying results, influenced by the individual recording the data, their methodology, level of attentiveness, and expertise of the strandwachers (beach guards, a term used to describe the members of SWG), contributed to this decision. Instead, the data was

sent to ANEMOON Foundation. ANEMOON works in collaboration with a dedicated team of citizen scientists, conducting research focused on monitoring changes in marine ecosystems and gaining valuable insights into the ecology of various species, aiming to understand and preserve the underwater world. ANEMOON analyzes and integrates the data gathered by SWG into their publications, news magazine (*Zoekbeeld*), newsletter (*Zeevonk*) and on Nature today (nature news platform). Once everything was written down, we walked back along the flood line this time, again focusing on what lay before our feet. Reaching the original beach pole, Dirk jotted down what species we had seen and in what numbers (this was done via a logarithmic scale, as it is nearly impossible to count 100 or more shells). In the following evening, we received an email containing the official document that would be sent to ANEMOON, listing all the organisms we had counted. This allowed each of us to review the findings and verify if anything had been overlooked during the beach walk that morning.

This glimpse into an activity of the *Strandwerkgemeenschap* (SWG) on Texel illustrates elements of the three promises of citizen science on which I will expand in this chapter. Citizen science initiatives have emerged as a means to make science more democratic, increase scientific literacy, and contribute to scientific breakthroughs (Strasser et al. 2019). Firstly, in my description of a monitoring beach coast walk it can be seen that the participation of individuals from diverse backgrounds, including both scientists (Dirk) and non-scientists (Peter and Melissa), reflects the democratization of scientific knowledge production. Secondly, by actively engaging in hands-on activities and learning from experts, like Dirk and Peter, participants like Melissa and me enhance their scientific literacy, gaining knowledge about the coastal environment and its various components. Lastly, while the collected data may not be utilized by NIOZ, it is sent to ANEMOON foundation which then analyzes and publishes the data, demonstrating the potential for citizen

science to contribute to scientific breakthroughs. The collective efforts of citizen scientists generate valuable datasets that provide insights into ecological dynamics and contribute to a broader understanding of coastal ecosystems. At first glance, one could say that these three promises are a success. However, in this chapter, I would like to take a deeper look into how these different promises are actually experienced by my interlocutor. I argue that the promises connected to citizen science are more nuanced in practice. The people involved in SWG assert that while citizen science has made significant progress in fulfilling many of its promises, it remains constrained by certain limitations and barriers.

Knowledge as a currency of citizen science

Citizen science is as much about science as it is about knowledge. I say this because when exploring how people involved in SWG experience the promises of citizen science the concept of knowledge came up in all three promises. Knowledge is at the heart of all three promises, knowledge is the currency of citizen science: Making science more democratic means making the production of knowledge more democratic, increasing scientific literacy among the public means increasing knowledge on how to conduct science / scientific knowledge, citizens contributing to scientific breakthroughs means having citizens contribute to the creation of significant scientific knowledge.

Barth (2002) argues that knowledge encompasses not only information and concepts but also emotions, embodied skills, and viewpoints. Our stock of knowledge shapes our understanding of reality and guides our actions and coping strategies. In any given field, such as aesthetics, spirituality, personal experience, scientific inquiry, or local knowledge, there are different types of knowledge. However, certain epistemic systems become privileged and dominant over others as a

result of historical and political processes (Wayland 2008). When one thinks of different epistemological systems, local lay knowledge and scientific knowledge, discourses are usually focused on global South countries regarding lay knowledge as less than scientific due to colonial history. However, what I want to illustrate is that similar dynamics of dichotomy and hierarchy of knowledge and epistemologies exist not only in global South countries but also in Western countries such as the Netherlands.

In Western countries, scientific knowledge is often privileged and considered the authoritative source of knowledge. It is grounded in the scientific method, rigorous research, and peer-reviewed publications. This scientific knowledge is typically associated with objectivity, universality, and the pursuit of truth. It is valued for its ability to provide systematic explanations and predictability. The Netherlands, where I conducted my fieldwork, identifies itself as a knowledge driven country, where the ‘kenniseconomie’ (knowledge economy) is something to be proud of and continue developing. Scientists and the knowledge they produce are held in high regard by the public, as they are seen as the “experts”. During the 1980’s, many Western countries put educational policies in place to encourage education and occupations in science, technology, engineering, and mathematics (STEM). Combined with the notion that investing in the knowledge economy and technological innovations would increase economic growth (Strasser et al. 2019). This ideology has remained dominant in many Western countries, including the Netherlands. Contesting this was citizen science, by making room for non-scientists in the prestige discipline of science. Through citizen science and its embedded promises, citizens can provoke and challenge science and scientific knowledge. The practice of citizen science can be viewed as a way for citizens to fill the gaps where they feel science is lacking. Citizen science as a way to challenge

conventional science and scientific knowledge as the sole important epistemology and expertise plays into the different promises and politics of citizen science.

Democracy and science: science for the people and by the people

The town I was staying in was quite small, so I occasionally ran into my interlocutors when running my errands. On one of the many cold days in February, I went to get groceries for dinner, and I happened to see Peter at the end of one of the aisles. I met Peter on my first bi-weekly coast walk and later asked him via email if I could interview him. At first, I wasn't sure if he would recognize me as I had only met him once before, all wrapped up in winter gear, on that one windy beach walk. I went over to greet him and to tell him I had just seen his email with the possible moments I could interview him. In my conversation with Peter, he said that I could interview him that evening if I was available. I took him up on his offer. Before the interview, I made a quick pit stop at my house to eat and prepare for my interview. Luckily Peter's home was within walking distance of mine, as I did not have a bike nor was public transport great on the island. Peter is an elderly man, who used to be a schoolteacher in the same town he still lives in. He has been active within the SWG for quite some years and also volunteers at other organizations focused on nature in the area.

Sitting at his kitchen table, I asked Peter how he experienced the democratization of science through citizen science activities. He started off by mentioning how different associations, such as the astronomy association or bird watching association, invite scientists to give lectures and readings as a way to share knowledge to the public, with sometimes more than 60 people attending these lectures. A scientist from the University of Groningen was going to give a lecture on astronomy at the astronomy association. He was planning on going to it the next day and invited

me to join, unfortunately I already had other plans and had to kindly decline. Sharing scientific knowledge to citizens is according to Peter a good way for science to reach the public so that science can become a little more democratic. These activities are usually free for its members and school children (to increase the interest of the youth), but others need to pay a small fee (5 euros). Peter also excitedly said that there was a man, who lived to be 99, who up till a year before his passing was active in giving lectures and writing his scientific publications in a second readable version. This second version was one written in a more understandable language for the community. Peter ended by stating that “(...) you can say that [through these different activities] science reaches the people (..) and there is a lot of interest for that here [on Texel]” (interview, 02-20-2023).

Peter's experience with citizen science activities demonstrates his belief in the potential of citizen science to make science more democratic. He highlights the role of knowledge-sharing through readings and lectures organized by various associations. He considers these events as opportunities to share scientific knowledge with the public. Moreover, Peter mentioned that these activities are often free for members and school children, which further supports the idea of democratizing science by removing barriers to access. However, it is noted that some individuals may need to pay a small fee, implying that financial limitations could still be a potential obstacle to democratization. Peter enthusiastically mentions an example of a man who wrote scientific publications in a second version, using more understandable everyday language. This example showcases Peter's appreciation for efforts made to bridge the gap between complex scientific concepts and the general public. By making scientific information more accessible and comprehensible, Peter believes that science can effectively reach people from different educational backgrounds and promote democratic participation. Overall, Peter's experiences underscore the

potential of citizen science activities to democratize science by involving and engaging a broader range of individuals. Through knowledge-sharing, accessible events, and efforts to simplify scientific information, Peter believes that science can become more inclusive and generate greater interest among the public.

I approached Willem, who serves as the head of ANEMOON, to gather a different perspective on the potential of citizen science in fostering a more democratic approach to scientific endeavors. Given his leadership position within the foundation, Willem possesses a broader viewpoint compared to my previous conversation partner, Peter. Willem initiated our discussion by acknowledging that he frequently hears from participants that they engage in ANEMOON projects due to their desire to contribute to data collection, which in turn aids in formulating more effective nature policies. He emphasized their appreciation for the utilization of their observations in shaping such policies, recognizing that both the current and future governments increasingly rely on this valuable data. Willem (interview, 04-20-2023) expanded on this:

Citizen science certainly increases the involvement of citizens in science, but also in government nature policy. (...) if the government knows that there is a great deal of involvement with nature [through citizen science initiatives focused on nature], that nature will also be taken more seriously [by the government]. At least more seriously than if there were no involvement at all. Citizen scientists contribute to making this involvement [of citizens in nature] visible.

His observations underline the notion that the intersection of science and democracy goes beyond the mere democratization of scientific processes. It also encompasses the opportunity to exercise

democracy by actively participating in (citizen) science. Through their participation, they have a voice which can influence governmental decisions on nature policies. The quote from Willem exposes the interplay between citizen science, democracy, and nature policy in the Netherlands. He suggests that citizen science acts as a vehicle for citizens to actively engage in scientific endeavors and contribute to policymaking processes. Citizen science, by involving members of the public in scientific research, offers a means for individuals to participate in the production of knowledge. This active involvement empowers citizens and provides them with a platform to voice their observations, concerns, and interests regarding nature. As citizens collect data and contribute to scientific projects, their participation enhances the democratization of science. It breaks down traditional barriers between scientists and the public, allowing non-experts / non-scientists to become active contributors to the scientific process. This shift towards inclusivity and engagement aligns with the principles of democratic participation. Moreover, Willem suggests that when the government observes widespread citizen involvement in nature-related activities, the government is more likely to take nature conservation and environmental issues seriously. Citizen science, therefore, acts as a tool for making the involvement of citizens in nature visible to the government. The collection of data and active engagement in citizen science projects by citizens provides tangible evidence of their interest, concern, and investment in nature. This visibility encourages policymakers to consider and prioritize nature-related matters, knowing that a significant portion of the public is actively engaged and invested in these issues. In this sense, citizen science serves as a catalyst for government responsiveness and reinforces the connection between science, democracy, and policymaking.

During my second SWG coast walk on Texel, I had the pleasure of meeting Robert, a participant in the SWG program and curator at the nature museum Ecomare within the education

department. Listening to the conversations between Robert and Dirk, I noticed that they talked a lot about their work situations, and about the organizations they work for (Robert at the nature museum Ecomare and Dirk at NIOZ). This led me to ask more about Robert's work. He explained that as a curator and biologist, his responsibilities entail creating exhibits for the museum. As we struck up a conversation, his enthusiasm for his work became apparent, particularly when he spoke on a recent project he had undertaken. Over the course of three months, he had developed a sizable tablet featuring an array of information, pictures, and videos. Notably, the tablet included interviews with experts, all centered around a specific species found in the ocean. He excitedly shared how he witnessed the joy of two children who were thoroughly enjoying the exhibit for a remarkable 20 minutes. Intrigued by his perspective, I arranged to interview him at his workplace a few days later. We sat down in the cozy canteen of the nature museum to talk about how he experiences being a part of a citizen science initiative and his opinions on the promises of citizen science:

Aleysha: Do you think citizen science makes science overall more democratic?

Robert: It helps, but will an average person receive anything from it? It doesn't work that way, for some people in society, which is an increasing group, science is just an opinion. And these kinds of [citizen science] activities will certainly help in preventing that notion from gaining traction.

Aleysha: What exactly do you mean?

Robert: Well, that opportunistic behavior, of labeling science as just an opinion. I think that's very bad. Because humanity is, not that I am very proud of our species, but if we have made any progress in our history, then you can say that it was science

that managed to do that. So, I am strongly opposed to those who dismiss it (science) as 'just an opinion'.

Aleysha: Maybe because they don't understand how it works?

Robert: Well, stupidity/ignorance needs to be combated as well. And I think citizen science does a good job of getting people involved. Perhaps also that if politicians have to make a decision, like "guys, are we going in that direction? Or are we going to ensure that there is less nitrogen so that there is more biodiversity?" That they [the citizens] would find it more acceptable if they had participated in it a bit and had therefore started to think about it and gain a better understanding. (Interview, 03-07-2023)

Robert's acknowledgment of citizen science as a tool for democratizing science was accompanied by a critical question: Does the average person truly benefit from it? He raised concerns about a growing section of society that viewed science as subjective and arbitrary. Robert brought this up in a time where post-truth politics and climate denial are gaining traction throughout the world (Fischer 2019). That this perspective undermines the credibility of scientific knowledge and poses challenges to fostering a scientifically informed public. Intensely opposing the labeling of science as "just an opinion," Robert emphasizes the pivotal role scientific advancements have played in human history. To his understanding, dismissing science as subjective opinion disregards the objective and evidence-based nature of scientific inquiry. Delving deeper into the reasons behind the perception of science as opinion, I probed the possibility that this perspective stems from a lack of understanding of scientific processes. Since knowledge systems are diverse and embedded within specific cultural contexts, a lack of familiarity with the intricacies of scientific methodology

and discourse (also known as scientific literacy, which I will explore further in the next chapter) could possibly have contributed to the view of science as merely subjective by the group he speaks of. Partially agreeing, Robert expressed the need to combat ignorance and emphasized the potential of citizen science in this endeavor. According to Robert, citizen science can offer a platform for public engagement, allowing individuals to actively participate in scientific activities and gain firsthand experience. In turn decreasing ignorance on scientific knowledge among the public and fostering a deeper appreciation for the scientific process.

Furthermore, Robert proposed that citizen science could influence policymaking processes. He draws on a recent societal debate in the Netherlands regarding environmental issues. The Netherlands has been experiencing excessively high levels of nitrogen oxides and ammonia emissions, which negatively impacts the environment. To lower these emissions the government had to make hard decisions with regard to minimizing the amount of prohibited agriculture livestock. This created heated tensions between farmers, politicians, and environmentalists. Robert argued that citizens/farmers would be more inclined to consider the scientific evidence and recommendations (on the need to reduce nitrogen emissions) if they themselves participated in science activities. This aligns with the notion that citizen science can promote democratic ideals by empowering individuals to actively participate in scientific research and decision-making processes. By involving citizens, especially in matters that directly impact their lives and communities, it is believed that decisions will be more inclusive, reflective of diverse perspectives, and ultimately more democratic in nature. Additionally, Robert's viewpoint reveals the kind of citizen he aspires to be and others to be as well. A citizen who is responsible, educated on environmental matters and is not led by ignorance.

Scientific literacy: citizens with scientific skills

[When moving to Texel] I knew nothing about shells. And now I have the shell field guide [a book]. Well, I'll tell you, when I bought it, I really thought "well this is rocket science" (really difficult) but gradually you make it your own. So, it's kind of like self-study (...). But it all takes longer, because yes, I have to teach myself or learn from others [unlike people who have a traditional education in biology].
(Rose, interview, 03-22-2023)

Rose's quote vividly captures the journey of self-education and discovery that she embarked upon when she moved to her new environment, hereby increasing her scientific literacy. Scientific literacy, in its essence, refers to the ability to understand and critically engage with scientific concepts, methodologies, and findings. It encompasses a range of skills, from the ability to read and interpret scientific information to evaluating the reliability of scientific claims and engaging in scientific discourse. Her initial lack of knowledge about shells reflects the limited scientific literacy she possessed at the start. However, her acquisition of a shell field guide symbolizes her proactive engagement with citizen science, a movement that promises to increase scientific literacy among citizens. Rose's comparison of shell study to rocket science emphasizes the perception of scientific subjects as complex and intimidating to individuals without formal education in the field. Nevertheless, her determination to make it her own illustrates how joining a citizen science initiative empowers her to navigate and comprehend scientific knowledge. Rose's self-study process exemplifies the democratization of education and the potential for citizen science to bridge the gap between formal education and scientific literacy. The acknowledgment that self-study

takes longer than traditional education underscores the challenges faced by citizen scientists, who rely on personal initiative and learning from others rather than structured curricula. However, despite the additional time required, Rose's experience underscores the value of citizen science in enabling individuals like her to develop a deeper understanding of the natural world and actively contribute to scientific knowledge. This example contributes to the anthropological discourse surrounding citizen science's potential to enhance scientific literacy among citizens (Strasser et al. 2019), by emphasizing the transformative learning experiences and self-empowerment it can offer.

This was also the case for many of my other interlocutors, they acknowledged that by joining SWG they had learned a lot about determining species and overall knowledge of their coastal environment. They gained a greater understanding of how science works, especially because they carried data gathering themselves. Moreover, Rose mentioned that this specific knowledge increase was made possible by the scientists that are part of the SWG, sharing the knowledge they have with the non-scientist members of the group. Likewise, the institutions the scientists are connected to play an important role. Being part of an institution such as a research center or museum facilitates connections with other knowledgeable individuals, who can assist in classifying unknown washed up flora and fauna. In the next chapter, I will elaborate on this transfer of scientific knowledge from scientists to non-scientists.

When I asked Peter if his scientific literacy had increased since joining the SWG or through being active as a volunteer at Natuurmonumenten or Staatbosbeheer (two prominent organizations in the Netherlands that focus on nature conservation and the management of natural areas), he said it had not: “Pffff well, that is ehhhh no . . . , no”. He continued by giving me an example of a project he had been working on:

(...) We've got a new area. (..) There we have a sand dike. Well, they reinforced the dike there by spraying sand in front of it. And that's a new area, and I'm surveying [and monitoring] it with a few people. You can do that in two ways. Completely divided into four sections and precisely indicated from there and there and there. And yeah, that's hardly readable. And I don't find it interesting either. Or you can do it a little less scientifically. So that it is more readable and easier to understand. That's how we work. We walk there a few times a year with the three of us, and we look at developments. Which plants are disappearing? Which do we see coming? Yes. Yes, it kind of looks like science. But it's not real science. Because that is very difficult, yes. (Peter, interview, 02-20-2023)

In Peter's experience with citizen science, he expresses that his scientific literacy has not increased since joining the SWG (presumably a citizen science group) or being active as a volunteer at prominent nature conservation organizations in the Netherlands. This suggests that his participation in citizen science activities has not had a significant impact on his understanding or knowledge of scientific concepts. Peter provides an example of a project he has been involved in, which involves surveying and monitoring a new area with a sand dike. He mentions two approaches to conducting the survey: a more precise and scientific method divided into four sections, and a less scientific method that is more readable and easier to understand. Peter expresses a lack of interest in the more scientific approach and prefers the less scientific method that he and two others undertake a few times a year. From his description, Peter acknowledges that their approach may resemble science but emphasizes that it is not "real science" as that is more challenging. This statement indicates that he views scientific practices as difficult and perhaps

beyond his capabilities or interests. Overall, Peter's experience with citizen science suggests that he does not perceive it as a means to enhance his scientific literacy or engage in rigorous scientific inquiry. He seems to prefer a more accessible and less scientific approach to his involvement in nature monitoring activities.

I asked Robert, a SWG member who has a background of scientific education in biology, whether people who don't have that scientific background can learn scientific literacy from participating in the SWG initiative. Robert said the following:

Yes, I definitely think so. Firstly, because they are carrying it out. And when they bring that data to the scientists who will work with them, those scientists will certainly want to provide information as well. They will share what others have discovered and what it might mean. And if a scientist doesn't do that, they are certainly missing out. Not every scientist is equipped to communicate with the larger public. But usually, when you set up such a project, those are the scientists who have a knack for it. If not, then they should hire a scientist who can. (Robert, interview, 03-07-2023)

In this quote by Robert, he expresses his belief that citizen science initiatives have the potential to significantly contribute to scientific literacy among citizens. Robert argues that when citizens actively participate in data collection and bring their findings to scientists, the scientists themselves will likely provide additional information and share the discoveries made by others. This collaboration between citizens and scientists can bridge the gap between scientific research and the public, offering opportunities for knowledge exchange and fostering a greater understanding

of scientific concepts. Robert acknowledges that not every scientist may possess the skills to effectively communicate with the larger public but suggests that projects engaging citizen scientists are more likely to involve scientists who are equipped to do so. If a scientist lacks this skill, Robert proposes that they should consider hiring a scientist who can effectively communicate scientific information to the public. This quote underscores Robert's thoughts on the potential of citizen science initiatives to enhance scientific literacy by promoting dialogue, knowledge sharing, and effective science communication between scientists and citizens.

Promise of Contributing to Scientific Breakthroughs

The third promise is that partaking in citizen science means contributing to new scientific breakthroughs. Important is to mention that the type of contribution depends on the level of involvement. For example, individuals only involved in the crowdsourcing of data will have less direct contribution when compared to individuals who are involved in framing research questions (Strasser et al. 2019). In the realm of scientific research, breakthrough discoveries and advancements have traditionally been the domain of professional scientists working within established institutions. However, in recent years, citizen science has emerged as a promising avenue for engaging non-professional individuals in the scientific process and harnessing their collective power to contribute to groundbreaking scientific discoveries (Strasser et al. 2019). This section will explore how my interlocutor experienced the promise of contributing to scientific breakthroughs. I argue that the notion of contributing to scientific breakthroughs is not always at the forefront of participants' minds, as their responses vary. Some participants do not feel they are directly contributing to scientific breakthroughs, while others recognize their contributions but consider them to be on a more modest scale. This indicates a noticeable gap between the

contributions made by individuals and their lack of knowledge or level of concern regarding the outcome of those contributions.

Remco, who has been part of SWG for nearly two decades, mentioned that he doesn't notice the effort towards science until ANEMOON publishes something, which is not that often. This is because it usually takes many years to see a trend, though the data gathered along the Dutch coast by all the SWG groups. This appeared to dampen his immediate sense of contributing to breakthroughs. Remco's observation about the infrequent publication of ANEMOON's findings exemplified this temporal disconnect, as participants had to wait for substantial periods to witness tangible outcomes of their efforts. The extended time frame highlights the intricate nature of scientific research, where long-term data gathering by the different SWG through the coast of the Netherlands and rigorous analysis are necessary to uncover meaningful insights.

Additionally, participants demonstrated varying levels of awareness regarding the trajectory of their data and its transformation into scientific knowledge. While some were familiar with the publication of reports on government sites and ANEMOON's informative magazine, others lacked clarity on the broader dissemination and utilization of their contributions. Willem mentioned how the data gathered through the SWG is used in reports that are published on one of the sites of the Dutch government (Environmental Data Compendium). However, not all participants seem to be aware of where the data ends up and how that happens. They know it ends up in an informative magazine of ANEMOON, but that is it. This could explain why they are not confident about their efforts contributing to scientific breakthroughs. This knowledge gap might have contributed to a sense of uncertainty and diminished confidence in the impact of their work. The need for effective communication channels and transparent feedback loops, elucidating the journey of data from volunteers to scientific breakthroughs, becomes apparent.

Within this multifaceted landscape of perspectives of my interlocutors, the dichotomy between the experiences of Peter and Rose provided contrasting viewpoints. Peter's perception of limited contribution through his participation in the SWG is in contrast to Rose's perception, who sees her volunteering at the SWG as a contribution to science.

Within the SWG group, our contributions to science are very limited. Because [people doing research for an official research institute], they are real scientists [and I am not]. And they have a lot of contact with each other. It's only a few times in such a period that you [as a SWG member] actually walk, maybe once or twice a quarter. And then you see a day like today for example, it won't make you any wiser. (Peter, interview, 02-20-2023)

Peter expressed the perception that their contributions within the beach working group are very limited compared to “real scientists” who have more contact with each other. Peter mentioned that they only walk once or twice a quarter, which may not provide enough opportunities for significant scientific insights. His comment could imply that more frequent engagement or direct communication with scientists might enhance participants' confidence in their contributions and deepen their understanding of the potential impact of their work. On the other hand, Rose, one of the younger SWG members, offers a contrasting viewpoint. She states, “Well, in a sense, of course, I do that [contribute to science] with that beach workgroup. Yes, I think a lot of volunteers are the eyes for science.” Rose recognizes the value of volunteers' observational skills and the crucial role they play in providing data to scientists as the “eyes for science.” Her perspective aligns with the core principles of citizen science, emphasizing the collaborative relationship between scientists

and volunteers in gathering essential information for scientific research and scientific breakthroughs.

In conclusion, the people involved in SWG believe that while citizen science has made significant progress in fulfilling many of its promises, it remains constrained by certain limitations. Moreover, knowledge is not only a crucial element of citizen science, but also a currency that drives its progress and impact. The promises of citizen science revolve around democratizing the production of knowledge, increasing scientific knowledge among the public, and empowering citizens with knowledge to contribute to significant scientific breakthroughs. Barth's perspective on knowledge as a multifaceted entity, encompassing information, skills, attitudes, and social relations, further emphasizes its profound influence on individuals and communities. However, it is important to recognize that certain epistemic systems, such as scientific knowledge, have historically been privileged and dominant, often overshadowing local lay knowledge. Citizen science disrupts this hierarchy by providing a platform for non-scientists to challenge conventional scientific knowledge and contribute meaningfully to the scientific endeavor. A discussion of the dynamics between scientists and non-scientists as well as what it means to be an expert will take place in the following chapter.

Chapter 2 - Scientists and Experts: Thinking Beyond the Dichotomy

Friday 17 February 2023 - My interlocutor Dirk invited me to have a one-on-one tour of the Royal Netherlands Institute for Sea Research (NIOZ). The building was near the water, you could see it

right away when arriving on the island by ferry. Dirk and I first sat down with a coffee and tea in the canteen, discussing how NIOZ works and what he does. After finishing our drinks, Dirk showed me around the building, going along to the different departments of NIOZ. We started the tour at his department where they gather samples to map organisms living in the soil of the Wadden Sea. With the samples they determine the different types of organisms, estimate the numbers and collect any other important data. He showed me how they get the samples and how they prepare them with special liquid to ensure the flora and fauna they collected stayed good. Our tour continued, explaining the two main projects running at the moment, and how they do the research. How they count and weigh all types of flora and fauna they dig up from the ocean bed. Just how much the boats cost per day to go to their research sites on the Wadden Sea. How students from all kinds of levels can be found working and interning at NIOZ. The different universities connected to this research institute. It was an overwhelming amount of information. However, there was little mention of what role SWG played. So, towards the end of the tour, I asked about the Strandwerkgemeenschap (SWG) and if the data is used at the NIOZ. Dirk answered that they (NIOZ) do not really use data from SWG, I was surprised to hear this. This made me question whether the initiative (SWG) I was planning to study was actually a citizen science initiative. Since SWG was not directly working with NIOZ as I expected at first, I prematurely concluded that it was not the bridge between science and citizens I was looking for. This was merely a scientific institute, not citizen science.

I found myself naturally inclined to classify things based on my preconceived notions of what citizen science should entail. In my simplistic view, I rigidly separated "science" from "citizen science," assuming that only non-scientists citizens of Texel would be the ones to assist research institutions like NIOZ in monitoring the beach wash up on Texel. However, I soon

realized that this perspective was far from accurate and overly simplified when it comes to the dynamic relationship between scientists and non-scientists within the realm of citizen science. Dirk worked for NIOZ as a scientist and is also a member of the SWG as a volunteer. Even though NIOZ does not directly use the data collected by SWG, through Dirk, NIOZ is able to stay up to date on anything out of the ordinary happening on the shore / at sea. The bridge that Dirk is between NIOZ and SWG is one which they as organizations want to foster. Before Dirk became the new coordinator of SWG, it was another NIOZ employee who filled this position. As Dirk explained, SWG purposely wanted another NIOZ employee to be the coordinator due to this person having connections to the research institution NIOZ. In the scientific field, there is a distinction between scientific knowledge and lay knowledge, the Dutch scientific field is no exception. However, through citizen science, this distinction is said to be blurred, forming a bridge between citizens/communities and scientists, where participation in scientific research is encouraged (Bonney et al. 2015), instead of science as a discipline being closed off from the public. Through the practice of citizen science, experts, non-experts, scientists, and non-scientists work on the same knowledge creation, but not from identical roles or knowledge backgrounds. Since the knowledge we have shapes our perception and understanding of reality and guides our actions (Barth 2002), we cannot look at these interactions within the SWG group without taking their knowledge backgrounds into account.

In the forthcoming chapter, I will explain how the SWG challenges the notions of expertise and how the dichotomy between scientists and non-scientists remains active. This dichotomy, while not devoid of complexities, continues to shape social dynamics and perceptions with the SWG members. By examining this divide through an anthropological lens, we can gain a deeper understanding of its culture and social underpinnings. The division between scientists and non-

scientists can be traced back to the cultural construction of knowledge and expertise within societies. Different cultures assign varying degrees of value and importance to scientific pursuits and specialized knowledge. In some societies, scientific expertise is highly esteemed and seen as an integral part of progress and modernity. This is the case for the Netherlands and its knowledge economy. Furthermore, the dichotomy between scientists and non-scientists can be seen as a manifestation of broader power structures and social hierarchies. Scientists often occupy positions of authority and influence due to their specialized knowledge, which can grant them access to resources, funding, and decision-making processes. Non-scientists, on the other hand, may find themselves on the receiving end of scientific knowledge or be marginalized in the creation and distribution of knowledge. These power dynamics contribute to the perpetuation of the scientist non-scientist binary and influence how it is perceived within societies. The perceived objectivity and rationality of scientific inquiry often align with dominant Western ideologies, reinforcing the notion that scientific knowledge is superior to other forms of knowledge. This cultural bias can marginalize alternative knowledge systems and ways of knowing, which began on a global scale in the era of European imperialism. This historical underpinning likely assisted in creating the perceived divide between scientists and non-scientists. In an anthropological Vital Topics Forum Bolnick, Smith, and Fuentes (2019) express the importance of recognizing and valuing diverse knowledge systems and forms of expertise to foster greater inclusivity and respect for different ways of understanding the world.

Expert and expertise

What I saw in the field was that ‘expert’ does not equal ‘scientist’, and ‘non-expert’ does not equal ‘non-scientist’. Not all scientists involved are experts when it comes to identifying organisms that

have been washed up ashore, and not every expert on the flora and fauna of the Dutch coast has a scientific background in biology or marine sciences. Robert, a Strandwerkgemeenschap participant who I met during one of the bi-weekly monitoring walks for ANEMOON and later on got to interview. He had a university background in biology and now works at a nature museum as curator. In an interview, when I asked Robert about the relations between the non-scientists and professional scientists in the SWG group as well as on a more national scale, he mentioned that it he has seen it change over the past years:

(...) When I started my studies, the really professional biologists or professional scientists kind of looked down on the amateur biologists or amateur scientists. That was at that time, I always looked at it as weird, [but] that was very common. If you had become quite an expert in a field [such as biology] through self-study or experience, then you simply remained an '*amateurtje*' (some amateur) in the eyes of people who had done an '*opleidingtje*' (some education/degree) in it. But that has completely changed nowadays. You have experts like Dirck Mol. Or for example, Klaas Post, who I don't think has ever really had a university degree, but he is certainly taken seriously. If not, he is seen as 'THE' specialist in this field, even by scientifically trained scientists. (Robert, interview, 03-07-2023)

In this quote, Robert stresses the shifting dynamics between amateur and professional scientists over the years, providing valuable insight into the realm of citizen science. Initially, Robert observes that in the past, professional scientists held a condescending attitude towards amateur scientists. The latter were considered mere enthusiasts without formal education, regardless of

their expertise gained through self-study or practical experience. This perception, although peculiar to Robert, was prevalent at the time (late 1980s and the early 1990s). However, Robert goes on to assert that the situation has undergone a significant transformation in contemporary times. He notes that individuals like Dirck Mol and Klaas Post (could not find anything about them online), who may not possess university education, are now regarded as respected experts and specialists in their fields, even by scientifically trained professionals. This shift exemplifies a changing paradigm in which the expertise and contributions of citizen scientists are recognized and valued. Robert's account sheds light on the evolving relationship between amateur and professional scientists, revealing the increasing acceptance and recognition of non-traditional pathways to expertise within the realm of citizen science. Illustrating that being an expert (within the field of biology) does not require having a university education in the subjects, but having experience and competence is what matters (how this shift has happened was not mentioned). This is in line with the anthropological writer Boyer who defines an 'expert' as "an actor who has developed skills in, semiotic-epistemic competence for, and attentional concern with, some sphere of practical activity" (2008, 39). Thus, an expert is something an individual becomes by doing, in this case the scientific practices of biology. Rose, a non-scientist active in the monitoring walks of SWG, mentioned how she knew very little about shells before joining the SWG, but her knowledge has been growing ever since:

[When moving here] I knew nothing about shells. And now I have the shell field guide [a book]. Well, I'll tell you, when I bought it, I really thought "well this is rocket science" (really difficult) but gradually you're making it your own. So, it's kind of like self-study (...). But it all takes longer, because yes, I have to teach

myself or learn from others [unlike people who have a traditional education in biology]. (Rose, interview, 03-22-2023)

Rose's quote provides a valuable perspective on the process of self-study and learning within the field of biology, specifically focusing on her journey in acquiring knowledge about shells. Initially, Rose admits to having no prior knowledge of shells when she moved to her current location. However, she explains her progress by mentioning the acquisition of a shell field guide, a book that initially seemed quite difficult, similar to rocket science. This analogy emphasizes the perceived complexity and difficulty she anticipated in learning about shells through self-study. Nevertheless, Rose gradually familiarizes herself with the subject matter, indicating a process of personal ownership and mastery. She recognizes that self-study requires more time and effort compared to individuals with a traditional education in biology, who benefit from structured learning environments and formal instruction. Rose's account illuminates the challenges and rewards of self-directed learning in citizen science, highlighting the commitment and perseverance required to gain expertise in a field without formal training. Her experience underscores the value and efficacy of personal initiative and the potential for individuals to become knowledgeable and proficient through self-study and learning from others within the realm of citizen science. In addition to Rose's journey of self-study and learning about shells, it is essential to emphasize the significance of being able to identify different shell and crab species accurately. Rose's acquisition of knowledge in this regard is crucial for effectively collecting data and monitoring the coast. The ability to distinguish between various species ensures the accuracy and reliability of the information gathered during citizen science initiatives. By correctly identifying different shell and crab species, researchers can contribute valuable data to ongoing monitoring efforts, enabling a

comprehensive understanding of coastal ecosystems. Rose's recognition of the importance of species identification underscores the role of citizen scientists in actively participating in data collection and monitoring, highlighting their contribution to broader scientific endeavors.

In an article in the local paper promoting the National Shell Counting Day, it refers to the SWG members who would be there that day as *deskundigen*, meaning experts (see appendix A). This again shows that even though not all members of the SWG are scientists they are seen as experts on the flora and fauna of the Dutch coast by more public entities such as the local newspaper. These examples demonstrate that within the SWG as well as further out, the non-scientists who are experts are acknowledged for their specific knowledge and expertise. However, this does not mean that the non-scientists are perceived to be the same as the scientists.

Relations between scientists and non-scientists

According to the scientists and non-scientists I interacted with, the relations between scientists and non-scientists are positive, at least within their own SWG group. During the National Shell Counting Day on Texel, I met Marco, just like me, he had come to volunteer that day. He was a SWG member and worked as biologist and curator for Ecomare, a nature museum, aquarium and sanctuary for seals and birds. This was the location for our stand during the National Shell Counting Day (see figure 2). At the stand, people could come and ask questions with regard to the shells they had found and let them be determined by 'the experts' (see appendix A and C). On the tables we sat behind lay an array of shells from all across the world, a pile of books about shells, and two piles of flyers. One was an informative flyer on classifying beach wash up that can be found on the Dutch coast, anyone interested could take one with them (see appendix B). The other

flyer was a form which people participating in the National Shell Counting Day excursions could use to classify and record their observations (see appendix C). This form also included instructions on how to properly count the shells, using the spiral method. The meeting place for



Figure 2: A group gathering at Ecomare for the second shell counting excursion. (Photo taken by Aleysha Korver)

the three shell-counting excursions we would lead that day as SWG volunteers. While walking with the second excursion group, from the meeting point to the beach, Marco expressed his love for biology fieldwork. He said he learned fieldwork at *Nederlandse Jeugdbond voor Natuurstudie* (NJN) (Dutch Youth Association for Nature Studies). This is an association many others I have met during my time on Texel were a member of growing up. This is an association for youth aged 11 to 25 who have a passion for nature and a curiosity to learn more about it, they organize activities such as camps and excursions. Marco excitedly voiced that once you have done (biology) fieldwork you will keep doing it, “you will do it until you are in your grave”. Expressing that being a hands-on biologist and being in nature is what he loved doing and will always love doing. Moreover, he proudly mentioned to me, while we were carrying the tables, we needed to set up

the stand for the National Shell Counting Day, how he started the first citizen science initiative in the Netherlands many years ago and also helped to set this one up.

When it was now our turn to hold up the fort at the stand, because some others of the group were now at the beach with the next excursion group, I got to chat with Marco and Maria. I asked them about the duality between scientists and non-scientists within citizen science. Marco proudly answered that the interactions go quite smoothly in their field (biology). Maria nodded, showing that she agreed. This was also my experience during my three months of field work. From what I observed during the SWG coast monitoring walks is that everyone got along well; there seemed to be a mutual respect and appreciation between the scientists and non-scientists. It was difficult for me to distinguish who was a scientist and who was not, since it did not seem like anyone positioned themselves higher than the other. Looking at it from my own perspective, although I was not an expert on Texel's flora and fauna or a professional biologist, I felt welcomed and not judged for my lack of knowledge. However, Marco mentioned that this is not the case in all fields where citizen science is active. According to him, the field where there is the most tension between scientists and amateur scientists is archeology. The tensions were described as the non-scientists not feeling respected by the professional scientists. In turn, causing conflict and unpleasant interactions between amateur archeologists and professional archeologists. I asked if it was because of the money involved, he said that that was indeed part of the reason. He said that those people are so focused on finding special relics which could be worth thousands and also could result in the fame of the one who found the item. Consequently, the archeology field is more competitive, and that does not help with the scientist and non-scientists relations. Within their field of biology, in the SWG group, there is little competition. Rose, who I interviewed for example, mentioned that:

I'm not the person to put it on waarnemingen.nl, [a website where you can post your findings and observations]. I can see the point of it, but I don't have that drive. (...) How should I say it... It's keeping records, so to speak. I'm also not into the Excel stuff either. I'm of 'what you see is what you get', so to speak. And I'm not competitive in that sense either. There is a [nature tour] guide, he puts the things I find on waarnemingen.nl, under his own name, and I think that's fine. Then he has a higher score, whatever. No, but I don't have that competition. I'm not about the competition. I'm all about the amazement. (Rose, interview, 03-22-2023)

For Rose, citizen science is not about competition and finding the best shell before the other person might, but it is about enjoying the walks and being amazed by what you see and find. Rose's quote reflects a distinct perspective on the act of documenting and sharing observations through platforms like waarnemingen.nl. On this site you can upload your findings. On one's profile, you can see how many observations that person has made, the number of different types of species one has spotted and how rare the species are they have spotted (this usually includes pictures of the species observed). If you search a specific place, you can see a ranking of who has made the most observations in that specific area. Rose acknowledges the purpose and value of such websites for recording findings and observations but expresses a lack of personal motivation to actively participate. She explained that she is not inclined to keep records or engage with software like Excel. Rose prefers a more immediate and unfiltered approach to her observations, appreciating the notion of "what you see is what you get." Furthermore, she emphasized her lack of competitiveness, highlighting that her interest do not lie achieving a high score or outperforming

others. Instead, Rose priority is on the sense of wonder and amazement. This focus of participants on enjoying nature and collecting data rather than outperforming others could be an important key to friendly interactions between scientists and non-scientists within the SWG group.

This perspective describes an alternative aspect of citizen science, where some participants may prioritize the personal and emotional connection with nature over the systematic documentation and competitive nature. The speaker's emphasis on amazement underscores the profound impact that engaging with the natural world can have on an individual, enriching their personal experience and fostering a deeper appreciation for the environment. While their approach may differ from those who actively contribute data to platforms like waarnemingen.nl, their perspective reminds us of the diverse motivations and priorities of citizen scientists. It shows the potential for individual participants to contribute to the broader understanding of the natural world in ways that align with their personal values and interests, ultimately enriching the collective knowledge of our ecosystems.

I was also told during one of the walks that it is usually not the aim to take home everything you find; you should leave it at the beach for others to see and enjoy. However, the really special things are taken home to add to their personal collection for the purpose of admiration and collecting. Take for example Rose (interview, 03-22-2023): “(..) because how it works with ANEMOON is that, basically, you leave it. Also, so that others can enjoy it. Yes, look, I have a small collection, just, that's my own, that's private. I can't pass up the very nice things [which I find] either, to be honest, haha” The urge to take home beautiful and special things still exists, but from a place of amazement rather than competition. It is cliché, but even here ‘beauty is in the eyes of the beholder’, not everyone had the same worth for each beach find. There was a SWG member who for example had more interest in finding fossils further up the shoreline than shells,

and thus did not take many shells home during his walks. This focus on enjoying the things you find instead of competing for things to find could be a reason for the overall positive interactions between non-scientists and scientists within the SWG group.

Despite the lack of competition, relations between the scientists and non-scientists within the Texel SWG group do not always run smoothly. Possibly due to there being a certain hierarchy, prejudices, or preference in collaboration. In my interview with Rose, she spoke on how she was having a conflict with a scientist on the topic of the duality between scientist and non-scientist: “Well, yes, I had quite a heated discussion about that recently. That the scientists actually prefer to work with scientists.” She did not elaborate on the conflict or identify the scientist, but she was clearly not amused by the situation. To partially rectify her statement, she said that “(..) actually a lot of experts don't pose in a way as if they look at things in a different, scientific, way.” What she meant by this was that most scientists she has interacted with via the SWG do not behave as if they know it all or know it better because of their degree. They act the same as any other citizen. The interview excerpt with Rose displays the dynamics within the scientific community. Despite the absence of intense competition, it becomes evident that smooth relations are not always guaranteed, and a certain hierarchy persists. Rose's mention of a heated discussion regarding the duality between scientists and non-scientists reveals the presence of conflicts within this domain. Such conflicts could arise from differing perspectives and approaches to scientific inquiry, possibly leading to tensions between the two groups. The example that scientists prefer working with their peers suggests the existence of a preference of someone with the same level of scientific literacy. This type of attitude may maintain the hierarchies and power dynamics with regard to science and the public dichotomy. In addition, Rose's observation that many experts do not adopt a scientific perspective suggests the coexistence of diverse viewpoints within the scientific

community. This insight underscores the nuanced nature of scientific work, with individuals approaching problems from various angles and potentially engaging in interdisciplinary debates. Overall, this anthropological analysis underscores the complexity of scientific relationships, revealing the interplay of conflicts, hierarchies, and diverse perspectives within this particular social context.

During my fieldwork, I dedicated significant attention to the linguistic expressions employed by my research participants. I firmly believe that the choice of words is not arbitrary; rather, it carries profound meaning. Closely observing the specific words individuals choose to articulate their thoughts and emotions represents a crucial avenue for exploring their internal worlds and gaining a richer understanding of their perspectives. In an interview with Peter, an elderly man who used to be a schoolteacher, he told me about the kind of people and scientists he knows. He started to tell me about a scientific professor he admired for not being having become a scientist on a 'high horse' as a result of his higher academic education: "I think it's great that such a professor has 'descended' [from his high position as a professional scientist] to the IVN and actually plays a very stimulating role [at the IVN]". He continued by telling me that the Institute for Nature Conservation Education (IVN) is, according to him, compared to the Royal Dutch Natural History Society (KNNV), seen as less 'classy'. The KNNV had more members who had gone to university to become professional biologists, in comparison to IVN where there were more people from different academic levels present. From this interview with Peter, one could say that the vocabulary used, unconsciously or consciously, shows that the hierarchical culture of science still seems to be present. The interviewee, Peter, refers to a specific scientist as a 'professor' who has 'descended' from his high position to be involved in the Institute for Nature Conservation Education (IVN). His use of language implies a hierarchical distinction between

scientists and non-scientists. Suggesting that scientists tend to hold a superior position and therefore act as if they are better than non-scientists. Peter's statement also reveals a perception of the IVN as being less prestigious or 'classy' compared to the Royal Dutch Natural History Society (KNNV). This perception is based on the composition of the membership, where the KNNV is described as having more professional biologists with university degrees. This implies that the presence of professional biologists from the KNNV adds prestige to the organization. The use of language like 'descended' and the distinction between different organizations based on the educational background of their members indicate a lingering hierarchical mindset within the scientific community. This mindset may contribute to a perceived division between scientists and non-scientists, reinforcing the idea that scientists are on a higher intellectual and social level.

Although there might be conflicts and tensions, the non-scientists acknowledge the scientists in their groups as a source of knowledge, which they can utilize. Take for example Rose, who said in her interview: "There are a few people, Dirk who does this for a living [at NIOZ], Marco [for the nature museum]. They are simply the specialists. If they say this is how it is [for example which species they have found on the beach], then I accept it. Yes, look, yes, they studied for it." She added just how useful it is to have scientists in the group, with specific knowledge on different matters. She expanded on this by giving an example of this one time when she had found a squat lobster in a crate on the beach. Rose didn't know what it was, but she knew it was special. Through her connections to the scientists, she was able to figure out what it was: "I saw that it was not normal, and then it is nice that the specialists can look at it, and they know that it is a little roll-up lobster, I believe, never heard of it. That's really great!"

In conclusion, the observations and accounts presented illustrate the evolving dynamics between amateur and professional scientists in the realm of citizen science. The shifting perception

of expertise is evident as non-scientists with self-study and practical experience are increasingly recognized and respected as experts in their fields, even by scientifically trained professionals. These examples emphasize the changing paradigm that values non-traditional pathways to expertise, highlighting the significant contributions and growing recognition of citizen scientists within scientific endeavors. Additionally, the interactions between scientists and non-scientists within the SWG group appear to be mainly positive, characterized by mutual respect and appreciation. The emphasis on enjoying nature, rather than competition, fosters a harmonious atmosphere among participants. However, tensions and conflicts can still arise, particularly in fields such as archaeology, where competition for valuable relics and recognition may strain relations. The presence of hierarchies and differing perspectives within the scientific community further influences the dynamics between scientists and non-scientists. Nevertheless, the recognition of scientists as a valuable source of knowledge highlights the importance of their expertise within the SWG group and the benefits of collaboration.

Chapter 3 - Participatory Science and Social Involvement

23 April 2023 - This was my first coast walk where the weather actually felt mild. There was no sun, yet it didn't feel cold at all. I had put on some of my warmest clothes getting ready for this day. What I remembered from my previous monitoring coast walks, it could be very cold and windy. Which meant that I now was overdressed, in the sense that I now had too many warm layers on. Once I had introduced myself to everyone, we made our way down to the shoreline, where the seashells were waiting for us to be looked at, touched, discussed, and counted. We didn't count every shell, but at the end of the walk we estimated the amounts of the different species we had seen. Having the experience of two prior monitoring walks, I felt more confident in my personal

process of becoming a citizen scientist. I now understood the methods we used and why we counted certain shells and discarded others. In the search of answering my research question I myself had become a citizen scientist. During the walk, there was enough time to talk with everyone. It was not as windy compared to the previous coast walks, which made it much easier to communicate. I made it a habit to ask each new person I spoke to about how they ended up joining the SWG. This was a good starting point to understand their motivations for participation. A common answer I got was that they were invited by their friend/acquaintance who was already a SWG member. Mirjam and Nelleke, for instance, knew each other from their sports group. Nelleke invited Mirjam to join, and ever since Mirjam joined the walks whenever she could. Mirjam mentioned how it's great to be outdoors with others, searching for special shells, quietly saying that “we are enjoying ourselves outside, I needed it.”. Multiple times during the walk, individuals mentioned the social connection as an important aspect of participating. Richard excitedly told me how, some years back, they had even gone on a shell finding trip to France together. After having walked up and down the coast in about an hour, first a kilometer along the ebb line and then a kilometer back along the tide line, we had finished. Before going our separate ways, Stefan, who has been actively participating in this SWG project for about 30 years, said: “we went to get some fresh air, that's all it was for today”, not in a disappointed tone, but rather in a realistic one.

This vignette shows the deeper layers of participating in citizen science, which I initially did not expect. For many of the research participants, including Mirjam, joining the citizen science Strandwerkgemeenschap (SWG) project is about so much more than just helping collect data for science. It is a way to build a network, build friendships, find like-minded people, and have an incentive to go outside. Which can all be ways to practice one's citizenship. In this final chapter

of my thesis, I will explore what it means for my interlocutors to be a citizen scientist, emphasizing the participatory nature and citizenship inherent in citizen science. I take a look at their reasons for participation, shedding light on the intrinsic motivations that drive individuals to engage in citizen science initiatives. I examine the role of volunteering and social involvement in the context of citizen science, illustrating how these activities foster a sense of community and collective purpose among participants. Additionally, I discuss the crucial themes of inclusivity and diversity within citizen science and how the lack thereof could form a limit for democratic participation of science and equal opportunities in expressing citizenship.

Unpacking the motivations for participation

I discovered that there are various reasons for SWG members to participate in this specific citizen science initiative. The main motivations are building and maintaining a network, gaining knowledge on determining flora and fauna of the Dutch coast, being in nature, getting some fresh air and having social interactions with others.

Network

For both Rose and Dirk, a large part of being part of SWG involves fostering and building new contacts. Rose mentioned how she was active at different organizations on the island as a volunteer, and at the SWG for three years. Due to her freelance work, she can manage her time freely, leaving her with enough time and flexibility to volunteer next to her job. She doesn't have to go to the office every day and only has a few job assignments per week, which leaves her with a lot of spare time. Participating in the SWG and other volunteering allows her to utilize this extra time productively. She then said the following: "I also receive things in return. I don't get paid, but

simply networking, I expand my network" (interview, 03-22-2023). Rose was not specifically talking about SWG but about her volunteer work in general. In an earlier conversation I had with Rose, she excitedly told me about her journey of moving from the Dutch mainland to Texel 5 years ago and not knowing anybody. This resulted in her wanting to purposefully make new connections. Volunteer work played an important role in making her new place home through the building of connections with the people of Texel. She mentioned that she went and did almost all the courses available, even the integration course meant to teach the Dutch language and how Dutch society works⁴, all to be able to learn the ins and outs of the new place she had settled.

For Dirk the network is important as well, but different from Rose. Dirk, in his role as a NIOZ Research Assistant, in the Coastal Systems department, emphasized the significant benefits of participating in the SWG. Stating that it provides a valuable vantage point to monitor the arrival of new species along the coast of Texel to detect any noteworthy changes. In addition to these observations, Dirk finds the SWG particularly advantageous due to the network and connections it offers to people and institutions. Within the SWG group of Texel and other SWGs groups along the Dutch coast, there are members employed by notable organizations like Ecomare and Naturalis, establishing a direct connection between the SWG and these institutions. By leveraging these connections with fellow participants who work at Ecomare and Naturalis, Dirk can foster valuable relationships that significantly enhance his work, and vice versa. Dirk said that this is why it is useful that a NIOZ employee (himself) has taken over as coordinator of SWG Texel once again. The previous coordinator was also from NIOZ, whereafter his retirement Dirk took over his position. Having another NIOZ representative ensures a seamless transition, continuation of expertise within the group and ensures the link between the SWG and NIOZ stays strong.

⁴ According to Rose many other *Texelaars* (Texel inhabitants) joined as well.

A good example of how the network made itself useful was the National Shell Counting Day on Texel. The National Shell Counting Day was a joint initiative of Naturalis, the Dutch Malacological Association, the ANEMOON Foundation, Het Groene Strand, the North Sea Foundation and the SWG. On this day, the first official National Shell Counting Day (Saturday, March 25th, 2023), volunteers successfully counted over 34,000 shells on Dutch beaches. With the help of experts, more than a thousand participants conducted shell counting and shell identification at 19 different locations along the Dutch coast. SWG on Texel had at least two members who worked at Ecomare. Their direct link to Ecomare probably made it possible for the National Shell Counting Day to take place at Ecomare. As a means for promotion Ecomare even posted it on their website⁵.

To gain knowledge

Joining a citizen science project offers a means to enhance knowledge through hands-on practice and through knowledge sharing of scientists in the group. This is particularly true for individuals like Rose and Melissa, who initially had limited knowledge of coastal flora and fauna. Walking along the coast in their personal time spiked their interest in their surroundings and made them want to learn more about the nature around them. Having developed this keen interest, they looked for a way to increase their knowledge, this was one of the motivations for them to be part of a citizen science project. This could also be seen as their motivation for increasing their scientific literacy. I will refrain from delving further into this topic since I have already elaborated on Rose's motivation to acquire additional knowledge in Chapter 1, where I explored the concept of scientific literacy. Moreover, Peter mentioned in an interview that he prefers to join the monitoring walks

⁵ Website link: [Schelpen tellen en determineren](#)

where one of the more knowledgeable members such as Dirk or Marc are joining as well. That way he can learn more during these monitoring walks than when he walks with members that have less knowledge on coastal flora and fauna than him.

Being outside and getting fresh air

For many research participants like Stefan, joining these walks is a moment to be outside, get some fresh air and enjoy nature. The way Stefan said “we went to get some fresh air, that's all it was for today” indicated that we as a group hadn't stumbled upon any remarkable beach discoveries, however we did get to be outside and enjoy the fresh sea air, which to him seemed just as important. Similarly, Mirjam a few minutes before mentioned how it was great to be outside with others and look for special shells, quietly (mumbling under her voice) saying that “we are enjoying ourselves outside, I needed it.”. For Mirjam having these few hours outside is just what she needed, for what reasons exactly I don't know. Maybe she didn't even know that herself. However, walking along the coast and engaging in nature made her happy. This indicates that SWG members' personal priorities are not automatically to collect data but to have an opportunity to be outside.

Gezelligheid - Social connection

When I asked Rose how she experienced these last three years of participating in SWG she answered: "...at You see, I walk alone every day, so it's really nice to walk with people who share the same interests. We [of course] also have completely different conversations [then only about the shared interest in marine flora and fauna]. I absolutely want to keep doing this, as long as I can." Rose expresses her desire to continue participating in the SWG monitoring walks, sharing her excitement about walking with people who share the same interests and engaging in diverse

conversations beyond the focus on marine flora and fauna. For Rose the social aspect of connecting with like-minded people during the monitoring walks is a motivating factor. Additionally, she finds personal fulfillment in participating, as it provides a break from walking alone and creates a sense of community. Rose's positive experience and eagerness to continue indicate the meaningful impact of the SWG walks on her well-being and draw the attention to the importance of social interaction and shared interests with her participation.

Throughout my participant observations I got the sense that this group of people cared about each other, there was a sense of community. On my first monitoring walk, with Dirk and Peter I carpoled with them to and from the beach location. On our way back we were first going to drop Peter off, in the car he was telling us about a small piece of public land/forest/garden where he had been planting snowdrops. He was proudly telling us about how they were beginning to bloom, creating a beautiful little area covered in flowering white bulbs. He asked us if we wanted to come see them. Dirk parked the car next to the street so we could take a look. It indeed looked very beautiful seeing flowers bloom, especially since it was still winter. After admiring the plants Peter was friendly enough to invite us back to his home for a cup of tea. Dirk had other plans, so he had to politely say no, I wanted to join, but Dirk was my ride back home. The carpooling indicates a willingness to share resources and collaborate on logistics, suggesting a cooperative and supportive dynamic among the group members. Additionally, Peter kindly extends an invitation for the group to visit his home for a cup of tea. This gesture points to a welcoming and inclusive attitude within the group, where members are open to extending their social interactions beyond the initial activity. Quite a few SWG members are above the age of 60, I can imagine that for the elderly members of the group it can be extra nice to have these moments like the monitoring

walk to connect with others. Thus, one of the main motivators of joining in the monitoring walks may be the ‘gezelligheid’, the enjoyment of social connection and interactions with others.

Contribute to society and nature

Engaging in citizen science often means dedicating hours as a volunteer, sacrificing your leisure time without monetary compensation. This most likely requires a strong motivator. Contributing to one's own social and natural environment could be one of these motivators. All my interlocutors had a certain devotion and admiration for nature. It was not explicitly said but I got the sense that they cared about the nature of the Dutch coast and by joining the SWG they could punt in time towards something they intrinsically cared about. Which is towards the collection of data important to nature and conservation policies. Moreover, Rose mentioned how she is on the board of a nature-focused organization, an unpaid position. She expressed her belief in the value of being a board member, stating, “...I think it's very good to be on a board. ... This happens to be related to nature, but, well, you contribute to society in that way.” She expressed the same motivations for her other volunteering activities, including participating in SWG.

Inclusivity and diversity

Citizen science promises to make science more democratic, fostering inclusivity and diversity in the creation of knowledge. However, according to different research papers, citizen science projects tend to largely consist of Caucasian, highly educated, and affluent people, often not reflecting the demographics of the population (Bonney et al. 2015; Dibner and Pandya 2018). Bonney et al. (2015, 12) stated that “if the field of citizen science is to truly contribute to democratizing science, then it must strive to reach a wider range of audiences and participants”.

Before even joining on the monitoring walks, I heard from one of my interlocutors that there the members involved are almost all Caucasians of Dutch descent. In an interview I had with Willem, founder and chairman of the ANEMOON Foundation, he said the following:

In all types of organizations, including the ANEMOON Foundation, you see that citizen scientists are composed of more than 99% white individuals. People of color are significantly underrepresented [in ANEMOON projects throughout the Netherlands], and that is certainly a cause for concern. However, within ANEMOON, we are unsure how to effectively bring about change in this regard. Somehow, we are unable to reach or engage people of color, and we are not successful in generating their interest to participate. Even at public gatherings and events, we rarely encounter people of color. (Willem, interview, 04-20-2023)

Willem's quote presents a significant issue regarding inclusivity and diversity within citizen science in the Netherlands, which falters democratic participation. He points out that the majority of citizen scientists, including the ones in ANEMOON, are predominantly white, with people of color being underrepresented. Willem views this lack of diversity as a cause for concern, as it indicates a lack of inclusivity and equal participation opportunities for individuals from different racial backgrounds. Even though he expressed a genuine desire to address this, he also admits that ANEMOON lacks a clear understanding of how to tackle this. Willem further mentions the difficulty in reaching or sparking the interest of people of color to participate in citizen science. This may be an example of a larger problem of insufficient steps being taken to improve the representation among historically marginalized groups in science. For science to become more

democratic there needs to be equal opportunities and equal representation within scientific endeavors. It is important to mention that citizen science is a voluntary activity, members do not get paid for the hours they put in. For individuals with less socioeconomic status, volunteering is likely not a luxury they can afford. This can be a barrier for people of lower socioeconomic status to participate in citizen science. If the government or scientific institutions were to pay for citizens to participate in citizen science this could possibly give the opportunity for marginalized groups to participate in the creation of scientific knowledge. However, Willem (interview, 04-20-2023) does mention that:

Within the white group of citizen scientists, we observe a significant diversity in terms of education, gender, religion, lifestyle, and sexual orientation. Most citizen science project groups form a mixed company with a shared interest in nature, where participants demonstrate consideration for one another and interact respectfully.

This quote highlights an important aspect of diversity within the white group of citizen scientists. While the previous quote focused on the underrepresentation of people of color, this statement emphasizes the diversity that exists within the white community itself. It acknowledges that diversity extends beyond race, encompassing factors such as education, gender, religion, and sexual orientation. The mention of a shared interest in nature as a common thread among citizen science project groups signifies the unifying force that brings diverse individuals together. It suggests that despite differences in various aspects of identity, participants are united by their passion for the natural world and their engagement in scientific activities related to it. Moreover, the quote emphasizes the positive dynamics within these groups, emphasizing the importance of

mutual consideration and respect. This indicates that within these diverse citizen science communities, individuals actively strive to create an inclusive and respectful environment where everyone's perspectives and experiences are valued. Overall, this quote presents a contrasting perspective to the previous quote, showcasing the diversity within the white group of citizen scientists while emphasizing the harmonious interactions and inclusive practices that characterize their engagement in citizen science projects.

Lastly, there is the lack of young people involved. Robert told me in an interview that “the group [SWG Texel] is shrinking”. For a project like SWG to function properly it needs enough members. However, the SWG could cease to exist due to members of old age leaving and no new young people joining. This is why, according to Dirk and Robert, activities such as the National Shell Counting Day are important (see figure 3). That through these events younger people will be encouraged to learn more about the coastal environment and eventually inspire them to be involved in citizen science projects like SWG. Nevertheless, Robert added that the lack of young people involved in citizen science on Texel has to do with Texel being an island. There are not many options for higher education for young adults nearby, especially not focused on nature. Most young adults leave Texel to further their higher education on the mainland of the Netherlands.



Figure 3: Father (left) and daughter (right) participating in the National Shell Counting Day with the expert help of Marco (middle). (Photo taken by Aleysha Korver)

In conclusion, the motivations for participation in the specific citizen science initiative of the SWG are diverse and multifaceted. Participants are driven by the desire to build and maintain a network, gain knowledge about the coastal flora and fauna, enjoy being in nature and getting fresh air, experience social connections and a sense of community, and contribute to both society and nature. These motivations collectively highlight the personal fulfillment, social interactions, and environmental stewardship that the SWG provides to its members. Additionally, the issue of inclusivity and diversity in citizen science is a significant concern in the Netherlands, as displayed by Willem's statement. The underrepresentation of people of color within citizen science projects indicates a lack of equal participation opportunities and inclusivity. Willem's acknowledgement of this problem and the challenges faced in addressing it underscores the need for effective strategies and initiatives to engage individuals from different racial backgrounds. However, it is worth noting that within the white group of citizen scientists, there is a significant diversity in terms of lifestyle, education, gender, religion, and sexual orientation. This showcases the potential for inclusivity and respectful interactions within citizen science communities, emphasizing the shared interest in nature as a unifying factor. Overall, efforts should be made to bridge the gap and create a more inclusive and diverse citizen science landscape in the Netherlands while also involving more young people.

Conclusion

Throughout this study, I have explored the experiences and perceptions of individuals engaged in citizen science in the Netherlands, particularly focusing on the citizen science initiative Strandwerkgemeenschap on the island of Texel. This investigation led to several important questions: To what extent do individuals engaged in citizen science in the Netherlands believe that

the three promises of citizen science are fulfilled? How does the supposed connection between scientists and citizens manifest itself in the field? What are the dynamics between scientists and non-scientists within this context? Additionally, in order to fully understand the limitations of citizen science, it was essential to explore the significance of participation for the citizen scientists themselves and comprehend their motivations for engaging in citizen science initiatives. To answer these questions, I conducted ethnographic research on individuals involved in the citizen science initiative SWG on the island of Texel, the Netherlands. Which brought me to the following research question: How do people involved in citizen science on the Dutch island of Texel experience the promises, politics, and the limitations of citizen science?

This thesis contributed to the academic debates centered around science and expertise, knowledge production, and democratic participation. These theoretical concepts and debates assisted in researching how science, scientific practices, citizens, discourses, and practices of citizenship are being made and remade through practices of citizen science. Firstly, the people involved in SWG believe that while citizen science has made significant progress in fulfilling many of its promises, it remains constrained by certain limitations. The promises of citizen science revolve around democratizing the production of knowledge, increasing scientific knowledge among the public, and empowering citizens with knowledge to contribute to significant scientific breakthroughs. Barth's (2002) perspective on knowledge as a multifaceted entity, encompassing information, skills, and social relations, further emphasizes its profound influence on individuals and communities. However, it is important to recognize that certain epistemic systems, such as scientific knowledge, have historically been privileged and dominant, often overshadowing local lay knowledge. Citizen science breaks down this hierarchy by offering a platform where

individuals who are not professional scientists can question established scientific knowledge and actively contribute to the scientific pursuit in a valuable way.

Secondly, the ethnographic accounts I have collected during my fieldwork show the evolving dynamics between non-scientists and professional scientists in the sphere of citizen science. The evolving perception of expertise is evident as non-scientists with self-study and practical experience are increasingly recognized and respected as experts in their fields, even by scientifically educated professionals. These examples emphasize how citizen science challenges the common understanding of expertise. Furthermore, the exchanges among scientists and non-scientists within the SWG group seem to predominantly be constructive, characterized by mutual respect. The participants' priority on amazement and enjoyment of nature, rather than competition, fosters a concordant atmosphere among participants. The presence of hierarchies and differing perspectives within the scientific community further influences the dynamics between scientists and non-scientists. Nevertheless, the recognition of scientists as a valuable source of knowledge highlights the importance of their expertise within the SWG group and the benefits of collaboration.

Lastly, the motivations for participation in SWG I have unpacked in this thesis are diverse and multifaceted. Participants are driven by the desire to build and maintain a network, gain knowledge about the coastal flora and fauna, enjoy being outside in nature, experience social connections and a sense of community, and contribute to both society and nature. These motivations collectively highlight the personal fulfillment, social interactions, and form of citizenship that the SWG provides to its members. Additionally, the issue of inclusivity and diversity in citizen science is a significant concern in the Netherlands. The underrepresentation of people of color within citizen science projects indicates a lack of equal participation opportunities

and inclusivity. This has consequences on citizen science's ideals of democratic participation. However, it is worth noting that within the white group of citizen scientists, there is a significant diversity in terms of education, gender, religion, lifestyle, and sexual orientation. This showcases the potential for inclusivity and respectful interactions within citizen science communities, emphasizing the shared interest in nature as a unifying factor. Overall, efforts should be made to bridge the gap and create a more inclusive and diverse citizen science landscape in the Netherlands while also involving more young people.

Moreover, I would like to suggest potential avenues for future research. It could be interesting and important to pursue additional research in the area of inclusivity and diversity within citizen science. Exploring the barriers that hinder inclusivity and diversity in citizen science initiatives, particularly in relation to the underrepresentation of specific groups such as people of color, could yield valuable insights. Understanding the reasons behind these barriers and identifying strategies to address them, while promoting equal participation opportunities, can contribute to fostering a more inclusive and representative citizen science and science landscape. Therefore, a valuable avenue for further investigation would be to identify a citizen science initiative in the Netherlands that has successfully engaged a diverse group of participants, including people of color. Conducting ethnographic research on the experiences of these specific members who are people of color can provide a deeper understanding of their motivations, challenges, and perspectives within the citizen science context. By examining their experiences and gathering qualitative data, this research could shed light on effective practices and approaches that contribute to increased diversity and inclusion in citizen science projects as well as science.

In conclusion, this study on citizen science in the Netherlands, particularly focusing on the SWG initiative on the island of Texel, highlights the progress made in fulfilling the promises of

citizen science while recognizing its limitations. It emphasizes the transformative potential of citizen science in democratizing knowledge production, challenging traditional hierarchies, and fostering constructive dynamics between scientists and non-scientists. Furthermore, the diverse motivations of participants and the need for greater inclusivity and diversity within citizen science projects are crucial areas for future research and development.

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Appendices

Appendix A

TEXEL

DIT WEEKEND

Wordt elke donderdag gratis huis-aan-huis verspreid (ca. 6.500 huishoudens, totale oplage 15.000) - 15
Redactie: Vismarkt 7 • 1791 CD • Den Burg • Tel: 0222-310111 • E-mail: redactie@t

Wie helpt tellen?

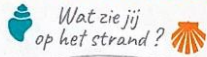


Foto: Taco van der Eb

Zaterdag 25 maart is de Nationale Schelpenteldag. Op dertien stranden in Nederland worden dan schelpen geteld. Ook vanuit Ecomare wordt eraan meegedaan. Er gaan zaterdag vier excursies naar het strand. Bovendien zijn in de hal van Ecomare de hele dag deskundigen aanwezig om schelpen op naam te brengen. De excursies op het strand beginnen om 10.00, 12.00, 13.30 en 15.00 uur bij Ecomare. Ze duren ongeveer anderhalf uur. Met elkaar wordt bekeken welke schelpen er op het strand liggen en worden de aantallen per soort geteld. Een gratis schelpendeterminatiekaart helpt hierbij en natuurlijk kent de gids ze ook allemaal. Je hoeft dus geen schelpenkenners te zijn om mee te doen. Deelname is gratis, vooraf aanmelden is fijn en garandeert je een plek. Aanmelden kan bij Ingrid Uitgeest, E: ingriduitgeest@ecomare.nl of T: 0222-317741. In de hal van Ecomare, voor de kassa, staat deze dag een 'schelpdesk', met gevonden schelpen van over de hele wereld. Hier zijn experts van Ecomare en de strandwerkgemeenschap te vinden. Zij beantwoorden alle vragen over schelpen. Iedereen kan met schelpen bij hen terecht voor determinatie en informatie. Neem gerust ook andere aanspoelsels mee! Het doel van de schelpenteldag is meer te weten te komen over de schelpen in de zee. Naast Nederland doen ook België en Frankrijk mee. Alle resultaten worden gebundeld en geanalyseerd. Belangrijk voor de wetenschap, maar voor de deelnemers vooral leuk en interessant. Meer informatie over de schelpenteldag is te vinden op de website <https://www.schelpenteldag.nl>

Appendix C

GROTE STRANDSCHELPEPENDAG



25 MAART 2023

Doe bij jou in de buurt gratis mee met de gezellige en interessante landelijke schelpenteldag en draag bij aan kennis van de Noordzee

WAT GAAN WE DOEN? Op meer dan 20 Nederlandse stranden verzamelen, identificeren en tellen we schelpen en slakken. Dit doen we met aanwezige experts of met excursies die lokaal plaatsvinden. Hiermee bepalen we de schelpenstand en kijken we samen hoe die door de jaren heen verandert. Dit jaar is het thema doubletten en enkele kleppen van tweekleppigen. *Wat is een doublet?* Een doublet is een setje van twee kleppen die nog op de natuurlijke wijze aan elkaar zitten.

WAT KAN JIJ DOEN? Dat is simpel: schelpen tellen!

- Zoek het vloedmerk op en maak een punt (bv. met een stokje). Het vloedmerk kan je vinden door te kijken tot waar na de laatste golf het water kwam.
- Verzamel vanaf dat punt spiraalsgewijs naar buiten alle hele schelpen en slakkenhuisjes (geen gebroken stukken) tot je er 100 hebt.
- Breng de schelpen/huisjes op naam en tel het aantal doubletten (gebruik de tabel, het internet, of vraag ons expertteam om hulp).
- Schrijf de aantallen op dit formulier en lever je formulier in bij het expertteam.
- Probleem met op naam brengen? Vraag de experts van het schelpenteam.
- Benieuwd naar de resultaten? Schrijf dan je e-mailadres op het formulier. We zullen dat alleen gebruiken om de resultaten te versturen.

Op welk strandvak sta je? Vul in:

Je e-mailadres. Vul in:

Scan de qr-code voor meer info en een filmpje over de telmethode



Heel erg dank voor je deelname! Met je tellingen kunnen we de diversiteit van de strandschelpen in beeld brengen!

Nederlandse Malacologische Vereniging - Het Groene Strand - Naturalis Biodiversity Center - Stichting Anemoon - Stichting de Noordzee



TEL OOK MEE!

schelpen	aantal losse kleppen		aantal dubbele kleppen
1 Oester (<i>Ostrea edulis</i>)			
2 Japanse oester (<i>Magellana gigas</i>)			
3 Mossel (<i>Mytilus edulis</i>)			
4 Kokkel (<i>Cerastoderma edule</i>)			
5 Halfgeknotte strandchelp (<i>Spisula subtruncata</i>)			
6 Stevige strandchelp (<i>Spisula solida</i>)			
7 Ovale strandchelp (<i>Spisula elliptica</i>)			
8 Grote strandchelp (<i>Macra stultorum</i>)			
9 Otterschelp (<i>Lutraria lutraria</i>)			
10 Amerikaanse Zwaardschede (<i>Ensis leei</i>)			
11 Nonnetje (<i>Macoma balthica</i>)			
12 Tere platschelp (<i>Macomangulus tenuis</i>)			
13 Rechtsgestrepte platschelp (<i>Fabulina fabula</i>)			
14 Zaagje (<i>Donax vittatus</i>)			
15 Witte dunschaal (<i>Abra alba</i>)			
16 Platte slijkgaper (<i>Scrobicularia plana</i>)			
17 Amerikaanse boormossel (<i>Petricolaria pholadiformis</i>)			
18 Witte boormossel (<i>Barnea candida</i>)			
19 Strandgaper (<i>Mya arenaria</i>)			
20 Venusschelp (<i>Chamelea striatula</i>)			
21 Gewone tapijtschelp (<i>Venerupis corrugata</i>)			
22 Filipijnse tapijtschelp (<i>Venerupis philippinarum</i>)			
23 Gewone schaalhoren (<i>Patella vulgata</i>)			
24 Alikruik (<i>Littorina littorea</i>)			
25 Grote tepelhoren (<i>Euspira catena</i>)			
26 Glanzende tepelhoren (<i>Euspira nitida</i>)			
27 Gewone wenteltrap (<i>Epitonium clathrus</i>)			
28 Muiltje (<i>Crepidula fornicata</i>)			
29 Wulk (<i>Buccinum undatum</i>)			
30 Fuikhoren (<i>Tritia reticulata</i>)			
Andere soorten:			
Andere soorten:			

Foto's: PIC/AN/Stichting ANEMOON, Naturalis, Wikipedia, Olivier P. Avants, Jan J. Jansen ter Horsten

