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Climate Change and Coastal Vulnerability: Application of Vulnerability Assessment Methodologies in Two Coastal Communities in South Africa

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Plagiarism Declaration

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

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Abstract

Climate and environmental change is a phenomenon which is having a significant effect on human-ecological systems around the world. It is predicted to have a detrimental impact on certain groups and populations; among those most at risk are those who have the highest exposure and sensitivity to the climate and environmental changes and the lowest adaptive capacity. This includes coastal fishing communities and therefore necessitates action at a variety of scales in order to build the resilience of these individuals and groups to the predicted changes and their potential impacts.

Vulnerability assessments (VAs) have been identified as an effective way to discover who is most vulnerable and to what threats or hazards. This is valuable as assistance can then be provided to the individuals, groups, regions or countries identified as most vulnerable. VAs can be conducted at a variety of scales and can be either quantitative or qualitative. This research project focused on vulnerability assessments conducted at the local level. These community-scale assessments are important as they are able to elicit finer-scale details, identify the greatest hazards and stressors, and conceptualize adaptation strategies that are locally-informed, context specific and targeted towards a specific community.

The focus of this research project was to first assess the vulnerability of two coastal communities in South Africa, namely Doringbaai and St Helena Bay, using a suite of mixed methods which included focus group discussions, the review of secondary data, and key informant interviews. Secondly, this project aimed to assess the potential contribution of a 'rapid vulnerability assessment' (RVA) methodology, conducted in the same two coastal fishing communities, to gain information required to identify appropriate adaptation strategies in the context of climate and environmental change. The RVA is conducted as a workshop over a two-day period and may be followed by key informant interviews on the third day, if appropriate and required. This research sought to compare and contrast the information emanating from the RVA workshops with information obtained from the triangulation of mixed methods used in this study with respect to: key threats and stressors faced by the two small-scale fishing communities, identified environmental changes, impacts of these changes on fisher livelihoods, current coping strategies and potential adaptation strategies. Criteria for assessing the performance of the two different approaches were drawn from the literature and systematically documented.

The outcome of the assessment showed that the RVA has value as a VA methodology and is able to identify locally relevant, potentially viable adaptation strategies. It is an effective approach for obtaining a good overview of the vulnerabilities of a community and is thus especially useful in under-resourced and data-poor regions. The conclusion was therefore that it is an exceptionally useful tool as a starting point for vulnerability assessments but can be enriched by combining it with other methods such as the review of secondary data, focus group discussions, surveys, questionnaires and key informant interviews. Furthermore, it is recommended that the RVA includes follow-up research and focuses on flexible adaptation strategies.

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List of Acronyms

AB – Angola-Benguela

AIS – automatic identification system

ATM – automated teller machine

BCC – Benguela Current Commission

BCLME – Benguela Current Large Marine Ecosystem

BCLMEP –Benguela Current Large Marine Ecosystem Programme

CBO – community-based organization

CL – Coastal Links

DAFF – Department of Agriculture, Forestry and Fisheries

DB – Doringbaai

DDT – Doringbaai Development Trust

DTI – Department of Trade and Industry

EPA – United States Environmental Protection Agency

EPWP – Expanded Public Works Programme

FAO – Food and Agricultural Organization

FG – focus group

FGD – focus group discussion

GPS – global positioning system

GULLS – Global learning for local solutions: Reducing vulnerability of marine-dependent coastal communities

HAB – harmful algal bloom

IPCC – Intergovernmental Panel on Climate Change

IRP – interim relief permit

LOW – low oxygen water

MLRA – Marine Living Resources Act

MLS – minimum legal size

MPA – marine protected area

NGO – non-governmental organization

NSRI – National Sea Rescue Institute

ODI – Overseas Development Institute

OECD – Organization for Economic Co-operation and Development

PVA – participatory vulnerability assessment

RAF – Road Accident Fund

RFLP – Regional Fisheries Livelihood Programme for South and Southeast Asia

RVA – rapid vulnerability assessment

SAHO – South African History Online

SHB – St Helena Bay

SoVI – social vulnerability index

SSF – small-scale fisher

TAC – total allowable catch

UCT – University of Cape Town

UIF – Unemployment Insurance Fund

UNEP – United Nations Environmental Programme

VA – vulnerability assessment

VMS – vessel monitoring system

WCRL – west coast rock lobster

WWF – World Wide Fund for Nature

Chapter 1: Introduction

1.1 Introduction

Climate change is a phenomenon which is having a global impact on different environments and systems, both temporally and spatially. It is causing the earth to become warmer as a result of anthropogenic forcings such as greenhouse gas emissions and deforestation (Brovkin et al., 2004; UN Habitat, 2011; IPCC, 2014). The effect of this on the ocean is especially significant as the total energy uptake has been over twenty times that of the atmosphere; on average there has been a global warming of the ocean's upper layer of 0.6°C over the last century (Bijma et al., 2013). The consequences of this warming with regard to fisheries could include: changes in the distribution and seasonality of coastal and freshwater species, potential decline or even extinction of species, an increase in the frequency and magnitude of extreme weather events and sea-level rise, to mention a few (Cochrane et al., 2009). This in turn could have a significant and potentially detrimental impact on fishery systems - especially on people and communities who depend on the coast and its resources for their survival.

In South Africa, the coastal system which surrounds the country's south and southwest coastline, known as the Benguela Current Large Marine Ecosystem (BCLME), is a system currently observed to be undergoing changes. It is predicted that the BCLME "may well be an early site for the manifestation of global climate change" (BCLME Programme, 2007: 1). As the system is highly complex and naturally variable, it is difficult to discern the exact cause of the changes (Hampton & Willemse, 2012). However, according to the BCLME Programme (BCLMEP) (2007: 3), "the body of evidence that climate change or variability is implicated is growing". As the future impacts of climate change are laden with great uncertainty, it is important to determine who is most vulnerable and to what threats or hazards (Preston, 2012). This is essential so that measures may be taken to ensure the protection of these groups and provide assistance with building their adaptive capacity. It is also important to see how communities are currently responding and adapting to climate and environmental change and variability so that successful adaptation initiatives may be supported. The Intergovernmental Panel on Climate Change's (IPCC) fifth report (IPCC, 2014: Annexure II: Glossary: 1758) defines adaptive capacity as being: "The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences". Adaptation initiatives and preparation are essential in the face of climate-related uncertainty as "failure to invest in adaptation may leave a nation poorly prepared to cope with adverse changes and increases the probability of severe consequences" (Scheraga & Grambsch, 1998: 85).

Fisheries are central to many coastal communities and any changes to climate or environment may aggravate stress on what is already a vulnerable group. The Food and Agricultural Organization (FAO) of the United Nations describes the most vulnerable fisheries to be "those with a large number of people living in communities heavily dependent on fish for food, with almost no ability to adapt, such as…rock lobster and small-scale line fisheries in South Africa" (FAO, 2014: 184). It is therefore important that the most

vulnerable of these communities be identified and their vulnerability assessed so that current and potential adaptation strategies may be evaluated.

The need for assessing vulnerability is becoming pertinent to climate change and variability research and is a field which has gained increasing momentum, especially over the last 40 years (Barsley et al., 2013). Through an assessment of who is vulnerable (the scale of which would need to be determined, for example, on an individual, household, community, regional or national level) and to what threats or hazards, the formulation of effective and targeted responses can be facilitated. Vulnerability assessments (VAs) are a tool which enable the provision of knowledge which can be used to enhance the understanding of climate change impacts and inform effective adaptation strategies (Raemaekers & Sowman, 2015). According to Barsley et al. (2013: 1), VAs "can play a vital role in the design of appropriate adaptation and mitigation policies targeted towards climate change and its impacts on marine and aquatic ecosystems, and those who depend upon these resources for their livelihoods and well-being".

Vulnerability assessments can be done at a variety of scales depending on their application. Assessments at global or regional scales are important to assess and compare the vulnerability of different countries to climate change impacts (Allison et al., 2009; Hughes et al., 2012). These larger scale assessments are especially useful for international climate change organizations, such as the IPCC, as they provide a deeper insight into the understanding of vulnerability and enable the most vulnerable regions to be identified (Allison et al., 2009). These global or national scale studies have mostly focused on industries other than fisheries, especially the agricultural sector; however, there has been an increasing focus on fisheries in the past few years (Vörösmarty et al., 2000; Brooks et al., 2005; Allison et al., 2009; Hughes et al., 2012). Figure 1 shows a map depicting the vulnerability of countries' fisheries to the impacts of climate change based on an assessment undertaken by Allison et al. (2009). These types of large scale assessments are generally quantitative, based in the natural sciences, and make use of tools such as models and indicators.

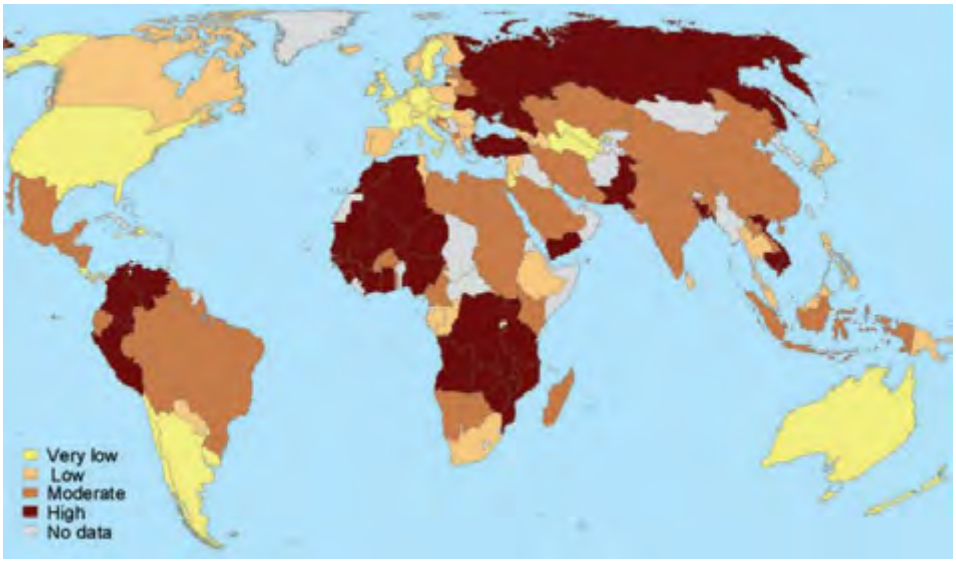

Figure 1: The impact of climate change on fisheries around the world and the resultant impact on national economies; this takes into account the sensitivity, exposure and adaptive capacity. Darker colours demonstrate a more pronounced impact (Allison, 2009: 187).

On the opposite end of the scale, there are community-level studies. These are usually stakeholder-based and can make use of a variety of tools to assess vulnerability including workshops, focus group discussions, surveys, Delphi methods, questionnaires and participatory rural appraisals (Barsley et al., 2013) to obtain quantitative (Nelson et al., 2010; Pamungkas et al., 2011; Mills et al., 2011; Cinner et al., 2013) and qualitative data (Clark et al., 1998; Dolan & Walker, 2006; Cinner et al., 2012). These finer-scale examinations of vulnerability are significant to elicit details not seen at the broad level, details which will be relevant for shaping policy and formulating potential mitigation and adaptation strategies (Dazé et al., 2009; Barsley et al., 2013; Mamauag et al., 2013). These assessments are becoming an increasingly used tool, especially in the fields of climate change and adaptation responses, as they are largely context specific and thus make use of a more targeted and effective approach to assessing vulnerability (Barnett, 2008; De Young et al., 2012).

A vulnerability assessment which is rapid (spanning over the course of only a few days) and participatory is a potentially propitious methodology for less developed areas as it can provide great insight and understanding to areas where information is currently limited (Brugère & De Young, 2015). This approach "does not require extensive datasets and can incorporate expert judgements as well as locally relevant knowledge to assess vulnerability… [it] can also identify fisheries with the highest vulnerability and therefore prioritize for adaptive actions" (Mamauag et al., 2013: 2). Johnson and Welch (2010: 118) further stipulate that: "Simple processes and approaches for assessing vulnerability in a data-limited environment are needed that are transparent and locally relevant so that appropriate fisheries management can be implemented in a timely manner".

The focus of this research project is thus to assess the effectiveness of a rapid vulnerability assessment (RVA) methodology developed for application in the context of coastal communities in the BCLME which assesses the vulnerability and adaptive capacity of small-scale fishing communities to climate and environmental change in Southern Africa. The development of a RVA was undertaken by members of the Department of Environmental and Geographical Science based at the University of Cape Town (UCT) who are working on a project commissioned by the Food and Agricultural Organization (FAO) of the United Nations and the Benguela Current Commission (BCC). This dissertation therefore aims to assess whether this 'rapid vulnerability assessment' methodology has the potential to contribute to vulnerability assessments and obtain an accurate overview of a community's main vulnerabilities and threats, specifically those that result from climate and environmental change. It also seeks to determine what adaptation methods are currently being employed by the community and what other strategies could be effective in the context.

This study will therefore examine the effectiveness of the RVA methodology by conducting complementary vulnerability assessment studies with smaller focus groups from the same two communities as well as conducting key informant interviews and reviewing secondary data. The aim will then be to compare and contrast the data generated from both methodologies to determine the potential of the RVA methodology to contribute to VAs and the identification of adaptation strategies, the application of which has its value in requiring few resources for obtaining a good overview of information. This can be especially significant in a variety of sectors in third world, under-resourced countries threatened or

potentially threatened by climate change and environmental variability (Johnson & Welch, 2010; Mamauag et al., 2013).

1.2 Rationale for the Study

The importance of access to fisheries by coastal communities has been globally recognized as it serves as both a key source of food security and livelihood. There are however a multitude of challenges to do with coastal management on an international level; pollution, demand for coastal development, declining fish stocks and habitat degradation are factors which contribute to increasing the pressure on the often already vulnerable coastal communities (Belmont Forum, 2014). Climate change and variability is a further stress for these communities, with the outcomes at this time largely unknown. Management of coastal and fisheries resources are also fraught with weaknesses. One of the main causes of the shortcomings in management can be attributed to a lack of collaboration between social and natural science when it comes to formulating management strategies. Furthermore, fisheries science and research is often not translated into effective adaptation strategies (Belmont Forum, 2014). This is further extrapolated in the literature review in Chapter 2.

This study is part of the 'Global learning for local solutions: Reducing vulnerability of marine-dependent coastal communities' (GULLS) project which is co-ordinated by Rhodes University. The key aim of the project is to reduce the vulnerability of marine-dependent coastal communities in countries based in the southern hemisphere through an interdisciplinary research approach that seeks to find best practice and innovative strategies through the provision and sharing of knowledge (Belmont Forum, 2014). The information generated from the project can then be used to facilitate adaptation action by governments and stakeholders around the world. The project is a collaborative, international initiative, bringing together leading researchers from the southern hemisphere; namely: Australia, South Africa, India and Brazil (and includes input researchers from the USA and UK), with varying social, natural and economic backgrounds.

This particular dissertation contributes to the GULLS project by assessing the application of a 'rapid vulnerability assessment' (RVA) methodology being applied in two coastal fishing communities in South Africa. It is increasingly recognized that these more localized types of participatory assessments can better identify which individuals and groups are most vulnerable and to what actual and potential threats; this is important for effective and efficient strategies to be formulated. The participatory aspect of the research identifies that these fishing communities are not homogenous entities whereby a 'one size fits all' approach can be implemented (Hinkel, 2011; Schwarz, 2011). It also recognizes and aims to highlight that "local people have knowledge and capabilities greater than outsider professionals often believe" (Dazé et al., 2009: i) and it is vital to ascertain and examine this knowledge for successful, targeted adaptation strategies to be devised.

1.3 Research Question and Objectives of the Study

Research Question: What is the potential of the RVA to contribute to vulnerability assessments and the identification of locally relevant adaptation strategies?

Objectives:

- To describe and assess the vulnerability context/socioeconomic system of two case study sites on the west coast of South Africa, namely Doringbaai and St Helena Bay.

- To compare and contrast information emanating from the RVA workshops with information educed from the triangulation of other methods including focus group discussions, key informant interviews and other secondary data sources, with respect to: the key threats and stressors faced by the two small-scale fishing communities, environmental changes identified, impacts on fisher livelihoods, current coping strategies and potential adaptation recommendations.

- To assess whether the RVA methodology is useful in providing information that can be used to determine key threats and vulnerabilities facing coastal fishing communities, their current coping strategies, and potential adaptation responses that could be employed to reduce vulnerabilities.

1.4 Brief Introduction to the Case Study Sites

Two case study sites were chosen for this research, namely Doringbaai and St Helena Bay (see Figure 2). These communities are both situated on the west coast of South Africa. These sites were chosen as the RVA was conducted in both communities. The RVA project leaders decided on these case studies as they had previous experience working with the communities and therefore had fair knowledge of the districts and their contextual backgrounds. Furthermore, this past involvement allowed the formation of contacts with local leaders and members of the communities who could assist with the setting up and facilitation of the workshops.

Doringbaai is a small fishing community, of about 1260 inhabitants, approximately 315km from Cape Town (SAexplorer, 2014) (Figure 2). It is "historically a fishing community" (Authar, 2008: 2) whereby fishing serves as the central livelihood option for income and food as well as being part of the cultural identity of the denizens (Authar, 2008). Doringbaai falls under the Matzikama Municipality, an area prone to drought conditions (Sowman et al., 2011a). There is a high level of poverty in Doringbaai; however, the town "is characterised by relatively robust social cohesion and solidarity" (Sowman et al., 2011b: 84).

St Helena Bay comprises three small-scale fishing villages and is located 164km from Cape Town and is 144km south of Doringbaai on the west coast (Figure 2). The fishing community is far more fragmented than Doringbaai, both physically and socially. The communities within St Helena Bay focused on for this case study were: Stompneus Bay, Steenberg's Cove and Laingville (see Figure 24 in Chapter 4). The geographical separation of these villages creates more conflict among the towns and less solidarity compared to Doringbaai. This can potentially be attributed to the lack of synergy as a result of the geographically disparate communities as well as the inherent competition that stems from this separateness. The populations of Stompneus Bay, Steenberg's Cove and Laingville are 718, 1118 and 8418 people, respectively. Small-scale fishing is a key source of income for approximately 400 inhabitants (Raemaekers & Sowman, 2015), however "St Helena Bay has the highest concentration of fish processing factories in South Africa and the crayfish industry was set

up in 1915" (Comet Corporation, 2015), which allows for employment opportunities in the commercial fisheries sector. It is estimated that about 2000 to 3000 people in St Helena Bay rely on the fishing sector for their livelihood (Raemaekers & Sowman, 2015).

Figure 2: A map depicting the locations of Doringbaai and St Helena Bay on the west coast of South Africa (To South Africa, 2015)

1.5 Study Limitations

A major limitation for conducting the research was finding a suitable time to conduct workshops. On several occasions favourable fishing conditions on the scheduled interview or workshop days would result in having to reschedule interviews or having far fewer informants at the workshops. Another limitation was the language barrier; first because Afrikaans is my second language, and secondly, because of people speaking in the vernacular, it was sometimes difficult to decipher what was being said. It is important that misinterpretations and misunderstandings are avoided so as to get uncompromising data that accurately represents the fishers and their knowledge. The research assistants and FGD facilitators were thus of great importance as they were able to assist with the translations and interpretations of what was being conveyed by the participants.

1.6 Structure of this Dissertation

This dissertation consists of seven chapters. The first chapter is an introductory chapter, and provides an overview of the study, including the research question, objectives and rationale for the study. The second chapter reviews literature pertinent to the study, allowing an in-depth review of key topics and themes. The third chapter explains the research approach and method employed to collect and analyze data. The fourth chapter gives a contextual overview of the two case study sites, namely Doringbaai and St Helena Bay. The fifth chapter elucidates the detail of the results from the research conducted in the two case study sites including information gathered from secondary data research, focus group discussions, and key informant interviews and compares this information to findings from the RVA workshop. The sixth chapter discusses these findings in relation to the literature presented in Chapter 2. The seventh and final chapter concludes the study and includes proposals for future studies.

Chapter 2: Literature Review

2.1 Introduction

This chapter explores why fishery systems are increasingly referred to as 'complex socioecological systems' and why conceptualizing and approaching fisheries in this way is a vital step forward in understanding and managing such systems. Amongst the key authors informing thinking about complex systems are Heylighen et al. (2007) and Cilliers (2000a; 2000b) while ideas of fisheries as complex socioecological systems are drawn from authors such as Garcia and Charles (2008), Cochrane (1999), Berkes et al. (1998), Berkes et al. (2003) and Berkes (2009). The chapter then progresses to explore coastal fishery systems which are complex and increasingly vulnerable to climate and environmental change. It specifically explores the concepts of vulnerable systems, vulnerability assessments and adaptation strategies. It then reviews the literature on climate change, especially focusing on the documented changes to the Benguela Current Large Marine Ecosystem, and explores the effects of these changes on fisheries, fisheries in South Africa, and on small-scale fisheries in particular.

2.2 Fisheries as Complex Socioecological Systems

2.2.1 Fisheries and Complexity Science

Complexity science emerged in the late 20th century as a response to "reaching the limits" (Mazzocchi, 2008: 10) of Newtonian Science. It is based on the realization that the world is not a simple, predictable entity but rather a myriad of social, environmental, economic and technological systems which form "an ever more complex 'system of systems' where a change in any component may affect virtually any other component and that in a mostly unpredictable manner" (Heylighen et al., 2007: 1). For centuries Traditional or Newtonian Science has been the philosophy that underlies scientific thinking and practice, whereby "to understand any complex phenomenon you need to take it apart i.e. reduce it to its individual components" (Heylighen et al., 2007: 3). However, this philosophy is reaching its limitations as "linearity and order seemed to be being forced on a world which isn't really like that" (Byrne, 1998: 3). The past 30 years have thus seen the rise of complex systems thinking which understands the natural and social world to not be predictable but rather dynamic and have non-linear pathways. This philosophy highlights the importance of uncertainty, whereby it is no longer viewed negatively but rather "as factors of creativity, adaptation and evolution" (Heylighen et al., 2007: 19). This section will explore fisheries as a complex socioecological system and investigate why this new approach assists the better understanding and managing of the sector.

Fisheries are "among the most complex of human activities… [due to] the inherent interplay between humans and the natural world, as both an economic 'industry' and a socio-cultural foundation for people and communities" (Charles, 1994: 201). Their complexity therefore makes them extremely difficult to manage and, at this point, according to various authors and fisheries management agencies, the current state of fisheries is in a crisis (OECD, 1997; Cochrane, 1999; Coulthard et al., 2011). The causes of this are vast but can be attributed to

four key problems: “enormous biological uncertainty; the existence in all fisheries of multiple and conflicting objectives that are normally specified poorly; dominance of social and economic objectives over attempts to utilize resources sustainably; and the historical but still prevalent failure to include the major stakeholders in meaningful decision-making…[this] is also the major part of a broader problem of institutional weaknesses and poor decision-making in fisheries management” (Cochrane, 1999: 917). Scientists of varying disciplines have recognized the need to approach fisheries from a complexity science perspective (Berkes, 1998; Cochrane 1999; Berkes 2003; Garcia & Charles, 2008; Berkes 2009); this has been realized for decades, however, the actual implementation of this approach has been slow and ineffective in most cases. Garcia and Charles (2008) provide an interesting metaphor; while Newtonian Science views life as “clockwork”, fisheries in all their complexity should rather be viewed as “soft watches”, like in Salvador Dali’s *The Persistence of Memory*, whereby things are not at all straightforward (Garcia & Charles, 2008: 505).

Fisheries are complex systems as they “consist of structurally and functionally heterogeneous components which interact (generally informationally or mechanically) with varying intensities and spanning different spatio-temporal scales. They are also adaptive and goal directed, changing and fitting their behaviour to emerging constraints” (Balague et al., 2013: 5). To explore fisheries as complex socioecological systems, this section will draw on the characteristics as set out by Cilliers (2000a): complex systems have many components, they interact dynamically and have non-linear causation, they have direct and indirect feedback loops, they are open systems, they have memory/history, they have emergent properties and they are self-organising and adaptive.

2.2.2 Fisheries as a Complex Socioecological System

Fisheries are complex systems as they first have a great number of components (Cilliers, 2000). These are vast and span the social, economic, technological and ecological realms. The social realm includes all the human dimensions of fisheries; the various types of fishers (small-scale, commercial, recreational and subsistence) and their households, marine and fisheries scientists, government officials in the sector, non-governmental organizations (NGOs) and community-based organizations (CBOs), and so forth. The humans themselves are complex organisms (Davids, 2013). Then, the ecological realm includes factors such as marine organisms, climate, the ocean and ocean’s processes. The economic sector largely refers to the market-related factors and processes related to fisheries including, for example, labour processes, resource availability, earnings, and costs (Charles, 1994, Charles, 1995). Finally, the technological realm includes all technology involved in any aspect of the fishery sector. These realms are all interconnected and hierarchical as the components have sub-systems and form part of super-systems (Heylighen et al., 2007); as stated by Garcia and Charles (2008: 505): “All fishery systems are part of the higher-level natural and human systems, interconnected as they are through the aquatic system, the global economy, and the society within which they exist”.

Secondly, fisheries are recognized as complex systems as interactions are rich, dynamic and non-linear (Cilliers, 2000). The non-linear nature of complex systems means that “a single cause can produce multiple and unpredictable effects and even small fluctuations can have unexpected consequences” (Mazzocchi, 2008: 12). This therefore makes fisheries

completely unpredictable as “the situation of the system at any time is driven by the alignment of the various system components, by external forces, and by its historical trajectory, with its accidents and surprises, and non-average events” (Garcia & Charles, 2008: 514). The notion of uncertainty is therefore vital in complex-systems thinking. Newtonian thinking viewed uncertainty negatively, as a constraint needing to be overcome, while complexity science embraces it. Accepting uncertainty is a challenge for many scientists as solving uncertainty is embedded in the nature of the field. The uncertain and unpredictable nature of fisheries therefore requires management of fishery systems to be flexible and adaptive. Charles (1994) demonstrates the importance of this in a case study of two fishery systems. The first fishery in North America used the adaptive management approach, which involved fisheries’ regulations being adapted to suit the present conditions, sometimes even on a daily basis. In contrast, a neighbouring fishery in Canada had a fixed annual plan for their groundfish management which then came close to collapse in the 1990s. The rigid management structures were not adaptive to the changing conditions of the fisheries and therefore nearly failed completely as a result while the other strategy proved to be very effective, although requiring more resources. This is one of many examples demonstrating the need for flexibility in fisheries management to prevent potential destructive feedbacks.

The third characteristic, as set out by Cilliers (2000a), is concerned with feedbacks. These can be direct or indirect and positive or negative. Direct and indirect feedbacks in the fishing sector can take many forms. For example, an oil spill or some form of pollution in a water source would directly affect and possibly poison the species which occupy the habitat, thus having a direct feedback. If humans eat the fish and get sick from it, this is then an indirect feedback of the water pollution as, although people were not directly affected, they still get sick through the sequence of events that occurred.

Positive and negative feedbacks are a result of the non-linear nature of complex systems whereby: “A positive feedback amplifies the change in input, pushing the system toward a more pronounced change…[while] negative feedback counteracts the change in input, tending to maintain the system in its current state” (Chapin & Whiteman, 1998). Complex systems consist of these varying temporal and spatial interacting feedbacks (DeAngelis et al. 2012). An example of a positive feedback in a fishery system is the extinction of a species resulting in its prey’s population growing to unprecedented levels. A social example is strict regulations implemented without the input or consultation of small-scale fishing communities; this could lead to many people engaging in illegal fishing activity, which could significantly damage the marine ecosystem of that region. Negative feedbacks in natural systems would for example be the relatively stable population sizes of marine species when the system is healthy and in its dynamic state of equilibrium. If a fish species population increases, the predator is likely to become more abundant over time and therefore decrease the prey population. This therefore keeps the size at relatively stable levels (Chapin & Whiteman, 1998). A case that illustrates this socioeconomic negative feedback is with supply and demand (Figure 3). If the demand for a species increases, the price increases. Consumers then purchase less of the product which then decreases the demand. This allows the supply of the fish species to increase as the fishing pressure decreases with the decreasing demand. In this way this phenomenon is believed to protect finite resources (Marten, 2001).

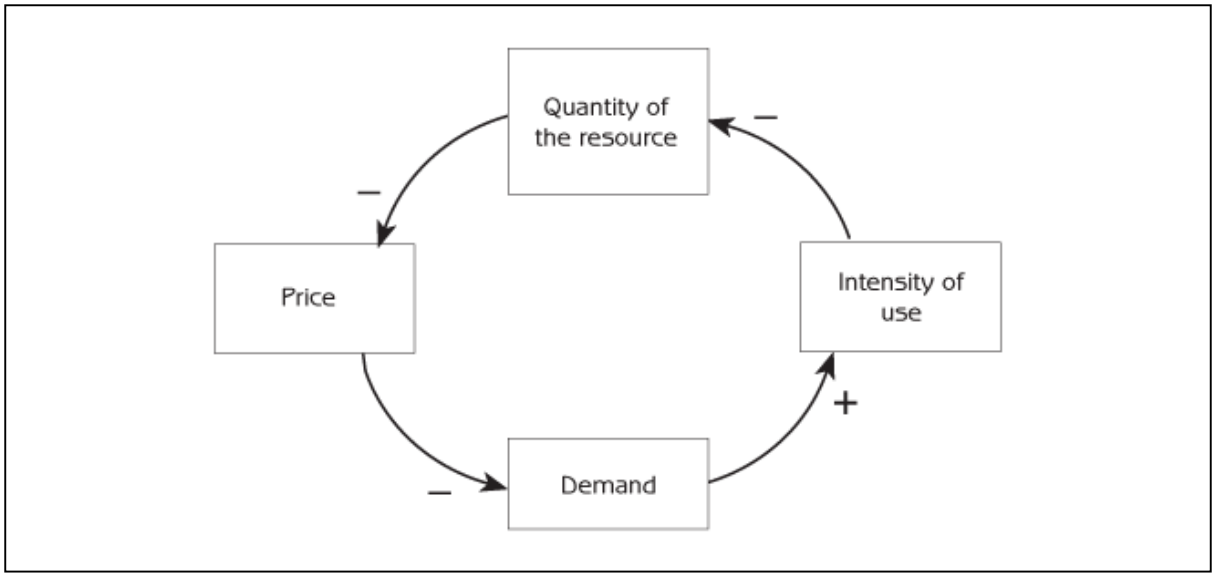

Figure 3: The role of supply and demand in protecting finite resources (Marten, 2001)

Fisheries are fourthly regarded as a complex system as they are open systems, meaning that "they exchange energy or information with their environment and operate at conditions far from equilibrium" (Cilliers, 2000a: 24). As mentioned previously, fisheries systems are vast, it is difficult to define where the boundaries are, especially as boundaries themselves are socially constructed (Paasi, 1998). Boundaries used for fisheries research are therefore a "theoretical choice" (Heylighen et al., 2007: 16). A simplified diagram showing this flow of energy and information exchanges between the natural and social systems is illustrated in the book by Marten (2001) in Figure 4. The open system nature of fisheries therefore takes many forms and spans vast hierarchical levels and scales. On the social side exchanges of energy and information at the individual and community level could include the food people eat (energy exchange) and how it affects the way people behave, perform and their longer term health. Exchanges of information can be through word of mouth communication with other members of the community, people from outside the community, the media, government and so forth. The community is open as people and cultural/societal influences are able to enter and exit, with varying constraints to these. On the ecological side, there is a flow of information and energy in the ecosystem, as marine species are part of a food chain and respond to stimuli (Garcia & Charles, 2008). Species have inherent information, for example they live in certain habitats and eat certain prey. This can change though; for example if the prey of a species becomes extinct, it is possible to adapt to a new prey, thus changing the 'information' of the ecological system (Chu et al., 2003).

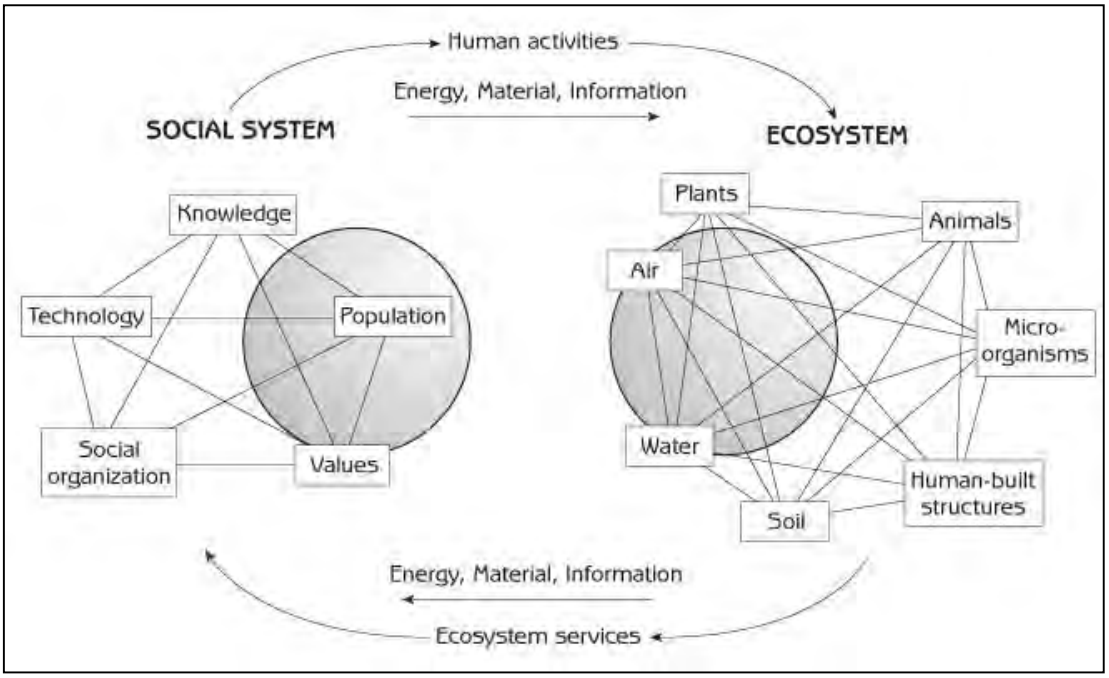

Figure 4: Flow of energy and information between social and natural realms (Marten, 2001)

Open systems are inherently susceptible to an infinite range of influences. Climate change is an example of an unpredictable phenomenon which is having significant impacts on fishery systems. Open systems characteristically contain inputs and outputs. These can be looked at in a simplified fisheries manner by looking at gear. If a fisher has modern gear (the input) that is of good quality the output will likely be that he/she will be able to catch more fish, would not have to spend as much time out at sea and will earn more money. The sector itself is open; people are able to effectively enter the sector as a fisher or some other fisheries-related activity, and are able to exit to pursue other activities or livelihoods. Fisheries as open systems make them very difficult to manage effectively (Cochrane, 1999; Garcia & Charles, 2008). In South Africa for example, restricting the areas where small-scale fishers may fish is not always practical unless it is done with flexible management; if the fish migrate for example, fishers are left without many options and will fish in other areas. The inherent challenges associated with fisheries as open systems therefore require a complex systems approach to understanding and managing fisheries resources.

The fifth characteristic is the history or memory of a system. Complex systems are "fundamentally historical" (Byrne, 1998: 15) as past events and circumstances lead to the present state of the system. The current abundant species and endangered or extinct species are as a result of past events as are the behavioural migration patterns of marine species. The small-scale fishers' history is an important reference for their current knowledge and skills, both generationally and individually; this could include weather forecasting and navigational skills, knowledge of fishing spots, species knowledge and the evolution of their gear. Their history can also be attributed to political factors and challenges. For example, in the case of South Africa's discriminatory policy of the apartheid government, policy strategy failures, including the failure to include small-scale fishers in the reformed fisheries policy after democracy in 1994, have resulted in distrust and resentment towards government. This indignation can also explain other outcomes such as poaching. The implication of history for management of fisheries, in this case, therefore

requires rebuilding the trust between government and fishers and shows the importance of engaging with stakeholders and dealing with fisheries using context specific strategies as complex systems "cannot be conceived without taking their context into account" (Cilliers, 2000b: 9). The past is therefore not "the key to the future" (Issar, 2010: 1) as "evolution is path-dependent (depending on history and culture), and may include multiple equilibria that are not totally predictable"; the implications for fisheries management is therefore that history limits "human control of the system's future and performance" (Garcia & Charles, 2008: 523).

The sixth feature characterizing fisheries as a complex system is that it has emergent properties. This means that it is not about the individual components of the system but rather the interactions between these components that determine the resultant behaviour of the system. "Since the interactions are rich, dynamic, fed back, and, above all, non-linear, the behaviour of the system as a whole cannot be predicted from an inspection of its components" (Cilliers, 2000a: 24). In the natural world, an example of an emergent property is the way fish have evolved to group together and form schools as a mechanism of protection (Magurran, 1986). In the social context, emergent properties are an important argument for the context specific approach to management as there are vast differences from community to community based on the interactions of different components producing different outcomes. In the two case studies this dissertation explores, emergent properties are the key to explaining why some communities have unity among the denizens while others are far less cohesive. Components which could potentially have the emergent property of making a community more unstable, unsafe and not unified are drugs and alcohol.

Finally, fisheries are complex systems as they have the ability to adapt and self-organize. Systems that are self-organizing, according to Mazzocchi (2008: 12), "spontaneously arrange their components and their interactions into adaptive structures with emergent properties. Such structures are able to create new and modify existing strategies to adapt to changing environmental conditions". However, there is "no guarantee of success" (Heylighen et al., 2007: 12) as it is possible for systems, or parts of systems to fail.

Components of a system are intrinsically selfish; this means that they aim to maximize their own well-being, even if this is at the expense of other components in the system (Heylighen et al., 2007). On the social side of fisheries this is seen with poaching; although it negatively affects the other natural, social and economic systems, it is still prevalent. It is possible for systems to evolve and become more cooperative. This leads to mutual adaptation whereby "agents will co-evolve… [and] constantly adapt to the changes made by other agents, but through this modify the others' environment, thus forcing them to adapt as well" (Heylighen et al., 2007: 12). In South Africa, some small-scale fishing communities are more cooperative than others. These communities show a more functional social system whereby agents (the people) aim to maximize the overall well-being of the community rather than just their individual well-being. Similarly, fishers who are more concerned with the state of marine resources, may return endangered species and undersized fish to the sea and stay within their total allowable catch, as they see the potential benefit of these measures to the sustainability of the resource.

2.2.3 Complex Systems Thinking and the Importance of this Approach to Fisheries Management

The potential for a fishery system to adapt and self-organize will be affected by climate change. The physical and biological changes in the ocean will force fishers to adapt their gear and their strategies. Changes in species migrations, species compositions, seasons, weather, ocean temperature, and so forth, will require fishers to adapt (Hampton & Willemse, 2012). Small-scale fishers may require different gear as conditions are not what they once were. Forecasting, which was common amongst experienced fishers, is now more unpredictable and the use of technology to help better forecast is becoming essential. Fishers may also look at alternative livelihood strategies as a way to minimize risks, as fishing may no longer be viable with the potential effects of climate change. The fishery system is inherently complex; the added threat of climate change thus makes it essential for flexible structures to be put in place and for resilience building of vulnerable systems. Garcia and Charles (2008: 516) state: "In complex systems what becomes central is the vulnerability of ecological and social components to change, and their capacity to respond adequately to change".

Complex systems thinking is therefore an important new way of thinking as Newtonian science does not adequately take account of the complexity of the real world. Complexity science demonstrates the importance of flexibility and 'learning-by-doing' to deal with complex systems (Charles, 1994; Berkes & Folke, 1998; Garcia & Charles, 2008). Nelson et al. (2010: 24) states that: "the science of vulnerability assessment urgently needs to be redirected toward identifying diverse and flexible options for adapting to the multiple, interacting and uncertain dimensions of future climate change". In dealing with fishery systems, this adaptive approach, combined with collaboration and cooperation among stakeholders, is believed to be the most effective strategy in what is termed "adaptive co-management" (Berkes, 2009). Cochrane (1998) states that the most significant developments in fisheries management include: being aware of uncertainty and its potential to be an opportunity rather than a shortcoming, incorporating key stakeholders in the decision-making process, realizing that open access in fisheries will result in certain failure, and finally, that the users of a fishery system need to be assured a secure, long term stake in the resource, in order to ensure their dedication to the sustainability of the resource.

This approach shows that there is not a 'universal/one size fits all' approach to fisheries management but rather the need for context specific management (Berkes, 2009). Each small-scale fishing community, for example, will have varying strengths, weaknesses, opportunities and challenges. A single, generic management strategy, implemented in all contexts, will not be effective as it does not take complex systems into account (Berkes et al., 2003; Sowman, 2011). This therefore highlights the need for collaborative vulnerability assessments, which includes all stakeholders in the formation and implementation of fisheries management and adaptation strategies. Complex systems thinking is therefore an important way forward to deal with the complexity and uncertainty inherent in fisheries systems and the management of these; especially with the current and potential threat posed by climate change.

2.3 Vulnerable Systems

The IPCC's third report (2001: 388) defines vulnerability as: "The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes". The vulnerability of a system depends on three key factors: exposure, sensitivity and adaptive capacity (IPCC, 2001; Allison et al., 2009; Dazé et al., 2009). In terms of climate change, these three factors have specific meanings. Exposure refers to the nature and magnitude of climate variation that the system is exposed or susceptible to (Cutter 1996; IPCC, 2001; Dazé et al., 2009). Sensitivity is the degree or magnitude to which a system is impacted by climate-related stresses; these perturbations can be direct or indirect and can refer to positive or negative impacts (Dazé et al., 2009). Finally, the adaptive capacity is the ability of a system to resist and recover from climate change related shocks and stresses; it is essentially how well a system can cope with climate change (Adger et al., 2004; Dazé et al., 2009). As shown by Figure 5 (Marshall et al., 2010), vulnerability is a function of these three concepts.

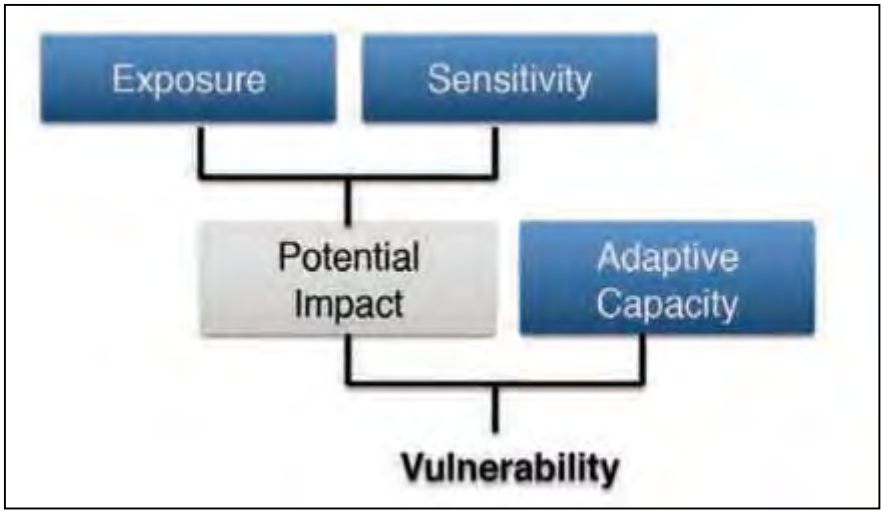

Figure 5: Vulnerability as a function of sensitivity, exposure and adaptive capacity (Marshall et al., 2010)

Small-scale fishing communities are regarded as being highly vulnerable to climate change; according to Williams and Rota (2012:4): "they have contributed little to the causes of climate change but will be amongst the first sectors to feel its impacts". They are generally highly *exposed* as they are geographically close to the ocean and thus susceptible to storm surge and sea-level rise (Cutter, 1996; Daw et al., 2009; Dazé et al., 2009). They are *sensitive* as their livelihoods rely on a system (the ocean) that is variable, uncertain and at risk from the effects of climate change. Furthermore, small-scale fishing communities are generally among the poorest groups in a nation with little economic or material wealth, thereby making their *adaptive capacities* low (Dazé et al., 2009; FAO, 2014). Their vulnerability to climate change and variability is thus exceptionally high.

The degree of vulnerability will, however, vary between and within different fishing communities. Generally "poorer and less empowered countries and individuals are more vulnerable to climate impacts, and the vulnerability of fisheries is likely to be higher where they already suffer from overexploitation or overcapacity" (Daw et al., 2009). Dolan and Walker (2006) describe the vulnerability of coastal communities to climate change as being

directly proportionate to their ability to withstand shocks and changes. They identify six factors that influence the degree of vulnerability of SSF to climate change (Dolan & Walker, 2006). These include: the amount of financial capacity people have to deal with, and recover from, shock; access to infrastructure and technology; education, skills and information available to communities; consciousness and perception of risk; co-operation between members of the community; co-operation with external institutions (government, NGOs and the private sector).

It is therefore important that the most vulnerable groups are identified and measures are taken to build adaptive capacity. Dazé et al. (2009) suggest community-based adaptation (CBA) as the way forward as it is a more holistic approach to decreasing the vulnerability of communities and building resilience to climate and environmental change. CBA involves a methodology which integrates innovative strategies with local knowledge in order to address vulnerability and educe targeted, context specific adaptation strategies. Key components of this integrated approach include the application of vulnerability assessments which aim to identify the most vulnerable groups, the inclusion of all stakeholders in devising plans to increase adaptive capacity and reduce vulnerability, and to ensure that these strategies are implemented.

2.3.1 Vulnerability and Women in Fishing Communities

One of the greatest challenges of this century will be to bestow equal rights upon women as, on an international level, formidable gender imbalances prevail. A report from the United Nations Development Programme (UNDP) (1995) stated that of the 1,3 billion people living in penury, just over two-thirds are women; furthermore the wages of women are about 40% less than men for commensurate work. It is also stated in the UNDP Human Development Report from 2014 that women and other groups (children, elderly, minority groups and those with disabilities) are more vulnerable when it comes to recovering from disasters because they generally have less support structures available and fewer assets (Figure 6). With the threat of climate change, these groups could therefore become increasingly vulnerable.

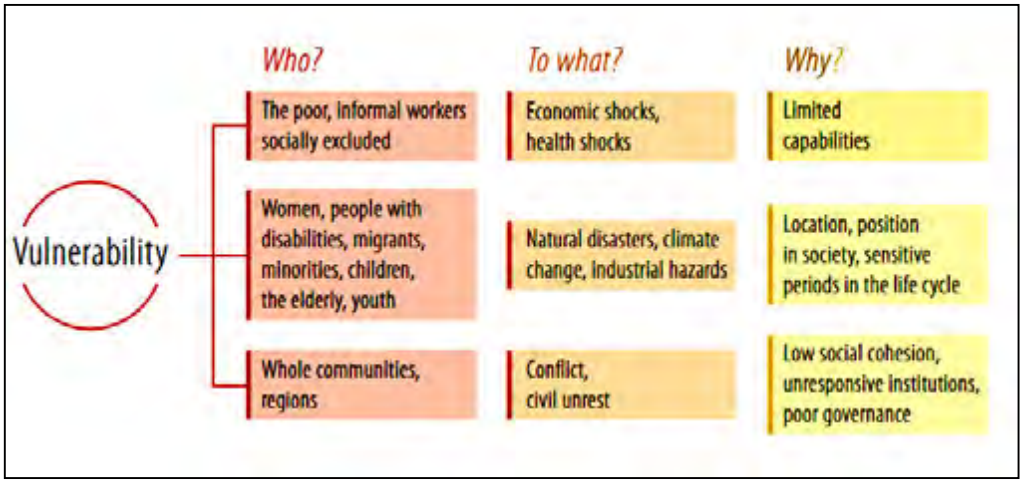

Figure 6: A simplified diagram depicting who is vulnerable, to what and why (UNDP, 2014: 19)

Women currently have an “invisible role” in fisheries (RFLP, 2011); their contribution to fisheries is significant, however, this is often not adequately recognized and partly or wholly disregarded in policy and management (Rohe, 2012; Harper et al., 2013). This is generally a worldwide phenomenon and results from a myriad of reasons including culture, a nation’s laws and policies, and the historical remnants of gender inequality (Williams et al., 2002). The book by Williams et al., (2002) goes into detail about how the role of women in fisheries is undervalued and neglected in the fisheries industry in Asian countries, from a local to national scale; Africa and Asia are stated to be the regions where inequalities in fisheries are most prevalent (Harper et al., 2013).

In fisheries, women are most often involved in the pre- and post-harvest activities or the harvesting of shore-based species such as mussels and crabs (Sowman et al., 2014). These activities are of great importance to fisher households’ livelihoods and food provisions but, because they are not classified as ‘fishing’ in the traditional sense of the word, they are often undervalued (Harper et al., 2013). This leads to the marginalization of women, the implications of which are a **“**substantial under-estimate of fishing pressure in coastal areas and an under-valuation of the economic and societal benefits that women in fisheries provide” (Harper et al., 2013: 56). In South Africa, the new Marine Living Resources Act (MLRA) of 1998 policy seeks to better recognize and include the important role of women in fisheries. The necessity of supporting and protecting women has been recognized and provisions have been made, such as preferential access to coastal resources for women living in fishing communities (Sowman et al., 2014). The movement towards a more gender equal society through policy and management provisions is an important step; however, there is still a long way to go at the local level (Sunde, 2010; Rohe, 2012). Equal rights and recognition of the important role of women in fisheries is vital for the better protection and overall wellbeing of women (Masifundise, 2008).

2.4 Vulnerability Assessments and Adaptation Strategies

2.4.1 Introduction to Vulnerability Assessments

Vulnerability assessments are important as they have the potential to identify communities, regions and countries which: are greatly exposed to the potentially detrimental impacts of climate and environmental change; include livelihoods which render certain groups of their population more sensitive to these changes, such as agriculture and fisheries; and have limited capacity to adapt to the impacts of these changes (Adger, 2005; Allison et al., 2009; Daw et al., 2009). The ability to identify regions most at risk facilitates the implementation of adaptation and mitigation strategies from stakeholders such as government and the private sector (Preston, 2012). VAs can be done at a range of scales spanning from international to more local settings such as fishing communities; the scale of assessment depends on the objectives of the research (Mamauag et al., 2013). Community level assessments are generally stakeholder-based and can be either quantitative (Nelson et al., 2010; Pamungkas et al., 2011; Mills et al., 2011; Cinner et al., 2013) or qualitative (Clark et al., 1998; Dolan & Walker, 2006; Cinner et al., 2012) or a mix of the two (Krishnamurthy et al., 2011). Quantitative assessments may use tools such as indicators and models in the assessment method while more qualitative data may be generated using methods that

could include interviews, workshops, surveys, expert interviews and cognitive mapping (Barsley et al., 2013).

Participatory vulnerability assessments involve research being conducted at a local level with communities and other stakeholders living in the area; in this way valuable knowledge from the local people can be extracted (Preston 2012). "The main purpose of participatory vulnerability assessments is to identify adaptation strategies that are feasible and practical in communities…[they] allow for the recognition of multiple stimuli beyond those related to climate, to include political, cultural, economic, institutional and technological forces" (Smit & Wandel, 2006: 288). Furthermore, this tool enables one to "diagnose vulnerabilities, assess a community's risk priorities, and work together with the people to devise ways of increasing their capacities to resist hazard impacts" (Van Aalst et al., 2008: 166). A summary of this method is depicted in Figure 7 (Smit & Wandel, 2006).

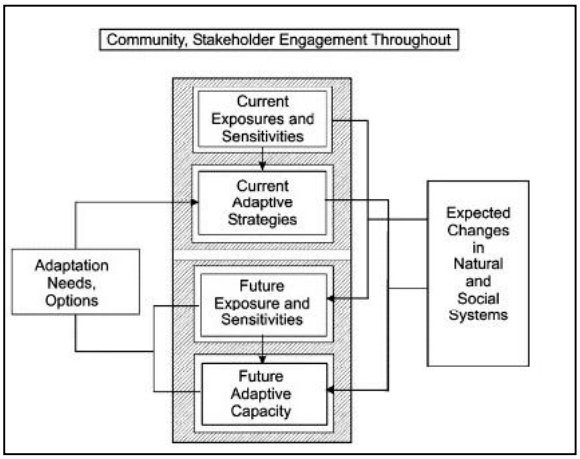

Figure 7: Theoretical framework for assessing vulnerability (Smit & Wandel, 2006: 288).

Participatory vulnerability assessments (PVAs) are largely recognized as an important procedure to involve stakeholders in adaptation action so that such action is context specific and effective. However, this methodology encompasses many challenges. It requires a large amount of resources and needs to be performed in a large sample of case studies for it to be valuable and meaningful at a broader level (Van Aalst et al., 2008). There have also been challenges with translating the information from the assessment/research stage to actually having any meaningful utility and action in policy and implementation of adaptation strategies; the research generated often ends up as an academic exercise (Zollett, 2008; Preston 2012; Hind 2014).

The resource intensive inherent quality of PVAs may thus not be feasible in countries and contexts where intensive participatory research is difficult and that have fewer resources available. The FAO therefore commissioned a study to develop and apply a rapid vulnerability assessment which aimed to obtain information over a short period that could be used by communities and authorities to understand the vulnerability context and identify adaptation strategies to address vulnerabilities associated with climate and environmental change. The central goal of the RVA is to "assess socioecological vulnerability of coastal communities taking account of their experiences and perceptions of environmental variability and climate change" (Raemaekers & Sowman, 2015: 18) and propose adaptation strategies to reduce vulnerabilities.

2.4.2 The Importance of Vulnerability Assessments to Inform Adaptation Strategies

Adaptation is defined as "an adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities" (Adger et al., 2005: 78). Successful adaptation strategies "enhance adaptive capacity while decreasing exposure and sensitivity" (Wongbusarakum & Loper, 2011: 9). Adaptation can be planned (in response to the potential threats of climate change) or autonomous (a change made by the affected entity in response to the changing environment, such as small-scale fishers changing their fishing locations) (FAO, 2014). Adaptation strategies are either in response to long- or short-term changes while coping is more a short-term survival mechanism (FAO, 2014). If a system is consistently just 'coping' with changes rather than implementing effective adaptation responses, this may erode the resilience and adaptive capacity of the system. The incentive for adaptation "can be motivated by many factors including the protection of economic well-being or improvement of safety" (Adger, 2005: 77).

Successful adaptation strategies are a challenge for two key reasons. First, the action may be effective in the short-term but not for a longer time frame. An example of this was seen in Europe whereby consecutive hot summers resulted in the mass installation of air-conditioning for both household and commercial use. Whilst this was an appropriate short-term solution, the intensive energy use of air-conditioning is not appropriate in the initiatives required for mitigating global warming (Adger, 2005). Secondly, the action may successfully solve one problem but cause another. This is often the case with hard-engineering solutions to sea-level rise and storm surge such as sea walls; while they may protect a certain area, they could divert the wave energy to another area, increasing the force of the waves there or causing sand erosion (Adger, 2005). Effective adaptation responses therefore need to involve intricate planning, the input of locally affected communities, and be as flexible as possible. Johnson and Welch (2010: 118) state that: "Decision frameworks should support climate change adaptation options that have the greatest overall 'benefits' while minimizing 'costs' and being responsive to inevitable change in the ecosystem or stock".

Adaptation is important to inform the safety of people most at risk from the effects of climate change. However, necessary action is often only implemented after a disaster; "adaptation action is likely to be triggered through extreme events that raise the consciousness of climate change within policy making and hence giving legitimacy to governmental action" (Adger, 2005: 85). It is important that this reactive approach to adaptation changes to a more anticipatory approach so that the most vulnerable communities' safety and resilience may be protected (Figure 8).

Vulnerability assessments are therefore important to inform appropriate adaptation responses, especially with the threat of climate change. These assessments reveal who is vulnerable and to what threats or hazards; this is vital to determine where the adaptation effort is needed most (Nelson et al., 2010). Communities differ in terms of their threats and opportunities and therefore this context specific strategy is essential for an effective, targeted approach to adaptation (Preston, 2012; De Young et al., 2013). Adaptation to the

adverse effects of climate change thus involves collaboration amongst stakeholders; it "not only depends on governments but also on the active and sustained engagement of stakeholders including national, regional, multilateral and international organizations, the public and private sectors, civil society and other relevant stakeholders" (United Nations Framework Convention on Climate Change, 2014). Applying vulnerability assessments that involve local communities and other relevant stakeholders is increasingly seen as necessary to identify locally appropriate adaptation strategies (Barsley et al., 2013).

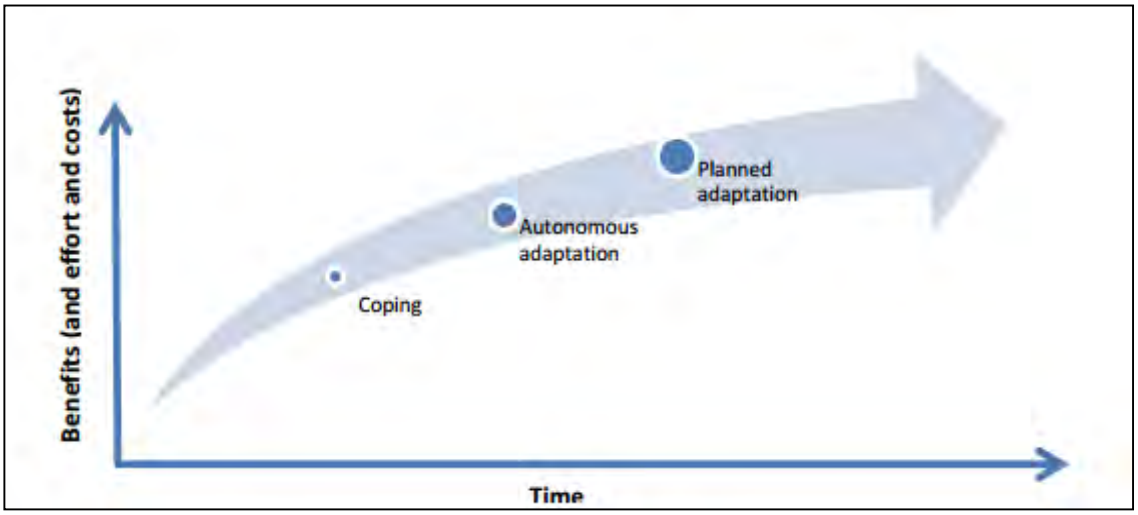

Figure 8: The need to move from 'coping strategies' to planned adaptation (Shelton, 2014)

The key objectives of a VA are to develop a methodology that is context specific, implement the methodology, identify what the main threats and hazards to the communities are and the main causes of these, determine how they are currently coping with these stressors and what adaptation strategies they are currently employing, and finally, to disseminate the information to government and other NGOs to use for adaptation planning (Preston, 2012). This is in order to determine who (humans, human activities (such as fishing and farming), and what places) are most vulnerable and to what hazards, now and in the future (De Young et al., 2013).

In addition to these objectives, Schröter et al. (2005: 577) identifies five criteria that a VA should possess. First, a VA should have a diverse knowledge base. This means that it should employ an interdisciplinary approach to assessing vulnerability and incorporate processes of collaborating and engaging with major stakeholders in order to obtain relevant local knowledge. Secondly, it must be "place-based", that is to say focused on a particular study area and have the scale of the study match the objectives of the VA. Furthermore, it should include relevant processes that operate at other scales (it needs to be aware of the nested spatial scales). Thirdly, the VA needs to incorporate and be aware of the fact that there are multiple and interacting components within a system and that these could potentially work to reduce or amplify risk. Fourthly, the VA should be aware that communities are heterogeneous entities (Hinkel, 2011; Preston, 2011; Schwarz, 2011; Balague et al., 2013), both within and between communities, and therefore the VA "should allow for differential adaptive capacity". Finally, the VA needs to be structured so as to obtain information that is both historical and prospective. The key objectives of a VA stated by Preston (2011) and Preston (2012) as well as the five criteria laid out by Schröter et al. (2005) will be used in

Chapter 6 to assess the RVA methodology and the mixed methods approach used in this study.

A vulnerability assessment that encompasses both the socioeconomic and ecological dimensions is vital as these factors are all intrinsically linked. According to Cinner et al., (2013) the social exposure is directly proportional to the ecological vulnerability, this is represented in Figure 9 (although this figure does exclude other structures that affect a community's vulnerability, it gives a good overview of how changes in the ecological realm have an impact on the socioeconomic realm and vice versa).

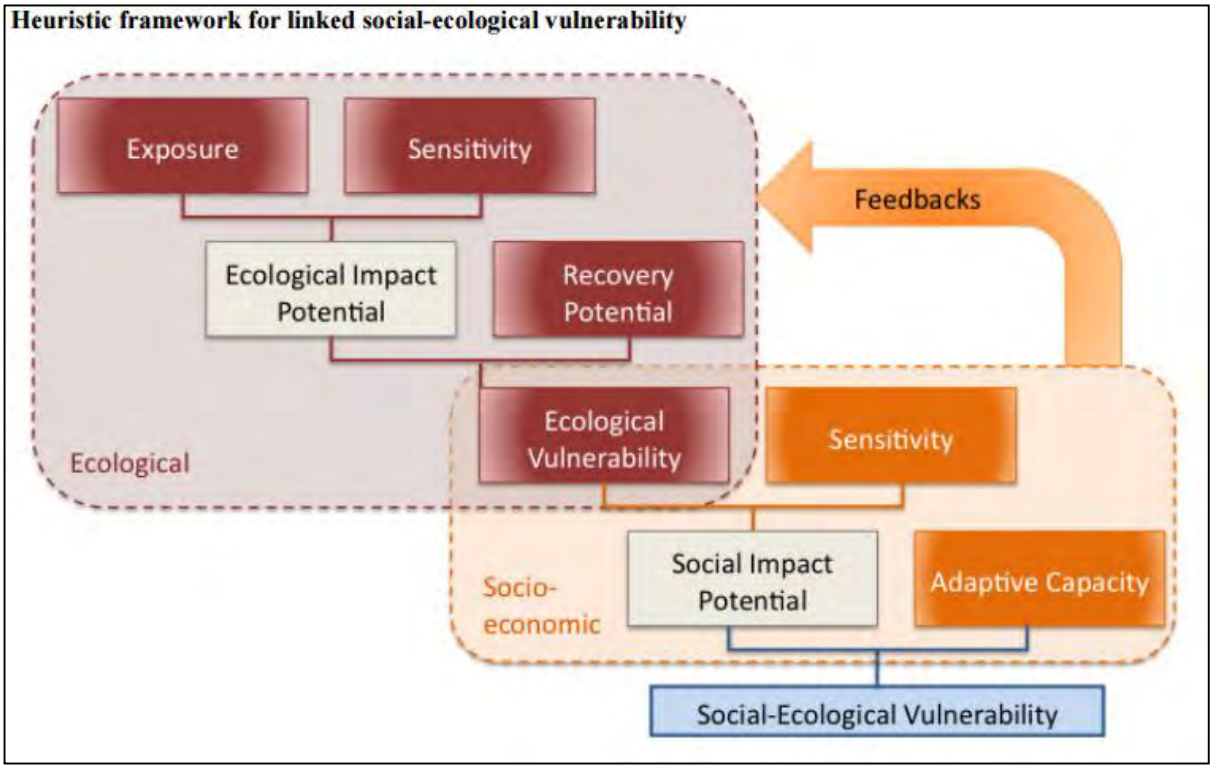

Figure 9: The inter-connectedness of socioeconomic and ecological factors which determine the overall socioecological vulnerability (Cinner et al., 2013)

PVAs are becoming a popular tool as part of adaptation planning for a number of reasons (De Young et al., 2013). A PVA is a targeted and effective way to determine vulnerability (De Young et al., 2013). Furthermore it is collaborative, co-operative and makes use of the local/traditional knowledge. This knowledge can be used to supplement the existing scientific data (if available) and help to create adaptation options which will be effective and well received by the communities. Working in collaboration with the communities also helps to decentralize the decision-making power and thus give a greater sense of ownership to the community (De Young et al., 2013). Including the community is also considered to be "procedural justice" (De Young et al., 2013: 9) as it is fair to include the community members in the future planning of resources which are central to their livelihoods. PVAs are increasingly seen as an effectual method to engage with stakeholders, both the vulnerable communities and other stakeholders (such as NGOs and the government), in order to create effective adaptation responses to climate and environmental change.

There are, however, a number of limitations and concerns associated with VAs. First of all, as it is a relatively new tool, there is no formalized, best practice way to go about

conducting a VA (Preston, 2011). There are also issues with scale. It is increasingly being noted that for the VA to have any meaning, it has to be conducted at the local scale (Barnett, 2008; Preston 2011). The importance of communication in the VA process must also be highlighted. The questions asked and the way in which they are asked must minimize confusion or misunderstanding; there could be cases of uncertainty from the community side if their meanings and perceptions of climate change differ to the group conducting the VA. Furthermore, the goal and primary objectives of the VA need to be determined for it to be useful. Preston (2012) found that 40% (out of 81 studies), did not engage stakeholders; assessments were conducted and thereafter the information was not utilized for any practical purpose. The potential of eliciting adaptation responses is misused if it is merely used for academic purposes.

2.4.3 Vulnerability Assessment Frameworks

"The complexity entailed in encompassing and measuring various geographical, spatial, temporal and social dimensions of vulnerability has resulted in a multitude of different methodologies for measuring vulnerability" (Barsley et al., 2013). According to Preston (2012: 14): "This diversity ultimately generates problems for the development of a consistent definition and its operationalization in assessment"; however, different objectives require different assessment strategies. The literature identifies four vulnerability assessment models: risk-hazard models, social vulnerability/adaptive capacity models, pressure-and-release models, and expanded vulnerability models (Blaikie et al. 1994; Turner, 2003; Preston, 2012; Barsley et al., 2013; Raemaekers & Sowman, 2015). These are explained below.

Risk-hazard models "sought to understand the impact of a hazard as a function of exposure to the hazard event and the dose–response (sensitivity) of the entity exposed" (Turner, 2003: 8074). The 'hazard' mentioned here usually refers to events including extreme weather events, flooding, fires and so forth, while 'sensitivity' includes factors that could potentially heighten or diminish the risk associated with these hazards such as proximity to the high water mark, population density and thermal tolerance of the population. These models are generally more quantitative and based in the natural sciences. They do, however, have their limitations in that: "information on hazard alone is insufficient for assessing or reducing the potential for harm to societal assets and values, particularly when one is interested in temporal trends" (Preston, 2012: 16). Pielke et al. (2008) describes an example of this limitation with damages from tropical cyclones in the United States which, over the 20th century, appeared to have decreased. The reason for this, which risk-hazard models fail to account for, was due to an increase in the populations' overall wealth as opposed to other factors such as change in the magnitude or frequency of the cyclones. The risk-hazard models are therefore lacking in their comprehensiveness (Preston, 2012).

The social vulnerability/adaptive capacity models are essentially the obverse of the risk-hazard models. While the risk-hazard models focus on biophysical hazards as the key driver to vulnerability, the social vulnerability/adaptive capacity models focus more on the social dynamics (Hilhorst & Bankoff, 2004). As Raemaekers and Sowman (2015: 9) describe: "these types of vulnerability assessments emphasize the fact that physical environmental drivers and hazards are one component of vulnerability, but the ultimate outcomes associated with such physical processes are often dependent upon the socioeconomic context in which

these processes occur". The population density, different population attributes, and settlement characteristics are examples of some of the factors that are believed to affect the degree of vulnerability. A useful example of this framework is in the work by Cutter et al. (2003) whereby a social vulnerability index (SoVI) was created. This index used census data, such as ethnicity, employment and earnings as a means to assess vulnerability. Another example of this framework is used by Fekete (2009) whereby social vulnerability to river flooding was mapped in Germany. The assessment has proven to be quite accurate in this context and has demonstrated that higher risk groups are indubitably more vulnerable including people who are less financially secure, the elderly and people living in more urbanized areas (Fekete, 2009). These types of vulnerability assessments are not very common but are beneficial in that they take into account the human-dimensions that influence vulnerability. However, they have their limitations in that their approach can be rather top-down; this being a "category of analytical methods based on the handling of data by scientists, with no inputs from beneficiaries, e.g. statistical analysis, modelling, downscaling etc." (Brugère & De Young, 2015). Furthermore, "questions arise as to whether the context generated by such methods is relevant to vulnerability processes or simply an artificial construct based upon *a priori* assumptions. Commonly utilized data do not provide information regarding human perceptions of risk, behavioural responses, or the robustness of political institutions" (Preston, 2012: 18).

The risk-hazard and social vulnerability/adaptive capacity models are often critiqued for not being holistic and comprehensive enough as the one has its focus on the biophysical components and the other, the social sciences. The pressure-and-release model is therefore an amalgamation of the previous two models, aiming to achieve a more integrated approach to vulnerability "in pursuance of [a] more systemic understanding of human/environment interactions" (Preston, 2012: 18). Developed by Blaikie et al. (1994), it has become the most widely used framework for assessing vulnerability. Importantly, the model reflects that a group can be vulnerable without any climate or biophysical-related hazard but then this vulnerability becomes markedly evident in the face of such a hazard (Preston, 2012). In the paper by Singh (2014), a case study of the pressure-and-release model was used to assess the vulnerability of three communities in India who were located near fertilizer and petroleum factories. The outcome of the assessment showed that the combination of the polluting conditions emanating from industries as well as the inherent vulnerability of the people living in the villages (determined by the lack of facilities and basic infrastructure, illiteracy, and low levels of income) consequently render the people highly vulnerable. The author therefore concluded that there is a need for measures to reduce vulnerabilities so that the groups may be more resilient to potential future hazards (Singh, 2014). The model has its strengths in that it is more holistic than other frameworks and explores livelihoods in conjunction with vulnerability. However, the limitations are that the model "cannot be applied operationally without a great deal of data collection and analysis" (Disaster Assessment Portal, 2015) and "it provides little detail on the structure of the hazard's causal sequence, including the nested scales of interactions" (Turner, 2003: 8074).

Finally, Turner (2003: 8075) proposed a vulnerability assessment framework that aims to be more comprehensive and holistic than the previous three. This model "directs attention to coupled human–environment systems, the vulnerability and sustainability of which are predicated on synergy between the human and biophysical subsystems as they are affected by processes operating at different spatiotemporal (as well as functional) scales". The more

holistic nature of the model greater reflects the “interactive and dynamic nature of vulnerability” (Preston, 2012: 20); however, the complexity associated with this kind of framework poses many challenges. The integration of different temporal and spatial scales along with multiple stressors includes massive sets of data and great complexities that may be too intricate to adequately assess. The work by O’Brien et al. (2004: 311) does a commendable job in demonstrating a case study of this framework that aimed to “increase the rigor and enhance the utility of vulnerability assessments for both researchers and policymakers”. The study was based in India and assessed vulnerability based on the potential impacts of climate change, as well as multiple other stressors including the effect of economic globalization on local agricultural communities. The study used regionally downscaled climate models to assess the potential impacts of climate change and performed household surveys in local communities (O’Brien et al., 2004). The study encountered many limitations such as uncertainty related to downscaled climate models and problems with changes in time scale for factors such as adaptive capacity. Nonetheless, it demonstrates advancement towards more integrated and holistic assessments of vulnerability.

2.5 Climate Change

The Intergovernmental Panel on Climate Change's (IPCC) fourth assessment report declared that: "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level" (UNEP, 2008). Furthermore, this phenomenon of climate and oceanic changes has been occurring for the last hundred years and will likely occur at a faster pace in the future (IPCC, 2007).

Climate change is predicted to have a significant impact on ocean conditions, especially on: temperature, upwelling, salinity, oxygen levels, biogeochemistry, currents and circulation, fresh water run-off and water acidity (IPCC, 2007; Diaz & Rosenberg, 2008; UNEP, 2008; Sumaila & Cheung, 2010). This will in turn affect the ocean's living organisms and consequentially the industries, people and communities that rely on these resources. It is predicted to have a significant impact on the ocean's ecosystems and living marine resources through a variety of manifestations. These include, but are not limited to: changes in species abundance, distribution and phenology, species invasion, diseases, regime shifts, and impacts on food chains (Barange & Perry, 2009). These impacts will differ in space and time and will result in some countries and groups benefiting at the expense of others (Adger, 2003).

The impacts of future changes will be felt “particularly by resource dependent communities through a multitude of primary and secondary effects cascading through natural and social systems" (Adger, 2003: 387). Climate change will therefore present "one of the greatest challenges of the 21st century" (Adhikari & Taylor, 2012: 54), especially due to the uncertainty which surrounds it, the strain already on oceans due to overfishing, pollution and other anthropogenically damaging activities (UNEP, 2008), and the current and potential adverse impacts on people, ecosystems and economies (Adhikari & Taylor, 2012).

2.5.1 Benguela Current Large Marine Ecosystem

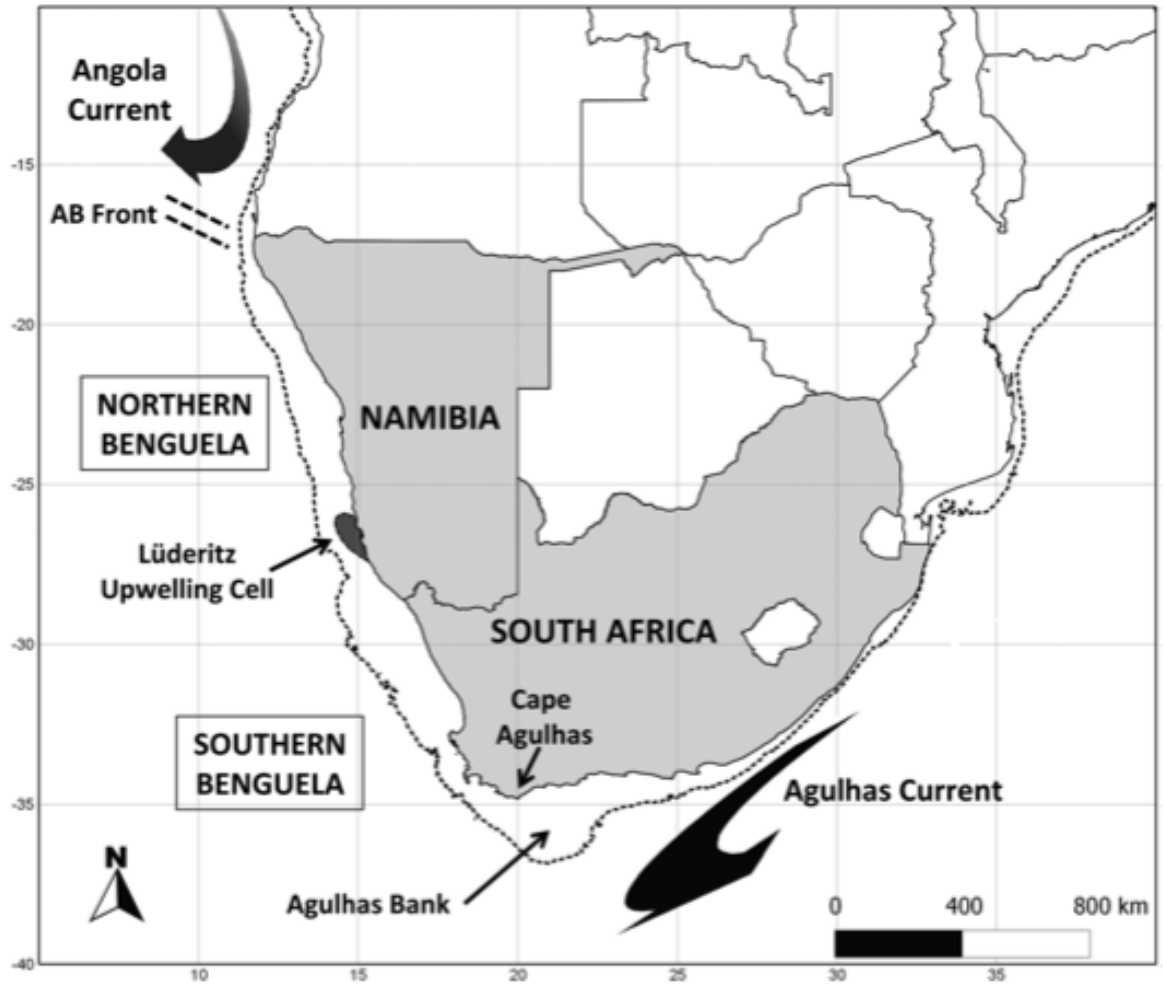

Figure 10: The Benguela Current Large Marine Ecosystem (AB Front refers to the Angola-Benguela Front) (Roux et al., 2013: 250)

The Benguela Current Large Marine Ecosystem (BCLME) or Benguela Current is the "strongest wind-driven coastal upwelling system known" (Duffy, 2008) and is thus highly productive and dynamic (Roux et al., 2013). The Benguela Current is situated on the southwest coast of Africa and extends from Angola to South Africa (Figure 10) (Cury & Shannon, 2004; Roux et al., 2013). It is divided into two subsystems separated by the permanent upwelling cell located in the region of Lüderitz, Namibia (the South African/Namibian border, at the Orange River mouth, is sometimes also used as the separation point of the subsystems) (Cury & Shannon, 2004; Roux et al., 2013). The northern subsystem extends from the Angola-Benguela (AB) Front to the Lüderitz upwelling cell (Cury & Shannon, 2004). The southern system extends from this point to East London on the east coast of South Africa (Cury & Shannon, 2004). The southern subsystem is diverse in that it flows along the upwelling-intense southwest coast of South Africa, characterized by cold, nutrient rich water, and then extends across the south and southeast coast of South Africa, whereby, due to the influence of the Agulhas Current, the water is warmer and not as rich in nutrients (Cury & Shannon, 2004; O'Toole, 2006; Roux et al., 2013; FAO, 2014).

The system is a highly complex and variable one “that displays considerable environmental variability on several time and space scales, which is mirrored by variability in its living marine resources" (BCLME Programme, 2007: 3). These characteristics of the system therefore make it difficult to discern what changes are natural or from other pressures, and what changes are climate change induced (Hampton, 2012). The BCLME is already facing a large number of anthropogenically-induced challenges aside from climate change. These include: pollution, fishing, mining and oil and gas extraction (BCLME Programme, 2007). The effect of these pressures, which become superimposed on one another and thus have to be thought of in terms of complex systems, are vast. The following sections will examine the physical and biological changes which have occurred in the Benguela Current with a focus on the southern subsystem, as it is the region in which this study takes place.

2.5.1.1 The Physical Changes to the BCLME

Several significant physical changes to the BCLME have been detected. First, Hampton (2012) documents the observation of the cooling of near-shore waters on the south and west coasts of South Africa but a warming of the sea surface waters in the Benguela Current; this could result in an intensification of weather events due to the sea's increased temperature gradients. Evidence of this change is demonstrated by wind, upwelling and ocean temperature data as well as an eastward expansion of cool-water species and the withdrawal of warm-water species from these cooling regions (Blamey et al., 2014). Secondly, there have been events of warmer water intruding from the Angola Current and Agulhas Current into the Benguela Current. This water has a lower salt and oxygen content and thus affects several organisms, most notably the hake stock and west coast rock lobster (WCRL) (Shannon & O’Toole, 2003; O'Toole, 2006; Hampton, 2011; Hampton & Willemse, 2012). The intruding warm water may cause marine species to migrate to cooler waters and can even result in mass mortalities, as was the case in the northern system with horse mackerel, silver kob, sardines and seals in 1995 (Matthews, 2004; Allison et al., 2009).

Thirdly, an increase in the upwelling in the southern system has been detected, especially on the west and south coasts, and a decrease in upwelling in the northern system (Hampton & Willemse, 2012). Fourthly, a decline in the oxygen levels below the thermocline has been observed in some areas in the south, most notably in the St Helena Bay region (De Young et al., 2012; Hampton & Willemse, 2012). Fifthly, there has been a warming of the Agulhas Current (O'Toole, 2006). Sixthly, alterations have been observed in the speed and direction of the wind (Cury & Shannon, 2004; De Young et al., 2012; Hampton & Willemse, 2012). And finally, eruptions of hydrogen sulphide have frequently occurred in the northern system (O'Toole, 2006). The most notable consequence of this is the subsequent decline in oxygen levels which can result in mass mortalities of marine species (Heileman & O’Toole, 2009).

2.5.1.2 Phytoplankton and Zooplankton

Several changes to the phytoplankton and zooplankton in the BCLME have been detected over the last several decades. These changes, and the recording of these, are important as “long-term variability in plankton is closely linked to climate change…food web changes are also manifested in long-term variations in the abundance, distribution and species composition of the plankton” (Perry et al., 2004; Hutchings et al., 2006: 127). Hutchings et al. (2006) explain that there are essentially three mechanisms that control marine ecosystems and their trophic levels. The first is bottom-up control. This has to do with

primary production [i.e. phytoplankton and zooplankton] and is affected by changes in the environment; “a marked change in the environment will alter the primary productivity of the ecosystem and its availability to higher trophic levels” (Hutchings et al., 2006: 127). The second mechanism is top-down control and refers to predators regulating the lower levels of the food web. Finally, wasp-waist control “occurs when species at an intermediate trophic level influence other species at both higher and lower trophic levels — a classic example being small pelagic fish, which exert a top-down control on zooplankton as well as having bottom-up influences on predators” (Blamey & Branch, 2012: 43).

The changes to phytoplankton over the last four or five decades have been informed by shipboard sampling as well as satellite observations. The shipboard sampling within the BCLME has proven to not be consistent enough to derive any valid conclusions; however the satellite data has produced two important findings. The first is that there are clear inter-annual variations in the phytoplankton on the west coast of South Africa, which are most likely caused by fluctuations in the quantity of warm, nutrient poor Agulhas waters, which are advected from the south to the west coast. Secondly, variability has been noted in both seasonal and inter-annual trends of phytoplankton; however, there have been no clear trends established over the last decade of monitoring (Blamey et al., 2015). As stated by the BCLMEP (2007: 9), the inter-annual trends of phytoplankton in the Benguela appear to be “weakly apparent”. Furthermore, O’Toole (2006) states that from 1980 to 2000 there was an increase in the abundance of phytoplankton in the southern system, followed by a decrease from 2000. However, observations made through the analysis of nitrate deficits in the upper layers of the ocean in the region of St Helena Bay evince the increase of phytoplankton since 2000 (Blamey et al., 2015).

The long-term trends of zooplankton in the southern system show that from 1950 to 1995 the abundance of the species has increased by about 100 times, especially in the Western Cape region; thereafter there has been a 10-fold decrease (Hutchings et al., 2006; O’Toole, 2006; Veitch, 2007; Hampton & Willemse, 2012). According to the BCLMEP (2007: 9): “This change is most marked for the large copepods and may be related to the changes in pelagic fish abundance and species composition”. There have also been changes in the species dominance since the 1950s; larger species dominated in the 1950s and 1960s and smaller species from the 1990s (Hampton & Willemse, 2012; Blamey et al., 2015). The recording of inter-annual and seasonal variability has also shown trends between 2000 and 2011; the biomass of zooplankton peaks in summer and decreases thereafter as a result of less upwelling and the movement of pelagic fish through the inshore regions.

Harmful algal blooms (HABs) or ‘red tides’ have reportedly increased remarkably. HABs are “overgrowths of algae in water. Some produce dangerous toxins in fresh or marine water but even nontoxic blooms hurt the environment and local economies” (EPA, 2015). Blamey et al. (2015: 11) remarked that the southern Benguela has experienced a “six-fold increase in HABs per decade from the 1960s until 2005 with a concurrent increase in severity”. This has negative impacts for certain species and ecosystems due to the toxicity associated with the event which can lead to low oxygen levels known as ‘anoxia’ (O’Toole 2006; BCLMEP, 2007). The regions of the southern Benguela in which these HABs usually occur are north of Cape Columbine; the fishing communities most often affected are Lamberts Bay, Elands Bay, and St Helena Bay (Blamey et al., 2015).

2.5.1.3 Biological Changes:

All countries within the BCLME region have suffered major declines in catches of certain species (Veitch, 2007; Hampton, 2012; Hampton & Willemse, 2012; Jarre et al., 2013). In both the northern and southern Benguela systems there have been biological changes to pelagic fish stocks. These changes are highly complex and not well understood but are summarized by Figure 11 below (Cury & Shannon, 2004: 226).

Summary of the status of components of the pelagic ecosystem in (a) the southern and (b) the northern Benguela ecosystems

	Early 1950s	Late 1950s	Early 1960s	Late 1960s	Early 1970s	Late 1970s	Early 1980s	Late 1980s	Early 1990s	Late 1990s
(a) Southern Benguela time line										
Sardine	High	High	Decrease	Low	Low	Low	Low	Increase	Increase	High
Anchovy	Low	Low	Low	Increase	Increase	Increase	High	Fluctuating	Fluctuating	High
Zooplankton	Low copepod abundance; large calanoid copepods dominated								High abundance of copepods; small cyclopoid copepods dominated	
(b) Northern Benguela time line										
Sardine		High	High	Decrease	Low, slight increase	Decrease	Low	Slight increase	Slight increase	Low
Anchovy				Low	Increase	Decrease	Low	Low	Low	Low
Other					Increase in horse mackerel, goby and jellyfish			Good hake recruitment	Hake, horse mackerel and monkfish declined	Low abundance of most species

Figure 11: Status of the pelagic ecosystem in the BCLME (Cury & Shannon, 2004: 226)

In the southern Benguela system the sardine and anchovy stock are the "greatest contributors to the South African small pelagic fishery and have shown alternating dominance in the catch since the fishery's inception" (Blamey et al., 2015: 12). As shown in Figure 11, the sardine stocks declined from 1950. This was due to pressure from commercial fisheries which then resulted in the collapse of the species in the 1960s (Jarre et al., 2013). Anchovy consequentially dominated the catch until the 1990s. The period from 1990 to 2000 then saw an "unusual upsurge" (Blamey et al, 2015: 12) of both species followed by a second collapse of the sardine stock in the early 2000s (Cury & Shannon, 2004; Veitch, 2007). There have also been spatial observations made with the anchovy and sardine species.

There have been shifts in the distribution of both sardines and anchovies from the west to east of Cape Agulhas between 1985 and 2008; this is shown in Figure 12 (Blamey et al., 2015: 12). This is not thought to be due to a regime shift as the opposite trend is now occurring; it is thus likely to be as a result of environmental changes or pressure from fisheries (O'Toole, 2006; FAO, 2013; Blamey et al., 2014).

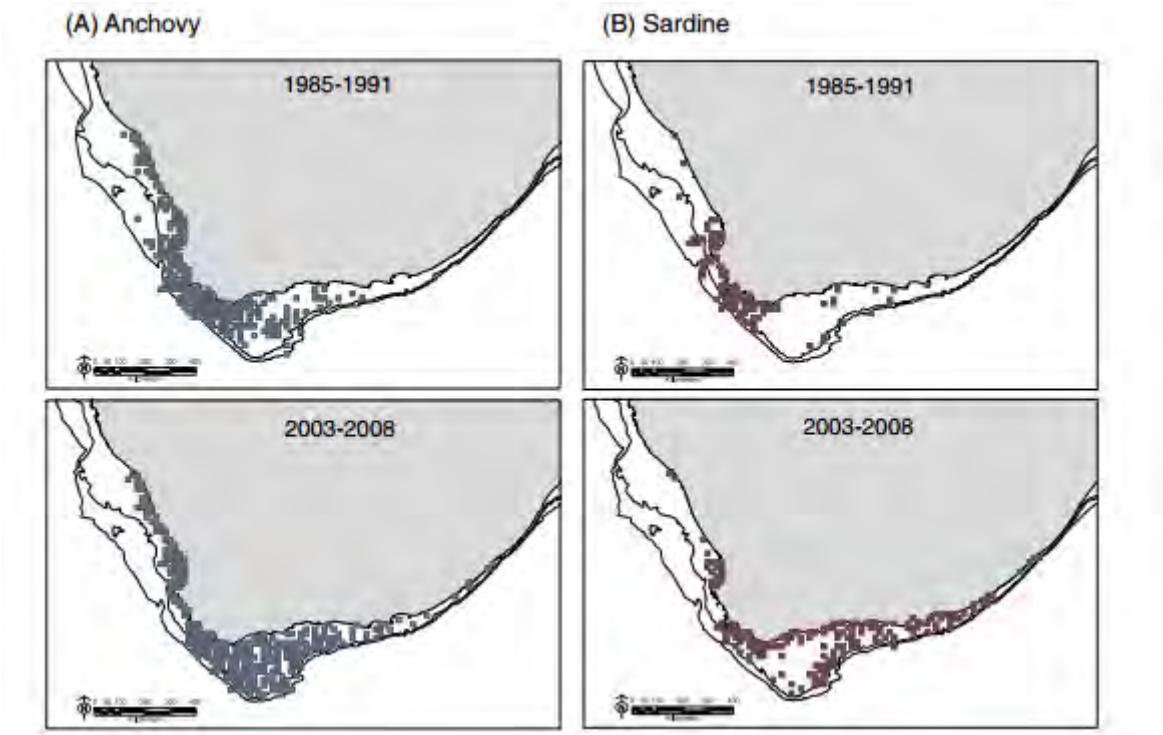

Figure 12: Distributional shift in sardine and anchovy species (Blamey et al., 2015: 12)

Demersal fisheries, which are based primarily on shallow and deep water hake, reached a peak in the 1970s. At this point, the fisheries were realized to be unsustainable and therefore management plans were enforced, reducing total allowable catch (Cury & Shannon, 2004; Jarre et al, 2013). The line fishery, which is an important sector for small-scale fishers, "denotes a multi-species, multi-sector, multi-area cluster of low to medium technology fisheries in which more than 200 fish species are caught by hand-line or rod and reel (long-line fisheries excluded) over a large geographical range" (Blamey et al., 2015: 14). This fishery has fluctuated over the last few decades but has overall experienced decline in abundance of most of the species. Figure 13 demonstrates the change in fishing effort for selected line fish species from 1985 to 2010 (Blamey et al., 2015: 14).

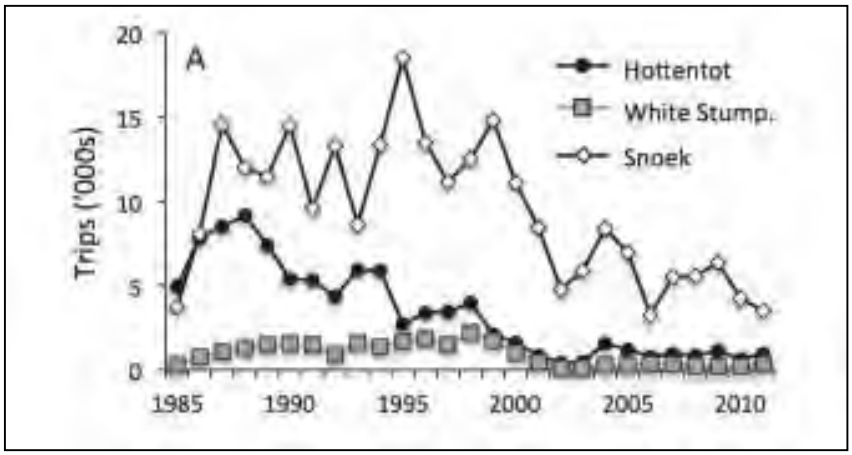

Figure 13: Change in fishing effort for major line fish on the west coast of South Africa from 1985 to 2010 (Blamey et al., 2015: 14)

There has also been a distributional shift of the commercially valuable west coast rock lobster (*Jasus lalandii*) (Blamey et al., 2012). The species has been predominantly found on the west and southwest coast of South Africa since the start of the fishery in the 1800s (Blamey et al., 2014). The fishery peaked in the 1950s and then declined unpredictably in the 1990s; in the same period, there was a shift in the distribution of WCRL from the west to the southwest coast. This coincided with an increase in upwelling on the southwest coast and an increase in southerly winds in the Cape Point region and had a significant effect on the WCRL's ecosystem, especially on kelp ecosystems, the diet of the Cape Clawless Otter, the breeding regions of the Bank Cormorants and has negatively affected the populations of urchins and abalone where there have been increases in WCRL (i.e. on the southwest coast) (Blamey et al., 2012; Blamey et al., 2014). The population has failed to recover; it is estimated that the number of adult males remaining totals only about 3% of the pre-exploitation level (Johnston, 2013). The cause of the distributional shift from the west to southwest coast is inconclusive. However, Blamey et al. (2015) hypothesizes three key factors which could have contributed to the spatio-temporal change in WCRL and therefore the "catch and effort" (Blamey et al., 2015: 24).

First, the growth rate of lobsters has decreased since the 1980s. This is likely as a result of various factors including lower oxygen levels, a decrease in food availability (due to a decrease in upwelling) and an increase in competition as well as a cooling of the southwest coast's inshore waters (Blamey et al., 2014; Blamey et al., 2015). Secondly, the last two decades have seen five lobster walkouts. Three of these were very severe "with one event resulting in the loss of ~2000t – approximately equal to the annual national catch" (Blamey et al., 2015: 24). This therefore had a significant effect on the population size of the WCRL. Thirdly, in the 1990s there was a dramatic shift of lobster abundance from the False Bay vicinity into a region that previously had few lobsters. This was suggested to be from a sudden high concentration of adult lobsters and thus an expansion of the existing population. The sudden shift is, however, not fully understood but could potentially reflect a cause of the distributional shift to the southwest coast on a more localized level (Blamey et al., 2015).

Cockcroft et al. (2008: 149) attributes this shift in WCRL to environmental variability; he states that although this variability is poorly understood, the "temporal coincidence of the shifts in lobster distribution with events such as the onset of reduced somatic growth and increased lobster walkouts suggests environmental forcing factors, as do congruent changes in other components of South Africa's Western Cape marine ecosystems". These changes are significant as it means the available percentage of lobster to legally catch is reduced (Pollock et al., 2000). Furthermore, Brouwer et al., (2006: 236) explains that fishing and handling of rock lobster also plays a significant role in the productivity and growth rates of lobsters: "Capture by traps, sorting by fishers and discard of lobsters smaller than minimum legal size (MLS) may induce physical injuries, such as loss of appendages, which can reduce somatic growth rates and population productivity". Some measurements are being introduced to prevent this, such as holes in traps for undersize lobsters to escape (Brouwer et al., 2006).

The distributional shift has also affected the diet of the WCRL. In non-invaded sites, lobsters have a high energy diet of mobile, large marine species such as winkles and sea urchin. In the invaded sites, the diet is predominantly smaller, lower energy, stationary prey such as

barnacles, certain types of algae and sponges (Haley et al., 2011). The differences are mainly attributed to competition and availability of prey. Haley et al., (2011: 160) states that: “These dietary differences have important ramifications not only for the lobster populations but also for the structures and functioning of the radically different communities that have developed in invaded areas, reflecting a regime shift induced by lobster predation”.

The above changes to the Benguela Current have consequentially had significant socioeconomic effects, these include factories and fishing industries having to close down due to stock declines, changes in fish distribution and the collapse of fish stocks. The exact cause of the changes in the Benguela Current is highly uncertain and met with debate from the scientific community. The FAO and Hampton (2012) attribute the cause to overfishing stating that "the most important driver of change in the Benguela Current region is not climate but overfishing" (FAO, 2014: 185), while other scientists declare that: "Climate is the primary force driving the LME, with intensive fishing as the secondary driving force" (Duffy, 2008). This therefore further highlights the uncertainty surrounding climate change and the BCLME, making it difficult to effectively plan for the future of fisheries in the face of climate-related changes in this region; as Cury and Shannon (2004: 238) state: "When attempting to manage fisheries from one year to the next, it is difficult to separate environmentally driven regime shifts, regime shifts induced by fishing down the food web, annual fluctuations and overfishing". Essentially, “overexploitation of marine species, coupled with human-induced climate change, is putting severe pressure on marine ecosystems on a global scale” (Blamey et al., 2015).

2.5.2 Climate Change and Fisheries

Climate change is expected to have a substantial impact on global fisheries (Blamey et al., 2014). To date, most effort regarding climate change and vulnerability has been focused in the agricultural sectors; however, there has been an increasing focus on fisheries as the potentially immense effects of climate change on the industry are realized (Benkenstein, 2011). According to Johnson and Welch (2009: 112-113): "The most pressing and direct implications of future climate change for fisheries include increasing sea surface temperature, changing ocean circulation, rainfall patterns and nutrient cycling, and extreme weather events. Indirect effects through habitat degradation will have significant implications for many marine capture fisheries". This will therefore increase the natural variability of the ocean and exacerbate the uncertainty and complexity involved in sustainable fisheries management (Johnson & Welch, 2009). Dealing with climate change and the current and potential future impacts is therefore a massive challenge for governance entities as it is "not often possible to differentiate climate change issues from wider processes…While several changes in the sector could possibly link up with climate change, the cause-and-effect relationships are seldom linear or clear, and are frequently overlapping or interchanging" (Salagrama, 2012: 6).

The world's fisheries are already in a vulnerable state as: "Almost 80% of the world’s fisheries species are currently considered to be beyond or close to their harvest capacity" (UNEP, 2008: 106). The changes that will affect fisheries specifically are linked to several factors. First, fisheries may have to target different species. It can already be seen that fisheries around the world are adapting by targeting species that previously were discarded or not sought after (Cochrane et al., 2009; Salagrama, 2012). Secondly, due to change in the

distribution of fish (both in depth and location), fisheries may have to relocate or get new gear for the deeper habitats (Salagrama, 2012). Thirdly, seasonal changes in fish stocks will require fishers to adapt by altering their fishing periods (Cochrane et al., 2009; Salagrama, 2012). Fourthly, fisheries have to adapt to different sea conditions due to changes in the distribution of fish stocks which may require fishers to go further out to sea or to new locations (Barange & Perry, 2009; Salagrama, 2012). Extreme weather events, which are expected to increase in frequency and magnitude as a result of climate change, will further enhance the potential danger of fishers at sea (Daw et al., 2009; Salagrama, 2012). Whilst developed countries' large industrial fisheries generally have the resources and capacity to adapt, this will be more challenging for developing countries.

Sumaila and Cheung (2010) declare that developing countries, who have had little implication in causing climate change, will be the ones who will be most affected by the negative effects of the phenomenon and will bear the heaviest costs in terms of adapting fisheries to climate change. The "impacts to fishing sectors in developing countries in terms of loss in landed values or gross revenues from fishing and household incomes is estimated at about 2–3 times higher than those for developed countries" (Sumaila & Cheung, 2010: 24). Africa is identified as being particularly vulnerable to the impact of global warming on fisheries, having 64% of the most vulnerable countries located in Africa (The WorldFish Center, 2007; Benkenstein, 2011). According to Benkenstein (2011: 1), the reason for this is that: "Fisheries play a critical role in contributing to food security in many African states, as well as in supporting livelihoods through economic activity in the capture, processing and trade of fish products". The current and potential impacts on fisheries in Africa should therefore be a key focus for governance initiatives.

2.5.3 Climate Change and Fisheries in South Africa

The Food and Agricultural Organization of the United Nations declared that in 2010, of the fish available for human consumption (which is in excess of 130 million tons), Africa had the least supply (FAO, 2014). Furthermore, while there is a global trend of an increase in fish available to consumers, "it has remained static or decreased in some countries in sub-Saharan Africa (e.g. the Congo, Gabon, Liberia, Malawi and South Africa)" (FAO, 2014: 62). South Africa is at risk with regard to governance of its fisheries and the potential future impacts that it has to prepare for. This is due to a combination of factors including shifts in commercially valuable species, increases in intraseasonal environmental variability and the challenging implementation of the MLRA (The Marine Research Institute, 2012).

Moreover, as a result of the political history of South Africa, coastal and fisheries management has inherently been managed in a very fragmented, top-down way, which has proved to be ineffective (Duffy, 2008; Sowman, 2011); as stated by Adhikhari and Taylor (2012: 62): "Inclusive governance is critical to the success of building capacity for all kinds of adaptation efforts". The transformation of fisheries governance is, however, not an easy task and especially in South Africa where there is limited capacity in terms of time, money and personnel available.

In South Africa, there are several categories of fisheries: commercial, recreational, subsistence, and small-scale fisheries. The fisheries least vulnerable to climate change are "those of low economic value and societal importance in which companies and individuals

are best able to adapt to changes in the environment (e.g. recreational fishing and midwater trawling in Namibia and South Africa and fishing for large pelagic fish in South Africa)" (Hampton, 2012: 11). South Africa's large fishing industries, such as the hake trawling industry, have the financial capacity to adapt to changes and, generally, the larger demersal species of fish are more resilient to environmental changes (Hampton, 2012). Conversely, fishing communities that rely almost exclusively on fish as a means of income and food will be among the most vulnerable to climate and environmental changes as they generally have low adaptive capacities (FAO, 2014) The suggestion by Hampton (2012: 31) on how to approach the vulnerability of these groups is to focus on participatory vulnerability assessments by "finding socioeconomic ways of adapting to them [the variations in climate and the environment] and combating their adverse consequences", rather than trying to determine the variations themselves.

2.5.4 Small-Scale Fisheries in the Face of Climate Change

Small-scale fisheries (SSFs) are increasingly being recognized as playing a vital role in "poverty alleviation and food security" (FAO, 2014: 77), especially in developing countries. Fish serves as a key source of dietary protein for many coastal fishing communities; according to the FAO (2014: 66), "fish provided more than 2.9 billion people with almost 20 percent of their average per capita intake of animal protein, and 4.3 billion people with about 15 percent of such protein". Small-scale fisheries differ greatly from large-scale fishing operations; Figure 14 below summarizes the key differences:

Some generalized differences between large-scale and small-scale fisheries

Characteristic	Large-scale, industrial fisheries	Small-scale, artisanal fisheries
Perpetrated by	Mostly developed countries	Mostly developing countries
Found in	Mostly marine (often oceanic) waters	Near-shore marine and inland waters
Vessels and equipment	Mechanised, advanced technology, possess distant water-fleet not limited to local waters	Manual, simple technology, fishing limited to local waters
Vessels and equipment	Mechanised, advanced technology	Manual, simple technology
Use of fuel	High (14 to19 million tonnes, 2 to 5 tonnes fish/t fuel oil)	Low (1 to 2.5 million tonnes, 2 to 5 tonnes fish/t fuel oil)
Use of catch	High value international markets for food and reduction to fishmeal	For food, mostly local, but increasingly global high-value
Direct employment	~500 000 fishers	~50 000 000 fishers
Catches per man hour	High	Low
Fishers	Full-time, professional, income often high relative to society	Full and part time, often poor
Complexity of fishery	Low, fewer fishing units, similar gear, few species	High, more fishing units and diverse gear, many species
Management capacity	High, large management bureaucracies, extensive scientific attention and capacity	Low, fishing communities remote from government, limited or no scientific information available

Figure 14: Differences between large and small-scale fisheries (Daw et al., 2009: 116)

SSF are already considered a vulnerable group due to a profusion of existing pressures. According to Mamauag et al., (2013: 9): "Impacts on fisheries such as increasing human population growth, overfishing, and changes in land use will be greater than the effects of climate, but the pressures are strongly interrelated". It is thus very difficult to discern the impacts that are caused or enhanced by climate change and what impacts are as a result of other factors due to the complexity and inter-relatedness of climate change and environmental variability.

Climate change is expected to affect SSF in a variety of ways. First, the location of fishing communities, being directly on the coast or next to bodies of water, make the inhabitants susceptible to climate change impacts such as sea-level rise and extreme events such as storm surge (Daw et al., 2009; Mamauag et al., 2013; FAO, 2014). Secondly, the negative impacts of climate change on other industries may cause people from other sectors to transfer to fisheries; this would increase competition and therefore potentially increase conflict over fishery resources (Daw et al., 2009; FAO, 2014). An example of this has already occurred in the Caribbean following the event of a hurricane (Daw et al., 2009). Thirdly, SSF generally do not have insurance and hence, when they do experience negative impacts from climate change, their ability to recover is hampered (De Young et al., 2012). Fourthly, the increase in frequency and magnitude of extreme weather will have a direct impact on the fishers' safety at sea (Allison et al., 2009; Mamauag et al., 2013; FAO, 2014). Fifthly, the restructuring of commercial fisheries, as a result of climate change, may lead to loss of employment. Sixthly, the effect of climate change on the fishery resource itself, as mentioned previously, will have a vast impact on SSF.

The vulnerability of a community to climate change has been described by Dazé et al. (2009: 5) as: "The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity". In the context of this study, the 'system' mentioned refers to a coastal fishing community. 'Community' is a difficult term as it is a heterogeneous, complex entity with variations within it (for example, not every household will have the same income or the same number of people) (Preston, 2011; Schwarz, 2011). The vulnerability between and within different fishing communities thus varies greatly in space and time. "Fishing communities are highly vulnerable to climate change if they are highly exposed to climate variability, their fish stocks are highly sensitive in combination to other pressures such as overfishing, and have low adaptive capacity (high reliance on fishing for food and livelihood)" (Mamauag et al., 2013: 2).

This research project will therefore focus on assessing the vulnerability of two coastal fishing communities in South Africa using a suite of methods. The information emanating from this research will then be compared to that of the RVA workshop in order to assess whether it contributes to VAs and the identification of potentially viable, context specific adaptation strategies.

Chapter 3: Research Approach and Methods

3.1 Introduction

This chapter describes the general approach to the study and the methods employed to conduct the research. The key research aim was to examine the potential of the rapid vulnerability assessment methodology to contribute to VAs and the identification of adaptation strategies. This was undertaken by comparing outcomes of a suite of other methods for assessing vulnerability to the outcomes of the RVA. The fieldwork took place in two fishing communities on the west coast of South Africa, namely Doringbaai and St Helena Bay. The study was conducted through a multi-phase approach using mixed methods which according to Haines (2011: 74) can provide an "increased understanding" of the phenomenon. The first phase of the research consisted of being involved as a research assistant with the development and implementation of the RVA in these two communities. The second phase involved conducting focus group discussions (based on the questions used in the RVA workshops) with different groups of fishers, as well as key informant interviews and a review of relevant literature and government reports. The research was largely based on qualitative methods, although, as qualitative and quantitative methods are rarely pure at the theoretical level (Hanson, 2008), quantitative methods also informed the study. This chapter therefore outlines the context of the research, the research approach, methods employed, data collection and analysis, and finally ethical considerations relevant to the research.

3.2 Context of the Research

This research project falls under the auspices of two projects; both of which have shaped the direction and execution of the study. This study has been conducted as part of the 'Global learning for local solutions: Reducing vulnerability of marine-dependent coastal communities' (GULLS) project, the central aim of which is to reduce the vulnerability of coastal communities across 'hot spots' in the southern hemisphere (Belmont Forum, 2014). These 'hot spots' refer to marine regions that are warming at an accelerated pace and those experiencing increased social stressors due to climate and environmental changes (Howard et al., 2015). The reason hotspot areas have been targeted is first because these are areas that are likely to become increasingly vulnerable, and secondly, these regions represent "laboratories" whereby changes, and the effects of these, can be observed and adaptation strategies and policies developed in response (Belmont Forum, 2014).

Key objectives of the GULLS project are therefore to form an international collaboration of academics from different backgrounds in order to share knowledge among and between regions, to enable access to funding for the most vulnerable areas and areas at highest risk from current and future changes, and to help create a framework for policies and adaptation options for managing and safeguarding coastal communities. It is hoped that the project will assist government and key decision makers in formulating effective coastal management and adaptation policies. It is an international initiative funded by the Belmont Forum and the G8 Research Council. This study sought to contribute to methodological aspects of the project in view of its focus on VA methodologies.

The second project was commissioned by the Food and Agricultural Organization of the United Nations (the FAO) and the Benguela Current Commission (BCC) and aimed to "develop and apply a community-level vulnerability assessment, with a particular focus on understanding the effects of environmental variability and climate change, on selected coastal fishing communities within the BCLME region" (Raemaekers & Sowman, 2015: 3).This research is based on vulnerability assessments conducted at the community level in sites located in the Benguela Current Marine Large Ecosystem (BCLME). The methodology for this study was developed by Raemaekers and Sowman (2015) after a review of the VA literature across sectors, VA methods most commonly used, and consideration of what would be most appropriate in the context of the BCLME region. It was agreed by BCLME stakeholders that the methodology should be "participatory, easy to apply, conducted over a relatively short period, and require limited resources" (Raemaekers & Sowman, 2015: 3). Consequently, a rapid VA methodology was developed, piloted and implemented in eight coastal fishing communities in the BCLME. These vulnerability assessments were conducted in the form of workshops spanning two days with follow-up focus group meetings on the third day (if necessary). The intention was to gather as much information over this short timeframe hence the name 'rapid' vulnerability assessment.

The study was conducted at a regional level at selected sites in South Africa, Namibia and Angola. Eight sites were selected altogether, three in South Africa and Angola and two in Namibia. This study (RVA) yielded information, in particular adaptation strategies, that could support local communities in addressing vulnerability to climate change. However, given the rapid nature of the assessment, it was considered prudent to investigate whether the use of different methods, and different stakeholders, would yield similar results. This would give an indication of the reliability of the RVA.

The research approach for this dissertation was therefore to investigate and assess vulnerability to environmental and climate change, in two of the RVA case study locations, using a mixed methods approach (secondary data, conducting focus group discussions and key informant interviews) and compare the findings from these investigations to those gleaned from the RVAs.

3.3 Research Approach

3.3.1 A (Complex) Systems Approach

A fishery system is not a simple system but rather a highly complex one that involves a myriad of subsystems that interact in a dynamic and unpredictable manner (Perez & Batten, 2006). Garcia and Charles (2008: 51) allude to fishery systems being of a complex nature because they are "the architecture of biophysical, ecological and socioeconomic components, along with interconnecting processes, fluxes of matter, energy and information, as well as a range of stocks and controls, that, together, are responsible for the system’s characteristics and performance, composition, productivity, historical changes, resilience and sustainability". In this study, making use of this approach has value in its attempt to understand the human component within its broader context, to realize the dynamic and unpredictable nature that characterizes complex systems and to recognize that uncertainty is inherent and should not be viewed negatively; as Berkes et al. (2003: 8) state:

"because of a multiplicity of scales, there is no one ‘correct’ and all-encompassing perspective on a system". This study therefore acknowledges and applies the thinking of complex systems (explained in more detail in Chapter 2) to facilitate a better understanding of the intertwined processes, components and entities when dealing with the fishing communities of Doringbaai and St Helena Bay.

3.3.2 A Case Study Approach

This study makes use of case studies as a primary means of generating and comparing data. A case study is: "an empirical inquiry that a) investigates a contemporary phenomenon within its real-life context; when b) the boundaries between the phenomenon and context are not clearly evident, and c) in which multiple sources of evidence are used" (Jentoft, 1999: 3). To gain understanding of the two cases the study uses multiple sources of evidence including researching secondary data sources such as past dissertations, government and research reports, and academic articles, as well as conducting FGDs, and conducting key informant interviews. The case study approach can be either qualitative or quantitative, or a mix of these (Yin, 1981), and is valuable for research as "it is the intimate connection with empirical reality that permits the development of a testable, relevant, and valid theory" (Eisenhardt, 1989: 532). Case studies allow researchers to undertake a hands-on approach to their research, whereby they can get in-depth knowledge and understanding on their topics of interest. This method also prevents a removed apprehension of the subject; as stated by Flyvbjerg (2006: 219): "Great distance to the object of study and lack of feedback easily lead to a stultified learning process, which in research can lead to ritual academic blind alleys, where the effect and usefulness of research becomes unclear and untested".

This approach is suitable for this particular study as it enables the researcher to get an in-depth cognizance of the place as well as an intricate understanding of the knowledge and experiences of the people living in the fisher communities of Doringbaai and St Helena Bay and their experiences and perceptions of environmental and climate change. This approach is also necessary as the research conducted follows on from the FAO project which applied the RVA to these two case studies as a means of obtaining data. This method of using the same case study sites to compare information is an important means of testing research; as Jentoft (1999: 4) elaborates, "multiple case studies designed to be comparative, is as close to the laboratory experiment as one can get in social science". Furthermore, as this study looks into vulnerability and current and potential adaptation strategies, these entities are all context specific and therefore the case study approach is ideal as it can be performed at the local level and prompt site-specific information (Jentoft, 1999). The case study method does have limitations; Svein Jentoft (1999) himself states that there is the risk that the information may not be truly representative. This can be the case when the voice of the more assertive group are the only ones heard, when the group tries to push a certain agenda, or are biased towards a current issue rather than the usual state of affairs. The researcher was aware of these possible shortcomings and made every effort to minimise the dominance of one or two voices in the FGDs.

3.4 Methodology: Data Collection

The key objectives of this study were first to assess the vulnerability of the two fisher communities with a view to informing adaptation strategies. Secondly, to see whether the RVA gives a reliable picture of fisher communities and recommendations for adaptation strategies which have the potential to be acted upon. The key methods employed in this research project can be divided into two main parts. The first part pertains to participating in two of the RVA workshops as a research assistant. This therefore allowed access to the data generated from the workshops. The second part consisted of enriching the information provided by the RVA with secondary data (in the form of researching past dissertations, government and research reports, and academic papers), conducting focus group discussions with fishers from the two case study sites of Doringbaai and St Helena Bay, and undertaking key informant interviews. The mixed methods employed in this research, and the triangulation of these data, were important to compare with the information generated from the RVA workshops. The value of this process was therefore to assess whether the RVA has the potential to contribute to VAs and is a reliable tool; this was ascertained by evaluating whether the information from the RVA gave a similar picture to the research generated from this study or whether the information was quite different and whether the short time period makes the RVA too superficial to be reliable.

3.4.1 Participant Observation: A Brief Overview of the Rapid Vulnerability Assessment

The rapid vulnerability assessment was implemented by a team working under the auspices of the FAO and BCC, led by Professor Merle Sowman and Dr Serge Raemaekers. This researcher participated in the stakeholder planning workshop for the RVA and served as a research assistant for two of the RVA workshops (in Doringbaai and in St Helena Bay). The data generated from these workshops was used to compare and contrast the information generated from the other data sources and in particular the FGDs in order to assess the utility of the RVA tool.

The RVAs took place in a total of eight case studies; three case study sites in South Africa, three in Angola and two in Namibia. The RVA for this research required a skilled team comprising “at least one lead researcher, a local expert based in the respective country, and a community fieldworker from the NGO sector or a community-based organization (CBO)” (Raemaekers & Sowman, 2015: 19). Members of the communities were informed about the meeting either through pamphlets being handed out, through a group meeting held by a local facilitator or through local leaders being contacted to organize groups for the workshop.

The workshop was structured to run over a period of two and a half days, in which eight exercises would be performed. These exercises are depicted in Figure 15. The process required about 20-30 participants from the local communities who were involved in fisheries; "the focus was on obtaining a diverse group of participants in order to gain various perspectives" (Raemaekers & Sowman, 2015: 20). It was explained to the participants that the objectives of the workshop were:

"To hear your voices, to learn about your lives and livelihoods as fishing communities, and the threats/stressors that you experience, especially the environmental and climate-related

changes you experience, the impacts of these environmental changes/stressors on your livelihoods, the strategies you use to cope with and adapt to change and difficulties, and what support is required to better cope with and adapt to changes/stressors" (Raemaekers & Sowman, 2015: 20).

The workshop commenced with everyone introducing themselves, an explanation of the workshop to the participants as well as the possible follow-up actions.

Figure 15: Depiction of the different RVA workshop exercises

3.4.1.1 Rapid Vulnerability Assessment Workshop Exercises

This section documents the various exercises performed at the RVA workshop (a more detailed description of which can be found in Appendix 1 of Raemaekers and Sowman (2015: 106)). A review of this methodology is necessary as the findings are compared to information emerging from the application of different methods (undertaken in this research project) in order to ascertain vulnerability.

Figure 16: The RVA workshop being conducted in Doringbaai

Village Mapping

The introductory exercise consisted of dividing the participants into two or three smaller groups. These smaller groups were each given a piece of flip chart paper to provide a rough drawing of their community including the main assets (fisheries, facilities, amenities, resources) and the various livelihood activities available to the community members and where they pursued these. Each group was then given the opportunity to report back to the workshop participants on their maps; this was important as an 'ice-breaker', as a way to validate what was drawn up by the groups, and as an opportunity to give the facilitators a brief overview of the community.

Figure 17: An example of the village mapping exercise done at the RVA workshop in Doringbaai

Identification of Key Stressors/Pressures/Threats and Ranking of These

These next two exercises (identifying key stressors and then ranking these) focused on identifying the greatest threats and stressors as experienced or perceived by individuals in the community. Each individual was given 5 cards on which to write the greatest pressures related to: the environment, the government/management and socioeconomic conditions. These were collected by the facilitator and grouped under main themes on a board for the group to see. The facilitators then listed the main themes/issues emerging on flip chart paper under each of the three categories (this process was performed during the tea break as it took some time). After the break, the facilitator went through the lists and the group was asked whether there were any additional stressors they felt should be added.

Once the lists were finalized, each participant was given six stickers; their task was to stick these next to the issues that, for them, were the main concerns (Figure 18). They could place more than one sticker on an issue if they chose to and could choose issues from any of the three headings. Men were given different colour stickers to women in order to decipher what was most important to the different genders. This exercise was important to determine the most pressing issues of the community.

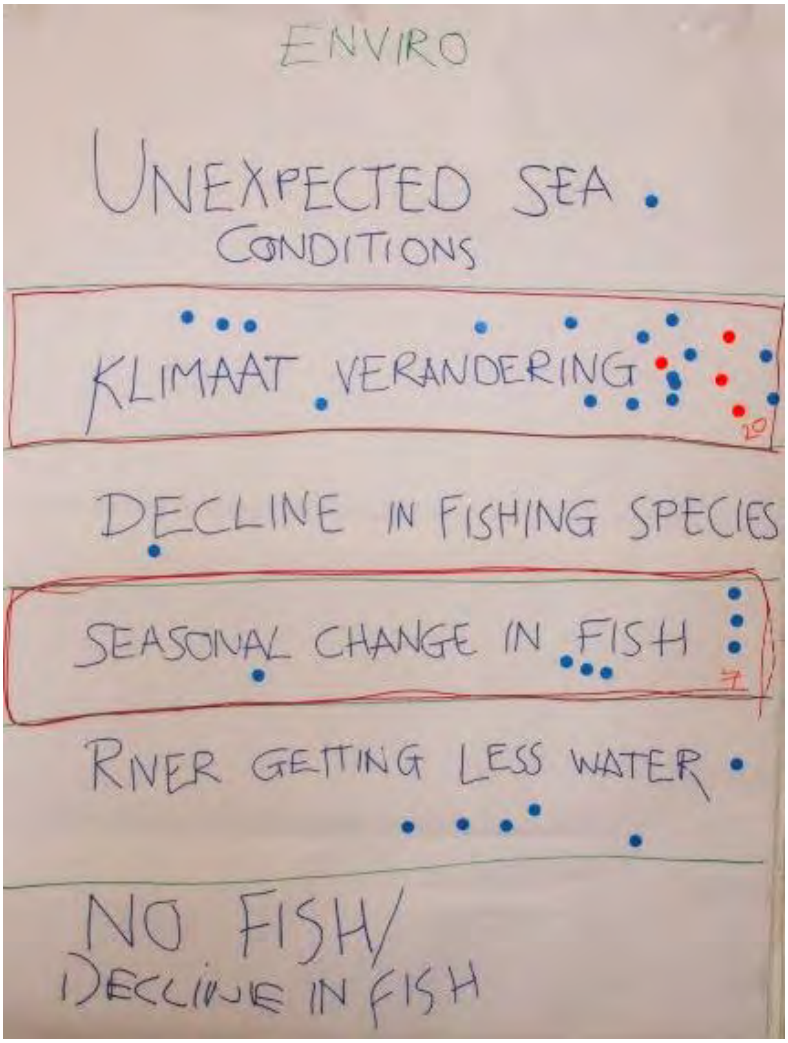

Figure 18: Ranking of the key threats and stressors at RVA workshop in Doringbaai

Timeline of Key Changes and Events

This exercise attempted to find out when specific events happened or how things have changed over time in the communities. Two of the highest ranked issues from each category (environmental, socioeconomic and government/management) were used as the topics to explore in more depth. The participants were split up into three groups and each given two of the key identified stressors/threats. They were asked to go as far back as the 1980s (or even further if possible) and document any changes noticed or key events that had occurred with regard to that specific issue. The desired final outcome was to have a 'timeline' of events showing the changes that had occurred in the community as shown in Figure 19. A report back on the timelines generated was followed by a discussion whereby modifications could be made and other events could be added by the workshop participants where necessary.

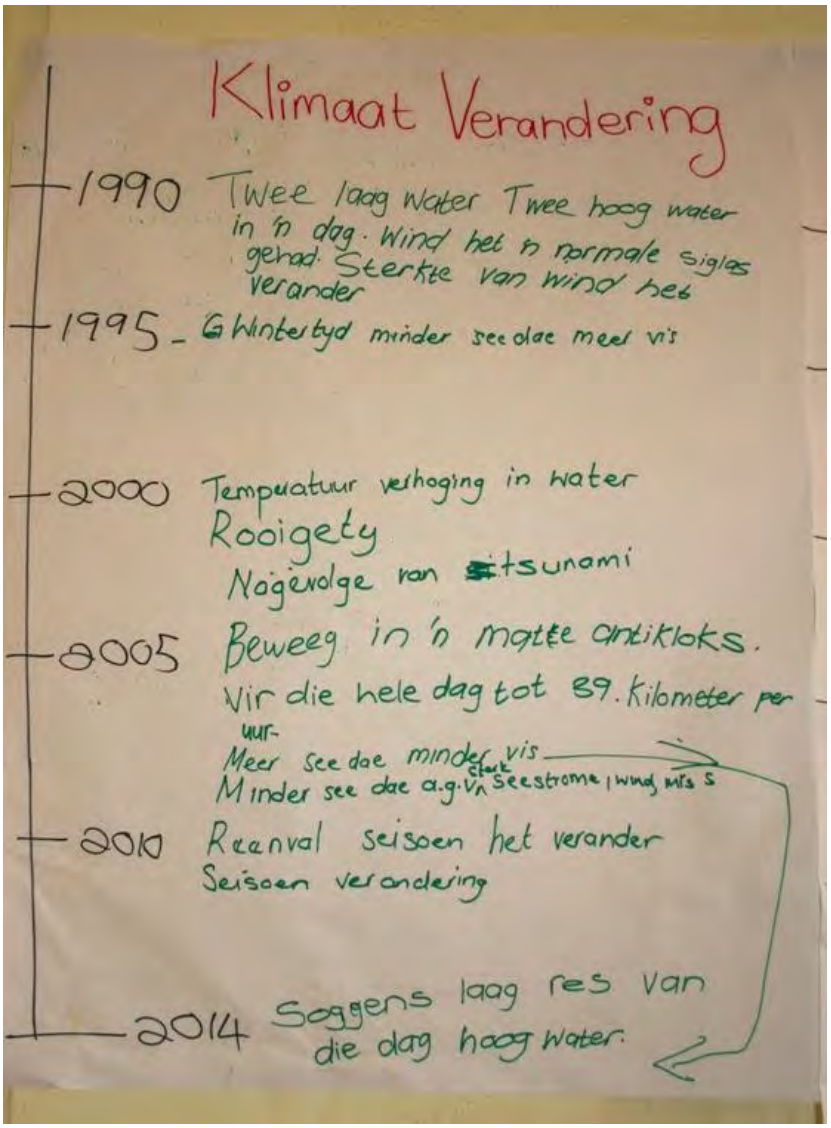

Figure 19: Timeline of environmental changes as identified by one group in Doringbaai RVA workshop

Institutional Mapping

This exercise was conducted in order to discover the main institutions and governance actors pertinent to the fishers and their livelihoods. Venn diagrams were used as a means to identify the actors/institutions and demonstrate their varying importance. This was a significant exercise in the RVA in the different countries to identify key stakeholders and authoritative bodies. This exercise was not, however, formally performed in South Africa as this information was already known and/or available from other projects. Instead, it formed part of an informal discussion in the final exercise whereby participants were asked which institutions could potentially support prospective adaptation strategies (see 'adaptation strategies' exercise). This exercise was therefore also not formally conducted but did take place as a more informal discourse.

Impacts of Climate and Environmental Change

This exercise was more focused on the environmental and climatic changes experienced by the community members and aimed to elicit the impacts of these variations on livelihoods. The exercise takes the environmental stresses mentioned from the previous exercises and further explores these issues in relation to impacts on community livelihoods. The participants are asked to describe how these issues impact on their lives (both directly and indirectly), and then to rank these impacts as being high, medium or low impacts. Participants are then asked what they think could have caused these changes. An example of this exercise is shown in Figure 20.

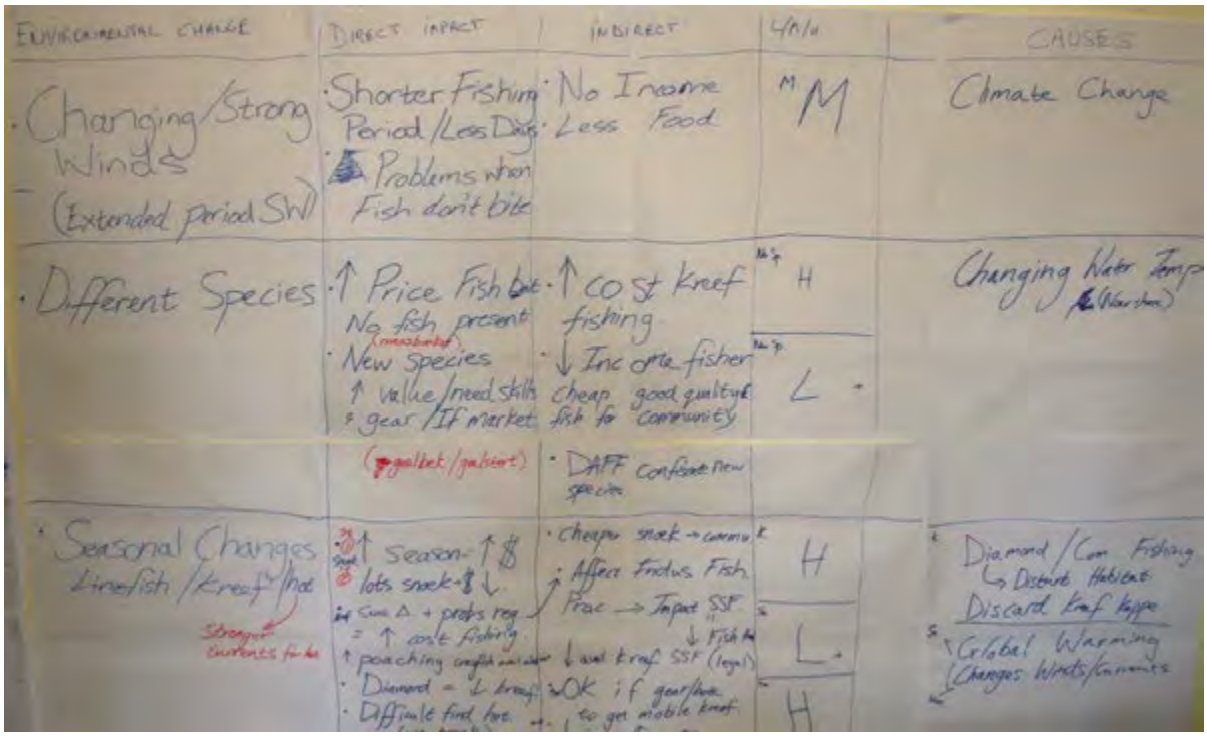

Figure 20: An example of exercise 4 from Doringbaai RVA workshop

Coping Mechanisms/Reactions

This exercise aims to explore what the people living in the community are currently doing in order to cope with the real or perceived changes with respect to climate and environment

change. They are asked how they are responding to certain environmental changes, who is assisting them with coping strategies, and whether or not these strategies are working (Figure 21). This exercise can be conducted in small groups or in plenary, depending on time constraints and the literacy level of the participants.

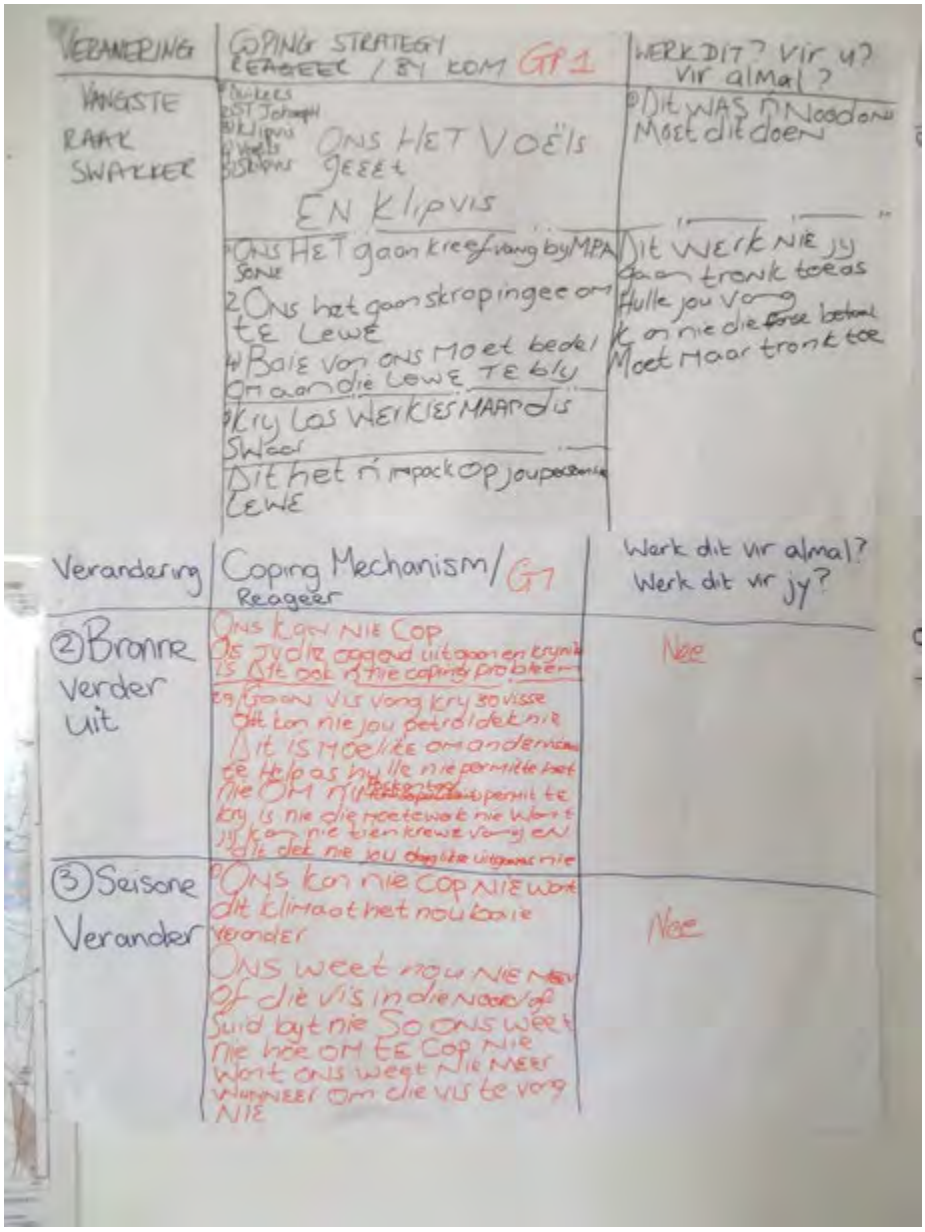

Figure 21: The coping mechanisms for different threats and stressors as done in the RVA workshop in St Helena Bay

Adaptation Strategies

The final exercise aims to explore what strategies work or could potentially work for the participants in the future. It asks what strategies work or can work in this community, what support would be needed for these strategies to be developed and implemented, and who should provide this support. This is done in plenary; an example is provided in Figure 22.

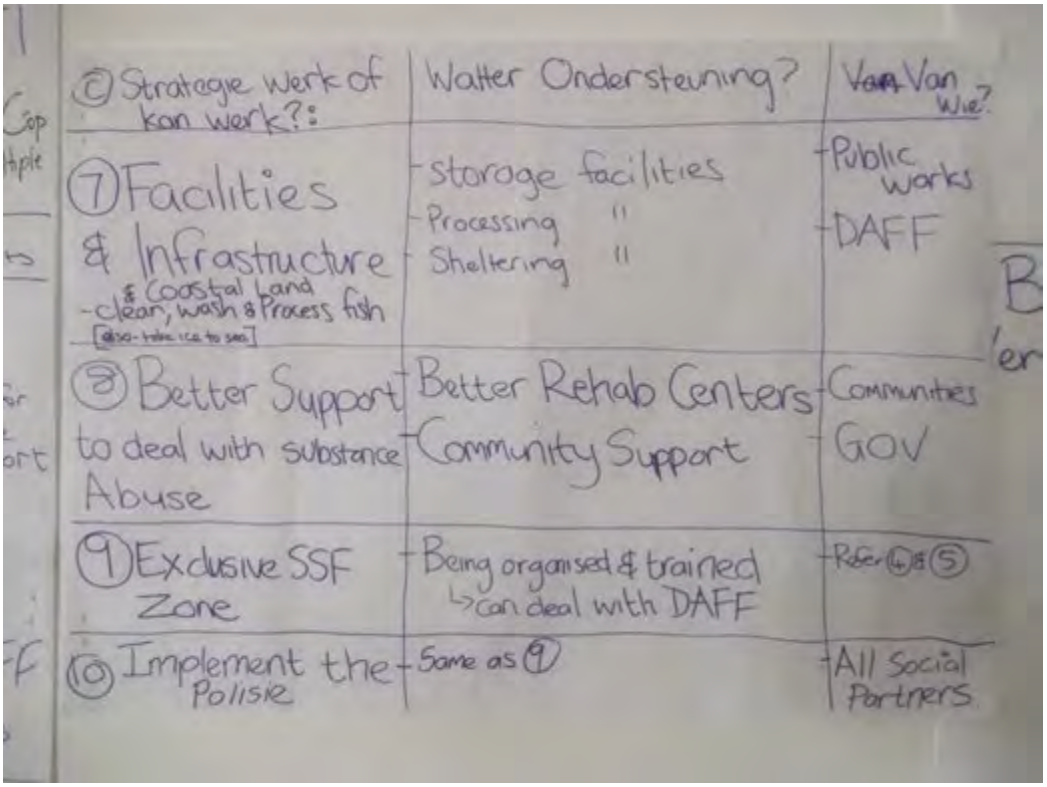

Figure 22: The adaptation exercise as done in the RVA workshop in St Helena Bay

Key Informant Interviews

Where appropriate and if time allowed, in-depth interviews were held on the third day. These informants included knowledgeable community members who had not been able to attend the workshop or could provide further clarity on key issues emerging in the RVA workshops. This was an important step in the context of the workshop in order to get more in-depth information on the issues raised in the sessions and to validate the findings. These interviews were useful and could fill in gaps in information from the RVA workshops and allowed for more detailed discussion on certain issues.

3.4.2 Scoping Visit

Scoping visits play an important role as they help to introduce and contextualize the researcher to the study site before commencing with research. The scoping visit for this research occurred simultaneously with the RVA workshops. In both Doringbaai and St Helena Bay, performing the role as an assistant to the RVA workshop was invaluable as it provided an excellent platform from which to get acquainted with the community, understand more about the people and pressures they face, and get a good insight into the environmental and climate changes; the research generated in these sessions has been an exceptionally useful foundation from which to conduct further research. During these workshops, this project was introduced to members of the community for the future fieldwork. This was an important step to make the community aware of future projects, to establish connections with people who could assist or be part of the workshops and to ensure the acceptance of the project by the community. In St Helena, as a larger period of time had elapsed since the RVA workshop, a second scoping visit was done to explain the project to key community members who were then able to play a significant role in the

organization of the focus group workshops.

3.4.3 Assessing Vulnerability Using Various Methods

3.4.3.1 Gathering Contextual Information from Secondary Data Sources

The first step in the research process for this study was to gather contextual information from secondary data sources pertaining to the two communities. This process included reviewing government reports (including integrated development plans (IDPs)), research reports, academic articles and student dissertations, as well as other relevant literature (such as census data) to better understand the vulnerability context and key stressors facing the community. There were various student dissertations that were conducted in the case study sites of Doringbaai (Authar, 2008; Rohe, 2010; Rogerson, 2011) and St Helena Bay (Schultz, 2010) which were important in informing this research, especially the contextual information provided in Chapter 4.

3.4.3.2 Focus Group Discussions

A focus group discussion is a valuable way of extracting/obtaining qualitative information about a specific topic from a group of people who are from a similar background, have had similar experiences or are from a similar demographic (Colucci, 2007). The usefulness of FGDs is that it encourages debate among participants and "provides an insight into how a group thinks about an issue, about the range of opinions and ideas, and the inconsistencies and variation that exists in a particular community in terms of beliefs and their experiences and practices" (ODI, 2009). It can be a challenging method though, as the moderator or facilitator needs to ensure that the proceedings are appropriate for the participants; this is important to ensure there is adequate participation so that good quality data may be generated (Colucci, 2007). FGDs are a good way of getting more in-depth information about certain topics as the informal conversation allows participants to more readily state their opinions and insights. The smaller groups also allow more people to voice their opinions as it is less intimidating than larger group workshops or meetings.

The FGDs took place in Doringbaai in May and June 2015 and St Helena Bay in June 2015. Well known, reputable members of the community were appointed the task of organizing participants for the FGDs and acting as facilitators during these sessions. Three FGD sessions were conducted in each community, and the different sessions targeted different demographic groups. These target groups were: older fishers who have worked in the fishing sector for over 30 years (these fishers included interim relief permit holders, commercial fishers or those that were no longer fishing), commercial fishers (fishers currently working on commercial boats or commercial line and WCRL fishers), and lastly, a group of women (this group was mixed, with women who work(ed) in the fishing industry, were partners of active fishers, or engaged in post-harvest activities). The groups ideally consisted of five to seven participants so that there would be more chance for debate and greater interaction. In some cases the groups were larger than this; however, if there were more people, no one was turned away. In practice, the groups therefore ranged from 5-11 participants. The sessions took an average of about two hours.

The format of the focus group discussions was based on the RVA workshop so that the data

could be contrasted and compared. The session started with an introduction from the researcher stating the purpose of the FGDs (including that it was for the fulfilment of a Master's degree), the importance of the groups' participation and an introduction of participants to the researcher. A vital part of the process was having assistance from knowledgeable, local facilitators. Furthermore, a research assistant was used for note taking, translating and to assist with the smooth running of the sessions.

The sessions took place in a room in the community hall in Doringbaai and the group sat around a table for the duration of the session. In St Helena, a community member hosted the sessions at his house; the group sat in the lounge on couches around a coffee table (Figure 23). Both of these settings allowed for a more relaxed, intimate setting. The sessions were facilitated by the researcher with assistance from the community facilitator and were primarily conducted in an informal manner, whereby there were group discussions and debate that were loosely guided by the exercises and questions based on those used in the RVA. However, there were times when the sessions did not strictly follow the proposed format of the proceedings. If other matters of interest came up these were explored. The FGDs were recorded by means of a portable digital audio recorder, exercises performed on flip chart paper, as well as extra notes taken by the researcher and research assistant. The FGDs consisted of seven exercises, each aligning with the exercises from the RVA workshop (except for the institutional mapping exercise which was not included in the FGDs or South African RVAs). The exercises can be found in Appendix 1. The outcomes of these exercises are explained in Chapter 5.

Figure 23: The FGD with the older fishers in St Helena Bay

3.4.3.3 Key Informant Interviews

The final method used for this research project was key informant interviews. This is an effective qualitative approach as it enables a richer understanding of specific topics and allows for the validation of other information from experts in the field (Kumar, 1989; Barsley

et al., 2013). The interviews for this study were conducted with fisheries scientists. These were useful to further explore the climate and environmental changes stated by the fishers, to see whether scientific findings were showing similar or different information. Furthermore, other information stated by participants was on occasion clarified by a community development worker for the Masifundise Development Trust.

3.4.4. Limitations

Three FGDs occurred in each of the two communities. The length of time of the sessions varied depending on the number of participants and their time constraints. There were occasions whereby, due to unforeseen circumstances, the FGDs had to be rescheduled. This happened in Doringbaai when a local fisherman had a heart attack on his boat and subsequently died. This caused some commotion in the community when the boat, carrying the fisherman's body, returned to shore. Due to the distress among participants, the session was postponed on the advice of the facilitator. It also became apparent that Friday is not a good day for research with the fishers as it is "drinking day"; the community members (especially the men) start drinking alcohol early on Fridays. For future planning, it was noted to avoid scheduling focus group discussions/meetings on this day.

The exercises did not always follow the RVA protocol for various reasons. In the sessions with the two women groups, the timeline exercise was not performed. This was because the women participants were not fishers themselves and did not go out to sea (although many were involved with the fishing industry). It was therefore thought that it may be challenging for the women to state when environmental changes occurred. However, in retrospect, it may have been interesting to have attempted to proceed with the exercise and explore their observations and perceptions of climate and environmental change. The timeline exercise was also not performed with the older fishers in St Helena. This was because the men were not comfortable stating when changes occurred as they explained these are natural, gradual changes and so it is not possible to pinpoint when exactly changes happened. After discussing this exercise at length and little progress being made, it was decided to move on to the next exercise.

A further limitation was the fact that the researcher is not fluent in Afrikaans and, although was able to understand most of what was discussed, certain responses needed to be translated. This made communication with the group a challenge at times but was overcome by the assistance of the facilitator and research assistants; some groups were also happy to converse in English. Attempts were made by the researcher to communicate in Afrikaans when possible. Another limitation, mentioned previously, was assuming a certain literacy level of the participants. Following the first session when the facilitators advised that some participants were not literate, some exercises were altered to perform the exercise in plenary and orally. A further potential limitation to the research process was having local facilitators in the FGDs. Although their role was invaluable in the process, it is possible that they may lead the groups to certain answers or conclusions. A final limitation was that it was intended that more key informant interviews would be conducted with fisheries managers and local government officials. However, due to a poor response to the request for interviews and ineluctable time limitations, further interviews were subsequently not possible.

3.4.5 Analysis of Data

The majority of the data generated was qualitative but also included some quantitative data. The nature of this type of information entails that the data is not only generated from the structured activities, but is rather gathered throughout the research process. It is therefore a more subjective task of the researcher to attempt to discern what is and is not important information; as stated by Stake (1995: 49): "All researchers have great privilege and obligation: the privilege to pay attention to what they consider worthy of attention and the obligation to make conclusions drawn from those choices meaningful to colleagues and clients". Quantitative data was also used, for example when the participants were asked to rank stressors in exercise 2 of both the RVA workshop and FGDs.

To analyze the data from the research, the information was recorded in a more accessible format. The data generated in the RVA workshops was recorded in Microsoft Excel and any additional notes were written up in Microsoft Word for future analysis. The same was done with the FGDs data. The FGDs sessions were recorded using a portable digital audio recorder and these recordings were transcribed in Microsoft Word. The sessions generally alternated between English and Afrikaans; however the transcription of these was done exclusively in English for easier use by the researcher. The FGDs were therefore designed with a similar structure and format to the RVA workshop to allow for easier comparison. The outcome of these comparisons is described in Chapters 5 and 6. Finally, the recorded interviews were transcribed in Microsoft Word and analysed for applicable references on certain topics.

The secondary data, including the government and research reports, academic articles and other literature, was reviewed to inform the context of the two case study sites. This was initially done at a more general level to be better versed in the history and circumstances of the community. The research then focused on informing understanding of the vulnerability context and the main threats and stressors impacting the communities. This research informed Chapter 4, the context of the study.

The triangulation of the FGDs, the key informant interviews, and the literature review therefore provided the basis of this study's research. This provided the information with which to compare the RVA workshops' data. The aim of this was to assess whether the RVA gives a reliable and comprehensive picture, and adaptation strategies which can be acted upon, or whether the research from this study revealed major differences and gaps in the information generated in the RVA. The criteria used to evaluate this were based on the fundamental objectives of a VA as explained by Preston (2011) and Preston (2012) as well as the five criteria set out by Schröter et al. (2005). These are listed and discussed in Chapter 2.

3.4.6 Research Ethics

Research needs to be conducted in such a way that the participants' human rights are protected; ethics are therefore an important aspect of research "to protect the autonomy, safety, privacy, and welfare of human research subjects" (Adams, 2013). When conducting research, the primary concern of the researcher is to ensure no harm, mental, emotional or physical, comes to the participants of the study (Adams, 2013). Given that this study focused on people that live in poor and marginalised conditions, it was important to ensure

precaution and be sensitivity when dealing with certain topics and issues.

Autonomy is an important ethics concept; it "refers to the right of an individual to determine what activities they will or will not participate in" (Adams, 2013). For the FGDs, before commencing, the researcher was introduced to the group and the purpose and nature of the study was explained; although this had been explained at the earlier RVA meetings, there were different participants at the FGDs. The participants could then decide whether or not they wanted to participate in the research. In Doringbaai, in the beginning of the session, one of the fishers asked why he should be in this meeting instead of being out at sea. It was important to explain to the group the benefits of being part of the research to validate their time and effort. It was explained to the fishers that these research sessions are important as it is hoped that by learning more about the fishers and their communities, more can be done in the future to design policies and management plans better suited to their needs and potential strategies may be devised to decrease their vulnerability to climate and environmental change. Furthermore, it was explained that there is great value in sharing ideas/knowledge and learning from each other. A point was made to explain to the participants that they were the experts of their own communities and the fishers' experts of the sea and its resources and the information they provide is extremely valuable. It was important to not make any promises or state that things will change, but to explain that this research should be seen as an important step in gaining a better understanding of their circumstance and as part of the process of better including the fishers and their communities in planning and decision-making.

The selection of the participants was a process undertaken by the members of the local community. The process required that participants were not part of the RVA workshop. This was important as the outcomes of the RVA workshop and FGDs were to be compared and contrasted and thus required a new group of participants who were not influenced and/or would not have preconceived ideas from the workshop proceedings. The groups were also told that complete anonymity would be given; if any person's name were to be used they would be asked for consent first. Lastly, where possible, local amenities were used, for example venue hire and catering, so that the research may provide benefits to the community where possible.

Chapter 4: Context of the study

4.1 Introduction

The study took place in two coastal fishing communities on the west coast of South Africa, namely Doringbaai and St Helena Bay (Figure 2). These two communities are approximately 3 hours apart from one another. These sites were primarily chosen for this research as they were sites used in the RVA workshop. They were chosen as they were relatively close to Cape Town where the researcher was based, the Environmental and Geographical Science Department at UCT had worked with these communities in the past and thus there were relationships established (especially in the case of Doringbaai), and lastly, these communities were relatively organized and more secure than other communities on the west coast.

4.2 Doringbaai

4.2.1 Geographic Context of Doringbaai

Doringbaai is a relatively small, rural, coastal community on the west coast of South Africa located approximately 4 hours from Cape Town. The town has a population of 1260 people, most of which are 'coloured'[1] (90,24%), this being a term from apartheid times which refers to people of mixed race origins (SAHO, 2015), and Afrikaans speaking (96,45%) (Census, 2011). The area in which Doringbaai is situated, which falls under the Matzikama Municipality, is typically a dry area, having an annual rainfall of about 189mm (Climate-data.org), and thus agricultural activities are limited. The community is traditionally a fishing village, and has been for at least the past three generations, especially relying on line fish and WCRL (Sowman et al., 2011a). In the past, Doringbaai had a thriving WCRL industry which has collapsed in recent years with the decline of the resource and the closure of the Oceana west coast rock lobster (WCRL) factory in 2007 (Jacobs, 2007). This has resulted in high levels of unemployment and poverty due to the great dependence on the fishing industry (Matzikama Municipality IDP, 2014).

Doringbaai is categorized in the local municipality's IDP as a "high-needs and low-development town" (Matzikama Municipality IDP, 2014: 102). The provision of social services, transport and education are lacking in the community. There is no high school in the community so children need to travel to other towns to obtain their secondary education; this is generally not an option though, due to the combined cost of schooling and the cost and limitations of transportation. There are currently 74 low cost houses that have been provided by the government but there is still a backlog of 276 houses (Matzikama Municipality IDP, 2015). However, all houses have access to water and electricity (Sowman et al., 2011a).

[1] The term 'coloured' used here does not refer generally to black people as in the international usage. In South Africa, this refers to people of 'mixed race', who are descended from a diverse heritage of European settlers, Khoisan people, slaves and other black African people. This group is classified as a separate racial category from 'white' people and 'black African' people. In contrast, the apartheid policy's definition of the generic term 'black' includes 'Coloured", 'Indian', or 'African' groups (Isaacs, 2006).

4.2.2 Doringbaai: A History of Fishing

Doringbaai has been a fishing community for decades, especially since the Oceana factory was established in the 1930s (Rohe, 2012). Traditionally, many of the men worked on the boats as crew for Oceana while the women worked in the processing factories. In the 1960s, Doringbaai was a key area for WCRL and at this stage the fishing industry flourished. In the 1980s, the Ministry of Environmental Affairs and Tourism decreased the total allowable catch (TAC) due to a decline in the resource (Rohe, 2012). In the early 1990s Doringbaai was no longer a lucrative location for Oceana due to the southerly migration of WCRL and the decrease in the TAC. This caused the factory to remove most of its fishing operations from Doringbaai and the industry "followed the fish, to Oceana's factory at St Helena Bay" (Rogerson, 2011: 7). Oceana removed most of their boats and the men working as crew lost their jobs and became unemployed. This also dispossessed them of their access to the sea as their access to marine resources was tied to their employment with Oceana. The women were still able to work in the lobster processing factories which remained in the area until 2007 when the factory was closed entirely as a result of the reduced TAC, the migration of the WCRL south and the more viable option of having the factory situated closer to Cape Town (Rohe, 2012).

The closure and abandonment of the factory led to the establishment of the Doringbaai Development Trust (DDT); the organization aimed to transform the factory building into an economic space through which the community could still benefit. In 2008 the Department of Public Works allowed DDT to have a ten year lease on the building. In its early stages, DDT was challenged by the community and Coastal Links (CL)[2] as it was felt DDT prioritized private interests over those of the community. This opposition to their community development approach forced DDT to reform; certain reputable local community members were thus given leadership positions in the organization (Rohe, 2012). Following DDT's reform, there has been a series of innovative projects including: tourism projects in Doringbaai, the establishment of lobster tanks in the abandoned factory in 2008 (with the help of the regional government), the pebble industry and the formation of the recent abalone aquaculture project (Matzikama Municipality IDP, 2014).

Two innovative projects which could prove to be valuable to the economic growth and employment levels of the community are the pebble factory and abalone farm. The Doringbaai Atlantic Pebble factory was started by DDT, the Department of Mineral Resources and a mining company in 2010. It employs about 20 people to transform the pebbles collected from the sand mines located in the Matzikama region into a range of products including bags of pebbles, mosaics and various landscaping commodities (Doringbaai Pebbles, 2015). The Doringbaai Abalone Farm Pty Ltd is the first abalone farm to be owned in part by a community in South Africa. The operations have been established in the abandoned Oceana factory building which is being leased from the Department of Public Works by DDT (Matzikama Municipality IDP, 2014). The farm is already underway, and has been successful thus far with the abalone growing in tanks in the old factory building. The project is mainly owned by the community and is projected to create 1000 direct and 1000

[2] Coastal Links a community-based organization working in over 50 coastal fishing communities in South Africa to strengthen local organizations and build awareness about their rights to access marine resources (Masifundise Development Trust, 2014). It was formed by the Masifundise Development Trust, an organization originally established in 1980 to support the needs of black students during apartheid times. Since 2002 though, the organization has shifted its focus to support the social and economic interests of fishers.

indirect jobs in the next five years; currently there are 21 people employed (Matzikama Municipality IDP, 2014). It is hoped that this project will be a key catalyst in providing economic growth and creating employment for the Doringbaai community members.

Finally, another significant organizational structure in the community is the cooperatives that were formed in 2008. The reasons for the community deciding to form cooperatives were threefold (Rohe, 2012). First, they found certain conditions of the newly implemented fishing permits[3] to be limiting, such as the catch limits per day. Secondly, getting the fish products to a market on an individual basis was challenging. Lastly, there was an opportunity for fishing communities that formed cooperatives to obtain funding and equipment from the Department of Trade and Industry (DTI). Ten cooperatives were therefore established in the communities of Ebenhaezer and Doringbaai and, in 2011, R3 million worth of new fishing boats, gear, and safety courses were granted to the cooperatives (Masifundise Development Trust, 2011). The cooperatives are still operational today and have served as the pilot project for other small-scale fishing communities (Rohe, 2012).

4.2.3 Doringbaai and the Present Day Fishing Industry

The fishing activities in Doringbaai are more than a source of income for the inhabitants of the community, fishing is their livelihood and part of their "cultural identity" (Sowman et al., 2011a: 84).The key species harvested in the area are WCRL and line fish, especially snoek and hottentot. Mussels are also important as they are used as bait. The main fishing activities of small-scale fishers in Doringbaai include line-fishing and fishing for WCRL (Rohe, 2012). The formal small-scale fishers' rights fall under one of two categories. First there are the long-term commercial rights. These were granted to an unknown number of SSFs in 2005 and give access to the WCRL, line fish and abalone resource for a period of ten years. Secondly, the interim relief permits (IRP) were granted to 1500 SSFs in the Northern and Western Cape; these are annual permits either held by the individual or the community and allocate small quotas for white mussel, specified line fish and WCRL. Interim-relief permits came about as a result of the exclusion of small-scale fishers from long-term fishing allocations, which aimed to redress the inequalities in the fisheries sector stemming from apartheid times, in 2005. This therefore resulted in legal action against the Minister of Environmental Affairs and Tourism. The ruling that was handed down by the Equality Court in 2007 was that the Minister must include SSFs in a new policy and, until such a policy is developed, the excluded fishers must be granted IRPs to enable their access to marine resources (Sowman et al., 2014, Masifundise Development Trust, 2015). The IRPs were intended to be a temporary measure until the Small-Scale Fisheries Policy was implemented. This was supposed to take two years, however, the policy has still not been implemented (Masifundise Development Trust, 2015).

These IRPs are causing SSFs great stress and hardship as the permits need to be renewed on an annual basis and, for fishers who do not have their own gear and boats, they have to work for other boat owners. This requires them to give up 50% of their catch and often leads to debt situations (Isaacs, 2013). Furthermore, permits are often issued late, many

[3] The 'fishing permits' mentioned here refer to the interim relief permits (IRPs), these are explained in the next section, section 4.2.3.

eligible applicants are left out while non-fishers are included, and there are allegations of corruption in the process of allocations (Masifundise Development Trust, 2015). These will likely be issued on an annual basis until the small-scale fishery policy is put into effect. The fishing gear used by the SSF is not very advanced. Ring nets and hand-lines are used for catching WCRL and line fish respectively. Many fishers use row boats to go out to sea, although there are some boats that have small engines (Sowman et al, 2011a).

4.3 St Helena Bay

4.3.1 Overview of St Helena Bay

St Helena Bay is located on the west coast of South Africa, and is approximately 2 hours drive from Cape Town. The town falls under the authority of the Saldanha Bay Municipality and has a population of 11 529 people, 69% being Afrikaans speaking and 60% being part of the coloured racial grouping (Census, 2011). The area displays a marked socioeconomic separation. The majority of the population (almost 90%) live in three settlements, namely: Laingville, Steenberg's Cove and Stompneus Bay (as shown in Figure 24), having populations of 8418 (in an area of only 3 km^2), 1118 and 718 people respectively (Census, 2011). The populations in the communities are predominantly coloured (86% in Steenberg's Cove and Stompneus Bay and 60% in Laingville), with Afrikaans as the main language (Census, 2011). The populations of these settlements are largely SSFs, factory workers and other people involved in the fishing activities of the area. These settlements consist mostly of low-income houses and lack basic services, facilities and infrastructure. There is no high school in the area, a lack of efficient and affordable public transport, and a lack of health care provisions. However, 95% of people have a toilet in their house and 100% have electricity for lighting (Sowman et al., 2011a).

Figure 24: Map of St Helena Bay showing the three settlements: Stompneus Bay, Steenberg's Cove and Laingville (Awhaleofaheritageroute, 2012).

In stark contrast to these three settlements, since the 2000s, the property market for holiday homes has boomed in St Helena Bay; the number of residential erven has increased in the area from 87 in 1980 to over 8000 in 2009 (Schultz, 2010). A few kilometres west of Laingville, in the areas of Shelley Point and Britannia Bay, upmarket homes, housing estates and even a luxury hotel with a golf course have been established; the contrast of this is

shown in Figures 25 and 26. These are welcomed in some ways as they help the local economy and contribute towards job creation, but at the same time they limit the locals' access to the coast (Schultz, 2010).

Figure 25: Bonn Hotel, Shelley Point (Booking.com)

Figure 26: Steenberg's Cove

4.3.2 St Helena Bay: A History of Fishing

St Helena Bay is described by the Saldanha Bay Municipality's IDP (2015/2016: 26) as being "one of the world's principal fishing centres". The fishing activities here began almost 70 years ago with the establishment of crayfish and fish factories shortly after World War II (Saldanha Bay Municipality IDP, 2015/2016); the industry centred around pelagic fish (sardines/pilchards and anchovy) but also included WCRL, mullet (known as 'harders' by the fishers) which were caught with nets, and line fish such as snoek (Raemaekers & Sowman, 2015). Horse mackerel used to be prevalent in the area but catches have declined since the 1950s; the species appears to have migrated south to the Agulhas Bank region (Jarre et al., 2013). Hutchings et al., (2012: 576) states that St Helena Bay "remains one of the most productive embayments in the Benguela Current in terms of plankton productivity and pelagic fish yield" due to the fact that it is "positioned downstream of the Cape Columbine upwelling cell and is a retention zone for nutrient rich water that is upwelled in this cell" (Anchor Environmental, 2012: i). However, despite the productivity of the area it has also been prone to harmful algal blooms and oxygen depleted waters which result in mass mortalities of fish and WCRL (Anchor Environmental, 2012; Jarre et al., 2013; Davies et al., 2015). Nonetheless, St Helena Bay was the "centre of the pelagic fishing industry since the

1940s" (Hutchings et al., 2012: 559).

St Helena Bay boasts a rich and complex series of events that led to the emergence of the small-scale fisheries sector in 1936 (Van Sittert, 1993). According to Van Sittert (1993), the key events that led to the rise of the small-scale fishery revolved around the historical underpinnings of the Piketberg fisheries and the Second World War. The former has to do with the retention of control over the fish resource by small boat owners. This was significant as in other parts of St Helena Bay, fishers were constrained by the debt and contractual obligations imposed on them by the commercial merchant known as the Stephan Brothers. The Piketberg area was exempt from this coercion as a result of the interests of Sandveld agriculture, who blocked any infiltration of the Stephan Brothers' commercial activities in the Sandveld region. Their vested interests were concerned with their reliance on fishers for labour supply, rent, and the supply of 'rantsoenvis' (ration fish), an inexpensive fish product used as the main food supply for farm workers. However, in 1936, a political transformation took place as the central government supplanted the provincial government. Pretoria wanted to form an alliance with boat owners with the notions of developing and modernising the sector; this lead to the independence of boat owners in the region.

The war also played a pivotal role for a number of reasons. The first was to do with South Africa's requisition of about 50% of the trawler fleet for naval use in 1939. This caused a massive shortage in the supply of canned fish. Furthermore, a rise in the price of meat products further increased the local demand for processed and fresh fish. Second, the Berg River fisheries provided the greatest enlistment rate in South Africa and thus reduced the competition for the remaining fishers in St Helena Bay. Finally, military control in the Saldahna Bay region was highly restricting for the local fisheries and thus arose the increased advantage for the fishers of St Helena Bay over the fish markets in the surrounding areas and in Cape Town (Van Sittert, 1993).

The small-scale fisheries therefore experienced great prosperity between 1936 and 1946. However, from 1946 the small-scale sector experienced decline due to a variety of factors (Van Sittert, 1993). These included: the environmental dependence of fishers as a result of a lack of technology on their boats, the newly imposed state fishing regulations, and a sharp decline in catches from 1953. The combination of these factors caused massive hardship for those involved in the sector. In 1956 there was a "crisis" situation as catches plummeted even further. The result was a detrimental transformation for small-scale fishers over the next five years which included a large-scale change of ownership of boats from private to company owned; the private boat ownership more than halved over this period from 77% to 38% (Van Sittert, 1993). Companies and the remaining skippers therefore held great control over the 'unskilled' fishers of St Helena Bay (Schultz, 2010). Furthermore, in the 1950s there was a movement of factories and fishing effort to the more profitable south coast, leaving in its wake a trail of unemployment and poverty (Van Sittert, 1993; Schultz, 2010). There was, however, a massive boom in catches from the 1960s.

The fishing industry had its peak in the 1960s and 1970s and provided thousands of people with jobs. However, from the 1990s and 2000s, a decline in the marine resources, which is largely attributed to overfishing but could also be due to environmental changes (O'Toole,

2006; De Young et al., 2012; Hampton & Willemse, 2012; FAO, 2013; Blamey et al., 2014; Saldanha Bay Municipality IDP, 2015/2016), caused factories to close and many people to lose their jobs. Several factories remain operational in the St Helena Bay area as shown by Figure 27 and are still an important source of employment for the people living in the settlements (Saldanha Bay Municipality IDP, 2015/2016).

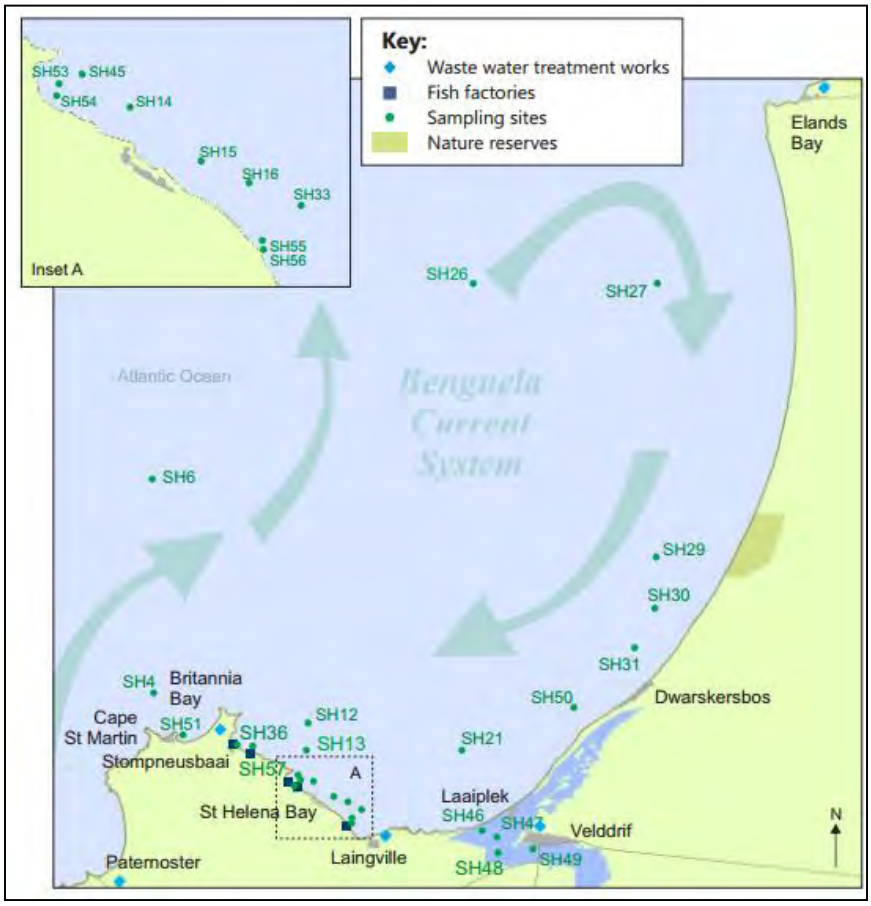

Figure 27: Map depicting the location of the fish factories in St Helena Bay (Anchor Environmental, 2012: 1)

The importance of St Helena Bay as a fishing hot spot since the 1940s has also made it an intensely researched area. The key outcome of this scientific research has shown that there have been no significant changes or clear trends in oxygen concentration and the warming or cooling of the waters over the last five decades but rather decadal variation is evident from the current research findings (Hutchings et al., 2012; Jarre et al., 2013; Pitcher et al., 2014). The pelagic fish species have also been observed to be smaller, younger and found deeper in the ocean than in the past. According to Jarre et al (2013), this leaves the populations more vulnerable to environmental variation in the water, such as changes in water temperature, and could have economic consequences for the fishery industry.

4.3.3 St Helena Bay and the Present Day Fishing Industry

Today there are about 2000-3000 people involved in the fishing industry in St Helena Bay with 400 of these being SSFs and 40 holding interim-relief permits; SSFs in St Helena have access to line fish, WCRL and mussels (Schultz, 2010; Raemaekers & Sowman, 2015). However, St Helena Bay is a closed area for catching WCRL (DEAT, 2008; WWF Sassi, 2015). Community members, especially women, also find work in the post-harvest fishing activities

such as the 'snoek vlekkers' who cut and clean the fish for the buyers. There are, however, tensions surrounding the fishing sector and the fishers in St Helena Bay as “there are fewer jobs in the formal industry and small-scale fishing rights have become circumscribed” (Schultz, 2010: 5). There is thus competition for jobs and for the scarce resources. Furthermore, the allocation of fishing rights and permits is largely contested by the fishers who feel the process is unfair. The process appears to the fishers to exclude some people, who have a legitimate claim to fishing, while including others who are seen as less deserving (Schultz, 2015); as with Doringbaai, fishing is more than a source of income and food, it is part of the “cultural heritage and identity” of the St Helena Bay fishers (Schultz, 2010: 51). The vexation surrounding the process has also led to racial tensions.

Historically, fishers on the west coast have been Afrikaans-speaking people of either the white or coloured racial group. South Africa’s political system of apartheid, which separated people according to their race, imposed a racially-based ideology that people classified as ‘white’ in terms of the Apartheid racial classification system are superior to those classified as ‘coloured’ and this group was considered superior to those classified as ‘black African’ (Posel, 2001). This way of thinking, combined with laws (such as the Group Areas Act implemented in 1950), prevented black people from living in certain areas, including St Helena Bay. Despite these restrictions, black migrant workers were documented to have moved to St Helena Bay and found employment in the fishing sector from the 1950s (Sowman et al., 2011a). Since the end of Apartheid there has been an influx of black African people, who are largely migrant workers from the Eastern Cape, into St Helena Bay in search of employment.

The scarcity of jobs in the fishing industry and declining fish resources has resulted in tension between the different racial groups in St Helena Bay; the coloured and white people “do not believe that black people played a part in the history of the west coast, rather they position them as outsiders who do not belong” (Schultz, 2010: 54). In 2005 these racial tensions escalated into violence between coloured and black African people in Laingville; this clash culminated in two deaths, many injured and three houses being burnt down (Schultz, 2010). Sowman et al., (2011a: 81) states that: “The issue of reinvigorated racial tension is an important emerging dynamic in many settlements along the BCLME, as the IRP permit and draft small-scale fishing policy raise the expectations of marginalised coastal dwellers who are competing for scarce resources”.

Aside from the difficult political conditions the fishers of St Helena Bay face, there are further challenges with boats and equipment. Many small-scale fishers work on their own small boats, known as ‘bakkies’ (as seen in Figure 26) (Rogerson, 2011); other fishers need to find work on privately owned ski boats or trawlers (Schultz, 2010). The row boats and nets that were used in the past to catch harders are no longer used as it is now illegal to catch the species in the area; furthermore, as St Helena Bay is a closed area for WCRL since the late 60s/early 70s (Danie van Zyl, Pers Comm., 7 December 2015), they have to travel further out to sea and thus a row boat is no longer a viable vessel option. This closed area is shown in Figure 28 (DAFF, 2014).

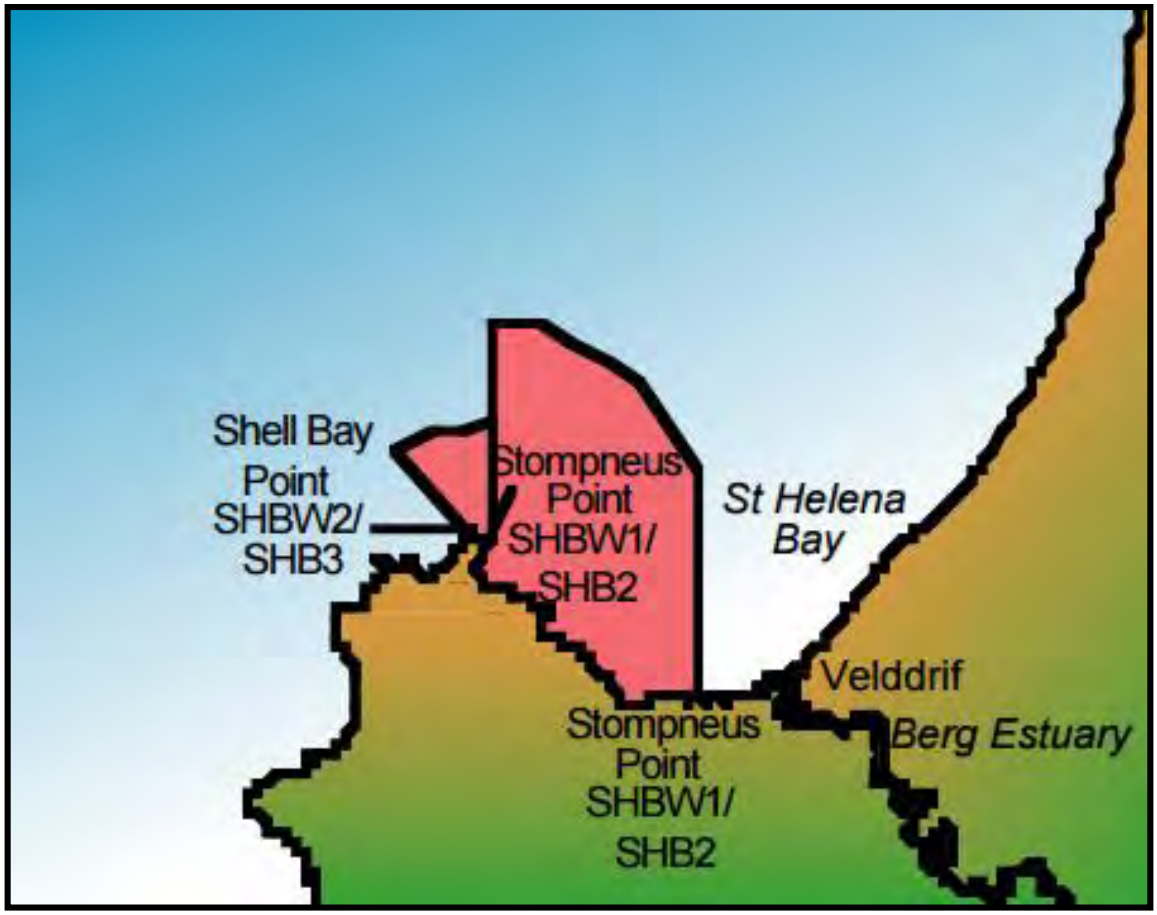

Figure 28: Map showing the region in St Helena Bay of the closed area for WCRL (DAFF, 2014)

Chapter 5: Findings

5.1 Introduction

This chapter documents the findings from the focus group discussions (FGDs) in Doringbaai and St Helena Bay as well as data gathered from technical reports, government documents, academic papers, past dissertations, and key informant interviews. The objectives of this activity were twofold. First, the FGDs were designed to uncover the communities' greatest vulnerabilities and challenges and document the current and potential adaptation strategies that participants suggested could be effective. This, combined with reviewing secondary data and conducting key informant interviews, was important to describe and assess the vulnerability context of the two communities. Second, the information emanating from the triangulation of these mixed methods could be compared and contrasted with that of the RVA workshop. This was done in order to assess whether the RVA methodology has the potential to contribute to VAs and the identification of adaptation strategies, or whether the short period of time renders it too superficial. The chapter is divided into the findings from this study's research in Doringbaai and then St Helena Bay. In this section, the particular FG was only distinguished if what was said was significant and distinctive to the demographic group. If issues were stated generally, by all the groups, only the community where the FGD was conducted was denoted. All the quotes used from the FGDs that were in Afrikaans have been translated into English.

5.2 Doringbaai

5.2.1 Understanding the Vulnerability Context

Doringbaai is a small, rural community, having about 1200 inhabitants (Census, 2011). To access the community one has to drive along one of two dirt roads, making accessibility an issue, especially in winter when the roads are dangerous to travel on. In terms of the facilities and amenities, the community is relatively well equipped, having access to basic amenities. There are two ATMs, but one would need to travel to the neighbouring towns for a bank. There is a satellite clinic which is open twice a week (on Mondays and Wednesdays) and "*needs upgrading*" (FGD Doringbaai (DB), 2015) according to the residents; a doctor is only present on one of those days (Sowman et al., 2008; Paterson et al., 2014). When the clinic is not operational, one would need to travel to Lutzville (42 kilometres away) which can be costly in terms of transportation. However, the clinic's services are free of charge.

Transport was highlighted as an issue for the residents. The Matzikama Municipality's IDP (2015: 103) even described it as the "ineffective and, to some degree, non-existent commuting system". There is a complete lack of public transport except for a bus provided by the Doringbaai Development Trust (DDT) which offers cheaper rates than private transport; however, generally hiring private transport is the only option. This makes finding work outside of the community difficult. Doringbaai can also only be accessed via a gravel road. A return journey from Vredendal, a town 35 kilometres away, costs about R300 (Sowman et al., 2011a). There is also a school bus which travels to Ebenhaezer for children attending grade 8 and grade 9. In Doringbaai there is only a crèche and schooling up to

grade 7. Most children do not study up to matric as it is too costly for the parents to pay for the schooling as well as the transport needed to attend the schools in the neighbouring towns (Sowman et al., 2008; Sowman et al., 2011a; Rohe, 2012).

There are three churches in the little town of Doringbaai; religion is described as being very important to the community members. There isn't one but "*many religions*" (FGD DB, 2015) practised in Doringbaai. Furthermore, there is a police station (where the personnel were described as "*taking hours to arrive*" (FGD DB, 2015) when there are emergencies or domestic violence issues), a small library, three restaurants, a winery (which is privately owned and does not really involve the poorer members of the community), a shop, and a vegetable garden. There is also the Expanded Public Works Programme (EPWP) which aims to provide employment and develop skills through temporary or contractual work. There are other potential income-earning opportunities arising in Doringbaai in the form of an abalone farm and a pebble factory (Doringbaai Atlantic Pebble, 2015). According to the FG participants the abalone farm is exciting in terms of the potential job opportunities it can create (Matzikama Municipality IDP, 2015); however, the community members were suspicious of the extent to which it will benefit them in the long term. In the FGDs, it was remarked that Doringbaai has 30% of the interest whilst so-called "*private investors*" (FGD DB, 2015) have 70%; the operation is regarded with suspicion as there is not much transparency from the government. However, according to the Matzikama Municipality's IDP (2015), the community, through DDT, have a 55% majority shareholding in the farm.

In Doringbaai there are few livelihood alternatives to fishing for the members of the community. From the start of the FG sessions it was made clear that the sea and marine resources are vital to the lives of the people living in Doringbaai. One of the fishers in the FG with older fishers stated that: "*everyone is dependent on the sea*" (FGD DB, 2015). A commercial fisherman also remarked, when asked whether there were other livelihood options in the area, "*not for me, because I have always been a fisher and that is my only option*" (FGD DB, 2015). There are a few Doringbaai fishers that obtain supplementary incomes elsewhere but most fishers indicated that they have no other options because they lack skills and formal education (Paterson et al., 2014); it was even stated in Sowman et al. (2011a) that government grants are the second most important source of income for households. The limited additional work opportunities often consist of menial work such as construction, gardening and mining. The older fishers stated though, that Namakwa Sands, the nearby mining company, does not employ local people, let alone veteran fishers. Women sometimes find work as seamstresses in Strandfontein, in the local shops or restaurants, the abalone farm, the pebble factory or working on farms harvesting tomatoes or potatoes in the surrounding towns of Lutzville, Strandfontein or Vredendal. Although the women get fetched and dropped off by the farmers, the towns are all quite far away (Strandfontein, Lutzville and Vredendal are 9km, 42km and 51km away respectively); this thus takes them away from their families and their home responsibilities for long hours.

The community was described by FG participants as, for the most part, being close-knit. This is confirmed in Sowman et al. (2011a: 16), which states that Doringbaai "is characterized by relatively robust social cohesion and solidarity". An example of this is when a community member dies the church bell is rung and everyone gathers to pay their respects. During one focus group session this was experienced firsthand as a fisherman died whilst out at sea. There are also 'safety at sea' training courses taught to the younger fishers by the FG with

older fishers. The older fishers stated that it is important as the younger men have the theoretical knowledge but the older men have the practical and experiential knowledge.

In terms of fisheries, the main marine resources harvested in Doringbaai are line fish and west coast rock lobster (WCRL); WCRL is also referred to by fishers as lobster, crayfish (although crayfish refers to the freshwater species (Danie van Zyl, Pers Comm., 26 November 2015)) or 'kreef'. The Matzikama Municipality's IDP (2015: 103) describes how the WCRL industry was one which flourished in this region in the past; in more recent times, however, the community of Doringbaai "currently endures high levels of extreme poverty due to the dwindling fishing industry". The complete closure of the Oceana factory in 2007 especially impacted this (Rohe, 2012; Sowman et al., 2011b). This decline in marine resources has therefore resulted in unemployment levels in Doringbaai reaching 85% (Matzikama Municipality IDP, 2015). According to the fishers, marketing and storage of fish is a problem. It was stated that DDT had provided three cold storage facilities but they are currently dormant. The holding tanks are plastic and make it difficult for the lobster to walk along the floor which affects the quality of the product. The tanks are therefore not very useful and should rather be made of a material that has more grip such as cement. There are similar major problems with the 'processing facility'. There is a building in the harbour intended for processing or 'vlekking' (fish cleaning), however, it is not adequately equipped or maintained by the municipality. As a result, the area is extremely unhygienic and has a foul odour which deters anyone from actually utilizing the facility. The EPWP will not even clean it because the conditions are so repulsive. One of the fishers in the FG stated that: "*the municipality owns the area but does almost nothing to maintain it*" (FGD DB, 2015).

In Doringbaai there is also no local market for the fishers to sell their catches; this is both in terms of physical space and processing. In the past, the fish were sold from the processing facility, but the smell and conditions in the building are a deterrent for potential buyers. The process for selling fish is equally lacking; the fish buyers or 'langanas' determine the prices for the fish which are often unfair and exploitative. They then sell the fish in surrounding areas for higher prices. As there are no set prices or marketing systems in place, the langanas are free to insist on lower prices (Sowman et al., 2011b). A commercial fisherman stated that line fish is especially difficult to sell; "*it is difficult because there are such high costs to catch the fish, but then local residents and langanas don't want to pay a fair price, and insist on very cheap prices. Without cold storage facilities, you are forced to take their unfair prices*" (FGD DB, 2015). The process of fishing for line fish is in itself expensive and then the langanas are free to declare these unfair prices and, without cold storage facilities, they have to accept these. If there were proper cold storage facilities and set market prices they could better manage the supply and demand relationship (Marten, 2001) for the fish as a product. Furthermore, there is a constant market for lobster (which still rarely acquires a fair price) but it is unreliable for line fish. This is important as line fish is a vital source of income for many of Doringbaai's fishers. The fishers stated that they also often sell to the white farmers from neighbouring towns but they offer unreasonably low prices too; for example, farmers offer to pay R50 for two snoek, when a fair price would be at least R70 per snoek with the calculation of the costs, labour and risks. As commented by a commercial fisherman in the FGD:

> "*There are so many costs! Bait and petrol are crucial necessities, but are very expensive. To make matters more difficult, there is no petrol station in Doringbaai, so*

if you have to [drive to] Lutzville to get petrol – so … you need money for petrol so that you can go and get petrol!" (FGD DB, 2015).

5.2.2 Key Threats/Stressors Facing the Doringbaai Community

This section documents the key threats/stressors facing the Doringbaai community based on the FGDs, secondary data and key informant interviews. In the FGDs, the participants identified their greatest threats and stressors and then ranked these. The way the stressors were ranked was by giving each participant six stickers which they could place next to the stressors they felt were most significant. If a certain stressor was of particular importance, they were able to place more than one sticker next to that point. Figure 29 depicts the outcome of this exercise.

The governance/management category demonstrates the frustration the fishers have with the government and the fishing rights and regulations. In the session with the older fishers, one of the men stated that "*the fishers are always being exploited*" (FGD DB, 2015). The most significant governance issue was with regard to the fishing permits, rights and regulations. According to Raemaekers and Sowman (2015), in Doringbaai there are 10 WCRL or line fish rights, 70-100 interim-relief permits, and the other SSFs operate informally awaiting formal access. There are also fishers who engage in shore angling using recreational permits. The participants felt that their fishing activities are not properly understood by the government and then conditions are imposed which restrict them and make their lives significantly more difficult. For example, the WCRL season appears to have changed but the regulations of the permits have not simultaneously changed to accommodate this. The fishers therefore lose out on a part of the WCRL season due to the rigidity of the permit conditions. This is also mentioned in Rohe's study (2012) where it is noted that the restriction of seasons limits the potential income for fishers. Furthermore, the season for commercial fisheries lawfully begins before the SSFs, giving them a 'head start' at the resource and potentially leaving less for the SSFs.

The fishers also find the limits on catches in general (species, areas where they may fish, total allowable catches and so forth) to be very constraining. The allocation of permits and fishing rights was also believed to be unfair and appears to be random to the fishers. The benefit of some fishers at the expense of others is also an issue of contention in the community, threatening to divide the community (Rohe, 2012). Furthermore, in Doringbaai there are only two commercial line fish permits. The regulations were described by the fishers as not being "*fisher-friendly*" (FGD DB, 2015). By this they meant that the processes that fishers need to go through are not well suited to their needs. Examples of this are: if someone drowns there is a very difficult administration process for the family, there are large fines if a fisher loses their permit (one commercial fisherman was fined R2000), there is a general lack of respect from officials, and the permits are made of paper which is not ideal to carry on the boats as they could get lost or wet. All of the above exacerbates the fishers' frustration with the government; one of the commercial fishers, in their reference to DAFF and how they feel they are not respected or taken into adequate consideration, stated that: "*we are obviously not human*" (FGD DB, 2015).

On par with the dissatisfaction with the allocation of fishing permits and rights was the lack of support and communication from the government. Examples of this are the lack of

maintenance of the slipways and the processing facility in the harbour as well as the clinic which is only available twice a week and was described as in need of an upgrade. The lack of gender equality in terms of allocating fishing rights to women was an important point raised by both the men and women. Furthermore, the FGDs revealed that the women feel they are excluded when it comes to fisher meetings held by the government; the unequal treatment of women in the fishing industry is a problem which has been highlighted by several studies (Masifundise, 2008; RFLP, 2011; Rohe, 2012). They stated that they do not get properly informed and then are only aware of events and deadlines after it is too late. The women also declared that there have been times when permits and quotas promised to women by agents and companies never actually reached the women; the companies used their details to obtain permits and then kept them for their own benefit. The lack of insurance was also important; by this the participants were referring to if something were to happen to them at sea, their wives and children could be left with nothing, not even their fishing rights/permits. There is a process of transferral, whereby the fishing rights are able to be passed from the deceased to another family member. However, the bureaucratic processes are exceptionally challenging for the community members, requiring people to travel to Cape Town multiple times to get to DAFF's offices there and requesting what was described as unnecessary documentation. The complicated and expensive process therefore deters many from actually pursuing the fishing rights. In 2009, a fisherman said they had done the entire transferral process and only recently found out (upon inquiring) that DAFF had no record of their application.

When asked about the socioeconomic issues in Doringbaai, one of the fishers from the FG with older fishers commented "*it's a mess!*" (FGD DB, 2015). The socioeconomic category was especially important in the women FGs (having nearly double the number of rankings as the men FGs), with alcohol and drugs being an exceptionally important issue in the community. The main drugs used in Doringbaai were identified by the FGs to be 'tik' (methamphetamine), 'buttons' (mandrax), and dagga. Alcohol and drug abuse was ranked as the most prevalent issue as shown by Figure 29 and leads to other problems such as early school dropouts (the second most ranked issue), domestic violence and early pregnancies. This differed from the RVA which had unemployment as a far more pressing issue, although it was stated that this often leads to an increase in substance abuse (Raemaekers & Sowman, 2015). There is an intrinsic link between unemployment, early school dropouts and substance abuse (Reincorpfish CoCooN Integrated project, 2011). Furthermore, the Department of Agriculture, Forestry and Fisheries (DAFF) has noted that there are direct links between poaching and organised crime syndicates, including the drug trade (Biyase, 2011). Drug abuse also leads to stealing, even from abusers' own families. One of the commercial fishers remarked that: "*They come and then steal out of your fridge!*" (FGD DB, 2015), demonstrating how nothing is safe from desperate drug abusers. The issue is universal, affecting men and women, old and young. Furthermore, it can be a factor leading to suicide, another issue which was raised by the women's focus group. The women stated that this is an increasingly significant issue, becoming more prevalent than in the past. One of the women in the meeting was especially affected by this issue as she had lost her son to suicide two weeks prior.

Poaching was also briefly mentioned and got one point but did not seem to be an especially pressing issue. In comparison, the RVA workshop in Doringbaai showed poaching to be the second highest ranked issue (Raemaekers & Sowman, 2015). This was also stated to be a

massive issue by Dr Andy Cockcroft (Pers. Comm., 2 December 2015), the principal specialist scientist at DAFF, who stated that "illegal harvesting or poaching is the biggest threat that faces the resource at the moment". The DAFF research technician responsible for the annual assessment of WCRL agreed with this sentiment, stating that poaching has escalated and is "a threat to the resource" (Danie van Zyl, Pers. Comm., 26 November 2015). Lastly, it wasn't made as a point on the list but a discussion arose about the local police being ineffective. It was said that when residents require assistance they are told to file a formal complaint which puts their identity at risk and when the police are phoned for immediate assistance they often only arrive about three or four hours later; the residents therefore have very little faith or trust in the local police.

The most significant environmental stressor identified in the FGDs was the increase in frequency of the 'mist' or rather the advection fog. This was interesting as it was not a stressor mentioned in the RVA workshop (Raemaekers & Sowman, 2015). This stress impacts the lives of fishers and their families greatly (as is shown by the almost equal weighting from men and women), as it both prevents fishers from being able to go to sea and is also a safety hazard (personified by one of the commercial fishers: "*he (the fog) is getting much more dangerous*" (FGD DB, 2015)). Species migration was the second most important environmental stress. This particularly referred to the migration of the WCRL south. This is rather referred to by Laura Blamey (Pers Comm., 1 December 2015) as the "eastward shift in the resource, meaning that WCRL abundance has increased in the south and east" (especially the Hangklip and Hermanus region). Blamey (Pers Comm., 1 December 2015) further states that there is no evidence of an actual migration from the north to the south having taken place, and the most likely explanation for an increase in lobsters east of False Bay is likely to be an expansion of the False Bay population. Although, at the same time this happened, it appears that WCRL on the west coast have been doing poorly/declined". The reasons for the change in abundance are therefore not known but environmental conditions, which have changed over the last few decades, could be the cause. There is no evidence to suggest climate is the cause (Blamey, Pers Comm., 1 December 2015).

The fishers say there also appears to be a shift in WCRL from Doringbaai to Lamberts Bay and Elands Bay. The result of this movement from the local area thus requires fishers to travel further and is more costly as a result of increased petrol expenses. According to fishers there are very few lobster in Doringbaai nowadays. One of the commercial fishers described spending the day at sea and catching only three lobster in the local waters, and, as he was using lobster itself as bait, it was a futile operation. The older fishers remarked that the lobster stay longer in Doringbaai but are of a much poorer quality, as the shells are softer and under-developed, than in the past. The wind was noted to have changed; the southwest wind was observed to come earlier and more often than it used to, bringing with it strong currents, rough seas and stormy weather. In the past it was the northwest wind that would bring these conditions. Winds were also perceived to be stronger in the morning than in the past (about five years ago). This was only ranked as an issue by the women.

Sand erosion in the harbour was spoken about as a pressing issue for the fishers. First it exposes more rocks in the bay area (one fisherman commented that "*the rocks are growing!*" (FGD DB, 2015) which can damage the boats. Even the veteran fishers who are experienced at coming in with their boats remarked that there are now "*new rocks*" (FGD DB, 2015) in places where they were not exposed before. The fishers said they have an old

trick of waiting for seven waves and then the lull for when they come in; however, they now need to navigate new places to come in due to the hazard of the rocks. Secondly, the sand erosion causes the water to cover a larger area of the beach in the harbour area which leaves less area to store the boats overnight. It requires fishers to store their boats above the beach on the concrete. This phenomenon was speculated to also potentially be due to sea-level rise as it was stated that the water level is surpassing the old high-water mark. A commercial fisherman even commented that: "*the beach at the harbour launch site is getting smaller, because the sea is coming up higher*" (FGD DB, 2015).

The water temperature was also observed to be warmer in November to January (14°) and colder than it was previously in March until July; the average temperature was stated to be about 12°C. The red tide was labelled by only two people as a stress; there was a recent red tide along the west coast four months prior making it fresh in the minds of the fishers. It was stated in the session with the older fishers that the red tide is more frequent and lasts longer. Danie van Zyl (Pers Comm., 26 November 2015) stated that "lobster walk-outs have become more pronounced during recent times and are related to low oxygen events". Finally, the women raised an issue of concern, noting that lobster were found further out and thus deeper. Annual surveys from DAFF do not confirm the movement of lobsters into deeper water though (Danie van Zyl, Pers Comm., 26 November 2015). However, Laura Blamey (Pers Comm., 1 December 2015) stated that: "It is well known that lobsters do move onshore/offshore, but I don't know what DAFF have observed in this regard. There is also a study overseas detailing lobsters that move when under stress or changing environment – so it is possible".

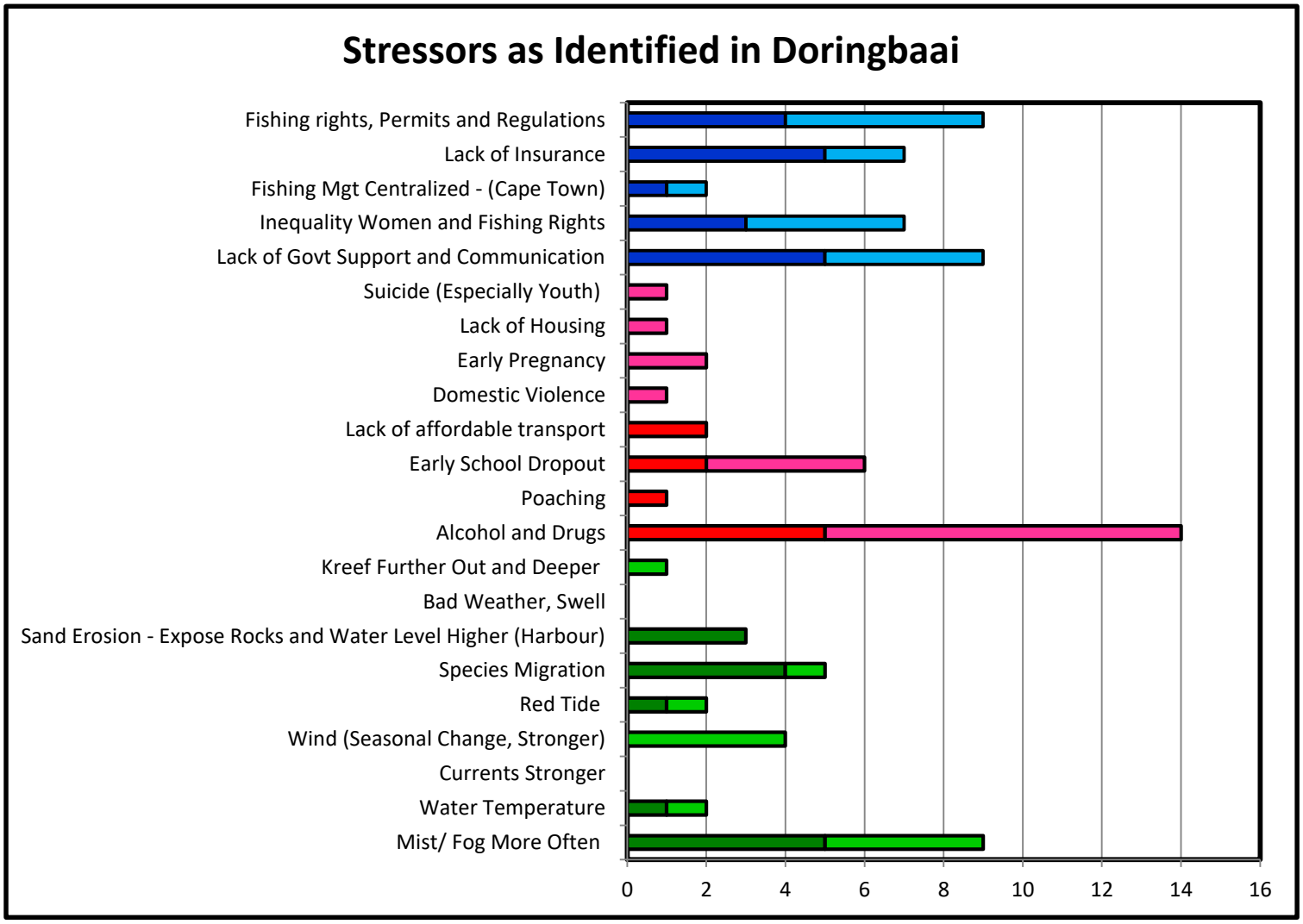

Figure 29: Stressors as ranked by community members in Doringbaai (Men=darker shade; women=lighter shade; environmental=dark/light green; socioeconomic=red/pink; governance=dark/light blue)

5.2.3 Perceptions of Environmental Variability and Change

This section documents fishers' perceptions of environmental variability and change educed from the FGDs, as well as key informant interviews and the review of secondary data where relevant. In this FGD exercise, participants were required to identify and discuss environmental changes and events they have observed and experienced and provide some indication of when these changes and events were noticed in Doringbaai. Table 1 documents these changes in chronological order.

Table 1: A summary of environmental events and changes identified by FG participants to have occurred in Doringbaai

1960-1970:	Massive storms, strong winds (1960-1980)
	WCRL seen migrating south past Doringbaai; at this time there wasn't much lobster in the Cape Town/more southerly region (1963)
	WCRL still abundant in Doringbaai

1970-1980	Huge Storms (in December) - limits access to the sea
	WCRL catches start to decline
	Water level begins to get higher on beach, continues over the next few decades at an increasing rate (1970s)
	WCRL traps introduced (late 70s, early 80s) (commercial fishers)
	Steady decline in WCRL catches from this period
1980-1990	Wind Direction (NW changes to SW): affects current direction
	WCRL traps introduced 5 miles out to sea (1980s) (older fishers – contrast with commercial fishers statement)
	Diamond boats arrive in Doringbaai, WCRL decline - sucks up WCRL
1990-2000	Storms not as big: better conditions, more sea days during this decade (1990s)
	Since the 1990s, it has become easier to catch WCRL because the sea "*is often flatter*" (FGD DB: Older Fisher Group, 2015)
	Current stronger, change in currents
	Line fish catches decline significantly
2000-2010:	Sea not as flat as in past; choppier conditions more often
	Water colder in March-July (since 2010)
	Stronger winds in the morning, delays going out; have to come back earlier often – in the last five years (since 2010)
2011-2012	'Pap' [bad quality] lobster: Temperature of water is warmer
	Tropical fish found in Lamberts Bay (2011)
	'Black Rain' following the Japanese Tsunami (2011)
	Underwater currents change direction (2011)
2012-2014	Massive storm - damages boats, wash up on beach (2012)
	Beach in harbour area has started disappearing dramatically
	Increase in magnitude and frequency of 'mist'/fog (since 2013)
	Aquaculture – harvest kelp; affects WCRL (less food)
	Low tide - very low, high tide - very high
2015	WCRL usually in berry in May. In 2014 and 2015 they were not in berry in this month. In 2014 they were only in berry months later, in December (for 2015 it was still to be determined); 2014 is the first year that this has happened
	Mist/fog weather conditions most severe this year

The participants from the FG with older fishers were able to recall as far back as the 1960s and began by recognizing that storms have decreased in frequency and magnitude; one fisherman remarked that: "*the sea does not get so angry any more*" (FGD DB, 2015). In the 1970s to the early 1980s, the men recalled massive storms that limited their access to the sea. One fisher recalled a particularly stormy December in the late 1970s or early 1980s where there were huge swells preventing them from fishing for an extended period; this resulted in what he called a "*black Christmas*" (FGD DB, 2015) as there were limited funds to celebrate the holiday. Since the late 1980s and early 1990s there has been a decrease in the occurrence of these great storms; they do still occur however, such as in 2012, when boats were washed up the beach and sustained damage.

The fishers have also noticed changes in the currents and wind patterns. They stated that since the 1990s the wind appears to be blowing from the southwest much more frequently than before, whereas previously the dominant wind was from the northwest. According to

the FG with older fishers, this change in wind pattern has also impacted the direction of currents. According to the commercial fisher FG there has been a change in the direction of the underwater currents since 2011 and continues presently, where the fishers have noticed that, while in the past the surface waters would flow in the same direction as the deeper waters, they now appear to be flowing in opposite directions. According to the fishers, currents were also stronger than in the past. This observation was reinforced when the body of a fisherman who drowned recently in St Helena Bay washed up later in Doringbaai. This was noted to be unusual as in the past bodies would wash up in similar vicinities to where the drowning occurred.

The water temperature was also noted to be colder in the period from March to July in the last five or so years. This was also attributed to the change in winds. The northwest wind brings warmer water whilst the southwest wind brings colder water conditions. With the increase in the southwest wind, especially in the winter months, the sea conditions have become colder. In the summer months though, there are times when the sea is warmer than it has been in the past. The colder water is an issue for the fishers as a commercial fisher stated: "*the fish don't like to bite when the water is too cold*" (FGD DB, 2015). The warmer conditions are also unfavourable as it makes the WCRL 'pap'; this means that the quality is poorer as the lobsters are softer and have underdeveloped shells. Another key observation was that, over the last three or four years, the tides appear to be more pronounced; high tides are higher and low tides are lower than in the past.

There have been a lot of changes observed with the WCRL over the last few decades according to all the FGDs. In the 1960s there was an abundance of WCRL in Doringbaai and the surrounds. The species then started to decline from about the late 1970s (FGD, DB: Commercial Fisher Group, 2015) or from the late 1980s/early 1990s (FGD DB: Older Fisher Group, 2015). Even in the 1990s still, one fisherman recalls catching one ton of lobster using only a row boat and a hoop net but states that nowadays there are few lobster in the local inshore area as they have migrated further out to sea. An older fisherman, about 80 years of age, recalls seeing huge numbers of WCRL migrating south on the 1 November 1963; he said that their antennae could be seen above the surface of the water. At the time there was not much lobster in Cape Town and people would travel to Doringbaai to get lobster but, following this migration, it then became abundant in Cape Town. His father had told him that he had witnessed a similar event decades before (this period was not specified but could have been in the early 1900s considering his age). He said that his father used to tell him: "*the lobster returns to where it was born!*" (FGD DB, 2015).

A final observation made about the WCRL was that the fishers observed that in 2014 and 2015, for the first time, the females were not in berry in May. In 2014 they were only in berry months later in December. This has also been observed by scientists at DAFF. Dr Cockcroft (Pers Comm., 2 December 2015) stated that it is not certain whether this is permanent or an anomaly but, if it is permanent, it is problematic as the fishing seasons then need to adjust accordingly. This is important to prevent the targeting of the females in berry. Currently the season for WCRL starts on the 15th November and therefore puts the lobster in berry at risk if this phenomenon is to occur in December again (Nico Waldeck, Pers Comm., 13 January 2016). Danie van Zyl (Pers Comm., 26 November 2015) added that the berry cycle takes place during the period May to September and that scientists at DAFF

noticed a large number of berry females during the last season and "suspect it is as a result of a double moult".

The fishers stated that in general they have observed the fishery resource to have declined significantly in their waters since the 1990s and 2000s. One of the older fishers stated that in the 1960s and 1970s it was possible to catch eighty bunches of hottentot whereas nowadays you are fortunate to catch five to ten bunches Furthermore, the mist has become a significant stressor for fishers. A fisherman stated that it "*became much more regular and thick [sic] from 2013*" (FGD DB, 2015). Another commercial fisherman added that "*nowadays the mist becomes so thick you can't even hear a fog-horn through it*" (FGD DB, 2015). All the focus groups commented that this year has been the worst in terms of frequency, duration and intensity of the mist. The mist is especially dangerous as it confuses fishers; it can make the sea appear flatter or calmer than it is and can also confuse them as to their whereabouts when out at sea. The mist combined with the sand erosion exposing more rocks in the bay area makes the launching and returning process much more hazardous. In the past the fishers stated it was easy to row a boat out and now, even with engines, it is a challenge.

Other observations were that there were strange occurrences for 12-18 months following the Japanese tsunami. These included a huge storm that damaged a few of the boats that were washed ashore and there were large schools of freshwater fish found in the Doringbaai and Lamberts Bay region (FGD DB, 2015). Since 2012, the beach has also been observed to be "*disappearing faster than ever!*" (FGD DB, 2015).

5.2.4 Impacts and Possible Causes of Impacts on Livelihoods Associated with Environmental Stressors and Changes

This section documents the impacts of environmental changes on fishers' lives and their perceptions of possible causes of these impacts. This information was obtained from the FGDs and other secondary sources.

The recent increase in frequency and duration of fog (especially in the winter months) was rated by the fishers as having a high impact on their lives and livelihoods as it prevents them from going out to sea (preventing them from earning an income) and is hazardous if they are already out at sea. The women's group said that the 'mist' often causes men to become lost or have to stay overnight at sea. Furthermore, the fishers stated that if they travel to Saldanha or other fishing areas and there is mist, they are not able to fish and thus waste their time and the money spent on petrol. Their boats are also put at risk if they are out at sea in the mist as they can damage the boats on unseen rocks. The groups attribute the cause to nature and the women even spoke about climate change. The older fishers joked about whether the desired answer is "*climate change"* (FGD DB, 2015), but then said it was possibly because of the drier conditions inland. They concluded by saying they do not know but they do see the changes.

Another impact is the change in the wind. In this part of the session the men described a pattern whereby the east wind used to blow for seven or eight days (mainly in autumn). This was then followed by the northerly wind and thereafter there would be calm, perfect sea conditions; the older group of fishers even stated that they "*believe in the north*" (FGD DB,

2015). Nowadays, the east wind blows for fewer days, only two to three days, and the relationship between the east and north wind has changed. The older fisher group stated that the east wind brings better fishing conditions and thus, the result of the shorter duration of the wind, has resulted in less favourable and less predictable fishing conditions. The east wind therefore used to signal that there would be good fishing conditions for a few days and now that is not really the case.

There were also observed to be stronger winds in the morning which prevent fishers from going out and thus earning an income; the women said that those who "*have the guts*" (FGD DB, 2015) and better equipped boats still go out. Furthermore, the increase in the southwest wind (mainly in the winter months) makes the water colder than in the past; the fishers say that the fish (especially hottentot) do not bite when the water is so cold. The changes in the wind and stronger winds in the morning were ranked as a medium to high impact on their livelihoods. When the older fishers were asked what they attributed the changes to, they responded: "*I don't know … We aren't climatologists!*" (FGD DB, 2015); but the cause was generally alluded to as being nature or just not knowing why.

The decline in and migration of WCRL was also regarded as a high-ranking problem. The lack of WCRL in Doringbaai has meant an increase in costs (such as petrol and possibly rent) because fishers now have to travel to other areas such as Elands Bay. The migration of the WCRL has resulted in growing conflict in Elands Bay between the local fishers and fishers from other west coast villages. The older fishers remarked that the conflict is unnecessary and largely due to the disrespectful attitudes of the usually non-local and younger fishers. The younger fishers come to Elands Bay, use drugs and alcohol, and then get into altercations with the locals. Moreover, these younger fishers engage in risky activities in order to increase their catches of lobster such as fish in fog or other perilous conditions or go out at night (which is illegal as per the permit regulations). This often results in drownings or fishers getting lost at sea. There is also conflict between the industrial and small-scale fishers as the industrial fisheries catch lobster on such a large scale, it is perceived to negatively impact the small-scale fishers; some fishers stated that it is not uncommon for the fishers to steal the industrial's catches and cut their nets to spite them.

The participants were of the view that the causes for the WCRL migrating were: natural migrations, the diamond boats, the lobster traps and less nutrition for the lobster in Doringbaai. The fishers commented that "*kreef moves*!" (FGD DB, 2015); they realize that there are natural migration patterns, which a few have attested to have witnessed. Secondly, the diamond mining vessels started operations in Doringbaai in about the 1980s, which corresponds to when the lobster began to move south. The fishers believe that the disruptive activities of the diamond boats, vacuuming up the sea floor as well as the lobster resource, caused the species to migrate (this was also expressed in the RVA workshop). The participants stated that the same phenomenon was observed in Port Nolloth when the diamond boats started operating there; the lobster then also moved south towards Doringbaai and the surrounding areas. However, Dr Cockcroft (Pers Comm., 2 December 2015) stated that although the mining boats can have a localized effect, he does not believe the mining boats would have a great effect on the lobster resource in Doringbaai. The fishers did comment that these vessels often work in similar regions to the fishers though.

Thirdly, the decline in lobster happened soon after the lobster traps were first implemented (there was some difference on when exactly this occurred; the commercial fishers stated that it was in the late 70s while the older fishers said late 80s, early 90s). The fishers therefore believe that there is a connection between the traps and the decline in abundance of WCRL. It should be further stated though, that during this period (the 1980s), Dr Cockcroft (Pers. Comm., 2 December 2015) declared that the productivity of the lobster resource was affected by reduced growth rates. Finally, the commercial fishers noted that the WCRL may have migrated because there is insufficient food for them in Doringbaai. As lobster sometimes eat their own species, they said when the lobster began to move and there was less lobster in Doringbaai, the rest had to follow as there was less food (in the form of discarded carcasses from fishers). Another fisherman noted that the industrial vessels would discard the entrails of their catches in the water and this became an important source of food for the lobster in the area. The abalone farm, which uses kelp as food which the lobsters also eat, was thus also attributed as a cause for less food availability for the lobster. Dr Cockcroft (Pers. Comm, 2 December 2015) stated that "removing kelp in large numbers will affect the benthos as well as potentially affect food. But I do not think that is the reason for [the lobster] moving".

The fishers also commented that since the 1990s there has been a decline in line fish resources. This is especially an issue as there are high costs implicated with this activity and it is difficult to get a fair price from buyers for line fish. Due to time limitations, the fishers' perceptions of the reasons for this decline were not explicitly investigated; however, Dr Cockcroft (Pers Comm., 2 December 2015) stated that it may not be that there is an actual decline in the resource. Rather, it could be that, due to an environmental perturbation there is a decline in abundance in a specific area but on a larger scale the resource may be stable. Furthermore, the mist has resulted in less sea-going days.

The IRP conditions, although not an environmental event, were attested to have a great impact on the fishers' lives and livelihoods. The permit stipulations are not suited to the fishers' needs. The offloading conditions (bringing the catch in to the harbour) are challenging for the fishers. First, they stated that they were not allowed to offload in areas other than Doringbaai, even if they have been fishing in other areas. This therefore results in an increase in costs and danger for the fishers as they have to return to Doringbaai by boat. The greater cost of petrol sometimes leads fishers to have to borrow money for petrol from the buyers which leaves them in debt. If they then arrive after 4pm in Doringbaai, they have to discard their catches as they cannot be recorded by officials. There are times when factors that are out of the fishers' control affect their timeous arrival, such as bad weather, engine trouble and the fog; these factors have not received consideration by the authorities. Furthermore, tensions are rising in Doringbaai between the interim-relief permit holders and commercial rights holders as the commercial fishers are able to offload in other areas such as Elands Bay and Lamberts Bay whilst the interim-relief permit holders are prohibited from so doing. Secondly, the times that they are allowed to fish work against the fishers. They are only able to fish from sunrise until 4pm; however, night is a good time for fishing and there is a dispute regarding first light. The fishers say it is when they see the morning star whilst DAFF decrees that it is from first light. If fishers are caught fishing outside the restricted times they are liable for huge fines.

The last point explored was the sand erosion and "*growing rock*s" (FGD DB, 2015) in the Doringbaai harbour area, where the boats are launched. The rocks appear bigger than before and are being exposed in new areas which create a risk for damaging the fishers' boats. This incurs additional costs for repairs. The sand erosion of the beach has resulted in a smaller beach area on which to leave the boats which leaves the vessels at greater risk from wave damage when they are left there overnight. The participants stated that the cause was from the bigger waves which wash the sand away faster and also stated that it is possibly from sea-level rise. The greater size of the rocks was also speculated to be caused by more shellfish growing on the rocks, making them appear larger than before.

5.2.5 Strategies Employed to Cope with Environmental and Climate Variability/Change

This section documents the outcome of the FGDs and other sources of information regarding the strategies fishers employ to cope with the changes in the environment and climate. When initially asked what they do when the fishers can't fish, the women replied: "*a fisherman is a fisherman and that's it*" (FGD DB, 2015). It was made quite clear by all three groups that, in terms of alternative livelihoods, the options are extremely limited. They explained that a fisherman is often labelled as just that and are then excluded from other work opportunities.

The fog, which has become a very pressing issue in the last two years, often results in the men not being able to go out to sea, unless they have a GPS; however, a few of the boats have these devices (some men have smart phones that enable them access to GPS). Some men still go to sea without a GPS but this is very dangerous and puts them at risk. The fishers sometimes go to other fishing areas such as Elands Bay and Lamberts Bay but this then requires using more petrol and there is the risk the fog may arrive in those areas after they get there. The men said they do try to search for other work, but as explained above, this is mostly a futile exercise. The FG with older fishers explained that if they are out at sea and the mist arrives they have signs they follow to get them safely to shore. This includes applying their traditional knowledge to navigate using the position of the sun as a reference point and following the direction of the sound of the waves; however, as stated by the FG with older fishers, you need experience to navigate through the mist without modern technology. They explained that the changing sea and weather conditions are an intrinsic part of fishing, they stated that: "*the weather changes … you just have to play along*" (FGD DB, 2015).

The need to travel further to fish for WCRL requires more petrol and thus more expense. According to the FG with older fishers, they cope with this by travelling as a group to make it more cost effective; they stated that this is a strategy which is working. Another less desirable response is to borrow money from the buyers to buy petrol but this is not at all effective as it often leaves the fishers in a cycle of debt to the buyers. The commercial fisher FG briefly mentioned poaching in Elands Bay; they remarked that this activity occurs as a response to the constraining fishing rights and the need to earn money and feed their families, and some men spoke about going out at night (which is prohibited by the conditions of the permits). The older fishers also said that some of the fishers cut the industrial traps and steal the catches as both a coping mechanism and to spite the bigger fishing companies.

The event of the higher tide in the harbour forces men to take their boats higher up the beach so that they do not get washed away, especially when rougher seas and storms are predicted. Finally, the community is in the process of implementing first aid courses for members of the community. While this is not in direct response to environmental events and impacts as such, this is an important response to deal with the limitations imposed by the clinic which is only open twice a week.

5.2.6 Adaptation Strategies for Addressing Environmental Variability and Change

This final section documents information from the FGDs and other sources regarding the current and potential adaptation strategies that could be effectively implemented in Doringbaai by the fishers themselves or other stakeholders. The aim of these strategies would be to assist fishers in adapting to the changing environmental conditions, reducing the vulnerabilities of the fishers and overall improving their community. All three of the focus groups stated that safety at sea needs to be improved. In the week prior to the first two sessions (in May 2015), a boat with four fishers became lost at sea and capsized due to the dense fog. Two men survived the incident and were rescued by the NSRI; however, the other two men were not found (Evans, 2015; NSRI, 2015). The commercial and older fishers suggested that safety could be improved by installing fishing vessel monitoring systems (VMSs) on the fishers' boats. This is a device which shows the location of vessels out at sea. They stated that they would need one that is better than what is currently being used in other fishing sectors in South Africa. Having a GPS on all the fishing boats was also seen as an important adaptation strategy, especially with the increase in frequency of mist at sea.

Another identified strategy was to have a 'mother boat' at sea which would have a GPS, communication equipment, and be able to tow the smaller boats if necessary. Furthermore, improved infrastructure including improvements to the current slipway, a breakwater and a tractor were seen as important measures to launch and land safely (there is a tractor but it is currently not working; the fishers said that there needs to be better maintenance by government). There is currently congestion at the slipway when boats return from a fishing trip; this puts the boats at risk due to the waves and rocks in the area. As one of the commercial fishers stated: "*landing our vessels is often difficult, and when there are many vessels, each vessel has to wait in single file until it is their turn to come in and this creates a risky situation*" (FGD DB, 2015). They said that before 1975 the bay was much safer but now the area has become too rocky. All FGs stated that these safety measures should be provided by the government.

It was suggested by both the FG with older men and the FG with women that a better processing facility be set up in the Doringbaai area. This could help women get jobs in the post-harvest activities and allow the fishers to have more control over the sale of their catches. It was suggested that an abandoned building, which was a school for white children in apartheid times, be used for this purpose. The school is owned by the Department of Public Works and so their permission would be needed. Many people in the groups also commented that there needs to be an improvement in the communication channels to the government. There is apparently a local government admin centre but it is not run properly and one is not able to do necessary administration; if there was, for example, a DAFF official

who could sign and issue permits, the fishers could save a lot of money by not having to travel to Cape Town. Furthermore, the fishers feel that they need better education and training with regard to the processes for applying for fishing permits. The fishers are also dissatisfied with the conditions imposed by the interim-relief permits. They feel there is not an equitable allocation of fishing rights; for example, they claim that the local 'dominee' [priest] has a fishing permit. Many fishers have been forced to settle for recreational permits but this is not viable for their livelihoods as they need a recreational permit for each species they want to catch and, crucially, they are not (legally) allowed to sell these catches. Furthermore, a commercial fisher stated that they are only allowed to catch line fish with this permit.

The groups also suggested that there should be better financial support from the government, especially during the off season times (referred to as "*kondeka tyd*" [hard times] (FGD DB, 2015) when they cannot go to sea and thus have no income. They also said that if they are injured or die there should be better policies in place to give financial assistance/support for them and their families. They feel that this is especially unfair as they buy a large amount of petrol and a portion of this money goes to the Road Accident Fund (RAF) yet fishers and their families do not receive any support from the RAF. It was felt that they should receive support from this fund due to the fact that they use so much petrol (often more than the average motor vehicle owner), or else a similar fund should be established.

On the more socioeconomic side, the groups felt that the people in the community need access to training for business management, accounting and so forth, so that they can run their operations in a more financially viable and profitable way. Their lack of business knowledge puts the fishers at risk from being exploited by the buyers. It was also stated that there needs to be improved policing services that are more efficient and effective. The groups felt that there should be more recreational facilities, such as sports gear and infrastructure, as this could prevent the youth from resorting to negative activities such as drug and alcohol abuse. Lastly, the groups commented that there should be an effort to become more unified as a community; the people are less supportive of each other than they were in the past because politics gets in the way.

It was commented at the end of the sessions that the people of Doringbaai need to take more initiative rather than relying on support from the government to improve the issues of the community. The majority of the adaptation strategies identified were suggested to be provided/implemented by the government.

5.3 St Helena Bay

5.3.1 Understanding the Vulnerability Context

St Helena Bay is an area on the west coast that represents stark socioeconomic contrasts. In the region there are three fishing communities which consist of 90% of the population, namely: Laingville, Stompneus Bay and Steenberg's Cove (Census, 2011). Just a few kilometres west of these settlements, in Shelley Point and Britannia Bay, there are affluent holiday homes, upmarket housing estates and even a luxury hotel with a golf course.

In the fishing settlements, according to the women's focus group:

> "*There is a lot of poverty. There are a lot of children walking around without parents and there are children walking around with parents who doesn't [sic] care about them. We need shelters, proper equipped social services here*" (FGD St Helena Bay (SHB), 2015).

In the community there are mostly dirt roads and low income housing, of which there is a massive shortage. There is no bank, only ATMs and no clinic in the immediate vicinity. There is a clinic in Sandy Point, near the harbour, but one needs to pay R16 to get there and the groups said that the clinic is understaffed and not well equipped; one of the women commented that: "*in an emergency, you die*" (FGD SHB, 2015).

There are "*a couple*" (FGD SHB, 2015) of churches in the three communities; there is a supermarket, public transport (mostly taxis), a library and a community hall. The women also stated that the community has a culture of sharing; if they see people without food this month they will give them some of theirs. They said that, for the most part, the community tries to look out for one another. There are schools but they only go up to standard 7 (grade 9), but it was said by all the groups that most children have their matric (grade 12). The older fishers explained though, that having a matric does not mean anything for the prosperity of the youth. They commented that:

> "*90% of St Helena Bay has matriculant children, they all are putting the fish into the tins. There is no way of them going further on the west coast. The majority has standard 10 but they go to the fish factories, they have no other employment. The government is to be blamed for the way we are living*" (FGD SHB, 2015).

The man who stated this went on to say that he has a son who is third year out of matric who sits at home because he cannot get work, whilst the 74-year-old man sitting next to him still has to go to sea, which most of the older men have to do in order to survive. When asked whether there were alternative livelihood options, an older fisher commented: "*No fish, no pay…you lay at home*" (FGD SHB, 2015). The commercial fishers commented that some men find jobs in boat building but generally if you cannot fish you do not get an income. A lot of women in St Helena Bay find jobs as snoek vlekkers, this means that they are involved in the post-harvest activities of cleaning the fish for the buyers. They also stated that without fish coming in they have no work. The groups commented that although there are all these property developments, St Helena Bay lacks tourism for most of the year. In seasonal times though, there are potential jobs as gardeners or domestic workers but they feel this is not really a viable option due to the scarcity of jobs available and the limited period of those jobs. Schultz's (2010) research concludes that the property developments in St Helena Bay have, for the most part, not been economically beneficial for people living in the three fisher settlements.

In terms of fisheries, there are several factories in St Helena Bay (Saldanha Bay Municipality IDP, 2015) although the exact number could not be confirmed as one group stated there are over ten factories while another group suggested six or seven were operational. The

factories are an important source of employment for the residents of the three settlements in St Helena Bay (Schultz, 2015). For the SSFs though, there are no cold storage or processing facilities, only the "*so-called people*" (FGD SHB, 2015), this referring to factories and fishing companies, have these types of facilities. The small-scale fishers of St Helena Bay generally fish from "*bakkies*" (FGD SHB, 2015), which are *"small wooden boats between three and five metres in length, operated either by oar or by a single five to ten horsepower outboard engine"* (Paterson et al., 2014: 4). One of the older men commented that these boats are one of the reasons why it is so dangerous to be a fisherman. He stated that:

> "*With these small bakkies, that's where the fishermen lose their lives, from these small boats. But people can't do anything, there isn't [sic] other things. To go to sea and to come put a piece of bread on the table, it's very, very hard. To go to sea you leave home in the early hours of the morning, your family doesn't know if you are coming back home, that's the first point. The wind blows in the morning, you go to sea. Your wife doesn't know if you are coming back. If the skipper tells you that you are going to sea, you have to go. You can't not go because of the wind*" (FGD SHB, 2015).

Finally, in terms of the 'market' to sell fish, the focus groups explained that, for the SSFs, it is comparable to an auction in the harbour whereby they only work on commission from the sales of the fish and do not get much of a say in the price.

5.3.2 Key Threats/Stressors Facing the St Helena Bay Community

This section documents the key threats/stressors facing the St Helena Bay community based on the FGDs, secondary data and key informant interviews. The FGD exercise allowed participants to highlight what, for them, are the most significant issues in the community. In St Helena Bay, stressors linked to government's poor performance stood out as the overall most significant issue, for both men and women, as was demonstrated by this exercise; this was especially to do with the fishing rights and permits and their regulations. The results of the FGD are shown in Figure 30.

The three focus groups stated that they feel "*the government don't [sic] look after us*" (FGD SHB, 2015). The IRP conditions imposed upon fishers make their lives very difficult and do not allow them to plan for the future. In the FG with older fishers, there were men over 60 and one man of 74 years old (and it was said he was sickly), who still need to go to sea in order to provide for their families. One of the commercial fishers stated that:

> "*It's only from the sea to the mouth, you can't put anything away. The government only gives you a little bit. It isn't sustainable, if you had to live on that permit*[4] *alone, it won't last you three months. What about the rest of the year? You have families to feed*" (FGD SHB, 2015).

They explained that the conditions imposed by the permits make their lives very difficult to sustainably provide for themselves and their families. The general feeling was that they feel neglected and marginalized as a community and fishing group as a whole. They also stated

[4] Referring to the IRP permit

that they feel the people put in charge in the government are not suitably qualified. One of the women said:

> "*It's because the whole government is black. I'm not a racist but the black people don't have a clue about the fishing industry, they only know about meat. They don't know what's going on in the fishing industry but they put places [sic] in the management that don't know what's going on. They are not fit for their jobs that's why the fishing industry is a mess*" (FGD SHB, 2015).

This discontentment with the government is reiterated in Schultz's (2010: 5) research with the SSFs in St Helena Bay, stating: "For small-scale fishers, the lack of recognition by the state of what they believe is their autochthonous right to access to [sic] the marine commons feeds an intense sense of frustration"

One of the key problems the groups had with the fishing policies was to do with the allocation of the IRP permits. As one of the older men explained:

> "*The policy they made was that the whole of South Africa can apply for fishing rights, that's the biggest problem they ever caused. That's why the doctors and the rich people, they are the people that are sitting with the allocations of the fish. And we as fishermen and our families, we are the sufferers. They are in Pretoria and Johannesburg; they don't even go to sea. That's why they must change the policy to only [sic] the fishing community*".

The women also felt this way. One of the ladies stated that: "*They give doctors, nurses and other people quotas and permits, people who doesn't [sic] need it. You give it to the poorer of the poorest; people who know about the sea and the fishing industry*" (FGD SHB, 2015). The women also commented that black people are not *"real fishermen"* (FGD SHB, 2015), representing a generalized view in the community that black African people are not fishers but traditionally work in agriculture. This racial stereotyping from local coloured people living in St Helena Bay is also documented by Schultz (2010) who states that the tensions between black African and coloured people are largely attributed to competition for jobs and the scarce marine resources.

The commercial fishers were also dissatisfied with the allocation within the community, where there is one permit allocated per household. This creates conflict as there could be four brothers living in the house but only one of them will get a permit and thus, essentially, only one can earn money. Furthermore, the men stated that communicating with the government and trying to appeal these decisions is a futile exercise. They stated that: "*Communicating with the government isn't easy. They only come and say these are the people getting permits and these are the regulations and bye. If you don't get a permit and you try appeal... it is just a waste of time. We did that, a number of times*" (FGD SHB, 2015). They explained they understand the need for the TAC and permits but the process and allocation seem to be a random process that does not consider their needs as fishers. The need to go to Cape Town for administration was also described as being burdensome for them due to the cost and time implications of travel.

The community-based approach of the permits is also causing some discontent among the fishers. This policy, which doesn't allocate a TAC on an individual basis but on a community

basis, finds its problems in dishonesty among the fishers and buyers. Sometimes people will catch fish in other people's names and then those people lose a big portion of what they are allowed to catch. One of the fishers explained:

> "*I make as if I am a guy catching your lobster, you don't know about it. I just come and say 'yes, put that 30/40 kilos on Trevor's name', Trevor is sitting at home he doesn't know what is happening. Me, I caught the fish, you, you pay me for my catch. I charge you R60 or R40 a kilo, you pay me my catching fees. You only pay the guy that's catching the lobster, but you don't pay the guy who is the owner of the permit*" (FGD SHB, 2015).

At the end of the day, this disadvantages many of the fishers who get unfairly robbed of their TAC; it was stated that, due to this community permit system, "*the middleman is gone with the fish and gone with the money*" (FGD SHB, 2015).

The permits also dictate the areas in which fishers are allowed to fish and the marine species they are permitted to catch. This restricts them as fishers. One of the commercial fishers stated that:

> "*That specific permit you get, you must work in that area. If you are in a different area and they catch you, you get a fine. Five thousand rand and up…Some of the guys go at night time, at least to put food on the table. The night time. And if the guy catches you on the harbour, it's also a problem*" (FGD SHB, 2015).

They also have a marine protected area (MPA) on their shores which makes their lives more difficult as they need to go further to fish and thus use more petrol in the process. They have asked the government to open up the reserve to the people living in the communities as they do not understand why it is a reserve, demonstrating the lack of communication from the government.

They are furthermore not allowed to drive by car to Elands Bay and launch their boats there, which would use less petrol; they are required to go by boat which is more dangerous with the looming potential of fog, rough seas and wind. Following the red tide in February (2015) in Lamberts Bay, where 280 tonnes of lobster walked out on to the shores, it became especially necessary to go to Elands Bay. "Fishers usually have an allocation of where they are allowed to fish in their particular areas but, for circumstances such as this, they may apply to move area" (Cockcroft, Pers Comm., 2 December 2015). Veitch (2007: 43) states that "mass mortalities of rock lobsters during the past two decades in the St Helena Bay area as a consequence of hypoxia and harmful algal blooms have had negative financial and ecosystem impacts". One of the fishers explained that:

> "*The guys in St Helena can't go to Elands Bay. They put R600 of petrol in the boat they go out here, they come in, they don't get a lot. They must pay themselves, pay the boat, pay the guy working with them. It's just a waste*" (FGD SHB, 2015).

With regard to St Helena Bay, it was stated that "*there is no point having a permit here*" (FGD SHB, 2015). One of the fishers said that industrial boats are often seen in the MPA but there seems to be no enforcement when it comes to these commercial boats. The law enforcement for the small-scale fishers on the other hand was described as being "*unnecessarily harsh*" (FGD SHB, 2015). The men said that the authorities ask for their

permits, even when they know they have one, and confiscate them to make their lives difficult. It was also stated that having a paper permit was discommoding.

The women felt that, as fish cutters, they are not recognized. They explained that their job requires tremendous skill, which they taught themselves, and their job is not sufficiently respected or acknowledged. They stated that if they could have their own permits: "*At least then we known as fish cutters, then we know we are part of the fishing industry because at this moment we can't say we are part of the fishing industry because they don't recognize us in the fishing industry*" (FGD SHB, 2015). They feel that with this recognition they will be given greater respect from the hawkers and this can lead to proper prices being put in place, so that they will no longer get exploited. Currently, the hawkers demand a price and, if the fish cutter does not accept it, they will just go to the next snoek vlekker until someone accepts it. They want a more unified group of recognized fish cutters. Furthermore, the women stated that there should be women at the fisher meetings with the government to represent the snoek vlekkers; presently, they are not informed about these meetings.

Another point raised was the lack of insurance for fishers. First of all, the older fishers stated that when they die, there is nothing left for their wives or children. Second, there is no unemployment fund or life insurance set up by the boat owners, which the women felt was an important development which should be made. Finally, the commercial fishers stated that health insurance is a fairly recent policy; it was stated that:

> "*Now you get medical cover on the boat, the government pressurised them. Someone got injured with a hook on the boat and didn't get compensation at all. They only paid for the doctor. It is very hard to get anything out of the companies. Those big companies could do more*." (FGD SHB, 2015).

The fishers also stated that some companies, like Lucky Star, treat the fishers well and provide them with warm clothes and safety equipment but most of the companies do not do this and do not seem to care for their employees. This particular fisherman who works at Lucky Star said that 50% of his salary is paid towards his insurance policy. The commercial fishers are also not allowed to get any permits for fishing; the companies have the permits and as fishers they work on the boats and get the fish for the companies. This does limit them in many ways as they cannot take fish home to their families. One of the fishers stated that you have to choose if you want to work for a company or on your own; he worked for a company but now works on his own and prefers it that way.

Socioeconomic issues were the second most significant of the three groups. Drugs and alcohol abuse was described by the commercial fishers as being the "*number one problem*" (FGD SHB, 2015) in St Helena Bay, with which the other two groups concurred. It was explained that drugs especially are a major problem and are used by all age groups, not just the youth. 'Tik' was identified as the most used drug and it was stated that this socioeconomic problem is fairly recent in the community, being introduced only about five to ten years ago from people "*outside*" (FGD SHB, 2015) the community; Capetonians were blamed for tik being brought in. Drugs were described as being so attractive to members of the community because "*there is nothing better to do*" (FGD SHB, 2015), both for the youth in terms of recreation and the adults when they are not able to fish or work. Schultz (2010: 44) comments that substance abuse in St Helena Bay is likely a "symptom of socioeconomic and political marginalization" rather than the origin of the challenges the communities face.

The women stated that it is common for husbands to come home with no money and say the fish were not biting when, in actuality, they have spent the money on drugs.

Another highly ranked problem was the lack of jobs. It was stated that most of the youth have their matric but can only find work in the fish factories and there are essentially no alternatives to working in the fishing industry for the people living in the three communities. There is also a "*massive shortage*" (FGD SHB, 2015) of housing. There have been RDP houses set up (only in Laingville though), but the quality of these is poor and there is still a huge backlog. It was also explained that there is a lack of recreation. They do have rugby, soccer and cricket in the communities (they jested that "*there is no golf though*" (FGD SHB, 2015) as there is an upmarket hotel situated on a golf course nearby), however, the facilities and infrastructure for these activities are lacking. Steenberg's Cove has no recreational facilities whatsoever.

The women felt very strongly about the lack of social services in the community. They stated that there is currently no organization set up to help the underfed, under clothed, neglected children, who are a common feature in the community. Furthermore, teenage pregnancy was described as "*an epidemic*" (FGD SHB, 2015) as girls as young as 10 years old are falling pregnant; one of the women stated that she "*is sick of it*" (FGD SHB, 2015). Education was not described as a pressing issue, but it was stated that from grade 9 onwards the children have to go to a school 17 kilometres away for further education, which therefore implies travel costs.

Finally, when asked about poaching, the men stated that they would not poach in the reserve because "*if we had to poach here, it's right in front of the door*" (FGD SHB, 2015). They added that to poach they would have to go way out to the nearby island or Eland's Bay.

The environmental category was rated equally to socioeconomic problems by the men; however, only two points (out of a possible sixty) were put towards the environmental issues category by the women. This demonstrates the lack of importance it has to the women, in the face of the other issues which they deal with on a daily basis, as they do not go out to sea and thus are not directly affected by the environmental events and changes. The women did know about the issues from hearing about it from the fishers and from their jobs as fish cutters.

The most pressing environmental issue, as shown by Figure 30, is the change in seasons and unpredictable weather. The older fishers stated that the northerly wind made the water warmer and brought fish whilst the southerly wind brought colder water, which made fish less likely to bite. Presently though, they stated that: "*In the past you knew north wind brings fish and now you don't know – it is unpredictable now*" (FGD SHB, 2015). They explained that the water is now colder than in the past which generally means there is a lesser catch. They went on to state that after a storm there was no fish but now you do not know what there will be. The pelagic fishers also said that they no longer know what happens with the wind, as they did in the past. They went on to say that in past years cold fronts came earlier in the year. They explained that there has definitely been a change in seasons which has affected their fishing as a result of the permit conditions:

> "*The weather is affecting the fishing because you have the seasons to go fishing, now the seasons are getting maybe a month and a half later so you aren't going to get the sustainable fishing amount that you have to take out because of the weather*" (FGD SHB, 2015).

The second most significant issue was the decline in fish, especially snoek, harders and lobster. The older fishers stated that: "*The fish is much less, snoek is not like it used to be before. Hottentot is another story. You go to sea and catch 2 or 3 and that's the day, it used to be a lot*" (FGD SHB, 2015). The commercial fishers agreed with this and added that they feel very limited because they do not have permits in other fish species categories, whereas in the past they could catch anything in the water, "*even sharks*" (FGD SHB, 2015). They had also noticed that fish, such as snoek, are further out to sea. The women also noticed the decline in catch as they have less fish to cut for the day than in the past.

The men and women had all said that storms and rough seas are a big problem as they have increased in frequency and thus there are more days in the year that fishers cannot go to sea. One of the older men explained how difficult and limiting this is for them: "*The whole of South Africa is working... what work are we doing now? Even if we can go to sea, we haven't got things that we can just take and go to sea. We must wait for the people, the owners of the ski boats, when they decide they want to go to sea, then we can go to sea. But otherwise if they don't go to sea, we are all at home, so we all lose out*" (FGD SHB, 2015). Many of the fishers stated that it makes their lives even more difficult having to wait for and rely on skippers and boat owners. One of the commercial men stated that: "*Our way of life is when you get time to go to sea, it's the fabriek [factory] or the skipper or whoever you work for, they got the permits*" (FGD SHB, 2015). Another observation which affects fishing is the increase in fog, in both the intensity and frequency; this prevents most of the men from going out to sea, except those that have sufficient navigational equipment.

5.3.3 Perceptions of Environmental Variability and Change

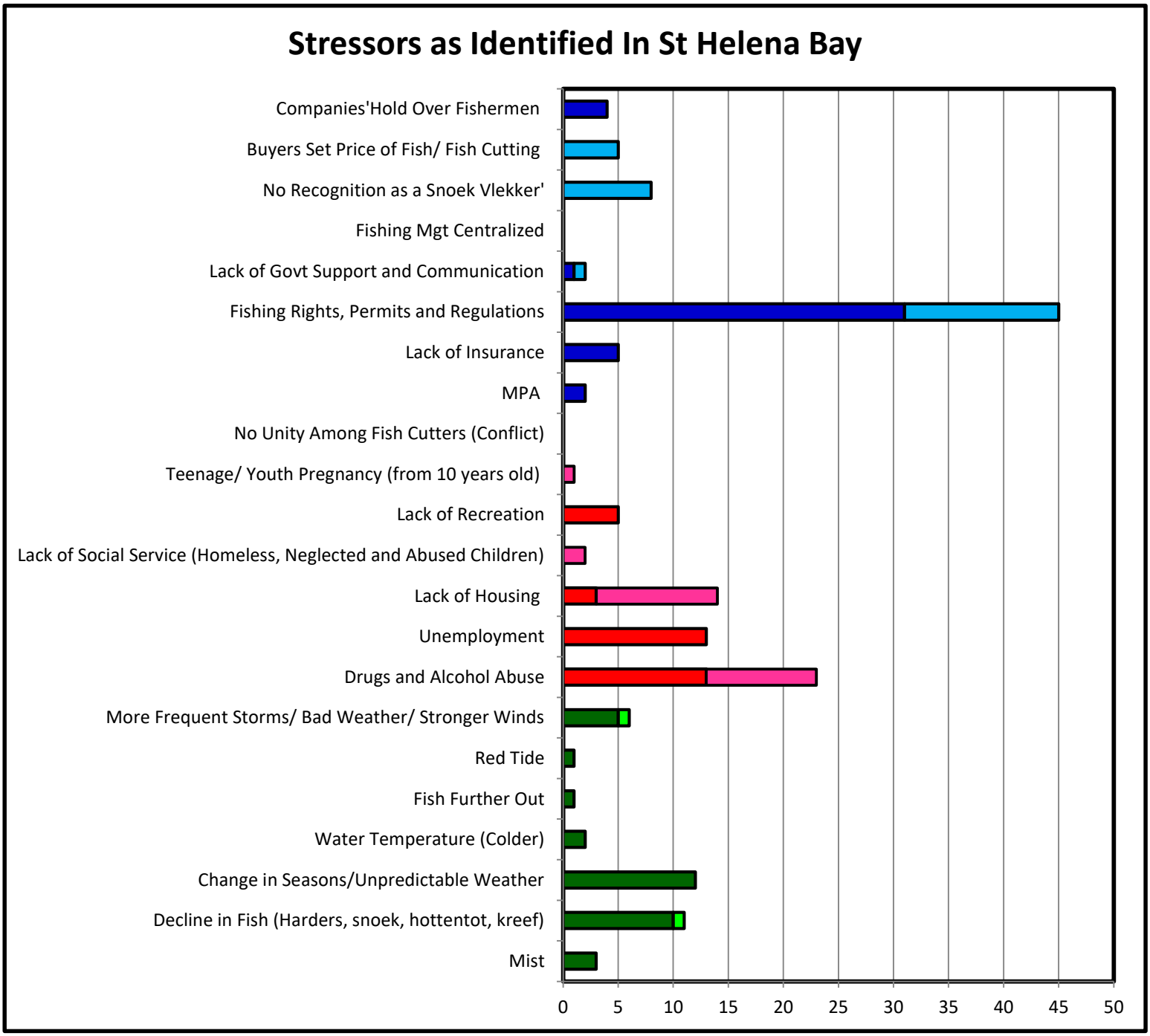

Figure 30: Stressors as ranked by community members in St Helena Bay (Men=darker shade; women=lighter shade; environmental= dark/light green; socioeconomic=red/pink; governance= dark/light blue)

This section documents fishers' perceptions of environmental variability and change based on the FGDs as well as incorporating information educed from key informant interviews and the review of secondary data where relevant. Table 2 summarizes the environmental changes and events that have occurred over the last few decades as expressed by the fishers in the FGD. The older fishers spoke about changes and events but when asked to

chronicle when changes had occurred, they did not want to state dates or time frames as they explained these are natural cycles and so you cannot pinpoint dates of change. They explained that: *"[we] don't know about the weather because the times have changed. They [fishers] see it on the sea. You must be a fisherman to see the change; it's hard to say this is when this happened. They can't say this was the time it changed. You can feel it but can't say when…it's just nature*" (FGD SHB, 2015). They did explain that, in the past, May was the good fishing season and the June months previously meant that the fish would be in Lamberts Bay, but now it is not so indubitable. They said that the water has definitely become colder, especially this year.

Table 2: A summary of environmental events and changes identified by FG participants to have occurred in St Helena Bay

1960-1980	Trawlers work in the MPA (illegally); Line fishers are not allowed to (1960s)
1980-1990	WCRL begins to decline
1990-2000	Water begins to get colder
2000-2010	Drug usage (especially 'tik' increases in St Helena) (2005)
	Decrease in frequency of northerly wind
	Southeasterly wind previously arrived in October or November; now arrives later
	Seasons change - fishers do not know the seasons now hence best fishing times are more unpredictable
2010:	Mist increase in frequency and magnitude; used to be misty with north winds only
	Only got northerly wind in the past, now also southerly
2011:	Insurance becomes a necessity by law for companies – they are now required to pay out fishers for death/injury
2012:	Cold front later – significant as it brings in certain species (especially snoek)
2013:	Price of Japanese Pike (sold as bait) increased exponentially
	Women were promised permits (5 women) - they went to fetch them and there were none
2014:	Fewer fish biting with the colder sea water; decreased catch (caused by the southerly wind)
2015:	Red tide occurred (January/ February) in Lamberts Bay
	Older fishers: "Plenty of fish". In contrast, a man at the women's meeting said in the last 9 months there have been no snoek or lobster. The women/the snoek vlekkers also said: "Fish is less, less cuts for the day"
	Water colder than previous year (due to southerly wind)
	Change in seasons. May was the good fishing season, but now they don't know (unpredictable). Don't know about the weather because the times have changed.
	WCRL is still available but numbers in catchable areas have decreased
	Bad weather more often than in past
	Laingville received only 28 permits; no permits in Steenberg's Cove
	TAC: 167kgs has gone down to 138kg (not sure when exactly)
	'Robbe' [seals] have become a massive problem

There was a contradiction between what the older fishers said and the other two groups. The older fishers had said that: "*Last year there wasn't a lot of fish, this year there is plenty, it is just nature*" (FGD SHB, 2015). In contrast, a man who attended the women's meeting

stated that there have been no fish in the last 9 months due to the later cold front which brings the snoek. The women agreed with this by also declaring that there are less fish, which they ascertained from their jobs as snoek vlekkers. It was agreed by all the groups that there have been changes in the seasons. The cold fronts are arriving later, the storms and bad weather come more often, there have been changes in the wind and an increase in the mist; this has thus resulted in the fishing activities becoming more unpredictable for the fishers.

The MPA, which had been established in the 1960s, was said to often have trawlers fishing in the area, while there are hefty fines for anyone else caught. The men explained that if you fish for harders in the MPA "*you get jail or a R3000 fine. It is also R2000 per net on the boat*" (FGD SHB, 2015). Another interesting point raised was the sharp increase in the price of Japanese Pike, a fish used as bait, in the last two years. Prices suddenly increased from R45 to R200 for 10 kilograms; it was furthermore explained that this source of bait is essentially the only option for fishers. The high demand and controlled supply has thus driven up the market price exponentially (Marten, 2001). Finally, it was said by the older fishers that seals have become a massive problem for the fishers; one of the men explained: "*I put in petrol, go to a school of fish, the robbe [seals] chases them away*" (FGD SHB, 2015). This is a pressing issue for fishers on the west coast and also raised in other research such as Rogerson's research (2011), whereby this point was also presented in interviews conducted with Lamberts Bay fishers.

5.3.4 Impacts and Possible Causes of Impacts on Livelihoods Associated with Environmental Stressors and Changes

The fog, or 'mist' as the fishers refer to it, was described as being a major hazard for the fishers; they stated that "*there is no warning and then it will suddenly come. Most people have GPS but not everyone*" (FGD SHB, 2015). The fishers said that other areas, such as Port Nolloth, have a fog horn or other infrastructure to help guide the fishers to shore, but stated that there is nothing like that in St Helena Bay. The fishers said that the mist is very dangerous; you cannot see where you are and there have been many cases of men drowning at sea or having to stay at sea overnight as a result. The fishers said that if there is mist and you do not have the correct equipment you cannot go to sea and thus cannot earn an income. The cause of the mist was attributed to nature and God by the fishers. The women also stated that they have definitely seen an increase in the frequency and magnitude of the mist. When they were asked what they believe the cause to be, one of the women replied: "*It is all part of global changing. Since global changing everything has changed…[including] my mind (*laughs*). I am more mad [sic] than I was*" (FGD SHB, 2015).

The change in the wind has also had a great impact on fishing. If it is too strong the men are not able to go to sea. The change from more northerly to southerly wind has also brought colder water conditions which are not favourable for fishing. One of the fishers stated that in the colder water the "*fish don't bite, fishermen go hungry. You can see on the echo, there are fish but they don't bite when it's so cold*" (FGD SHB, 2015). Furthermore, the cold fronts are now arriving later in the year. In the past, the cold fronts and northerly winds signalled that there would be snoek (usually in April, May and June) and now this is not necessarily the case; fishing has become more unpredictable (FGD SHB, 2015). Snoek was also said to be further out than before, which requires more petrol and therefore greater expenses for

fishing. Dr Cockcroft stated that the resource "might be fine but it is just some environmental condition that makes it less available" to the fishers (Pers Comm., 2 December 2015).

The permits have not simultaneously changed to match the change in seasons; this therefore results in less opportunity for catches and a decline in overall catch for the fishing season due to the limitations of the permit. The cause of these changes in the weather has been attributed to natural cycles and also, as indicated by one of the older fishers, by global warming. The fisherman stated that: "*This hot climate thing has changed everything in the sea water; there is no more fish that [sic] there used to be*" (FGD SHB, 2015). It was also said by another fisherman: "*Now with this global changing you can't say when is [sic] the season for snoek anymore*" (FGD SHB, 2015).

The red tide also has a great impact on the fishers' livelihoods as it results in a decline in lobster. The red tide that occurred in Lamberts Bay (2015) resulted in tonnes of lobster being washed up on shore, which was reportedly taken to the companies to be stored in tanks while the other fishers could have no claim. The problem, from a management point of view, is that beached lobster could pose a major health hazard and thus it cannot be allowed to be traded by fishers. There was an event where people bought lobster which had been collected from the beach and got very sick; there have even been cases where people have died as a result (Dr Cockcroft, Pers Comm., 2 December 2015). The event therefore resulted in fishers having to travel to Eland's Bay to catch WCRL. This required using more petrol and requiring the men to travel further by boat, increasing their risk of danger as they are not allowed to travel by car. The older fishers stated that the red tide is a natural occurrence.

5.3.5 Strategies Employed to Cope with Environmental and Climate Variability/Change

When it came to asking how people cope with the various events and impacts, the general response was rather despondent and the anger and frustration with government became apparent. One of the older fishers responded by saying: "*we have no other income, then [sic] we are all fishermen* " (FGD SHB, 2015). One of the men described that they feel disparaged by people outside of the community:

> "*In the communities, the people tour here and see the guys on the corner, see us on the corner and think these are gangsters we must stay away from here. We are fishermen. They must think: nobody is working in this place, how do people live? We live from the sea, when we don't get anything it's our families who suffer as well. We are always left hungry and it is 99,9% of the time that we are left hungry*" (FGD SHB, 2015).

They feel as if they are looked upon as gangsters or "skollies" when they are actually just fishers. The women expanded on this by explaining that alternative work is very limited. They try to get work as chars for the white people and other casual jobs but they are not prevalent. They went on to say: "*We can dry the fish, smoke them... whatever you want. We can cut sharks as well*" (FGD SHB, 2015). They explained that is where their skills lie and that is their livelihood, in the fishing industry. The women also revealed "*there is nothing for*

coloureds only for black people. There is conflict because of this" (FGD SHB, 2015); the underlying frustration due to competition and scarce resources was evident (Schultz, 2010).

When asked how the commercial fishers cope, the first response was: "*If you do something to cope the government says you are stealing*" (FGD SHB, 2015). This comment is likely referring to the "communal poaching" that is undertaken for "subsistence or, to supplement a low income or wage" (Schultz, 2010: 70). The women felt the same. They said there are permits for gathering limpets and white mussels in the rock pools for days when the people cannot work but you can only extract 10 of these. They said this is not enough to feed a family. Furthermore, most of the people do not have this permit. The women stated that they applied for permits and these were "*lost on the way to Cape Town*" (FGD SHB, 2015); they then wasted money travelling to Cape Town to follow this up, which costs over R250 and this is usually to no avail. The older fishers also spoke about the government in this exercise, saying that they feel neglected and marginalized by the government. They believe all the focus and resources gets put into agriculture and they get taken advantage of because of their lack of education. One of the men stated that: "*The fishermen are uneducated. Now that's the problem, because we never went to school, they are doing what they want with us*" (FGD SHB, 2015).

It was stated that generally, during the fishing season, things are fine. The problem is finding sources of income in the off-season months. When the weather is bad or it is misty the majority of fishers do not go out to sea, unless they have good equipment (such as a GPS). The pelagic and commercial fishers can only go out when they are called to by the skipper. If they do not go out they get no income from the companies; for them they feel very restricted in this regard as they have no say in the matter. In general, it was felt that the people needed assistance as trying to cope when there are no alternatives for income generating activities is a tremendous challenge.

One of the older commercial fishers stated that some of the men resort to poaching abalone. He explained that it was easy to do; you go diving and if you come up and see law enforcement you just have to release the abalone and get a bagful of sea grass. He said that they often hoax the authorities; they then get out and pretend to run with their bags and then when they are caught all that is found is the sea grass. The fine for abalone poaching has been extended though; it is now 12 years maximum jail time but in actuality, it is usually about 7 days.

5.3.6 Adaptation Strategies for Addressing Environmental Variability and Change

When asking the FG with older fishers about what adaptation strategies could be put in place to better the community, the response from one of the men was: "*The only way forward is that the government must change*" (FGD SHB, 2015). They feel that they are marginalized and ignored by the government; they feel St Helena Bay in particular has been excluded from any benefits from the government.

> "*The government have been going around to all the bays, certain bays. I don't know why we don't get these things. But certain fishing towns they got a good boost from the government, Port Nolloth, Doringbaai, Lamberts Bay. St Helena Bay, no. Why? I am*

still trying to find out why. But none of us could get what the other people got, we got nothing from the government…They must treat us all equal. They give Doringbaai trucks, tractors, factories, pickup trucks... Port Nolloth. St Helena gets nothing. We just get nothing" (FGD SHB, 2015).

One of the fishers stated that he thinks cooperatives should be put in place, like they have in Doringbaai and Lamberts Bay. He said that in Lamberts Bay they now have four holding rooms with refrigerators (so they can sell fish off season), four lorries and, between nine people, they get R6200 because of the cooperative that has been formed. He feels that this should be implemented in St Helena Bay so that they may also put money back into the community. The fishers could not understand why nothing like this has been implemented in their community while other communities seem to be amassing great benefits. When asked if anything similar was happening in St Helena, the response was: *"it isn't happening here, there is nothing for us here*" (FGD SHB, 2015).

All three of the groups felt strongly that changes should be made to the permits and their pertaining conditions. First, they felt that the criteria for people who can apply should be more in favour of people whose entire livelihoods are based on fishing. One of the women stated that: "*Some people not born in this place get permits. People from Namaqualand, Free State, Johannesburg get permits. We are born in this place, we know the mountains here, we know the sea but we get nothing, nothing, nothing*" (FGD SHB, 2015). Second, the fishers feel very restricted with the limited species they are able to catch. They feel that they are making a living and it should therefore not be so restricted; they stated that the way things are now they can barely survive. Both the older and commercial fishers stated that it would really help their livelihood if they could fish for harders. They could then use a rowing boat and their nets as they did in the past; this would save them a lot of money on petrol and help to feed their families. Presently though, fishers get hefty fines for catching harders in the MPA. The older fishers also said that the current TAC of 138 kilograms is "*a problem*" (FGD SHB, 2015). The TAC fluctuates depending on the state of the resource (Dr Cockcroft, Pers Comm., 2 December 2015). They stated it is not enough to live on. Finally, it was felt that the women should be better included. They feel that they are left out and not recognized, as was seen in 2013 when five women, who were supposed to get permits, received nothing on going to fetch them. Based on this point, the women also felt that there should be a satellite office closer to St Helena to do administration work, as it is very costly and time consuming to travel to Cape Town and back.

The women involved in fish cutting felt strongly that they need to be recognized. One of the women stated that: "*there is a lack of unity amongst the women, the women become 'ugly' with each other. There are no price regulations – women lie and steal business*" (FGD SHB, 2015). They have seen many changes in the fishing industry but feel there have been no changes for the fish cutters. They want to feel a part of the industry and be acknowledged for their work, of which they are very proud. They explained that

> "*you must have tactics to cut a fish, [otherwise] you cut off your fingers. We doing that in 26 seconds we cut a snoek…There is no preparations for us when we hurt ourselves, there is nothing from the government that they provide to the cutters. Off season time, when we get hurt there is nothing. Getting hurt happens every day,*

sometimes you sit with hands swollen for two or three days and you can't cut" (FGD SHB, 2015).

They felt that the prices need to be regulated and their position in the fishing industry endorsed. The women also stated that an adaptation strategy could be for government to give them the abandoned factories as, in the height of the fishing season, their current work area gets very congested with the large number of women involved with fish cutting.

The fishers feel that there should be changes made to enable them to have credit and insurance. One of the older fishers explained:

"*The worst is, we can't go to a shop and open up an account. We working on a commission base, a 50-50 base, there is no pay slip or nothing. You can't buy a car, you haven't got bank details, you have nothing. That's why fishermen stay poor. No insurance, nothing. When a fishermen dies then we must look for collections to bury him*" (FGD SHB, 2015).

They feel that this keeps them in a poverty trap and there should be mechanisms implemented, by the government and the companies/boat owners, so that they are able to open accounts and obtain assets. The women group stated that for the men that work on boats, the boat owners should put a portion of the fishers' salaries away each month for an Unemployment Insurance Fund (UIF) or life insurance. These boat owners take the men's ID numbers to get the permits and should therefore have responsibility here.

An innovative adaptation strategy suggested by the commercial fishers was to have tourism permits so that they may charter tourists out on their boats. They felt government should support this and provide them with these permits. It was also felt that the government should provide some sort of subsidy to the fishers and their families for the off-season months when it is very hard for them to cope. Finally, an adaptation strategy in response to the dangers of the mist and fishers getting lost at sea was the Automatic Identification System (AIS). This is a device which transmits a vessel's location and can send distress signals if a vessel is in peril. It was explained that it is like VMS but better as everyone can see the location, not just the authorities. It was felt that government should implement this as it could make a great difference to the safety of the fishers.

In general it was felt that there was a great deal government could do to improve the lives of the people living in St Helena Bay. It was also felt that the community needs to become more unified and that good, strong leaders were needed to represent and guide the community; this is a significant and progressive strategy identified by Adger (2003). This is important for the community as a whole but also to represent the community at meetings with government in order to enable transformation. A final, disturbing point made by one of the older fishers was that maybe the fishers should start burning things to see change as that is what the black people do and it seems to work for them. As things are currently, they feel completely marginalized and want to start being better included and seeing progressive changes.

Chapter 6: Discussion

6.1 Introduction

This chapter reflects on the findings of the research, recorded in chapter 5, while drawing on the literature provided in Chapter 2. The chapter discusses the key stressors and vulnerabilities identified by fishers in St Helena Bay and Doringbaai in relation to the literature that examines threats contributing to vulnerability of coastal fishers and explores possible measures for reducing such threats. The fishers' perceptions of climate and environmental change are discussed in relation to available science and the value of this expanded knowledge base is highlighted. The chapter then explores the coping mechanisms and adaptation strategies identified by fishers and highlights the value of local communities being integrally involved in identifying locally appropriate strategies. The chapter then concludes with a comparison of the different research methodologies against a set of criteria and comments on the extent to which the RVA can contribute to VAs and the identification of adaptation strategies.

6.2 Climate Change and Environmental Variability: Another Layer of Stress for Coastal Communities

Small-scale fishers are predicted to be among the most susceptible to the current and potential impacts of climate change due to their inherent vulnerability; these vulnerabilities stem from the impoverishment and marginalization which is often characteristic of fishing communities (Daw et al., 2009; De Young, 2012; Sowman et al., 2014). According to Mamauag et al. (2013: 7): "Socioeconomic factors are extremely important in measuring fisheries' vulnerability because of the tight relationship between people and fisheries resources. Communities that are highly dependent on fishing are likely to be vulnerable to climate-related factors such as elevated sea-surface temperature, increasing storm frequency, and wave surge". This study focused on three main categories, namely socioeconomic, environmental and governance issues, in order to assess the key stressors and vulnerabilities in the two fishing communities.

Table 3: The climate and environmental stressors that were most critical for fishers in Doringbaai and St Helena Bay

Key Vulnerabilities and Stressors in Doringbaai and St Helena Bay		
Environmental	**Socioeconomic**	**Governance/Management**
• Change in seasons/ unpredictable weather • Water temperature (colder in winter, warmer in summer) • Change in winds • Stormy/bad weather more often • Increase in frequency and density of mist • Decline in WCRL and fish	• Alcohol and drug abuse • Lack of housing • Youth pregnancy • Unemployment	• Fishing management centralized • Fishing rights, permits and regulations • Lack of government support and communication • Lack of insurance

• Fish found further out at sea • Red tide		

The focus group discussions revealed that the key stressors and vulnerabilities for fishers are based on **socioeconomic issues** (Table 3). The most pressing of these in both communities was alcohol and drug abuse, which is a common prevalent social issue in fishing communities (Schultz, 2010; Salas et al., 2011; Sowman et al., 2011a; FAO, 2015). The fishers expressed that this issue has become particularly severe in the last five to ten years and is exacerbated by the lack of alternative recreational activities for the unemployed and for when fishers are not able to go out to sea. Other major socioeconomic issues include lack of housing, youth pregnancy (which was stated to be starting as early as ten years old in St Helena Bay), lack of affordable transport, lack of social services, poaching, early school dropout and unemployment. These socioeconomic issues are generally prevalent among fishing communities across the world but are especially apparent in developing countries (Béné, 2003; Sowman et al., 2011a; Mamauag et al., 2013; Schultz, 2015) largely due to the nature of impoverishment. In the context of South Africa this stems from the great dependence on the dwindling fish resources as well as "a host of other factors such as inadequate infrastructure, poor education and health facilities, low levels of political organization and inadequate opportunities to participate in decision-making that contribute significantly to poverty in fishing communities" (Sowman et al., 2014: 33). Furthermore, Steedman (1985: 9) states that: "small-scale fishermen occupy a position near the bottom of the income scale. Livelihoods are meagre for a variety of socioeconomic and environmental reasons... [resulting in] a perpetual cycle of poverty among fishermen''.

These pressing socioeconomic issues often override environmental/climate related issues and impacts; this is especially because socioeconomic issues are more conspicuous and critical while the effects of climate and environmental change are not always easy to discern (Hampton, 2012; Salagrama, 2012). However, the improvement of these socioeconomic circumstances can help to increase the resilience of individuals and communities to environmental and climate change (Hampton, 2012). Badjeck et al., (2010: 375) states that the climate change responses should include "management approaches and policies that build the livelihood asset base, [as this can act toward] reducing vulnerability to multiple stressors, including climate change".

The **governance/management category** was the second most pressing issue; in both communities the fishers expressed great frustration and indignation with the government and the fishing regulations imposed upon them. The permit conditions were said to be very constraining and not "*fisher-friendly*" (FGD Communication: Doringbaai Older Fisher Group, 2015). Prior to 1994, fishers in these communities were largely ignored by the government allowing them to fish freely due to the low levels of enforcement in the region. The onset of democracy then brought with it a myriad of new rules and regulations which the fishers were not accustomed to (Hauck, 2008). According to Schultz (2010: 62) fishers described that life after democracy[5] became "less free" as state regulation increased and bureaucracy for fishers became far more complex. Many of these new regulations were enforced with

[5] The term 'democracy' here refers to the period from 1994 whereby new regulations (such as the Marine Living Resources Act of 1998) were enacted and stricter enforcement was implemented

little understanding of the small-scale fishers' activities and, preceding 1998, small-scale fishers were not even recognized by the government and had to either fish with commercial or recreational permits (Schultz, 2015). Furthermore, the fishers feel that the enforcement of these regulations is done "*in an unreasonable, unsympathetic manner*" (FGD DB: Commercial Fisher Group, 2015). A fisher from Doringbaai described an example of this where her permit got wet and then, when asked to present it to a compliance officer, she was not able to and was consequently fined R2000.

Other issues related to the governance category were the lack of government support and communication, the centralized management of fishing as the fisheries authority is based in Cape Town (this consequently requires fishers to travel long distances for administration purposes at times, which is costly), and finally, the lack of insurance for fishers. These stressors where also noted in studies by Sowman et al (2011a), Isaacs (2013) and Schultz (2015). The ability for fishers to acquire insurance is inhibited by their lack of assets and stable employment. This causes great stress for fishers, as shown by Salagrama (2006: 68) in a study of fishing communities in Orissa State in India, as a "lack of insurance can spell destitution for fisher families that lose wage-earners" (Salagrama, 2006). Furthermore, insurance could be of great value in mitigating the potentially destructive impacts of climate and environmental related events (De Young et al., 2012). The FGDs revealed that, for the commercial and pelagic fishers, it is now a necessity by law that companies have insurance schemes for fishers but this is not the case in the SSFs sector.

Finally, the **climate and environmental stressors** that were most critical for fishers are depicted in Table 3. A key stress that emerged for the fishers was the increase in frequency and density of the "*mist"* or rather the fog on the west coast of South Africa; as the west coast is a dry region, this coastal fog supplements rainfall (McKell, 2012). This is particularly hazardous for fishers as first, if fishers are out at sea when the mist manifests, it makes it difficult to navigate back to shore without technologies such as a GPS. It was stated that many fishers have become lost at sea, spent the night at sea, and fishers have even drowned or died as a result of the fog (NSRI, 2015). It also inhibits fishing at sea as, again without a GPS for navigation, it is very risky for fishers to take their vessels out in foggy conditions. In a study of artisanal fishers in Nicaragua, the fishers that used a GPS were at a great advantage as they could go out in more perilous conditions, fish further out at sea, find fishing grounds more efficiently and thus save petrol and time, and finally, they could put discrete markers where their traps were located, thereby reducing the possibility of theft (Daw, 2008). Another priority issue is the perceived decline in fish, especially snoek, hottentot, harders, and WCRL. This decline in catch of certain marine species is a phenomenon which has been observed in all countries within the BCLME region (Veitch, 2007; Hampton, 2012; Hampton & Willemse, 2012; Jarre et al., 2013). In addition fishers noted that increasingly fish is found further out at sea. The fishers, especially the older fishers, explained how their catches are less than what they were a few decades prior; they described this decline as having begun in the 1970s but then became most significant from the 1990s onwards. The women who perform the post-harvest activities also noted this decline in catches as they have less fish to work with than in the past.

Fishers have also noted a change in the seasons and the winds, stating that the weather is far more unpredictable than in the past. They observed that the seasons arrive about a month and a half later; this is problematic for fishers as it no longer complements the fishing

seasons stipulated by the fishing regulations. It was also stated that cold fronts used to arrive earlier in the past and cold fronts and northerly winds used to signal the arrival of snoek but this is no longer a certainty. The southwest wind, which brings strong currents and stormy weather conditions, was observed to arrive earlier than in the past. The northwest wind was the dominant wind which brought these conditions as well as warmer sea waters in the past; however now the southwest wind is more dominant. The increase in frequency of the southwest wind has made the water colder in winter months than in previous years which affects fishing as, although sonar devices show there are fish, they do not seem to bite when the water is too cold. Conversely, in the summer months the water is warmer than it was before and this, according to fishers, affects the quality of fish and WCRL. According to Allison et al. (2009) this change in water temperature increases the exposure of fishers as it impacts the fishery resources by affecting the productivity and distribution of species as well as increasing the abundance of invasive species and HABs (when there is an increase in water temperature). While this could provide opportunities in some ways, it will more likely increase the stress and vulnerability of coastal fishing communities. Finally, fishers also perceived winds to be stronger in the mornings than in the past, preventing fishers from going out to sea until conditions subside.

There was some contrasting information with regard to storms and bad weather; the FG with older fishers in Doringbaai stated that in the past there were massive storms from time to time during the winter months but since the 1980s there has been less occurrence of these storms and more sea-going days. In contrast, the St Helena Bay fishers stated that there have been less sea-going days than before; the reason for this discrepancy is likely that the older fisher group were looking at the trend over a longer timeline while the St Helena Bay commercial and pelagic fishers were referring to changes noted over the last few years. Furthermore, it could be possible that the older fishers could have been referring solely to their recollection of the intensity of the storms as opposed to their frequency and intensity; this was then not clearly understood in the FGDs. Nonetheless, storms increase the exposure of fishers as it reduces sea-going days and creates more danger for fishers (Allison et al., 2009). Finally, fishers spoke about the detrimental impact of red tides as, for months following the event, it causes a massive decline in catches and thus requires them to fish in other areas. This has been noted worldwide; according to Heisler et al. (2008: 4): “It is generally recognized that there have been more coastal algal blooms, often of greater geographic extent and/or longer duration, with more toxic species observed, more fisheries affected, and higher associated costs from HABs in the past decade than in previous decades”.

6.3 Incorporating Fishers’ Perceptions and Knowledge in Managing Complex Fishery Systems

6.3.1 Fishers’ Perceptions of Climate and Environmental Change in Relation to the Available Science

Complexity science emerged in the 1900s as a result of the inherent constraints and limitations posed by traditional science when dealing with dynamic, intricate systems (Byrne, 1998; Heylighen et al., 2007; Mazzocchi, 2008). Fisheries systems are highly complex

and, with the real and potential threat of climate and environmental change, are even more complex and vulnerable than ever before (OECD, 1997; Cochrane, 1999; Garcia & Charles, 2008; Berkes, 2009; Johnson & Welch, 2009; Benkenstein, 2011; Blamey et al., 2014). The most effective management strategies to deal with the inherent complexity and uncertainty therefore necessitates a collaborative, adaptive approach or 'adaptive co-management' to be employed (Berkes, 2009; Nelson et al., 2010). This requires that the key stakeholders are included in the generation of knowledge and decision making processes (Cochrane, 1998) and for adaptation responses to be flexible and tailored to the specific communities/groups that will be affected (Charles, 1994; Berkes & Folke, 1998; Garcia & Charles, 2008).

The participatory vulnerability assessments, such as employed by the FGDs in this dissertation, therefore seeks to decipher the risk priorities of fisher communities in order to devise appropriate adaptation strategies through direct communication and interaction with the fishers themselves (Van Aalst et al., 2008). The traditional knowledge that fishers can provide is exceptionally valuable in that it can supplement scientific data, it can give a greater sense of ownership to the community, and is a form of 'procedural justice' as it gives fishers a say in the future management of resources pertinent to their lives and livelihoods (De Young et al., 2013).

The perceptions of fishers from Doringbaai and St Helena Bay with respect to climate and environmental change were therefore very valuable in complementing existing scientific information. Hind (2014) emphasized that fishers have an expanse of valuable, context specific knowledge which could prove advantageous for informing adaptation strategies. Their insights are exceptionally useful to complement and aggrandize the scientific data; however, this research is rarely integrated into fisheries science (Zollett, 2008; Preston, 2012; Hind, 2014). Table 4 summarizes the key climate and environmental changes observed by the fishers and compares it with the available scientific literature. Some key insights follow.

Table 4: The key climate and environmental changes observed by the fishers and the comparison with the available scientific knowledge

Environmental Changes Identified by Fishers in Doringbaai and St Helena Bay		
Environmental Change Identified by Participants in FGDs	**Possible Cause of Impact (Participants in FGDs)**	**Observation and Possible Cause of Impact (Scientific Data/ Knowledge)**
• Change in seasons/unpredictable weather	• Natural changes, global warming/climate change	• Inherent variability in the BCLME. Could also be as a result of the temperature gradients caused by the cooling of inshore waters and warming of the sea surface waters.
• Water temperature - colder water from about March to July and warmer water from November to January (than in the past)	• The increase in the frequency of the southwest wind makes the water colder	• The change in water temperature could potentially be as a result of the winds (such as the increase in upwelling-favourable southeasterly and easterly winds). The warmer water could potentially be a by-

		product of El Niño events/ the intrusion of water from the Agulhas Current or also as a result of the winds.
• Change in winds - alterations have been observed in the speed and direction of the wind. The southwest wind blows more when the northwest should be blowing (mainly in the winter months). The east wind also blows for fewer consecutive days (from 7/8 days to about 2/3). Winds are perceived to be stronger in the morning	• Nature, do not know	• Substantial interannual and decadal-scale variability in winds and atmospheric pressure records in southern BCLME. Also an increase in southeasterly and easterly winds in the first half of the year
• Stormy/bad weather more often	• Natural cycles, climate change	• An observation of the cooling of near-shore waters on the south and west coast of South Africa but a warming of the sea surface waters in the Benguela Current; this could result in an intensification of weather events due to the sea's increased temperature gradients
• Increase in frequency and density of mist over the last few years, especially during the winter months	• The drier conditions inland, climate change, do not know	• The west coast has the highest frequency of fog in South Africa; the frequency increases with more southerly winds. The cooling of inshore waters could also have an effect (greater temperature gradients).
• Decline in WCRL in Doringbaai and St Helena Bay over the last few decades	• Natural migrations, the diamond boats disturbing the habit, the lobster traps (overfishing), less nutrition for the lobster in Doringbaai	• A shift in abundance of WCRL from the west coast to the south coast of South Africa. Furthermore, the decline may be as a result of slower growth rates which results in less available catch and intensified fishing pressure on the resource
• Red tide and increase in lobster walk-outs	• God/ a natural occurrence	• Lobster walk-outs have become more pronounced during recent times (most notably the 1990s). The cause of this is low oxygen events. The increase in upwelling could also cause an

		increase in plankton production which results in lower oxygen levels.

First, the fishers explained that there has been a noticeable change in seasons and reported that they experience unpredictable weather more often. According to the scientific literature this is not uncommon for this region as "conditions in the highly dynamic environment of the southern Benguela upwelling ecosystem shows no unidirectional change from the 1950s to the present …Large variability, however, has been observed throughout this period, and at various scales: seasonal, interannual, and decadal" (Jarre et al., 2013: 56). The fishers observed that there is less predictable weather and that there is stormy weather more often (although not all fishers agreed with this statement). Hampton (2012) suggests that this could be as a result of the cooling of inshore waters on the west coast and a warming of the sea surface waters in the Benguela Current which could increase temperature gradients and thus result in an intensification of weather events. The evidence of these changes is shown by wind data, ocean temperature data, and the shift in warm and cool water species (Blamey et al., 2014).

Alterations in the speed and direction of the wind on the west coast of South Africa have been observed and documented (Cury & Shannon, 2004; De Young et al., 2012; Hampton & Willemse, 2012). As stated by Cury and Shannon (2004: 230): "Substantial interannual and decadal-scale variability has been shown in winds and atmospheric pressure records in both the southern and northern Benguela regions". The fishers stated that there has been a shift whereby winds from the southwest blow more frequently (from about November to July but mainly in the winter months) while in the past the dominant wind was from the northwest; summer winds were also perceived to be stronger in the morning than in the past. This is in part confirmed by Hampton and Willemse (2012: 26) whereby it was stated that "more recent analysis of similar data from around the South African coast between 1982 and 2009… confirmed the increase in upwelling-favourable southeasterly and easterly winds in the southern BCLME in the first half of the year during this period, evident from their earlier analysis". Furthermore, according to Blamey et al. (2012), this phenomenon of winds switching from being predominantly northerly to southerly, and vice versa, has occurred several times over the past few decades. The fishers believe this (the increase in southerly winds) has influenced the temperature of the water. Over the last five years, from November to January, they stated that there are days when the water is far warmer than in the past and colder during the period from March to July. Scientific data shows that wind fields have an effect on water temperature and, in turn, this affects the distribution of fish species. Furthermore, scientific data shows that there has been a "statistically significant cooling trend of up to 0.5°C per decade along the west coast from January to August. These trends were attributed to the increase in upwelling-favourable southeasterly and easterly winds, noted earlier… They also found a statistically significant positive correlation between warm events along the west and south coasts from February to May and El Niño events in the southeast Pacific" (Hampton & Willemse, 2012: 27). The intrusion of warmer water from the Agulhas Current could also possibly have an effect on the water temperature (Shannon & O'Toole, 2003; O'Toole, 2006; Hampton, 2011; Hampton & Willemse, 2012).

The fishers' account of the increase in frequency and density of fog is not confirmed in the scientific literature; however, there are some indications that this could be the case. First, records demonstrate that the west coast has the highest frequency of fog in South Africa (Pretorius, 2009). According to van Schalkwyk and Dyson (2013) it was "determined that sea surface temperatures along the west coast vary between 13° and 15°C and with the arid, hot land surface, advection fog occurs almost exclusively and throughout the year". Perhaps, with the cooling of inshore waters on the west coast of South Africa (Hampton, 2012; Blamey et al., 2014) there is a greater temperature gradient which is causing an increase in frequency and density of fog. Furthermore, the increase in prevalence of southerly winds could also have an impact as the "frequencies of fog onset with a southerly wind component are slightly higher than with a northerly component" (van Schalkwyk & Dyson, 2013: 639).

In terms of species abundance, catch rates and distribution, the fishers stated that there has been decline in WCRL over the last few decades; this has also been confirmed by scientific research. It is documented that there has been a distributional shift of the commercially valuable west coast rock lobster (WCRL) *Jasus lalandii* (Cockcroft et al., 2008; Blamey et al., 2012; Blamey et al., 2015). The fishery peaked in the 1950s whereby the annual catch was about 18 000 tons with most catch occurring on the west coast of South Africa (Johnston & Butterworth, 2005; DAFF, 2013). The fishery was stable in the 1980s and then declined unpredictably in the 1990s; in the same period, there was a shift in the distribution of WCRL from the west to the southwest coast (Cockcroft et al., 2008). In 2011, the total allowable catch (TAC) of WCRL on the west coast was just below 2500 tons (Bergh, 2014). In the article by Laura Blamey et al. (2015), it is stated that on the west coast, the last ten years have seen a proportional decline of WCRL catches from 60-70% to about 10%, while the proportion of lobsters caught on the southwest coast increased to 70% from 10%. The cause of the distributional shift from abundance on the west to southwest coast is inconclusive. Blamey (Pers Comm., 1 December 2015) summarizes the possible factors contributing to these shifts as follows: "The WCRL resource has been fished hard for a long time. This, coupled with a more variable environment (productivity, food resource, HABs and low oxygen water) must have had negative impacts on the resource". In the article by Blamey et al. (2015), this is expanded on to explain that the reduced growth rate of lobsters and the increase in lobster walk-outs in the last two decades could have also contributed to the decline in the resource on the west coast of South Africa.

The participants in the FGDs labelled the red tide as being a major stress factor as it impacts the local distribution of lobster and, if their area is affected, causes them to have to fish in alternative areas. Some of the fishers stated that these events of red tide and subsequent lobster walk-outs have increased in frequency and duration. In relation to scientific knowledge, it was stated by Danie van Zyl (Pers Comm., 26 November 2015) that lobster walk-outs have become more pronounced during recent times (since the 1990s) and is related to low oxygen events (Danie van Zyl, Pers Comm., 26 November 2015). Laura Blamey (Pers Comm., 1 December 2015) expands on this by stating that: "Low oxygen water (LOW) in deeper waters causes rock lobsters to move inshore into the shallows to escape the LOW conditions. When the tide goes out, the lobsters cannot retreat quickly enough and then get stranded and washed ashore". The increase in LOW may be as a result of the increase in upwelling and therefore the increase in plankton, especially zooplankton, in the southern

Benguela (Hutchings et al., 2006; O'Toole, 2006; Veitch, 2007; Hampton & Willemse, 2012; EPA, 2015).

6.3.2 Limitations of Fishers' Perceptions and Knowledge

One of the potential limitations of fisher knowledge is the challenge associated with relative time frames. First, the fishers' perception of climate and environmental change is relative to their own histories, whereby the age, number of years living in the particular community (if they are from elsewhere), and years involved in the local fishing industry affect their perceptions and extent of knowledge (Raemaekers & Sowman, 2015). Secondly, as the process of interviewing people on events of the past is intrinsically subjective, the exact events and time frames may not be completely accurate; as Abbink (2009: 34) states: "actors might forget or misremember facts and/events... because of the possible influence on recollections of subjective recall and loss of memory, which could frustrate a reconstruction of past events". Thirdly, as environmental changes are often gradual, it may be difficult to pinpoint the occurrence of certain changes. This case was demonstrated with the older fishers from St Helena Bay who were not comfortable stating when environmental changes took place. They explained these are gradual, natural cycles and thus difficult to isolate. This therefore demonstrates some of the limitations of qualitative data as it is not always easy to substantiate people's own accounts of past events.

This was apparent in the FGDs whereby the details of accounts of the same events occasionally differed slightly from person to person. An example of this is with the perceived increase in the frequency and density of the mist in Doringbaai and the varying recollections of when this phenomenon first became apparent. Some fishers said two years ago, others said three or four years and there was even one fisher who said over the last decade. There were also occasions whereby there were contradictory statements such as with the decline in fish in St Helena Bay. The older fisher focus group stated that there have been "*plenty of fish*" (FGD SHB: Older Fisher Group, 2015) in recent times while, in contrast, a commercial/pelagic fisher stated that there had been no snoek or lobster in the last nine months. The women group also stated that there have been less fish which they observed through having "*less cuts for the day*" (FGD SHB: Women Group, 2015).

The fishers often alluded to 'climate change' as being the cause of the perceived changes in environmental conditions referring to it as "*climate change*", "*this hot climate thing*" and "*global changing*". This reference to climate change could be as a result of outside influences such as fisher participation in other workshops/meetings held by researchers or NGOs but, essentially, the significance to this reference is that they are noticing that there have been marked changes in certain climate and environmental phenomena. The Benguela Current Large Marine Ecosystem (BCLME), the ecological system which runs along the coast of South Africa in which Doringbaai and St Helena Bay are situated, is a highly complex and variable system. As stated by De Young et al. (2012) the "difficulty in long-term prediction relates to the wide-ranging natural variability of the system, which makes it very difficult to detect long-term trends related to global climate change". The exact cause(s) of the detected and perceived changes, whether natural, anthropogenic or climate change induced, are therefore, for the most part, uncertain at this point in time. There is even debate among scientists; some state that overfishing is the leading cause of the changes (Hampton, 2012; FAO, 2014) while other scientists believe the "Benguela Current LME has

been impacted by the effects of climate change" (Duffy, 2008; Hume and Duda, 2012: 14). Essentially, whether the changes and variations "are climate change or decadal cycle, nobody can tell you and that's the big issue" (Dr Cockcroft, Pers Comm., 2 December 2015); furthermore while many of the changes "could possibly link up with climate change, the cause-and-effect relationships are seldom linear or clear, and are frequently overlapping or interchanging" (Salagrama, 2012: 6).

The complexity in fisheries therefore requires an approach which harnesses the value of the knowledge of local stakeholders as is done in participatory vulnerability assessments such as the RVA workshops and FGDs. Despite the limitations mentioned above, local informants hold valuable knowledge which can enhance the understanding of climate and environmental change and the consequential social impacts, be incorporated into scientific data, and inform local fisheries management. Furthermore, this approach allows for "procedural justice" and helps to decentralize the decision-making power and thus give a greater sense of ownership to the community (De Young et al., 2013: 9).

6.4 Identifying Locally Appropriate Adaptation Strategies

Adger et al. (2005: 77) commence their article by stating: "Climate change is a reality…Along with changes in mean climatic conditions, the earth potentially faces irreversible and catastrophic system feedbacks and impacts associated, for example, with collapse of thermohaline circulation, the melting of the Greenland ice sheet, or other singular events". Adaptation planning is therefore becoming increasingly important; although most adaptation actions are currently reactive rather than anticipatory (Shelton, 2014). Adaptation refers to strategies in response to either short- or long-term changes while coping refers to a more immediate, survival mechanism response (FAO, 2014).

The ability of a system to cope with and adapt to perturbations is dynamic and, the ability of the adaptive capacity to increase or decrease, depends on both external and internal forces. Smit and Wandel (2006: 287) state that: "Coping ranges are flexible and respond to changes in economic, social, political and institutional conditions over time". For example, the coping ranges and adaptive capacity of a community may decrease after a massive natural disaster depletes resources; however, the capacities could also increase if better financial structures are put in place or if the region experiences economic growth (Smit & Wandel, 2006).

Table 5: Common adaptation strategies identified in the FGDs

Common Adaptation Strategies Identified in FGDs
• Safety at sea needs to be improved; fishers suggested better technology such as a GPS, AIS, VMS, a 'mother boat', better equipment such as protective, warm clothing, and safety-at-sea training (especially for youth) • Improve fisheries facilities and infrastructure • Better organization at local levels, such as cooperatives, and have a more unified community • Training and skills development including: business, first aid courses, government processes related to fisheries e.g. applying for permits • Better insurance for fishers and access to credit • Improve and develop alternative sources of income (e.g. tourism, aquaculture…) • Improve marketing and price regulation (for fishers and snoek vlekkers)

In the FGDs, when fishers were asked how they coped with the stressors and threats they are facing, the general response was rather despondent. It was essentially stated that if you cannot fish, you do not get an income. One of the older fishers in the FGD in St Helena Bay stated that: "*We live from the sea, when we don't get anything it's our families who suffer as well…you go hungry*" (FGD SHB: Older Fisher Group, 2015). It was made quite clear in the primary research that alternative livelihoods are very limited and thus not really an option. Furthermore, they feel that their lack of education makes them especially vulnerable: "*The fishers are uneducated. Now that's the problem, because we never went to school, they [government] are doing what they want with us*" (FGD SHB: Older Fisher Group, 2015). When they cannot go to sea there are permits for gathering mussels and limpets but they say the amounts are too small to even feed one person. One of the women in St Helena Bay stated: "*You can get a permit to gather from rock pools but you cannot get a lot with that. You can take ten lampols? [sic] Limpets? Only one person can eat that. It was fifteen, now ten. No one has permits for this. Ten white mussels – what will you do with that?*" (FGD SHB: Women Group, 2015).

The first coping strategy the fishers mentioned was to attempt to find alternative income. This included the men finding menial work, such as a construction worker or gardener, while the women attempt to find work as a domestic worker, a harvester of crops in the nearby town (for the women from Doringbaai), or as seamstresses. However, as mentioned previously, this is generally not really an option due to the scarcity of alternative employment. Another strategy when they do not catch fish in their own area is to go to other areas such as Elands Bay. However, unless they get permission from the government, this is not legal (Dr Cockcroft, Pers Comm., 2 December 2015). Furthermore, it often creates conflict between the locals and the fishers from other areas due to the increase in competition (Daw et al., 2009; Schultz, 2010; FAO, 2014). At the older fisher FGD in Doringbaai, it was explained that the younger non-local fishers exacerbate this tension as they often have a disrespectful attitude. They go to Elands Bay and use drugs and alcohol and get into altercations with the local fishers. There are often incidents where this escalates into violence.

Another coping strategy is to get an advance from the buyers, often for expenses such as petrol, but this generally results in cycles of debt and allows the buyers to have more power over the fishers and set the price at which they purchase the catch. This relationship has been described by Schlüter and Lindkvist (2014: 1) as being "unequal, exploitative and unsustainable". It was also mentioned that some fishers go out at night but this is prohibited and can result in hefty fines. Furthermore, some fishers cut the lobster traps of the commercial boats and steal the catches – both as a means of getting more catch and to spite the companies. It is therefore evident that there are very limited coping strategies available to fishers and these are, for the most part, inadequate. There thus needs to be a focus on the development of effective adaptation strategies to assist in increasing the resilience of fishers to the actual and potential threats of climate and environmental change.

Adaptation to climate change is defined by Adger et al. (2005: 78) as "an adjustment in ecological, social, or economic systems in response to observed or expected changes in

climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantages of new opportunities…[it] can involve both building adaptive capacity thereby increasing the ability of individuals, groups, or organizations to adapt to changes, and implementing adaptation decisions i.e. transforming that capacity into action". Adaptation is a significant strategy to protect the health of the human, ecological and economic systems (Scheraga & Grambsch, 1998). The need to create context specific adaptation strategies which includes the stakeholders who are directly affected is increasingly seen as important. This is reflected in the literature (Barnett, 2008; Dazé et al., 2009; De Young et al., 2012) as an "increasing emphasis on adaptation demands greater efforts to understand the diversity of users and their evolving climate needs" (Dow & Carbone, 2007: 302). Furthermore, a move from a top-down approach to bottom-up approach to management is seen as essential for including stakeholders and identifying more effective adaptation options (Van Aalst et al., 2008).

The participants of the FGDs identified several ways in which they think they could decrease their vulnerability, increase their resilience and thus increase their overall ability to adapt to current and potential stressors (this is summarized in Table 5). One of the most significant sets of adaptation options related to climate and environmental change, identified by the participants from FGDs, was to do with safety at sea. This is especially important as there are events whereby fishers get lost at sea, have to stay overnight at sea, and even drown as a result of environmental circumstances such as the fog. They therefore stated that having technologies such as a GPS, VMS and AIS are important for navigating through bad weather and for locating fisher boats that get into difficulties; these types of technologies have been proven to increase the safety of fishers at sea (Daw, 2008; Quinn & Kojis, 2011). Furthermore, protective, warm clothing and safety-at-sea training was seen as important. Some fishers also suggested a 'mother boat' would be very helpful to assist any boats in distress.

Another important adaptation strategy was to have cooperatives or some kind of structure that better organizes and unifies fishers. According to Pérez-Ramírez et al. (2012), a successful cooperative is able to strengthen and empower a community, and can lead to a more sustainable fishery. Doringbaai served as the pilot case study for cooperatives. However, the fishers in St Helena Bay feel that they have been completely left out in this regard. They see the benefits accrued from the cooperatives in Doringbaai and Lamberts Bay and they do not understand why they have not been given the same opportunity. Many of the fishers in St Helena Bay declared that they also want to have cooperatives so that they may also benefit and feel as though they belong to something.

Other adaptation strategies identified in the FGDs included improving the fisheries facilities and infrastructure; these improvements can help with storing and processing fish and preventing damage to the boats when they come into the harbour. In Doringbaai, the fishers stated that they needed a better space for processing as this could help women get jobs in the post-harvest activities and allow the fishers to have more control over the sale of their catches. Improvements to the slipway and breakwater and fixing the tractor were also seen as being important developments to be undertaken by government. In terms of facilities and infrastructure, Doringbaai does seem to be better equipped than St Helena Bay. An improvement in the recreational facilities in the communities was seen as a potential way to reduce the dependence on drugs and alcohol, especially by the youth.

The fishers also suggested that the availability of training and skills development courses should be made available, such as business management, marketing, and administration training, to be better prepared for the necessary government administration, which is sometimes felt to be unnecessarily complicated. Better insurance was also identified as important. Suggestions of pension funds, unemployment funds and funds similar to the Road Accident Fund, as fishers pay for petrol, were believed to be strategies which could make significant improvements to the lives of fishers and their families. This is especially important as there is inherent danger and risk associated with the fishing industry. Credit was also seen as important as fishers have few assets and thus no access to credit. One of the older fishers in St Helena Bay stated that: "*The worst is, we can't go to a shop and open up an account. We working on a commission basis, a 50-50 basis, there is no pay slip or nothing. You can't buy a car, you haven't got bank details, you have nothing. That's why fishers stay poor. No insurance, nothing*" (FGD SHB: Older Fisher Group, 2015). If they could have access to credit they could build up their net worth and would not have to rely on buyers to borrow money.

The development of accessible alternative sources of income was seen as important, especially for off-season times when they are not able to fish. This is especially significant with the increasingly unpredictable nature of fisheries including the decline and migration of certain species and the change in seasons. As stated by Laura Blamey (Pers Comm., 1 December 2015): "I don't think the situation is going to get any better given the prediction of more climate variability in the future and this, combined with resource depletion, will make life more difficult for fishing communities. I think it's important that alternative sources of livelihood are sought to add to fishing". The fishers in St Helena Bay suggested that permits be made available so that they may use their boats to charter tourists; tourism is a potential adaptation strategy that could be viable, however, it is seasonal (Jacobs, 2007; Paterson, 2014). Aquaculture, such as in Doringbaai, was also seen as a potential adaptation strategy for alternative income. The fishers also stated that, as they have very limited options, the government should provide some sort of financial assistance or permits for other species for off-season periods. In general it was felt that a massive reform in government, and the way fishers are restricted and regulated, was needed. They felt that more freedom in terms of areas where they may fish, what species they may catch, the TAC and so forth, would really make their lives easier. They want proper rights that are better tailored to their lives and livelihoods as, the way things are now, they can "*barely survive*" (FGD SHB: Older Fisher Group, 2015). Finally, it was stated that better marketing channels and price regulation was important so that they do not get exploited by buyers and have more options when it comes to the selling of fish.

In terms of pursuing the above adaptation strategies, it was most often commented that government needs to be the one to make these changes and take better care of the communities. After the FGDs in Doringbaai, the local facilitator stated that there needs to be a change in mindset, whereby the communities do not rely on government for transformation but rather start to strategize ways to bring about change for themselves. This therefore reiterates the need for well-organized communities that have good leaders; as stated by Adger (2003: 387), "the ability of societies to adapt is determined, in part, by the ability to act collectively".

The above therefore shows that local communities are well placed to identify appropriate adaptation strategies. They are able to identify the most pressing problem areas in the community and provide options that have the potential to be effective and well-received by the local inhabitants (De Young et al., 2013). The identification of adaptation strategies can thus assist stakeholders (such as government, NGOs, CBOs and other private organizations) in providing targeted adaptation strategies. Furthermore, as the exercise promotes the participants to identify the greatest issues and the strategies that could work to resolve these, it may potentially incite action from the fishers and community members themselves.

6.5 Methodological Comparison: Assessment of Mixed Methods approach versus the Rapid Vulnerability Assessment Methodology

One of the key objectives of this dissertation was to compare and contrast the information, specifically related to climate and environmental change, emanating from the RVAs and the mixed methods employed in this study. Another objective was to assess whether the RVA gives a reliable and accurate overview of the fishers' context and reliable information that can inform adaptation strategies. The following section therefore first compares the information generated from the two methodologies to see whether the information generated was similar or quite different. Secondly, the two methodologies are assessed using an amalgamation of criteria, as set out by Schröter et al. (2005), Preston (2011) and Preston (2012) to determine how effective the approaches are at assessing vulnerability and identifying appropriate adaptation strategies.

6.5.1 Comparison of the Key Stressors and Vulnerabilities that Emerged from the RVA Workshops and FGDs

This section compares the information generated in the RVAs and the FGDs based on the three categories (government/management, socioeconomic and environmental) in order to ascertain how similar or different the identified key stressors were (Table 6 provides an overview of this).

Table 6: A comparison of the key vulnerabilities and stressors that emerged from the RVA workshops and FGDs in Doringbaai and St Helena Bay

	Doringbaai		**St Helena Bay**	
	FGDs	**RVA Workshop**	**FGDs**	**RVA Workshop**
Gov/ Mgt	Lack government support and communication	Lack government support and communication	No recognition as snoek vlekkers	Poor communication with government
	Fishing rights, permits and regulations	Fishers not involved in management	Fishing rights, permits and regulations	No help from local government
	Lack of insurance		Lack of insurance	Laws don't protect fishers
		Limited agricultural land		
	Lack of women's rights	Limited involvement of women		

			Buyers set price of fish/fish cutting	No rights (long-term)
	Fishing management centralized		Companies' hold over fishers	Remnants of apartheid
Socio-Economic	Alcohol and drug abuse	Women and children abuse	Drug and alcohol abuse	Drugs and alcohol
	Poaching	Poaching		
			Lack of housing	Lack of housing
	Lack of affordable transport	Unemployment	Unemployment	No work
	Early pregnancy	Lack of youth development		
			Lack of recreation	Limited facilities
	Early school dropout	Lack of education	Lack of social services (Homeless, neglected and abused children)	
				High cost of equipment (sea)
Environ-mental	Fog more often	Climate Change	Fog more often	Reduced catches
	Species Migration	Seasonal change in fish	Decline in fish resources	Resources further out
	Change in wind	Unexpected sea conditions	More frequent bad weather/storms/stronger wind	Stronger/ changing winds
	Sand erosion – exposed rocks, water level higher	River water is getting less	Change in seasons/ unpredictable weather	Changing seasons
	Water temperature - warmer and colder than in past (seasonal)		Water temperature colder	
		Diamond mining boats disrupt		Marine Pollution

In the **government/management category**, similar responses were evoked from all the participatory assessments regarding the lack of government support and communication with the fishers. There was also a similar theme across the RVAs and FGDs regarding the issues with the fishers' rights and regulations. Furthermore, the limited involvement and, in some cases, exclusion of women in the fishing industry was highlighted by participants from both the RVA and workshop in Doringbaai. Finally, all the groups discussed the marginalization of fishers as a whole through explaining their issues with fishery management being centralized, the companies having a strong hold over the fishers and the legacy of apartheid still being apparent.

The **socioeconomic issues** from both the RVAs and FGDs also proved to be comparable. The FGD in Doringbaai, and both the RVA and FGD in St Helena Bay had drug and alcohol abuse as one of the most pressing socioeconomic issues. Although this issue was not explicitly listed from the RVA in Doringbaai, potential consequences of this are listed, such as the abuse of women and children. In the RVA and FGD in Doringbaai similar issues were elicited; namely: poaching, lack of youth development and early pregnancy, and early school dropouts and lack of education. In St Helena Bay this was also the case whereby both types

of assessment revealed comparable results, specifically: lack of housing, unemployment, and lack of recreational facilities. As stated above, the debilitating effects of impoverishment often results in these types of socioeconomic issues becoming prevalent in fishing communities.

The **environmental category** showed some similarities but also some differences. A key difference was that the FGDs revealed that fog has become a major issue for fishers but this was not bought up in the RVA workshops. In addition, only the FGDs revealed that the alterations in the water temperature were a key issue (due to it becoming seasonally colder and warmer than in the past). A possible reason for this is the different time frame; at the time of the RVA the fog was potentially not as great a concern as it came to be when the FGDs were conducted. In Doringbaai, the issue of sand erosion was also only mentioned in the FGD. There were many comparable environmental issues across the participatory assessments though, including: species decline/ migration, change in wind speed and direction, increase in stormy/bad weather, and the changes in seasons.

One limitation associated with the RVA is that the short time period, while beneficial in some ways, constrains the ability of the researcher to delve into the deeper complexities of all the identified issues. However, it is able to decipher the most critical issues in the community which can be used to identify some main adaptation strategies that communities support and that need to be further investigated and developed by government, NGOs or other stakeholders in partnership with fishers. Another key limitation of the RVA, as with other vulnerability assessment methodologies, is to do with time scale. As stated by Smit and Wandel (2006: 288): "What is vulnerable in one period is not necessarily vulnerable (or vulnerable in the same way) in the next, and some exposures and sensitivities (e.g. those recognized as ''creeping hazards'' by Wisner et al., 2004) develop slowly over time". This therefore necessitates follow up research and flexible adaptation strategies to be opted for over rigid strategies where possible (Charles, 1994; Garcia & Charles, 2008; Nelson et al., 2010).

One of the advantages of the FGDs over the RVAs was that it was able to have separate sessions with different demographic groups, namely a group of older fishers over the age of 60, a group of commercial and pelagic fishers, and a group of women. This is important as FGDs "provide insight into…the range of opinions and ideas, and the inconsistencies and variation that exists in a particular community" (ODI, 2009). It allows the researcher to explore whether there are different priority issues across different groups and then allows more in-depth analysis of these issues. Furthermore, several authors stress the "importance of putting a gender lens on social well-being in fishing communities" (DePauw, 1982; Rohe, 2012: i; Harper et al., 2013; Sachs, 2014; Coulthard & Britton, 2015); the role of women in fisheries is often not recognized and data generally fails to distinguish between male and female activities (Rohe, 2012). FGDs also help to create an environment that enables people/groups who are more marginalized or not comfortable voicing their opinions to have a more intimate setting to engage in discussion (Colucci, 2007).

The differential demographic dimension of the FGDs allowed for a better understanding of the variations in being a small-scale fisher compared to working for the commercial companies, and enabled the researcher to learn more about the snoek vlekkers in St Helena Bay, as there is currently limited research on this (Figure 31). Another interesting factor was

that there were differences between the priority issues for women and men (although, the RVA was able to differentiate key stressors amongst men and women in the one exercise, the FGDs allowed far more detail and insight into the different dimensions). In general, the men had more of a focus on fishery-related issues than the women groups; that is to say the environmental and governance categories of the FGDs. The men, in St Helena Bay especially, were highly frustrated with governmental regulations and how they restrict their livelihood. One of the older fishers in St Helena Bay stated that:

> "*The government is [sic] to be blamed for the way we are living…The government knows there is nothing for us. They must think about us. They control us so what they do to us we must just accept. Maybe we should start burning, the way I saw things already in this political system in South Africa. If you burn, you get everything*" (FGD SHB: Older Fisher Group, 2015).

This demonstrates the sheer frustration with the fishing conditions imposed on them. The men also spoke about socioeconomic issues that negatively affect the community, but not to the same extent as the women groups.

Figure 31: The women FGD in St Helena Bay; these women are mostly snoek vlekkers.

The women groups had far more of a focus on the socioeconomic issues. They felt very strongly about the dire issues their communities face, especially those that are detrimentally affecting the youth such as drug and alcohol abuse, teenage pregnancy, neglected children (as well as the lack of social services available), and suicide. NGOs, such as Masifundise, have highlighted the vulnerability of women fishers in South Africa, stating that there is a "lack of equal rights within their households, community and local governance structures [which] impacts on women's wellbeing" (Masifundise, 2008). Research on women in fisheries highlights their vulnerable position in society: "Women play a significant role in fisheries, yet lack of attention to gender roles and relations can result in policies or programmes failing to improve livelihoods or reduce vulnerability of fishing communities" (RFLP, 2011). The lack of recognition of the role of women in fisheries needs to be addressed in order to prevent the marginalization of women and improve their overall status and wellbeing (Williams et al., 2002; Rohe, 2012; Harper et al., 2013; UNDP, 2014).

The 'invisible role' of women was apparent with the women groups in both communities but especially stood out with the snoek vlekkers in St Helena Bay. They currently feel completely marginalized although they have a job that requires skill and adds to the income of their households. They felt strongly that they should be recognized as part of the fishing industry in some way for the job they do; one of the women even suggested they have their own fish cutter permits:

"*At least then we know, as fish cutters, then we know we are part of the fishing industry because at this moment we can't say we are part of the fishing industry because they don't recognize us…. That's why I say we went to college in our own way*" (FGD SHB: Women Group, 2015).

Furthermore, when asked if any women were fishers they explained that there are meetings they can attend but "*most don't go because they feel neglected by the government*" (FGD SHB: Women Group, 2015). They stated that in 2013 five women were promised fishing permits. However, when they went to fetch the permits, there were none for them to collect. This also happened to the women in Doringbaai. The women believe fishing companies use their names and then someone else operates these quotas for their own benefit. This marginalization of women in the fishing industry by government and other management structures therefore needs to be addressed to ensure inclusion and access to equal rights (UNDP, 1995; Williams et al. 2002; Harper et al., 2013). This is significant for the women living in these fishing communities as having work, especially work which is seen as important in the community, gives them a greater sense of hope and psychological well-being (Masifundise, 2008). This sentiment was clearly communicated by the participants in a research project which focused on the wellbeing of women in Doringbaai: "If there is work the women will realise there is a future, there's a life" (Rohe, 2012: 67). The more in-depth view of the different demographic groups was therefore one advantage the FGDs had over the RVA, although the RVA did differentiate between genders when exploring stressors.

6.5.2 Comparison of the Perceived Climate and Environmental Changes from the RVA Workshops and the FGDs

Table 7 overleaf portrays a comparison of the key outcomes of the perceived environmental changes educed from the RVA workshops and the FGDs. According to Jentoft (1999), this process of conducting research in the same case study sites (as was done with the RVAs and FGDs) is an important means of testing social science research. Table 7 shows that, for the most part, the information obtained was very similar, although differences did occur at times. There was only one occasion where the information obtained was contrasting. This could be due to a variety of factors. Perceptions can become confused, other individuals/groups may experience different phenomena, environmental conditions and what is most relevant at a particular time can change (temporal scale), and finally, there could be cases whereby fishers may have to fish in other areas and thus may experience different environmental conditions (spatial scale).

Table 7: Comparison between the outcome of the perceived environmental changes from the RVA workshops and FGDs in South Africa. Green shows that the same results were educed; orange shows the results were similar but differed slightly; red shows there were very different results obtained; the blue shows that the change was not mentioned as a stressor in the RVA workshop.

Environmental Change Identified by Participants in the FGDs	Environmental Change Identified by Participants in the RVA workshops (as taken from Raemaekers & Sowman, 2015)
• Change in seasons/ unpredictable weather • Cold fronts come later (affects fishing season as cold fronts bring certain species, especially snoek)	• Unexpected sea conditions and more unpredictable weather on daily basis but also less distinct fishing "seasons".
• Decline in WCRL in Doringbaai and St Helena Bay over the last few decades • WCRL in berry in December instead of May – affects fishing season (which starts on the 15 November)	• Decline in WCRL • Berried females move inshore sooner in the season than farther south (not clear whether this was always the case or whether this is an issue now due to regulations and linked to wind changes)
• Red tide and increase in lobster walk-outs • Red tide in Lamberts Bay (January/February 2015) causes a massive decline in the WCRL	• Red tide causes significant decline in lobster 1994/5, particularly in St Helena Bay
• Currents are stronger than in past • Surface waters flow in different directions to deeper waters; in the past they flowed in same direction	• SW wind brings stronger currents
• Change in winds • Alterations have been observed in the speed and direction of wind (even within a day) • SW wind blows more when NW wind would be blowing (mainly in the winter months). • E wind also blows for less consecutive days (from 7/8 days to about 2/3) • Winds are perceived to be stronger in morning	• More SE winds in summer but frequency and strength only increases later in season (in Jan–Feb and not in Nov–Dec). • Winters are milder, but longer characterized by dominant SW winds. • Overall, winters are less predictable: In winter northerly wind is not as predictable anymore. It used to blow for days, but now only blows in morning and is followed by southerly winds.
• Stormy/bad weather more often • One FG, older fishers in DB: storms are less severe than in past	• Less intense storms and increase in SE currents (in Struisbaai)
• Water temperature changes • Colder water in winter months (from about March to July) • Warmer water in summer months (from November to January)	• SE wind causes decreased water temperatures in summer months

• Increase in frequency and density of mist over last few years (especially during the winter months)	• Not mentioned in RVAs
• Sand erosion and higher water level	• Not mentioned in RVAs

The fishers in the RVA workshops and FGDs all stated that they perceived changes in the seasons and that the weather was more unpredictable than in the past. Both the methods revealed that there had been a decline in the WCRL resource and that there have been changes in the behaviour of the females in berry. Both processes (RVAs and FGDs) revealed that the currents were perceived to be stronger. The red tide events were also noted in both methodologies to have a major impact on the abundance of WCRL.

Then, the participants in both the RVA workshops and the FGDs stated that there have been changes in the wind. The information did differ slightly though. Both processes revealed that the southwest wind is dominant in winter. Furthermore, it was stated that there have been alterations in wind patterns, even within the course of a day. The participants in the FGDs expressed that the east wind used to blow for seven or eight days and now blows for two or three, while in the RVA workshop it was stated that the northerly wind had changed. It was described that it blows for less consecutive days and currently only blows in the morning followed by southerly winds. The FGD participants added that the wind is stronger in the mornings than in the past. Then, a point which only came out of the RVA, the southeast wind blows in summer but the strength and frequency only increases later in the season.

There was one point which was contrasting between the RVAs and FGDs and that was to do with water temperature. The FGDs revealed that there were days when the water temperature was colder in the winter months than in the past and warmer in the summer months. The RVA results are conflicting as it was stated that the southeast wind caused colder water temperatures in the summer months. One explanation could be that there was not a proper clarification of this perceived change; the RVA participants could have been explaining the average temperature while the FGD participants were possibly describing that there were anomalous days whereby the water temperature was perceived to be colder/warmer. If time allowed, a good strategy would have been to go back into the communities and conduct key informant interviews in order to clarify contrasting information such as this.

Finally, there were two important points that came out of the FGDs that were not expressed in the RVA workshops. These were the increase in the frequency and magnitude of fog, and the event of sand erosion and the higher water level perceived in Doringbaai. Again, it could be that these environmental factors only became significant after the RVA workshops were conducted or possibly that different individuals/groups have differential pressing issues.

6.5.3 Assessment of the RVA Methodology and Mixed Methods Approach

Table 8 summarizes how the RVA methodology and the mixed methods approach performed against the VA criteria as set out by Schröter et al. (2005), Preston (2011) and Preston (2012) (in Chapter 2, Section 2.4.2), and indicates the extent to which it: fully met the criteria; partially met the criteria; or did not meet the criteria.

Table 8: Assessment of VA methodologies based on the amalgamation of criteria as set out by Schröter et al. (2005), Preston (2011) and Preston (2012)

VA Criteria	RVA workshop	Rating (1. Fully met criteria; 2. Partially met criteria; 3. Did not meet criteria)	Mixed Methodologies (FGDs, review of secondary data, key informant interviews)	Rating (1. Fully met criteria; 2. Partially met criteria; 3. Did not meet criteria)
1) Diverse knowledge base	The RVA explores various themes through the eight exercises. Through this method it is able to gain a better understanding of the relationship and interaction between the coupled human-environmental systems within a community. It engages with community members in order to obtain their perspectives and local knowledge on the socioeconomic, environmental and government/management realms. Furthermore, it makes use of key informant interviews; through this process it is able to get a good overview of the community.	Partially fulfils criteria • The RVA does not include reviewing and integrating scientific knowledge; it could benefit from including some of the scientific data analysis • Expert interviews could also strengthen the RVA	The mixed methods approach allowed for a richer, more in-depth view than the RVA workshop on its own, with the more intimate process of FGDs as well as the additional methods of reviewing secondary data and conducting expert interviews.	Fully met criteria
2) Context specific/ place-based (scale must match the objective of the VA)	One of the objectives of the RVA is to provide context specific adaptation strategies for coastal fishing communities. The community-level workshops are therefore a logical and appropriate scale for the methodology. Furthermore, through the institutional mapping exercise and the adaptation strategies exercise, which asks who should provide the support for each proposed adaptation tactic, an	Partially fulfils criteria • A possible limitation of the RVA was the lack of contextual background research conducted prior to the workshops. This could be a useful exercise so that the facilitators of the workshops have a good theoretical understanding of	The mixed methodologies accomplish what the RVA did for this criterion but also enabled a more insightful understanding into the various nested spatial scales of relevant systems. For example, the review of the secondary data on climate change on an international level and then at the more regional scale of the BCLME, allowed the researcher to have a	Fully met criteria

	understanding of factors relevant to the communities which operate at other scales can be obtained.	the fishing communities and so that there may be a better understanding of the nested scales pertinent to the communities. A good base line understanding can help with a more efficient workshop process.	greater understanding of the environmental processes at the varying scales. Furthermore, the contextual scales (i.e. an understanding of the local community but also the broader context, including the national scale) reviewed in the secondary data, assisted with a greater understanding of the community and resultant socioeconomic situation.	
3) Identify main threats and hazards and the main causes of these	The RVA exercises were designed in such a way that the key threats/stressors specific to a community, and the causes of these, could be elucidated through a short process. The RVA did a commendable job at this as it was able to get a good insight into these stressors and identify the most pressing issues. A shortfall recognized though, was that due to the dynamic, heterogeneous nature of a community, follow up research is needed as well as flexible adaptation strategies, as the key stressors may change over time.	Fully met criteria	The mixed methodologies achieved the same as the RVA and were furthermore able to contextualize the stressors and causes through the review of secondary data. The FGDs were also able to identify the most pressing stressors for the different demographic groups. This was useful to assess differences and similarities between the different groups. The key outcome of this was that women tend to focus on the socioeconomic issues while men focused more on the environmental and government/management stressors.	Fully met criteria
4) Climate change and environmental changes should be recognized as multiple	The RVA achieves this criteria as it does not just focus on the environmental threats a community faces, but the broader socioeconomic and	Fully met criteria	The mixed methodology achieved this criterion similarly to the RVA. Through the review of secondary data and interviews	Fully met criteria

and interacting components within a system	government/management stressors as well. In this way, it uses the complex-systems approach, explained in Chapter 2, which recognizes that impacts on communities are as a result of the interaction of multiple components and not just a single driver. The RVA thus recognizes the dynamic nature of communities by including the three categories.		with experts, the mixed methods approach was again able to get a richer understanding of complex systems and the interacting drivers affecting an individual/group/community.	
5) Identify how individuals/ groups are currently coping with stressors	The RVA has an exercise to specifically uncover the ways in which individuals or groups are currently coping with the identified stressors. Furthermore, this exercise in the workshop questions whether the specific mechanism is working.	<u>Fully met criteria</u>	The FGDs employed a similar method to the RVA for this criterion and the outcomes proved to be quite similar. The more intimate nature of the FGDs perhaps allowed a more in-depth understanding. Furthermore, variations between the different demographic groups can be better discerned with FGDs.	<u>Fully met criteria</u>
6) Identify potential adaptation strategies recognizing that communities are not homogenous entities (VAs should allow for "differential adaptive capacity")	The RVA employs an exercise to discover adaptation strategies that could potentially be effective within the specific community. It furthermore asks who should implement these strategies. This assists in recognizing the various institutions and actors that are pertinent to the fishing community. The RVA does not differentiate between the needs for different groups within the community. At certain times though, the RVA did differentiate between genders.	<u>Partially fulfils criteria</u> • The RVA does not differentiate between different groups, although it did differentiate between gender at times • It could be strengthened by incorporating more methods to differentiate between different groups	The FGDs again followed a similar method to the RVA for this criterion and thus got similar outcomes. The process of conducting FGs with different demographic groups proved to be important to determine whether there are varying outcomes between the different groups. This is significant as communities are not homogenous and certain individuals/groups may be better capable of coping	<u>Partially fulfils criteria</u> • Although the FGDs did differentiate between different groups, there were only three groups • A method such as conducting surveys with a bigger population could better investigate different groups within a community

			with certain stressors than others.	
7) Information should be historical as well as prospective	The RVA methodology generally focused on the current status quo of the community but does include historical and prospective analyses at times. This is especially apparent with the 'timeline exercise' which uses the knowledge of the participants to get a historical overview of the environmental events and gradual changes that have occurred over the past few decades (at times it also explores the history of other issues where relevant). The prospective aspect referred to in this criterion could include the RVA exercise which identified adaptation strategies. It is prospective in that these strategies could, in the future, build the resilience and adaptive capacity of the communities.	<u>Partially fulfils criteria</u> • There is not a significant focus on the prospective aspects • Including scientific data and the future climate/environmental predictions for the region could strengthen the RVA	The mixed methodologies employed in this study were able to get a more enriched view of the historical and prospective components of the communities. The review of the history of the communities (and their broader level contexts) and the changes to the BCLME enables a more in-depth historical understanding. The 'prospective' component was also achieved through the adaptation strategy planning exercise in the FGDs, the review of secondary data and interviews with experts. The prospective view on the climate and environmental changes to the BCLME according to the scientific information is, however, a largely uncertain topic at this point in time.	<u>Fully met criteria</u>
8) Information should be disseminated to government or appropriate NGOs for adaptation planning	The RVA is a project which was commissioned by the Food and Agricultural Organization of the United Nations (the FAO) and the Benguela Current Commission (BCC) and therefore the information was disseminated to these organizations and was also made freely available on the internet. It therefore proved successful for this criterion.	<u>Fully met criteria</u>	This research project was conducted as part of the GULLS project and shall therefore form part of the overall contribution to the project. GULLS aims to facilitate adaptation action by governments and stakeholders around the world and thus will be disseminated to the appropriate actors and organizations at a later stage.	<u>Fully met criteria</u>

Both these VA methodologies performed reasonably well in terms of fulfilling the listed criteria. The outcome of the assessment of the RVA, an objective employed by this research, therefore demonstrates that the RVA has potential to contribute to vulnerability assessments and the identification of appropriate adaptation strategies. The RVA is able to give a good overview of a community and the different environmental, government/management and socioeconomic dynamics that exist within a community. This is important as fishing communities are complex socioeconomic systems and therefore require assessment based on the multiple and interacting components of the system (Berkes et al., 1998; Cochrane, 1999; Cilliers, 2000a; Berkes et al., 2003; Heylighen et al., 2007; Garcia & Charles, 2008; Berks, 2009). The methodology is able to extract key stressors and threats related to these three categories, and the cause of these, through a series of carefully designed exercises.

The RVA has its strengths in that it does not require many resources, including time, and therefore it could be prodigiously useful in countries or regions that are under-resourced and/or lack data and historical records (Johnson and Welch, 2010; Mamauag et al., 2013; Brugère & De Young, 2015). This kind of approach is thus important as Johnson and Welch (2010: 117) state: "Highly vulnerable marine fisheries are likely to be primarily those of developing or small nations that have weak social and economic indices and be data limited, further challenging sustainable fisheries management". The ability of the RVA to systematically educe a large amount of context specific, locally acquired information therefore renders it a useful starting point for assessing vulnerability. Furthermore, the RVA has value in its ability to conceptualize potentially viable adaptation strategies and possibly contribute to the available scientific data.

The RVA does have some limitations as is acknowledged by the authors in the RVA report (Raemaekers & Sowman, 2015). First, the short period of time limits the detail that can be elicited on certain topics. Secondly, the RVA does not differentiate between different demographic groups. According to Schröter et al. (2005), VAs should allow for “differential adaptive capacity” as communities are not homogenous entities (Hinkel, 2011; Preston, 2011; Schwarz, 2011; Balague et al., 2013) and some individuals/groups are thus better equipped to deal with certain stressors than others. The RVA did, during some exercises, differentiate between genders though, but not to the same extent as the FGDs. Furthermore, the information emanating from the workshop will be specific to the particular participants involved and their current, most prominent issues. This could therefore result in certain significant stressors being left out. A potential limitation of conducting a workshop with a large group of people is that some voices are heard at the expense of others. The authors further recognize that it is important that the facilitators of the workshop have a fundamental understanding of the community so as to make the process more efficient and so that the workshop may be adapted to the appropriate literacy and education levels of the participants.

The mixed methods approach predictably provided a deeper and more holistic overall understanding than the RVA methodology (Creswell & Clark, 2007; Haines, 2011: 1). By triangulating information from secondary data, FGDs and key informant interviews, a richer view of Doringbaai and St Helena Bay’s vulnerability context could be ascertained. According to McArt and McDougall (1985), the analysis of secondary data “represents a potentially efficient and cost effective method of research.” In this study, the secondary data had great

value in providing contextual and historical background for the researcher to gain good insight into the communities before commencing with the primary research. The FGDs were an essential component of this dissertation as it focused on similar issues and questions as addressed in the RVA and could therefore serve as a good means for comparison. Finally, key informant interviews were beneficial as they were able to fill any gaps in knowledge and give depth to conducted research. The interviewees were all experts in their field and the interviews provided some fresh insights (Kumar, 1989: 3). The triangulation of these methods therefore served as the foundation for this dissertation to assess the vulnerability of the two fisher communities and to compare and contrast this information with that of the RVA.

The RVA can thus be strengthened by using the contemporary methodology in conjunction with other methods which could include, but are not limited to, key informant interviews (which were done in some of the RVA's case study sites), FGDs with particular demographic groups, the review of secondary data, surveys, and questionnaires. Furthermore, to address the dynamic nature inherent in communities, it is important that this method employs longer-term monitoring, follow-up research and a focus on the conceptualization/implementation of flexible adaptation strategies.

It can therefore be concluded that the RVA methodology is effective in drawing out the key livelihood, environmental, socioeconomic and governance/management dynamics that exist in a particular community. It aligns with the theory by Van Aalst et al. (2008:16) of what a participatory assessment should encompass, in that it should: "diagnose vulnerabilities, assess a community's risk priorities, and work together with the people to devise ways of increasing their capacities to resist hazard impacts… [it fosters] participatory local adaptation to climate change that is focused on people's vulnerability, livelihood, coping and adaptive capacity". The comparison of information emanating from this research project with the information generated by the RVA, as well as the review of the methodology against the criteria, as set out by Schröter et al. (2005), Preston (2011) and Preston (2012), suggests that, for the most part, the RVA performs reasonably well as a vulnerability assessment methodology and has certain strengths which sets it apart from other approaches and makes it valuable for certain contexts.

Chapter 7: Conclusion

This chapter serves to summarize this research project and present the most significant findings that were educed. Furthermore, key recommendations for future work are offered.

This study was based on the recognition that the need for assessing vulnerability is becoming pertinent to climate change and variability research as it enables stakeholders to better understand and be aware of the potential associated threats and impacts. Through the assessment of who is vulnerable, and to what threats or hazards, VAs can help inform targeted adaptation strategies so that individuals and groups may be more resilient to the potential and real effects of global warming. VAs can be conducted at a variety of scales depending on their application. Global and regional scale assessments are important for informing international and national climate change and adaptation policy, such as for the IPCC. These larger scale models are generally quantitative. In order to respond to local socioecological vulnerabilities that may be linked to climate change, there are community-level assessments which are usually stakeholder-based and can be either qualitative, quantitative or a mix of the two. These are increasingly seen as being beneficial to the formation of effective and targeted adaptation strategies. This is especially due to their context specific assessment and harnessing of traditional and local knowledge and expertise.

This research project was conducted as part of the 'Global learning for local solutions: Reducing vulnerability of marine-dependent coastal communities' (GULLS) project, an international initiative funded by the Belmont Forum and G8 Research Councils Initiative on Multilateral Research Funding. The key aim of the GULLS project is to find innovative, best-practice ways to reduce the vulnerability of coastal communities, especially in the face of climate and environmental variability and change, through the global provision and sharing of knowledge. This research was also linked to a project commissioned by the Food and Agricultural Organization of the United Nations (the FAO project) that developed and applied a RVA methodology for application in poor coastal fishing communities in southern Africa that were experiencing environmental change (Raemaekers and Sowman, 2015). This study aimed to assess whether the rapid vulnerability assessment (RVA) tool, which is intended to serve as a more customized tool for assessing socioecological vulnerability in the face of climate and environmental change, has the potential to contribute to VAs and the identification of effective adaptation strategies. The RVA is an attractive tool in that it can be conducted over two and a half days in a workshop format, does not require extensive preparation, review of the literature or extensive fieldwork, and requires fewer resources than other participatory VAs.

This dissertation thus compared the information generated in the RVA with the information emanating from the application of a mixed methods research approach, namely: focus group discussions, key informant interviews, and the review of secondary data. The degree of comparability between the two was therefore assessed by comparing the outcomes of the two approaches. This comparison took three forms; first, the key stressors identified in the three categories (socioeconomic, governance/management and environmental) for the RVA and FGDs were compared for each community. Secondly, the perceived environmental events and changes emanating from both methodologies were analyzed in more detail and

the information was compared and contrasted. Finally, the RVA and mixed methodologies were assessed according to an amalgamation of criteria, as set out by Schröter et al. (2005), Preston (2011) and Preston (2012), to determine their ability to contribute to vulnerability understanding.

The outcome of the research therefore showed that the RVA has its value in its ability to give a broad overview of the vulnerability of a community to climate and environmental change using few resources. This is exceptionally useful for under-resourced and data poor regions. The study proved the RVA to be effective in drawing out key livelihood, environmental, socioeconomic and government/management dynamics that exist in a particular community. Furthermore, the RVA is beneficial in that it is able to educe the most crucial issues in a community and gain a better insight and understanding of them.

The RVA has its limitations in that the short amount of time does restrict the detail in which topics can be delved into. Furthermore, the dynamic, non-uniform nature of communities will ultimately result in information having inconsistencies with other tools and methodologies, as was shown in this study whereby, occasionally, varying results were obtained. This study therefore deduced that the RVA can serve as a useful starting point for conceptualizing potential adaptation strategies that are context specific and informed by the affected community; it is able to systematically produce valuable information that could contribute to the available scientific knowledge and data. The shortcomings can be addressed by using the RVA in conjunction with other methodologies, as was performed in this study. These could include, but are not limited to: smaller focus group discussions (with specific demographic groups), key informant interviews, and the review of secondary data. These additional methods help to enrich the RVA and harness its value as a starting point. Furthermore, the dynamic nature inherent in complex systems could also be addressed through longer term monitoring and follow-up research. This study thus demonstrates that the RVA does have the potential to contribute to VAs and the identification of targeted, potentially effective adaptation strategies.

It must be noted, however, that there were potential limitations which may have resulted in the outputs of this research not being completely consistent with the RVA. These were mostly to do with the FGDs conducted in the two communities. First, the researcher was not initially experienced at conducting FGDs and therefore became better equipped to probe certain information only as more experience was gained. Secondly, the participants were predominantly Afrikaans-speaking while the researcher is English; this could potentially have caused some misinterpretations and uncertainties at times.

This study has focused on assessing the vulnerability of fishing communities and also evaluating the utility of a rapid vulnerability assessment tool. Further studies could expand on these assessments and their usefulness in different regions or sectors, such as agriculture for example. The snoek vlekkers in St Helena Bay were a highly knowledgeable group and further studies could be done to highlight the importance of their role in communities and the need for them to be better recognized as part of the fishing industry. Furthermore, studies that aim to use fishers' knowledge and combine it with scientific data could be very useful for future climate and environmental change/variability research.

The information gathered from both the RVA (as it has shown to be a reliable indication of vulnerability and community relevant adaptation strategies) and this study could be used by

stakeholders to address the key vulnerabilities/stressors in the fishing communities and action some of the aforementioned adaptation proposals (in chapters 5 and 6). For example, this could take the form of local government, NGOs, or other stakeholders working with fishers to implement certain strategies. This is important so that the research generated may have meaningful utility and practical application so as to create better adapted, more resilient communities to the real and potential impacts of climate and environmental variability and change.

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Appendices

Appendix 1: Focus Group Discussion Exercises

Time (mins)	Activities and Key Questions	Notes
15	**1. Understanding the context** The first introductory exercise was based on the participatory mapping exercise from the RVA. It asked questions relating to the main resources, assets and attributes in the community, both generally and to do with fisheries specifically. This exercise also questioned the main employment and livelihood options in the community, to investigate whether there were alternative livelihood strategies available aside from fisheries and where people undertook these activities.	It may be useful to bring an aerial view map of the community so that the participants can point out significant features or where particular activities occur.
30	**2. Identification of Key Threats/Stressors** The next exercise was concerned with identifying key threats and stressors experienced by participants. The three categories were written as headings on repeat flip chart paper and the group could discuss what their greatest problems or stressors were for each.	Initially for this exercise, each participant was given three pieces of paper and asked to write down their biggest threats and stressors for the three categories. However, in the first session, the local facilitators advised that some of the men were not literate and suggested the exercise rather be done on flip chart paper and each stressor listed verbally; this was how the exercise was performed thereafter.
5	**3. Ranking Exercise** This exercise followed on from exercise 2. The group was instructed to place stickers next to stressors listed on the flip chart paper that, for them, were the most significant or pressing issues. A participant could place more than one sticker next to an issue. The participants' main stressors could then be deduced through this quantitative method as, theoretically, those were the stressors which had the greatest number of stickers.	If there are both males and females within the same focus group, or other different demographic groups that a facilitator wants to differentiate between, different colour stickers may be used. The outcomes between the different groups can thus be distinguished at a later stage.
25	**4. Perceptions of Environmental and Climate Variations and Changes** This exercise attempted to investigate specific and general environmental changes that the fishers had experienced in the community or that were linked to their fishing area or activities. Political and socioeconomic changes were also explored but not in as much depth. Stressors mentioned in the previous exercise were further explored in this exercise.	The length of time explored depended on the group. For the older fishermen, the exercise went as far back as the 1960s. The exercise started off open-ended but the fishermen were prompted at times if there was a lull. The researcher was careful not to lead the fishermen to answers but rather ask more generally about key events that may have occurred such as those observed with the climate and environment including the water

		temperature, sea conditions, seasons, species, and so forth
25	**5. Impacts on Livelihoods Associated with Environmental Stressors and Changes** In this exercise, environmental events or changes that seemed to be most pressing to the group were explored in more detail. The group was asked to consider the impact of the events/changes, how they would rank these (as a high, medium or low stress) and what they believed to be the cause of the event/change. The focus here was on the environmental issues specifically.	It was at the discretion of the researcher and the research assistant to decide which issues to explore in greater depth for this exercise.
25	**6. Coping strategies/Responses to Events or Impacts** This activity aimed to ascertain how the group was coping with regard to the environmental and climate changes/variations. The key questions were: how are you responding to the changes, who is helping, and are these coping strategies working.	This exercise started off as a general/open-ended discussion and progressed to asking about specific environmental events/changes.
25	**7. Adaptation strategies** The final exercise aimed to get in-depth responses on how to potentially adapt to the threats and stressors mentioned in the previous exercises. The exercise asked about the various adaptation strategies the group could think of, what support would be needed for these and who should provide the support.	Again, this exercise started open-ended and then investigated more specific issues

Appendix 2: Interview Schedule and Templates

Interview Schedule

Interview Schedule		
Date	**Interview**	**Organization/ Affiliation**
26 November 2015	Danie van Zyl	Marine Research Technician Inshore Resources Research (DAFF)
1 December 2015	Dr Laura Blamey	Marine Research (Ma-Re) Institute Department of Biological Sciences (UCT)
2 December 2015	Andy Cockcroft	Principal specialist scientist (DAFF)
13 January 2016	Nico Waldeck	Community Development Worker (Masifundise) and a community leader for Lamberts Bay

Interview Templates:

Interview Template 1: Fisheries Scientists at DAFF

1) What is your role within DAFF and what is your history in the fishing industry?
2) How long have you been involved in the fisheries sector?
3) What do you consider to be the greatest threats/vulnerabilities for fishers in St Helena Bay and Doringbaai on the west coast of South Africa?
4) In your experience with fisheries, have you been made aware of any environmental or climate variations or changes on the west coast?
5) The fishers in St Helena Bay and Doringbaai especially noticed changes in the wind, an increase in fog and change in water temperature; have any of these been noted by DAFF as being significant changes on the west coast?
6) Do you feel these environmental and climate changes impact on the lives of fishers and how?
7) What have you noted/observed in terms of how fishers cope or adapt to these changes?
8) What are your views on how fishers could better cope/adapt now and in the future to these environmental/climate changes?
9) Fishers have commented on the migration of WCRL and the decline of the resource. Can you advise on the migration and whether there has in fact been a decline in the resource?
10) What do you believe are the key reasons for the migration/decline in the WCRL resource?

11) Can you comment on the projected future of the resource?
12) In St Helena Bay, the fishers commented that there has been a change in when the WCRL are in berry. They said it has always been in May and last year it was in December, and again this year they were not in berry in May. Has this also been observed by DAFF/other sources at all? Why would this be?
13) In terms of lobster walk-outs, have these been more frequent in the past few decades/years? What is the key cause of this and what is done with the 'beached' crayfish?
14) The fishers commented that where WCRL are present, they are further out at sea. Have any scientific reports/scientists observed this?

Interview Template 2: Marine Scientist at UCT

1) From your and other researchers' work/papers, the consensus seems to be that there has been a southwards migration of WCRL. To what extent would you attribute this to environmental variability and even climate change?
2) Has there been a decline in the WCRL resource or is it more likely just a shift? When was this first observed?
3) What do you believe are the key reasons for the migration/decline in WCRL on the west coast?
4) Can you comment on the future of the resource on the west coast?
5) Some fishers described the WCRL to be further out and therefore deeper; have scientists also observed this?
6) Has the incidence of crayfish walk-outs/red tides on the west coast increased, decreased or stayed fairly constant over the last few years/decades?
7) What are the key causes of the crayfish walkouts?
8) What environmental or climate variations or changes have you observed on the west coast? Do you feel these impact or could impact on fishers' livelihoods?
9) Some of the fishers commented that in summer the water is warmer than in the past and that this affects the quality of WCRL. Based on your work and knowledge, would you support the fishers' observations regarding the quality and development of lobsters being impaired with warmer water?
10) In Doringbaai, the fishers commented that there has been a change in when the WCRL are in berry. They said it has always been in May and last year it was in December, and again this year they were not in berry in May. Have you observed this at all? Why would this be?
11) What adaptation strategies do you think could work for fishers' on the west coast?
12) What are your views on how fishers could adapt now and in the future to these environmental/climate changes?

Interview 3:

The interview with Nico Waldeck (Masifundise) was not a structured interview like the other three but rather consisted of clarifying certain information that emanated from the FGDs.