Towards the co-production of fisheries knowledge for co-management using mobile technologies

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By Tatiana Iversson Piazza
IVRTAT001

Supervision
Dr. Serge Raemaekers

For Oom Sias Marthinus (1957 – 2016)

Plagiarism declaration

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Abstract

Fishing is an ancient way of food gathering, which has been instrumental for the healthy living of many people, for many years. Nowadays, fishing is particularly important to developing countries since the value of fish surpasses that of agricultural commodities such as sugar and rice. People living along the coast have been harvesting marine resources for basic subsistence for generations and at present several small-scale fisheries operate along the South African coastline, ranging from the shore-based harvesting of intertidal resources such as mussels, to the targeting of migratory line-fish stocks using small motorized vessels. Due to their high dependence on marine resource harvesting, small-scale fishers (SSF) are among the most vulnerable socio-economic groups, and while small-scale fisheries employ the vast majority of the world's fishers, they are often marginalized and ignored.

The lack of appropriate governance in South African small-scale fisheries has made it hard for fishers to benefit from the resources that are readily available to them. However, changes within fisheries management practices have led to the move from conventional resource-centred strategies to management approaches that recognize the complexity of the sector. The new small-scale fisheries policy, currently in its implementation phase, embraces many of these new approaches but does not necessary prepare small-scale fishers to actively participate in the co-management of their resources. Furthermore, the lack of reliable data and information about small-scale fisheries, due to historical marginalisation, is currently one of the primary challenges facing the sector in the country, and preventing small-fishers from demonstrating to policy makers the potential of the sector to contribute towards food security and poverty eradication.

The purpose of this study was to explore the potential of a mobile app in bringing about a co-production of fisheries knowledge and stimulating the co-management of fisheries, using the fishing communities of Lambertsbaai on the West Coast and Struisbaai along the South Coast as case studies. The research aimed to understand and assess the concerns and uncertainties of formalizing the mobile app (Abalobi) and explore if the mobile app can entice fishers' enthusiasm towards the implementation of the new small-scale fisheries policy and rebuild legitimacy and trust in fisheries data among fishing communities.

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List of Acronyms

DAFF – Department of Agriculture, Forestry and Fisheries

DTI – Department of Trade and Industry

FAO – Food and Agriculture Organization of the United Nations

FCT – Fishermen's Community Trust

FRAP - Fishing Rights Allocation Process

IDP – Integrated Development Plan

IQ – Individual quota

ITQ – Individual transferable quota

IUU – Illegal, unreported and unregulated

IRP – Interim Relief Permit

IMS – Information management system

LTRA – Long-term rights allocations

MDT – Masifundise Development Trust

MLRA – Marine Living Resources Act

NGO – Non-governmental organization

NRF – National Research Foundation

NSRI – National Sea Rescue Institute

ODK – Open Data Kit

PAR – Participatory Action Research

SAMSA – South African Maritime Safety Authority

SSFP – Small-Scale Fishing Policy

TAC – Total Allowable Catch

TLF – Traditional Line Fish

UCT – University of Cape Town

VMS – Vessel Monitoring System

WCRL – West Coast Rock Lobster

WCRLRH - West Coast Rock Lobster Right Holders

WWF – World Wide Fund for Nature

Chapter One

Introduction

1.1 Background

Fishing is an ancient way of food gathering, which has been instrumental for the healthy living of many people, for many years. Nowadays, fishing is particularly important to developing countries since the value of fish surpasses that of agricultural commodities such as sugar and rice. According to the Food and Agriculture Organization of the United Nations (FAO), the world's population is predicted to increase to 9 billion people by 2050. Some of the highest rates of population growth are predicted to occur in areas that are highly dependent on the agriculture sector, which include crops, livestock, forestry and fisheries. Worldwide, 55 million people work directly in fisheries and aquaculture and around 60% of fish trade originates from developing countries (FAO, 2012), like South Africa. In this regard, the majority of fishers (including fish farmers) in the world are located in Asia (85.5 percent) and Africa (9.3 percent), and more than 200 million people in the developing countries depend on small-scale fishing to survive (Noone, Sumaila, & Diaz, 2012). In the near future, the importance of fisheries will increase immensely with respect to not only economic importance but also food security (FAO, 2012).

South Africa is a country largely influenced by the ocean. The encounter of two currents, the cold Benguela Current on the west and the warm Agulhas Current on the east, contributes to the plentiful marine biodiversity and species endemicity within the region (Branch & Branch, 1981). People living along the coast have been harvesting marine resources for basic subsistence for generations and at present several small-scale fisheries operate along the South African coastline, ranging from the shore-based harvesting of intertidal resources such as mussels, to the targeting of migratory line-fish stocks using small motorized vessels (Sowman, Sunde, Raemaekers, & Schultz, 2014). The long-term sustainability of its marine resources plays an essential role in the social and economic wellbeing of the coastal people. Fish and fishery products are one of the most extensively traded commodities in the world and developing countries account for a large portion of the production (Green

Economy, 2012). Fishing communities in South Africa are predominately coloured[1] and have been severely marginalized as a result of colonization, apartheid laws, commercial fisheries reforms, and market pressure. As a consequence, local fishers who depend heavily on the ocean for their livelihoods are forced to keep harvesting already depleted inshore resources (e.g., west coast rock lobster, abalone) in order to survive (Sowman et al., 2014). There is currently a lack of incentive for small-scale fishing communities in South Africa to develop effective co-management institutions and adopt more sustainable fishing practices. Furthermore, small-scale fisheries often suffer from a negative public image due to myths and misconceptions largely fuelled by lack of data, insight, and knowledge (Kolding, Béné, & Bavinck, 2014).

The small-scale sector currently employs more than 90 percent of the world's capture fishers, and their importance to food security, poverty alleviation and poverty prevention is becoming increasingly appreciated. However, the lack of institutional capacity and the failure to include the sector in national and regional development policies hamper their potential contribution (FAO, 2012). The new Small-Scale Fishing Policy (SSFP) developed by the Department of Agriculture, Forestry and Fisheries (DAFF) – the South African fishing authority – aims to close that gap and the Abalobi app has the potential to be a helpful tool in doing so.

1.2 Problem statement

Cellphones are the most widespread information technology across the world, including in developing countries and remote areas (Furuholt & Matotay, 2011). Currently, due to the increasing affordability of mobile devices and popularity of mobile apps, more and more organizations are making use of this technology to develop monitoring systems that address both social and ecological issues. The pending implementation of the new Small-Scale Fishing Policy in South Africa can be considered one of those issues and is the perfect opportunity to pilot more modern and mobile information technology approaches to small-scale fisheries governance in the country.

It is the intention that the policy recognize small-scale fishers' traditional rights and seek to implement innovative co-management approaches, as well as to de-

[1] Coloured, formerly Cape Coloured, is a person of mixed European ("white") and African ("black") or Asian ancestry, as officially defined by the South African government from 1950 to 1991.

centralize resource allocation, and involve small-scale fishers in resource monitoring and compliance. This new policy also aims to enable fishers to play a more empowered role across the entire value chain. The new policy environment, which is set to impact anywhere between 50 000 - 100 000 households involved in the small-scale fisheries sector along the South African coast, provides the perfect opportunity to engineer and test innovative information and communication systems (ICTs). The development of an integrated small-scale fisheries information management system (IMS) and mobile application can enable these communities to be incorporated into information and resource networks: from fishery monitoring and maritime safety, to local development and market opportunities.

An integrated catch management system and mobile application has the potential to assist in changing the existing status quo in South African fisheries from a top-down management with limited local knowledge influence to adaptive co-management with customary governance and greater input from fishers in decision-making. It is with this in mind that the Abalobi project was conceptualized.

1.3 Aim and objectives

The purpose of the proposed research was to explore if a mobile app could bring about a co-production of fisheries knowledge and stimulate the co-management of fisheries, using the fishing communities of Lambertsbaai on the West Coast and Struisbaai along the South Coast as case studies. The proposed research aimed to understand and assess the concerns and uncertainties of formalizing the mobile app (Abalobi) and determine if the mobile app can entice fishers' enthusiasm towards the implementation of the new Small-Scale Fishing Policy and rebuild legitimacy and trust in fisheries data among fishing communities. The overall aim of this study is to **determine if a mobile app can foster the co-production of fisheries knowledge and stimulate the co-management of fisheries**.

The main objectives of the study were to:

1. Introduce a mobile fisher logbook (Abalobi) in the small-scale fishing communities of Lambertsbaai and Struisbaai.
2. Monitor the use of the mobile fisher logbook in the small-scale fishing communities of Lambertsbaai and Struisbaai.

3. Evaluate the utility, acceptance and uptake of the mobile fisher logbook by the fishers in the small-scale fishing communities of Lambertsbaai and Struisbaai.
4. Understand the opportunities, concerns and uncertainties of formalizing a mobile app as a management tool for small-scale fisheries.

This dissertation forms part of a larger project, the ABALOBI[2] Initiative, currently in its pilot phase.

1.4 The Abalobi app

During the implementation phase of any resource-management programme, feedback is essential to evaluate its effectiveness, and to adapt management responses while ensuring that its goals are met. Despite this having being recognized by the fisheries authority, to date, very limited data analysis and feedback have taken place, most notably due to the lack of an integrated, transparent and participatory Information Management System (IMS). Similar to the process of building local resource knowledge and decision-making capacity, community associations, such as trusts, cooperatives or other legal entities, should be able to access the weather forecast, regulations, and market prices, manage their micro-finances, and communicate with members and with the fisheries authority. A mobile platform that offers all these services, coupled with the IMS, could serve those needs.

The mobile application "Abalobi" was developed by Dr. Serge Raemaekers (UCT), Abongile Ngqongwa (DAFF) and Nico Waldeck with the intent to be that platform. The app and its associated IMS were developed as a partnership between DAFF, UCT and the fisher communities. Abalobi is a cloud-based information platform, with a mobile application interface, user-defined functionalities and access to information and capabilities such as a few descriptive data (fisher profiles, socio-economic and livelihood data), live data (catch data), some basic analysis and reporting functions (fishing effort patterns, socio-economic impacts), apart from being easy to use and easy to access.

The data recorded through the app is uploaded in real-time to a secure cloud-based server (abalobi.appspot.com). All the data is encrypted and sent via GPRS, EDGE or 3G depending on availability. Data packages are small and do not require

[2] isiXhosa for small-scale fisher

much bandwidth, but this is being monitored closely and at least during the pilot phase all phones are being monthly recharged with 100MB. A second app, called Salesforce, is currently being used for basic visualization of data and analysis. The dashboard function in Salesforce allows for custom-made and user-defined reporting. Different users (manager, monitor, fisher) can access their Salesforce account online or via its mobile application.

Fishers in several fishing communities participated in workshops to fine-tune the data gathering indicators and input format of the app, which entered its pilot phase in the fishing towns of Struisbaai, Lambertsbaai, Port Nolloth and Hondeklipbaai (Objective 1) in August of 2015 and Kleinmond in September 2015.

1.5 Study sites

The two study sites chosen for this study were Lambertsbaai along the West Coast of South Africa and Struisbaai along the South Coast (Figure 1). Fishers in these communities are organized and have expressed interest in piloting the Abalobi app.

Figure 1. The study sites - Lambertsbaai and Struisbaai

Lambertsbaai is a small fishing town located along the West Coast of South Africa, within the Cederberg local municipality and the West Coast district municipality, about 280km north of Cape Town. Lambertsbaai fishers are well organized into several management and marketing structures and have already begun creating arrangements for the implementation of the SSFP. Struisbaai is a traditional fishing village located along the South Coast, about 200km south east of Cape Town. Aside from being a historical fishing community, the village has become a popular holiday destination due to its proximity to the Southern Most Tip of Africa, Cape Agulhas. Struisbaai forms part of the Cape Agulhas local municipality and the Overberg district municipality within the Western Cape region. Struisbaai fishers are

experiencing changes in their fishery, and attribute this to heavy fishing by different sectors and climate change (Raemaekers, Ngqongwa, Waldeck, Cawood, & DeRenzi, 2016).

The criteria for selecting these specific study sites is centred around the existence of a small-scale fishery operating from both harbours and the presence of a small-scale fisher community nearby with a traditional and historical dependence on harvesting marine resources. Both fisher communities are also representative of typical marginalized South African rural coastal community, vulnerable to poverty and subject to government regulations. Fishers in both communities are co-designing and refining the recording (ODK) and reporting (Salesforce) functions of the Abalobi app during its pilot phase and their insights have already resulted in significant improvements in Module 1 of the app.

1.6 Ethical considerations and limitations

Certain ethical considerations must be considered when conducting interviews and engaging with people about their livelihoods. Since personal identities are not relevant for this research respondents should remain anonymous. Respondents were encouraged to answer the questions in the language they are most comfortable with and a translator was organized when necessary.

This research also has some limitations. The use of PAR, for example, has obvious implications. Participation. Therefore, we relied on the participation of the fishing communities of Lambertsbaai and Struisbaai for this study to be completed. In this sense, a risk and at the same time an outcome is the possibility of non-participation of the community. A further limitation in this study was the language barrier that existed between the researcher and the respondents in Lambertsbaai and Struisbaai, where Afrikaans is the dominant language. To overcome this, a translator was present during the interviews while the focus group was conducted in both English and Afrikaans and the transcripts of the What'sApp conversations were translated to English.

Chapter Two

Literature Review

2.1 Introduction

Approximately 10 million people on the African continent rely on small-scale fisheries for their source of livelihood, while more than 90 million farmers and resource-poor people rely on fishing as part of their diversified livelihood strategy. South Africa has more than 100 000 fisheries, implying that fishing is an important source of socio-economic livelihood for a significant percentage of South Africans (Singiswa, 2013). However, there is a growing concern amongst fisheries management scholars and practitioners that fisheries governance has been a major hindrance to realizing resource sustainability and social equity. The lack of appropriate governance in South African small-scale fisheries has made it hard for fishers to benefit from the vast quantity of resources that are readily available to them.

The governance of small-scale fisheries in South Africa is currently in transition. Small-scale fishers argue that the current and past governance regimes have undermined fishers' pre-existing tenure rights. Most importantly, the current governance regime has failed to recognize fishers' tenure rights in relation to "living" customary laws. Instead, the regime has imposed a top-down, centralized tenure governance system. The regime bases the system on the principle of privatization of marine resources by allocating individual rights without making reference to any community framework (Sowman, 2006). Although the current small-scale governance regime follows principles enshrined in the Constitution, the regime has failed to promote an equitable, just, and fair system of governance. Nonetheless, the system has gained little legitimacy; most small-scale fishers believe that the system has undermined both fishers' rights and process toward sustainable utilization of marine resources.

Small-scale fishers in South Africa have begun articulating new approaches to governance that recognize the interdependency between economic, social, cultural, and ecological components and fishers wellbeing. The new governance regime recognizes small-scale fishers' rights to take part effectively and fully in marine resource governance (DAFF, 2012). Nonetheless, it should draw on both the policies on "living" customary laws and the international human rights standards to ensure a

more legitimate, democratic, and sustainable approach to the governance of the small-scale fishing sector in the country. Currently, a lot of the problems associated with small-scale fishing results from uncertainty and unpredictable nature of the sector (Bavinck et al., 2005).

The purpose of this chapter is to provide a literature review of the challenges faced by small-scale fishers in South Africa and the immediate opportunities of the small-scale fishing sector.

2.2 South African small-scale fisheries and the new Small-Scale Fishing Policy

Throughout the South African coastline, men, woman and children have been living in small coastal communities harvesting marine resources for consumption, livelihoods, medicinal purposes, and often also as part of cultural and spiritual practices (Branch, 2002; Branch et al., 2002; Sunde & Raemaekers, 2010). The fisheries sector in South Africa contributes to approximately 0.1% of the GDP and the total output in 2013/14 was estimated at 600 000 tons. The industry itself (entire sector) directly employs around 27 000 people and an additional 81 000 people are indirectly employed in industries that somehow depend on the fishing sector (DAFF, 2014).

Currently a diversity of small-scale fisheries operates along the South African coast. Small-scale fisheries have been defined in South Africa as "persons that fish to meet basic livelihood needs or are directly involved in harvesting/processing or marketing of fish, traditionally operate on/near the fishing grounds, predominantly employ traditional low technology or passive fishing gear, usually undertake single day fishing trips and are engaged in the sale or barter or involved in commercial activity" (DAFF, 2012). Some of these fisheries are still informal, operating under regulations for the recreational fishing sector, while others have only certain components recognized by the fisheries authority (Raemaekers, 2009). Most small-scale fishers in Africa are either poorly organized or lack suitable organizational structure for engaging in fisheries management and governance (Sowman et al., 2014). The existing structures either function at low levels of inadequate agency and information to participate in high-level policy-making processes or function at national level but do not have adequate capacity and resources to serve the high number of people relying on the small-scale fishers.

Similar to many of the world's fisheries, South Africa's fisheries management has favoured the development of a large-scale commercial fishery, often at the expense of the small-scale fisheries. Historically, South Africa's small-scale fishers have also been subject to marginalization due to historic, political, social and economic challenges (Clark, Hauck, Harris, Salo, & Russell, 2002). During the Apartheid era, access to fishing – quota system – was only granted to a selected few White-owned large-scale commercial companies under the Sea Fisheries Act (Act No. 12 of 1988) and the racial bias in the fishing sector led to the criminalization of *bona fide* small-scale fishers (Kleinschmidt, Sauer, & Britz, 2003; Daniels, 2002). Moreover, due to economic pressure, *bona fide* small-scale fishers in the Western Cape province were forced to take employment in the large-scale commercial sector, which greatly contributed to the destruction of fishers' traditional livelihood along the western and southern coast of South Africa (Glavovic et al., 2000).

In recent years, a fair amount of attention has been paid to the analysis of the "governance" of fisheries. Fishery management entities most commonly follow a top-down management approach based solely on scientific data, while a growing recognition of fisheries as complex systems saw the adoption of co-management as an effort to decentralize the power, increase participation and change the paradigm of top-down management. Despite its influence on fisheries management, co-management often fails to re-evaluate the manner in which fisheries are governed, hence the need to re-examine the concept of governance. Governance refers to the "interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other stakeholders have their say" (Lockwood, Davidson, Curtis, Stratford, & Griffith, 2010, p. 987). It includes all public and private interactions initiated in order to deal with societal problems and create societal opportunities, including the formulation and application of principles guiding these interactions (Kooiman, Bavinck, Jentoft, & Pullin, 2005). Governance is not restricted to the government, and whereas the government refers to the governing body, governance is the process or the act of governing, which can be done by members of the public (Bavinck et al., 2005). In simpler terms, governance is the sum of ways that individuals and/or institutions manage their common affairs (Weiss, 2000). An analysis of fisheries governance with regards to their interconnected social and ecological systems and their complexity resulted in the emergence of the so-called "interactive governance" theory (Kooiman

et al., 2005; Raemaekers, 2009), which aims to transform fishery systems into governance systems that learn, respond, and most importantly, adapt to change (Kooiman et al., 2005), promoting principles of stakeholder participation in a new approach to fisheries reform.

Achieving economic development, equity and sustainability requires governance approaches that seek to find a balance between the food and livelihood needs of the estimated 357 million people directly impacted by small-scale fisheries worldwide (FAO, 2012). The increasing overexploitation and degradation of marine resources, as well as the overcapitalisation of the entire industry, severely impacts the sustainability of these resources and threatens the livelihoods of 357 million people (Pauly, Watson, & Alder, 2005). In the South African small-scale fisheries sector, governance approaches that are underpinned by human rights principles and resource sustainability are increasingly being promoted (Allison, Ratner, Asgard, Willmann, Pomeroy, & Kurien, 2012; Sowman et al., 2014), and are evident in many of the principles of the new small-scale fishing policy.

The transition to democracy in South Africa in 1994 increased law reform processes in the country. In turn, new forms of governance emerged that aimed to address past injustices and empower marginalized communities. However, despite having a constitution that promotes respect and protection of people's environmental and socio-economic rights and recognizes "living" customary laws, the existing regime continues to marginalize small-scale fishing communities (Sowman et al., 2014). Power relations arising from the legacy of the apartheid continue to shape the governance of marine resources in the country. Decisions regarding rights to access, use, and institution for governance of marine resources in South Africa remain centralized and market-based rather than people-focused. Ideologies influence the system governing small-scale fisheries in favour of commercial fishers (Sowman et al., 2014; Sowman, 2006). Small-scale fishing communities have raised their concerns about this fisheries governing system (Sowman et al., 2014), arguing that the past and current governance regimes failed to acknowledge small-scale fishers' tenure practices and rights. As such, the regimes have undermined the basis of cultural and socio-economic relations among coastal communities.

South Africa's current small-scale fisheries legislation – the Marine Living Resources Act (Act No. 18 of 1998) (Republic of South Africa, 1998) – geared toward commercial fishers' interests overlaps the existing systems of customary

"living" laws, along the coastline, in particular. In other words, the current and past governance systems have failed to recognize the local fisheries' tenure (Sowman et al., 2014). However, small-scale fishers in the country continue to challenge the existing fisheries regime, demanding recognition of their rights and adoption of an unbiased governance system (Ratana, 2011). Constitutional acknowledgment of small-scale fishers, their rights, and customary rights is an important measure of good governance and crucial for the country to attain socially equitable and environmental sustainability.

Failure to acknowledge small-scale fishers as a sector resulted in the court case led by the non-governmental organization Masifundise Development Trust, among other civil rights activists (George K and others vs. the Minister of Environmental Affairs and Tourism, 2004), whose primary argument was that government's failure to recognize small-scale fishers and allocate them adequate resources and rights violated their fundamental constitutional rights (Sowman et al., 2014). Biased governance further led to significant socio-economic hardships. In 2007, the Equality Court in South Africa ruled that the minister responsible for fisheries should immediately formulate a new policy that would address the socio-economic needs of the marginalized group, allowing them access to marine resources (Ratana, 2011, Republic of South Africa, 2009).

In June 2012, after almost a decade in the making, the new Small-Scale Fishing Policy was gazetted, and in May 19th 2014 the Marine Living Resources Amendment Bill, which formally and legally recognizes small-scale fishers (Branch, 2002; Branch et al., 2002; Isaacs, 2004) was approved by Parliament.

The new policy was formulated in response to the lack of a holistic approach to fisheries policy and management; the fact that small-scale fishers are not a recognized category of fishers in the current legislation; the unfairness of past government decisions; international and regional agreements on sustainable fisheries; and concern over the possible environmental impacts of climate change on coastal communities of South Africa. It aims to promote the transformation of the small-scale subsector in order to assist fishing communities living along the South African coastline by creating jobs and generating income (DAFF, 2014). The policy moves away from previously technocratic, science-based and top-down management approaches towards one that advocates for community participation and co-management (Sowman et al., 2014). It is broader and inclusive of subsistence fishers,

while also taking into account fish workers involved in the pre-harvesting and post-harvesting phases of fishing.

According to the new Small-Scale Fishing Policy, the co-management of the fishery will be characterized by a number of features, namely:

- The empowerment of small-scale fishing communities;
- The participation of these communities in developing, implementing and evaluating fisheries policies and management plans;
- Community orientation;
- The inclusion of provincial and local governments in the decision-making process; and
- An adaptive management approach, which recognizes that local contexts and environments differ along the coast and management arrangements need to adapt.

All of which require extensive community empowerment and local level knowledge generation to ensure that the fishers are capable of participating in decision-making.

The overall objective of fisheries management systems is to balance economic efficiency, social equity and ecological sustainability (Sowman, 2006), and governance arrangements are critical to achieving this (Sowman, 2011), however the way of going about it remains largely top-down and centralized. Good governance would focus on co-management where Government and small-scale fishing communities share the responsibility and authority for the management of the marine resource (DAFF, 2012). The new policy is definitely a step forward towards recognizing the traditional rights of small-scale fishers and seeks to involve fishers in resource monitoring and compliance, however, there is still a long way to go before small-scale fisheries in South Africa can benefit from a good governance system and fishers can sit at the same table as scientists and policy-makers. Good governance is further hindered by the complex nature of the marine environmental and human interactions.

2.3 Background and context of the two study sites - Lambertsbaai and Struisbaai

Despite the overwhelming amount of people worldwide depending on small-scale fisheries, small-scale fishers are regarded as one of the world's poorest groups

(Allison 2001; Campbell 1999), often socially and politically marginalized and lacking access to basic infrastructure and services, such as transportation, health and education. Even though research has shown that fishers who own their own vessel and gear have the ability to earn higher incomes, this does not necessarily translate to better food security and living conditions. Fishing is a highly unpredictable activity and fishers and their families often live in and depend on a volatile institutional and biophysical environment (Garcia et al. 2008). Fishers' catch is highly dependent on factors that may fluctuate on a daily, monthly and seasonal basis, such as the availability or seasonality of the resource, weather and climate. The lack of effective fisher organizations and the occupational risks involved with being at sea also make fishers, in particular, small-scale fishers, vulnerable. Vulnerability is further experienced as a result of macro-economic factors, such as market fluctuations and fuel price increases, changes in governance and policies, conflict with other fishing sectors (commercial and recreational) and marginalization, be it social, economic or political (Béné, Macfadyen, & Allison, 2007). This section provides a more detailed description of the two study sites, Lambertsbaai and Struisbaai, highlighting some of the challenges faced by small-scale fishers in those communities and their current socio-economic status, as mainly described by Nthane (2015) and Parker (2013).

The small fishing town of Lambertsbaai, located along the South African West Coast, has a total population of 6120 people according to the 2011 Census, of which almost 75% are coloured (Census, 2011). Small-scale fishing in Lambertsbaai is integrally associated with the culture and the identity of the fishers themselves. Fishers in Lambertsbaai are currently either West Coast Rock Lobster Right Holders (WCRLRH) or possess an Interim Relief Permit (IRP) (Nthane, 2015), of which WCRLRH tend to be at least 10 years older than IRP fishers (see Table 1 below for a more detailed description of the various fishing permits available in the two study sites).

Table 1. Distinction between the various fishing permits

Type of Permit	Acronym	Explanation
West Coast Rock Lobster Right Holder	WCRLRH	Fishers who hold a right to harvest West Coast Rock Lobster during season

Interim Relief Permit	IRP	The Interim Relief Permit system was created by DAFF to provide temporary relief to small-scale fishers who did not benefit from Long Term Rights. Meant to be in place until the new Small-Scale Fishing Policy comes into effect
Long-term rights allocation	LTRA	Is the allocation of long-term rights to qualified fishers, done through the Fishing Rights Allocation Process (FRAP)
Individual quotas	IQs	Quota allocated to individual entities
Individual transferable quotas	ITQs	System of quota allocation introduced to South Africa with the promulgation of the Sea Fisheries Act 12 of 1988 and designed to implement the 200 nautical miles Exclusive Economic Zone. Establishment of a Quota Board whose primary function was the granting of rights of exploitation to new entrants. Under the ITQs system, fixed quantities of the TAC are allocated to individuals for a period of time.
Traditional Linefish Right	TLR	Permit issued to traditional linefishers – fishers who fish from a boat, with a hook and line (maximum of 10 hook per line)

The majority of the fishers grew up during the apartheid era and had their educational aspirations structurally arrested at the young age of 16 with the Bantu Education Act (Union of South Africa, 1953), which also prevented them from becoming legal rights holders under apartheid law. Thus for a long time their involvement in fishing activities was limited to being crewmen for White rights holders (Union of South Africa, 1953). According to Nthane (2015), who wrote his

master's dissertation on the livelihood of small-scale fishers in Lambertsbaai, no exceptional differences were evident between the WCRLRH and the IRP fisher groups that pointed to the influence of the type of permit they held. Furthermore, Nthane's (2015) research showed that both fisher groups had remarkably similar numbers of people in the household, in school, and as breadwinners, which confirms that both fisher groups have very similar life histories, suggesting that the household structure developed independent of the rights allocation process. This makes sense considering that long-term rights allocations (LTRA) were issued in 2005 and the IRP soon after from 2007.

The 10-year average age difference between the two fisher groups (WCRLRH and IRP) can be attributed to differences in the rights allocation processes. While the IRP is reviewed annually, in accordance with the determined Total Allowable Catch (TAC) and allowing new entrants, the WCRLRH system followed the LTRA process in 2005, meaning that entrants were only allowed to apply once every 10 years. Consequently, younger fishers were not eligible due to being too young at the time and only older and perhaps more established fishers were considered eligible, resulting in the 10-year average age gap between WCRLRHs and IRP fishers.

The low level of schooling amongst the fishers in Lambertsbaai can be attributed to structural factors, such as the Bantu Education Act, socio-economic hardships and the lack of school infrastructure in the area, which does not yet possess a secondary school, even though it was given priority in the 2013/14 IDP (Municipality, 2013). According to Kolding, Béné, & Bavinck (2014), Lambertsbaai SSF can be seen as another case of the tragic reality faced by small-scale fishers worldwide, who more often than not lack access to basic service needs, such as schools. The importance of education is further emphasized considering the implications of the new small-scale fishing policy, which aims to grant fishers greater autonomy in the management, post-harvest selling and marketing of the resource. According to Nthane (2015), fishers in Lambertsbaai welcome the new policy and what it promises but are at the same time concerned about their new responsibilities and feel inadequate regarding the extent of their preparedness to actively participate in the co-management[3] table – a local committee made of fishers, scientists and

[3] Co-management is, by definition, a process of management in which government shares power with resource users, with each given specific rights and responsibilities relating to information and decision-making.

compliance officers setup to discuss the results of community catch monitoring data and jointly decide on the appropriate actions with regards to bag and size limits – and manage the marketing of their catch.

Regarding differences in income, due to the imbalanced "lobster-centric" marine resource harvesting, WCRLRH tend to earn more than IRP fishers, who depend more on their permit due to the low value of their harvest. WCRLRHs on the other hand can afford to rely on their harvest as their sole income considering its high value. So, while IRP holders have a high dependence on marine resource harvesting, the actual economic value of their permit is fairly low, and the opposite proves to be true for WCRLRHs who have a lower dependence on the resource and yet the economic value of the permit is relatively high (Nthane, 2015). This wealth imbalance between the two fisher groups can be further observed in their capacity to invest in boat infrastructure. While all WCRLRHs interviewed by Nthane in 2015 were able to purchase boats for themselves, only half of the IRP fishers could afford one, putting them at a significant disadvantage if they tried to apply for commercial rights in the future, taking into account that the typical commercial rights application process looks at the extent of investment in the fishing industry (Nthane, 2015).

Distributing individual quotas (IQs), such as the West Coast Rock Lobster, inadvertently created a small elite of fishers who benefited from fishing rights allocations, but resulted in fishers with a legitimate claim to a fishing livelihood being denied access to the fisheries due to the limited availability of fishing rights. Benefiting only a small elite can often divide the community (Visser & Burns, 2013), as evident in Lambertsbaai and further corroborated by McCay (1995) and Charles (2013) who found that the dispensing of individual transferable quotas (ITQs) concentrated fishing rights amongst a few, excluding other legitimate fishers and reducing the community's overall economic base.

The issue of dysfunctional co-operatives in Lambertsbaai hinders the implementation of the new policy and is therefore worth mentioning, the most pressing being the fact that previous co-operatives were instituted by the Department of Trade and Industry (DTI) as the only entities they gave infrastructural and financial support to, therefore avoiding the challenges of issuing benefits to individuals. The department also helped fishers during the establishment of the co-operatives, which resulted in almost all IRP fishers finding themselves in non-operational co-operatives. Since not all fishers in the co-operatives meet the criteria of the new policy, *bona fide*

fishers often find themselves in co-operatives with fishers that do not qualify as small-scale fishers under the new policy, something that must be taken into account during the policy's verification process. According to Isaacs (2006), intra-fisher mistrust has its roots in the failed Fishermen's Community Trusts (FCTs) – short-lived reform led by government to equitably distribute the benefits from fishing – reinforcing the potential of successful and operational co-operatives to rebuild trust amongst fishers.

In the traditional fishing town of Struisbaai, small-scale fishers face different challenges, even though the roots of most are the same as in Lambertsbaai. According to the municipal Integrated Development Plan (IDP) for 2015–16, Struisbaai has a population of almost 4 000 people and 1 454 households (Municipality, 2015), but small-scale fishers mainly reside in an area known as Struisbaai Noord, which according to the 1996 census, has a population of about 1 100 people, of which 300 were identified as fishers by Parker (2013).

According to Parker (2013), who focused her master's dissertation on the livelihoods of small-scale fishers of Struisbaai, the community of Struisbaai Noord is heavily dependent of fishing activities for their income needs, with the fishers being the heads of their households and the primary earners. Similar to Lambertsbaai, schooling levels amongst fishers is fairly low and can be attributed to the lack of educational infrastructure in the area, which has only one primary school. The nearest high school is situated in Bredasdorp (about 30km inland) and the nearest tertiary education college is situated in Caledon (about 96km inland). The lack of public transport between these towns further hampers the enrolment rate of the region, which was at only 11.9% in 2011 (Western Cape Government Provincial Treasury, 2012).

The Struisbaai harbour is the launching and landing site for a variety of fishers, ranging from local traditional fishers, to commercial line-fishers coming from other areas, and recreational boat-based fishers. Small-scale fishing activities of Struisbaai are largely dominated by boat-based line fishing, using "chukkies", which are old traditional wooden boats with inboard diesel engines or more modern ski-boats with outboard engines, which can be easily towed from one fishing area to another (Parker, 2013). Struisbaai "chukkies" are old, slow and in constant need of maintenance, meaning that the cost of maintaining them in seaworthy condition is high. The fishers themselves consider these boats a safety hazard and a restraint on their ability to harvest marine resources, as it takes a chukkie approximately three times longer to reach the fishing banks as compared to the ski boats. This proves to be true,

particularly during the peak holiday seasons, when recreational fishers arrive in the area, creating additional competition for chukkie fishers (Parker, 2013). Recent studies undertaken in the region by Van de Bank (2012), Dennis (2010), and Isaacs (2011a) reinforce the urgent need for chukkie fishers to convert to ski boat licenses in order to be able to compete with outsiders and commercials. A few fishers have tried to transfer their licenses, but were unfortunately unsuccessful (Parker, 2013).

Struisbaai Noord currently possesses only one active fisher organization. Coastal Links is a mass based community organization that was established in 2003, with structures in the Western and Northern Cape, as a vehicle for small-scale fishers to secure their livelihoods and overall human rights. The Masifundise Development Trust (MDT), an NGO that promotes sustainable livelihoods for small-scale fishers, is the primarily funder of Coastal Links (Masifundise, 2010). Another fisher organization present in Struisbaai, but currently inactive, is the Struisbaai Fishers Forum (Struisbaai Vissers Vereeniging), a community structure established by the fishers of Struisbaai Noord which provides a platform through which the fishers can be represented (Parker, 2013).

The waters of the Agulhas bank surrounding Struisbaai are one of the most important economic and biological marine regions of South Africa (Olyott, Sauer, & Booth, 2006). Fishers of Struisbaai Noord harvest a vast array of species, ranging from yellowtail (*Seriola lalandi*), cape salmon (*Atractoscion aequidens*), kob (*Argyrosomus japonicus*), red roman (*Chrysoblephus laticeps*), carpenter (*Argyrozona argyrozona*), snoek (*Thyrsites atun*), soupfin shark (*Galeorhinus galeus*), to squid (*Loligo vulgaris reynaudii*) and skipjack tuna (*Katsuwonus pelamis*), of which the yellowtail, cape salmon and kob are the most profitable, and therefore desirable, species. The extent to which fishers can harvest and gain access to these species is determined by DAFF by means of licenses, permits or quotas. Most fishers of Struisbaai, particularly of Struisbaai Noord, are holders of traditional linefish rights (TLR), and regarded as commercial fishers (see Table 1). Traditional linefish rights have been allocated by DAFF for a period of 8 years (January 2006 – December 2013) and permit holders are by law not entitled to hold any other fishing permit, or use their boat for recreational fishing purposes (DEAT, 2005). Another requirement of the TLR is that vessels have an operating Vessel Monitoring System (VMS), which must be switched on whenever they are at sea, enabling DAFF to track the vessel's location (DEAT, 2005).

In a community level socio-ecological vulnerability assessment conducted in the region and published in 2015, Struisbaai fishers identified a series of threats to their ability to harvest marine resources for their food and income needs, the biggest being the perceived high fishing efforts by outside boats – as previously mentioned. Other issues surrounding the management of the fisheries itself, such as a top-down management approach and a poor market, were also identified but not nearly as highly perceived as the impact of overfishing by outside ski-boats (FAO, 2015), which is still a cause of concern for Struisbaai small-scale fishers.

Trade and post-harvest activities have the potential to contribute significantly to poverty alleviation and food security for small-scale fisheries (Béné et al., 2007). Within the local market dynamics of the Struisbaai small-scale fishery, issues of power and conflict are constantly at play and have serious implications for livelihood outcomes. Fishers with chukkies land their catch after the ski boats, losing out on best prices and having to settle for whatever the buyer is willing to offer, since they do not have the institutional capacity to market their catch themselves on more lucrative urban markets (FAO, 2015; Parker, 2013). Regarding governance, fishers often do not agree with the current regulations in terms of fish and bait species, fish sizes and available permits. The current top-down management approach of fisheries and overall lack of consultation, participation and transparency during decision-making processes is perceived by fishers as a major issue preventing them from having sustainable livelihoods (FAO, 2015).

While fishers from Struisbaai perceive the local small-scale fishing sector to have many challenges and difficulties, they recognize that, with positive change, the sector can once again be as sustainable to them as it once was.

Understanding the life history of the fishers involved in this research, along with the correlated changes in fisheries management and governance over the years, was crucial to better grasp the challenges currently faced by small-scale fishers in South Africa and assess their acceptance of the Abalobi app as a voluntary co-management tool.

2.4 Citizen science

Citizen science is the involvement of the general public or nonprofessional scientists in scientific research (Couvet, Jiguet, Julliard, Levrel, & Teyssedre, 2008). In this new era of scientific discovery, citizen science is one of the tools available for cost

effectively collecting and analysing the vast amounts of data generated by data-intensive science (Bonney et al., 2009; Silvertown, 2009). It is a voluntary activity based on the four dimensions described by Cnaan, Handy, and Wadsworth (1996):

1. Citizen scientists participate out of choice instead of coercion;
2. Citizen scientists do not receive monetary compensation;
3. Activities can be carried out for organizations or individually; and
4. The intended beneficiaries are widespread and may encompass the individual participant who learns more about science while being involved in a project, to the scientist who is running the project, and finally to the wider world that may benefit from the outcome of the research.

The term "citizen science" was first applied to amateur projects in the mid-1990s (Irwin, 1995). By then, the term was used to indicate a growing concern with the participation of non-scientists in expert decision and policy-making. The increasing participation of the public was, and still is, seen as a beneficial way to incorporate more people into the complex design of science and technological systems. Citizen science benefits society by increasing scientific knowledge and capacity, promoting scientific literacy, and encouraging broad public engagement in decision-making about the use and management of natural resources (Trumbull, Bonney, Bascom, & Cabral, 2000). Community monitoring carried out by citizens offers the public an exciting opportunity to participate in research and be part of a highly valuable learning experience (Lee, 2007).

Citizen science does come with some limitations though, especially in the study of ecosystems and conservation practice. Because ecosystems are complex and subtle changes can alter the entire community of organisms and environment, the reliability of citizen science is often questioned; very specific data collection methods are required and must therefore be taught to the general public in order for them to record observations of indicator species (Galloway, Tudor, & Haegan, 2006). This can be a time-consuming process and the data is only really reliable when the citizens willing to participate in the research can easily master the method chosen by the scientist. The problem of accurate data collection is a core concern for scientists who wish to assure that the data they are using for their research is sound and the conclusions drawn are based on sound scientific information (Delaney, Sperling,

Adams, & Leung, 2008; Galloway et al., 2006; Martin, 2008). Analysis of data accuracy among citizen scientists indicates that they can be as accurate as professional scientists given the correct training and appropriate incentives (Nerbonne, Ward, Ollila, Williams, & Vondracek, 2008). The overall concern with data accuracy is a clear indication if the relative novelty of citizen science as a method for scientific discovery, and until it becomes an accepted scientific protocol it is likely that practitioners will still need to justify the use of non-experts for data gathering and analysis.

Citizen science is common in participatory action research and advances in mobile computing, online mapping, web technologies, and the increasing affordability of mobile devices have further boosted its opportunities, making it an appropriate concept to underline the theoretical framework of this thesis. Even though the data recorded through the Abalobi app has not yet been used for stock assessment purposes, the opportunities are endless and the app could easily be adapted to be used as a citizen science tool in the near future, if this is the direction users wish to go.

2.5 Technology

Technology has become an integral part of the operations of the modern world. It is applicable to all industries and facilitates the growth of an economy. Technological advancements of the cell phone contributed to the majority of the African continent currently having mobile network coverage, with over half of the African population owning at least one mobile phone (Aker & Mbiti, 2010). Mobile phones can be a valuable resource, not only for connecting individuals but also most recently for providing a quick and easy access to information and the market (Aker & Mbiti, 2010). Hellström and Tröften (2010) reinforce the message by saying that cell phone technology is an integral tool in the everlasting effort to alleviate poverty in Africa.

Small-scale fish farmers in the African continent mostly use mobile phones to manage their daily farming activities, and often access information on the industry, which greatly influences decision-making on the management of the fishing activity (Hellström & Tröften, 2010). Many small-scale fishers and fish farmers come from poor rural areas, often with no access to government services (McClanahan et al., 2009), and have difficulty accessing a fair market for their produce (Hellström & Tröften, 2010). The challenge for farmers and fishers surrounds the lack of resources, such as information and communication networks, which informs the need for mobile

phones. The use of mobile phones makes it possible for fish farmers to gain information about the productivity of their work, the kind of feeds appropriate for different fish and the market rates for their produce. Mobile phones also ensure improved living standards for thousands of people (Sen, 1997). The fish farming and small-scale agriculture industry in Africa continues to appreciate their use due to their help in managing the resource and empowering the fishers/farmer (Sen, 1997).

Mobile technology empowers farmers to improve their livelihoods by better managing the natural resource they depend upon (Hellström & Tröften, 2010). Small-scale fishermen can access timely information about market prices and market preferences and thus make adjustments accordingly. In Kenya, for example, fish farmers with smartphones can obtain market information to determine the selling price for their fish. The information is available through a programme called Kenya Agricultural Commodities Exchange Program (Donner, 2009). Fishers know when the demand is low and thus increase the price of their fish to maximize profit and decrease the price when the demand is very high. The information is accessible from mobile phones, and enables small-scale fish farmers to plan their finances accordingly (Donner, 2009). With this information in hand, small-scale fishers can determine how many fish they must sell to meet their basic and secondary needs as well as feed their families. This specific programme in Kenya also enables fishermen to subscribe to fishing information groups, which send them SMSs on new data about the fishing industry, creating awareness amongst small-scale fishers at an affordable cost – less than $1 a week to subscribe. Donner (2009) further emphasizes the value of mobile phones to small-scale fish farmers by mentioning the Collection and Exchanging of Local Agriculture Content programme in Uganda, which SMSs tips regarding agriculture to participating farmers in the country (Donner, 2009). Kenya has a similar programme called Kenya National Farmers Information Service, where farmers can access voice responses to commonly asked questions about agriculture (Donner, 2009).

Fish farmers worldwide greatly benefit from mobile technology since it allows them to make business deals through a specific application or SMS and follow-up through phone calls to ensure the success of those deals when necessary (Donner, 2009). Zambia has a National Farmers Union that uses its website and SMS to provide information on the price of several commodities. The programme also contains information regarding the buyers and sellers of those products as well as

their contact information, directly connecting the consumers to the producer (Donner, 2009), and eliminating the need of a "middle man".

In Tanzania, fishermen in possession of a mobile phone often receive orders through phone calls and payment via simple mobile transactions after delivering the fish to the market. That same fisherman can then immediately use his cell phone to send money to his relatives or family. Mobile technology connects fish farmers from different parts of the continent via social media groups and sites, creating a platform for those farmers to discuss their challenges and brainstorm solutions together (Myhr & Nordström, 2006). Not only that, access to information regarding trends in fish farming and small-scale agriculture can help them improve their own productivity and livelihood.

Other than being an avenue for change and transformation, the use of mobile technology in small-scale fish farming also contributes to economic development (Sullivan, 2006). Access to information via mobile phones makes it possible to avoid excess search costs and facilitate coordination between market agents, hence increasing the overall efficiency of the market (Aker & Mbiti, 2010). This improved communication makes it possible for small-scale fish farmers to improve and enhance their productivity as well as better manage their supply chains.

Despite its benefits, the use of mobile technology does come with some risks. Cell phones are susceptible to damage and often cannot survive the harsh weather out at sea. Farmers often need two phones, one durable and cheap and one smartphone with access to the Internet and relevant mobile applications. The risk of losing a mobile phone often translates to the danger of losing the market for fish (Myhr & Nordström, 2006), since buyers will often look for other sellers if they're unable to reach a specific seller on the phone. However, despite all the risks involved, small-scale fish farmers and fishers consider it the best thing to happen to the industry (Myhr & Nordström, 2006).

Chapter Three

Research Methodology

3.1 Introduction

This chapter describes in detail the methods used throughout this study. It highlights the research design, data collection process, data analysis and limitations encountered during the fieldwork portion of the study.

The sample size for this research was fairly small since the fieldwork portion of the research began with the pilot phase of the ABALOBI app. Each study site started with five fishers using the ABALOBI app, one community manager and one or two catch data monitors. Community managers are part of the ABALOBI team and are the first point of contact of the fishers using the app. Their main responsabilities include approaching fishers interested in using the ABALOBI app, helping current fishers with any dificulty or troubleshooting related to the app and reporting back to the rest of the team in Cape Town. Catch data monitors are employed by JAYMAT Enviro Solutions, a diversified environmental services company encompassing environmental monitoring, rehabilitation, scientific research and advisory services. JAYMAT was recruited by DAFF to run the Data Monitoring of Small-Scale Fisheries Landings project in the Eastern, Western and Northern Cape; a fishery management/socio-economic development project funded solely by DAFF aimed at contributing to job creation and collecting critical fisheries catch data (JAYMAT website). According to their website, a total of 169 catch data monitors have been employed in accordance to the Expanded Public Works Programme to observe and record catches of oyster, line fish, abalone, brown and white mussels and west and east coast rock lobster.

3.2 Research design

In this chapter we explore the strategy created to answer objectives 2 to 4: monitor the use of the Abalobi app in the two selected study sites; evaluate its utility, acceptance and uptake; and understand the opportunities, challenges and uncertainties of formalizing the app as a management tool for small-scale fisheries in South Africa.

Participatory Action Research (PAR) was the underlying research methodology used throughout the entire research and data collection process and it is

therefore further explored in the below section. The concept of Complex Systems was the theoretical framing of the thesis and is also further explored in the next section.

3.2.1 PAR – Participatory Action Research

For years, researchers separated themselves from the object of their study, be it a community, family or single person. This separation was believed to be necessary in order to maintain objectivity in the research process and validity of the overall research. The Participatory Action Research methodology (PAR), however, allows for the interaction and partnership of the researcher and participants throughout the entire research process, and recognizes that a relationship must exist between them (Barbera, 2008). The aim of this methodology is "to produce knowledge and action that is directly useful to a group of people in their struggle" (Barbera, 2008, p.145), in this case, two fishing communities struggling to be included in the management of fisheries that directly impact their livelihoods and quality of life. The values of PAR, which include legitimizing popular knowledge and community relationships that rely on participatory democracy, are closely related to those of social work and are therefore crucial. Creating effective partnerships during the research process eliminates the barriers that often dictate who has the knowledge and who can produce knowledge between the researcher and the subject. By eliminating these barriers, we recognize that knowledge is shared. Also, the process of being involved and included in the research process gives the community legitimacy in the eyes of outsiders and officials – like DAFF – and builds capacity (Barbera, 2008). Specifically, in the context of this research project, fishers participated in the iterative refinement of the Abalobi app, while the data was processed by the research and fed back in day-to-day decision-making.

Key elements of this research method include the direct involvement of the researcher and the researched in an attempt to change the reality of a whole community universe (Barbera, 2008; Forrester, 2008); not letting the process be too intellectualized; and recognizing that emotions will be part of the journey and will therefore penetrate the research (Barbera, 2008). Another important pillar of PAR is that the articulation of and solution to the problem comes from the community itself and not from an external element (Wadsworth, 2011).

As the name implies, the PAR approach is guided by its two keywords. The research must involve more than just "finding out": it must also include as one of its

components some sort of “action”, seeking to create positive change. The second keyword, “participation”, highlights the collaborative feature of the process, in which the community should also be involved. The concept of participatory action research moves away from the idea of having an “outside expert” to an ideal where the researcher is engaged in solving a real problem in a real community (Walter, 2006).

Along with complexity theory, the use of participatory action research provides the theoretical background for the overall methodological approach. The core process of PAR allows participants to share perceptions about a problem, engaging and testing possible solutions. It is a process of shared learning for all involved, validating the knowledge and intelligence of ordinary people (Laws, Harper, & Marcus, 2003). Besides its orientation to action, PAR has a better chance of leading to a solution since it involves those who best understand the problem and its context – in this case, the fishers (Laws et al., 2003). The main purpose of PAR is to produce knowledge and action that is useful to a certain group in their struggle (Denzin & Lincoln, 1994). Its processes can be used to improve local situations through two main objectives: the production of knowledge and action directly useful to the community, and empowerment through an expansion of consciousness. Both goals are achieved through practice. And most importantly, the research methodology is conducted with people rather than on people (Savin-Baden & Wimpenny, 2007).

The use of PAR does, however, come with its limitations. Bennett (2004) suggests that since relationships take time to be built and communities sometimes do not understand the benefits of this kind of research, community members often decline to participate, which can create an unforeseen challenge to the data collection process and research outcomes. As a researcher using this method, my role was to, first and foremost, observe and take note of the interactions between the fishers and other stakeholders as well as among themselves without interfering in any way.

3.2.2 Complex systems

Systems are created to address the problems of any formula, structure, or mechanism, meaning that they are structured according to the needs of the target users. However, establishing a system is not a simple task – and there is no guarantee that they can be utilized and executed in a simple manner. Complex systems are far beyond normal and simple because they include complicated structures, formations, and properties that exceed the idea of classical mechanism. They can also be identified as a field of

science that studies the parts of a system, including its behaviours and interactions with other systems within its technical environment. The study of complex systems and complexity theory is about understanding interactions and indirect effects. Difficult problems to solve are hard to understand since the relationship between causes and effects are not obviously related. Complexity theory studies how patterns emerge from the interaction of the different components (Cilliers, 2000a).

There are wide arrays of studies discussing complex systems in different aspects including its nature, formulation, and paradigm, coverage that includes different industries, social science, and many others. This review aims to discuss the nature, structure, formulation, and utilization of complex systems in different industries and scenarios where complexity is addressed and resolved. In particular, this review aims to discuss how complexity theory applies to small-scale fisheries and is therefore a fundamental theoretical underpinning of this dissertation.

Rosen (1987), Prigogine (1987), Morin (1992), Cilliers (1998, 2000a, 2000b, 2001, 2008), and Urry (2005) studied and discussed the nature of complex systems. The researchers argued that it is necessary to explore the complexity of systems in order to understand how they work — along with their strengths and weaknesses. Their studies also emphasized that in this modern generation where everything is moved by technology, systems become complex as science becomes more vulnerable to changes or modification. According to Cilliers, "a complex system is not constituted merely by the sum of its components, but also by the intricate relationships between these components" (Cilliers, 1998). Cilliers' article on the theory of complexity also corresponds to Dominique Chu, Roger Strand, and Ragnar Fjelland's "Theories of Complexity". The researchers argued in their respective research articles that there are wide varieties of theories of complexity and these theories determine how the systems become complex in their structure and formulation. According to Chu, Strand, and Fjelland (2003), contextuality is necessary to identify the complexity of systems. In their defined theories, the researchers explicate that there are two important considerations in defining system partitions: system and ambiance. The system serves as the general structure, while the ambiance is the external and internal forces that affect the system.

It is interesting to note that complex systems exist in different structures, organizations, and in a wide array of industry, including fisheries and coastal governance. In fisheries specifically, part of the complexity of socio-ecological

systems is the dynamics of the "community" that directly depend on the fisheries to maintain their livelihoods. The divide between social and ecological systems is artificial, particularly for communities whose livelihoods are dependent on the natural resources in their proximity. For such communities, there is a need to adapt to and influence changes in the system, as their wellbeing is highly dependent of the state of the ecological resource (Berkes, Colding, & Folke 2003; Jentoft 2007; Kooiman, Bavinck, Chuenpagdee, Mahon, & Pullin 2008).

In their research, Jentoft and Chuenpagdee (2009) stated that to identify complex systems, problems should be defined and discussed. In the case of fisheries and coastal governance, the researchers identify the wicked problems, which are both internal and external factors that profoundly affect the system in a negative manner. Defining, discussing, and understanding complex systems is also complicated, since it is not a simple idea, model, or concept without branches and substructures. It is a concept that requires understanding of its nature, background, and history in order to understand its use and significance.

The perspective from complexity helps us understand that a system is more than just the sum of its parts and should, therefore, be analysed and examined as a whole. Complex socio-ecological systems are characterized by having a large number of elements that can be simple, but interact in a nonlinear rich and dynamic way exchanging energy or information, with many direct and indirect feedback loops. Complex socio-ecological systems are open systems exchanging energy and information with the environment that surrounds them, and operate under conditions far from equilibrium. They have a memory, not allocated in a specific location but distributed through the system, and the behaviour of the system is determined by the nature of the interactions, not by what each of its components contains. Complex systems are adaptive and can reorganize their structure without the intervention of an external agent (Cilliers, 2000a). However, for Cilliers (2000a) the history of a particular system has enormous importance regarding the behaviour of this system and since the interactions are rich, nonlinear and dynamic, there is an impossibility of deterministic ways of predicting the future.

3.3 Data collection

The methods employed in this research for gathering information were both quantitative (Salesforce data) and qualitative (interviews, focus group, participatory

observation). While qualitative data may offer a better understanding of social aspects and provides foundations for the theoretical understanding, quantitative data is typically considered to be a more scientific approach to undertaking social research, as it focuses on measuring attributes and responses (Tewksbury, 2009), hence the use of a "mixed method" approach for this particular research. Table 2 summarizes all data collection events, their dates and locations.

Table 2. Summary of all data collection events

Date	Number	Tool	Location
August 13th and 14th, 2015	-	Participatory observation conducted during a workshop organized by Dr. Serge Raemaekers with the fishers and community catch monitors of the community	Lambertsbaai
September 10th and 11th, 2015	-	Participatory observation conducted during a workshop organized by Dr. Serge Raemaekers with the fishers and community catch monitors of the community	Struisbaai
December 14th, 2015	-	Participatory observation conducted during a workshop organized by Dr. Serge Raemaekers to update fishers on new developments and update all phones to the newest version of the app.	Lambertsbaai
January 7th, 2016	6	Key interviews conducted with fishers, manager and community catch monitors at the harbour	Lambertsbaai
January 13th, 2016	6	Key interviews conducted with with fishers, manager and community catch monitors at the public library	Struisbaai
April 7th and 8th, 2016	-	Participatory observation conducted during a workshop organized by Dr. Serge Raemaekers to update all the phones to the newest	Lambertsbaai

		version of the app.	
May 5th and 6th, 2016	1	Focus group with participants from Struisbaai and Lambertsbaai	Struisbaai

3.3.1 Participatory observation

Marshall and Rossman (1989) define observation as "the systematic description of events, behaviors, and artifacts in the social setting chosen for study" (p. 79). Observations enable the researcher to describe existing situations using the five senses, essentially creating a "written photography" of the situation under study (Erlandson, Harris, Skipper, & Allen, 1993). Using participatory observation in the field typically involves "active looking, improving memory, informal interviewing, writing detailed field notes, and perhaps most importantly, patience" (DeWalt & DeWalt, 2002, p. vii). Participatory observation is "the process of learning through exposure to or involvement in the day-to-day or routine activities of participants in the researcher setting" (Schensul, Schensul, & LeCompte, 1999, p. 91).

According to Bernard (1994), participant observation also requires a certain amount of deception and impression management, as the process involves establishing a relationship with a community and learning to act in such a way as to blend into the community so that its members will act naturally, and afterwards removing oneself from the setting to immerse oneself in the data to understand what is going on and be able to write about it. The process of being a participant observer includes more than just observation, it also involves natural conversations, interviews of various sorts, questionnaires, and unobtrusive methods. For the process of participatory observation to be successful, actions such as having an open, nonjudgmental attitude, being interested in learning more about others, being a careful observer and a good listener, and being open to the unexpected in what is learned, are necessary (DeWalt & DeWalt, 1998).

Observation methods can be useful to researchers in a variety of ways. Apart from providing researchers with ways to check for nonverbal expression of feelings, observation can grasp how participants communicate with each other, check how much time is spent on the different activities, and determine who interacts with whom (Schmuck, 1997). Participant observation allows researchers to check definitions of terms commonly used by participants prior to the interviews, as well as observe

events that participants may be unable or unwilling to share for any number of reasons (Marshall & Rossman, 1995). According to DeWalt and DeWalt (2002), "the goal for design of research using participant observation as a method is to develop a holistic understanding of the phenomena under study that is as objective and accurate as possible given the limitations of the method" (p. 92). Participant observation can often be used as a way to increase the validity of the study since observations can help the researcher get a better understanding of the context under study (DeWalt & DeWalt, 2002).

Participatory observation of real time implementation was conducted throughout the pilot phase, with observations directed towards understanding the uncertainties around formalizing the app and the challenges currently faced by the fishers, monitors, managers and, whenever present, DAFF officials. These observations were mostly conducted during the first few workshops attended, in which I was not an active participant and could focus on observing and taking note of the behaviour of the participants towards the proposed ideas, questions and individual persons. These workshops were organized by Dr. Serge Raemaekers as part of the ABALOBI app launch in both communities, and I attended merely to observe the interactions among the fishers and their reactions regarding all the functions and options the app could bring about. Workshops were conducted indoors, almost always at a public building, and lasted a day and a half (with the exception of Dec. 14th, 2015). Due to the language barrier (most fishers spoke in Afrikaans), the participatory observation focused on the participants body language more than their answers per se.

Since the validity of the observation is stronger with the use of additional methods, such as interviews or other more quantitative methods (DeWalt & DeWalt, 2002), structured interviews were also conducted and a focus group was organized.

3.3.2 Interviews

Face-to-face, structured interviews with the fishers involved in the pilot of the mobile app, monitors and the managers of each community were conducted at the end of the pilot phase (Refer to Appendix 1 for the list of interviews and Appendix 2 for a copy of the questionnaires) in order to evaluate the acceptance of the mobile app by the fishers and determine if they were struggling with the technology or had any pressing issues moving forward. The interviews also helped understand their concerns and

uncertainties of formalizing the mobile app as a management tool for small-scale fisheries in South Africa (Objectives 3 and 4).

Interviews were conducted personally by the researcher with a translator present (the manager of each community), as Afrikaans is the first language of all fishers currently involved in the pilot of Abalobi. The translator was there to help translate questions if and when needed and also to translate their answers if the interviewee was more comfortable replying in Afrikaans. Interviews were not recorded, therefore instances where the interviewee replied in Afrikaans and the translator could have possibly paraphrased the answer were duly noted. Interviews in Lambertsbaai were conducted in the harbour (monitor's office) while interviews in Struisbaai were conducted in the public library as well as the harbour. Interviews lasted anything between 20 and 35 minutes, depending on how comfortable the interviewee was with the questions and the language.

Interviews were divided into two sections. The first section contained questions regarding their demographics, education and socio-economic status and was aimed at creating a profile of the fishers and catch data monitors piloting the Abalobi app. The second section contained questions related to the technology, aimed at assessing the currently difficulties and challenges, if any, associated with the use of the technology and the fisher's openness to sharing their personal catch information with other fishers and government.

Structured interviews are a commonly employed research method in survey research, where questions are prepared beforehand and presented to all interviewees in the same order. There is generally little room for variation in responses since the majority of the questions are not open-ended and the interviewer (myself) plays a neutral role in the process, acting casually and friendly but refraining from voicing its own opinion during the interview (Cohen & Crabtree, 2006). Interviews with key stakeholders are particularly useful as they clearly reflect how individuals perceive and understand local issues within their communities or region. In the context of this research, key stakeholders were identified as being small-scale fishers affected by the new Small-Scale Fishing Policy, monitors working in the region and DAFF officials involved in the implementation of the new policy.

In total, 12 key informant interviews were conducted with respondents from different sectors, such as fishers, monitors, and local programme managers. The majority of interview questions were the same amongst all interviewees (socio-

economic questions), while questions regarding the technology and use of the Abalobi app differed between fishers, monitors, and managers. Unfortunately, due to schedule conflicts, not all fishers currently utilizing the Abalobi app were interviewed and no DAFF official was interviewed.

3.3.3 Focus Group – World Café

Focus group discussions are an important method for qualitative data collection. A focus group has been described by Cassell and Symon (2004) as a rapid assessment, semi-structured method, where a purposively selected set of participants gathers to discuss issues and concerns based on a list of key themes drawn up by the researcher. Focus groups are especially valuable as they allow the researcher to gain insight into a group's shared understandings and beliefs, while at the same time creating a space where individual opinions can be voiced. Furthermore, it allows participants to reflect on the responses of their peers and reflect and compare them to their own experiences (Cassell & Symon, 2000).

For the purpose of this research, a single 2-day focus group was organized for the 5th and 6th of May 2016 combining fishers from Lambertsbaai, Struisbaai and Kleinmond[4]. It was decided that the focus group would also serve as an opportunity for fishers from the different communities using the Abalobi app to meet and exchange ideas and insights. In order to minimize some of the costs, it was decided to conduct the focus group in Struisbaai (Struisbaai Public Library) as oppose to Cape Town – that way we only needed to cover the costs of transport and accommodation of the fishers from Lambertsbaai. The focus group was purposely scheduled as the last data collection event so as to incorporate matters arising from the previously conducted interviews and other data sets, such as What'sApp conversations and ODK. The focus group discussion was centred around four main themes (Table 3), with questions aimed at understanding the current challenges faced by small-scale fishers not only at sea but also in the market, within the community and government. The main objective of the focus group itself was to bring fishers currently involved with the piloting of the Abalobi app together and assess how the app is or can help ease some of these challenges in the long term. Questions were open ended but semi-

[4] Fishers from Kleinmond (not one of the study sites for this research) were invited as the themes discussed during the focus group were also relevant to them and it so happen that transport to the fishers from Kleinmond to Struisbaai managed to be organized.

structured allowing for some flexibility during the sessions. The focus group was conducted by the researcher, with the assistance of Serge Raemaekers and two graphic facilitators who were hired to translate the discussion into a drawing. An internal protocol (Appendix 3) was developed and discussed beforehand amongst the researchers and graphic designers to ensure that the focus group ran smoothly.

Table 3. Focus group themes and questions

Theme	Questions
At sea	1A. What are some of the major concerns/issues currently affecting small-scale fishers?
	1B. How is or could Abalobi help?
Landing site and market	2A. How can small-scale fishers be empowered in the market?
	2B. How is or could Abalobi help?
Livelihood and community upliftment	3A. What are some of challenges faced by the fishers within the community?
	3B. How can Abalobi help?
Governance	4A. What opportunities do you think the co-management of small-scale fisheries with DAFF and the monitors can bring?
	4B. How is or could Abalobi help?

In total, we had 20 participants on the first day of the focus group, of which nine were from Kleinmond (six fishers and three co-op ladies), five were from Lambertsbaai (four fishers and the manager), and six were from Struisbaai itself (four fishers, one monitor and the manager). This number was smaller on the second day of the focus group, since the participants from Kleinmond only came for the first day. Apart from the fishers, a few other people were present to either run the focus group (myself, Dr. Serge Raemaekers and two graphic designers) or simply as an observer (a couple of students, photographers, Thelisa Mqoboka from WWF, Andrew Cawood, and Uvenathi Gcilishe from the Overberg District Municipality).

The focus group ran from 9am until around 5pm, with a break for lunch and coffee in between. The four themes proposed and its subsequent questions (Table 3) were designed to simulate a fishing trip, starting from challenges faced at sea, through to the landing site/market, livelihood and community challenges and ending with a discussion around the broader governance issues. Each theme consisted of two questions, part A related to the issues/challenges currently faced by small-scale fishers and part B to how the Abalobi app is or could help minimize or mitigate some of the discussed concerns.

Participants were given a set time to discuss each question amongst their table, which varied depending on the observed enthusiasm or lack of it towards the question itself. Afterwards, a member of each table was invited to stand up and share the main ideas of their table with the larger group as well as summarize them on a coloured piece of paper – collected afterwards to help the graphic designers with their drawing. In order to connect diverse perspectives, participants were also encouraged to exchange tables inbetween themes.

To encourage a more dynamic conversation and the active participation of all present stakeholders, a methodology known as *World Café* was employed (Brown & Isaacs, 2005). World Café is an easy-to-use method for creating a living network of collaborative dialogue around questions that matter in service to real work, hence a method appropriate for creating dialogue around Abalobi involving as many stakeholders as possible at once. It draws on seven integrated design principles (Table 4) for hosting large group dialogues and could be easily modified to meet our specific need.

Table 4. World Café design principles

Principle	**How?**
Set the context	Don't lose sight of what we want to achieve. Maintain the focus of the conversations around the challenges and opportunities of Abalobi, from different viewpoints.
Create a hospitable space	When people feel comfortable to be themselves they do their most creative thinking. Space should feel inviting and safe.
Explore questions that	Focus on compelling questions that are relevant to the

matter	real-life concerns of the group.
Encourage everyone's contribution	It is important to encourage everyone in the meeting to contribute his or her ideas and perspectives.
Connect diverse perspectives	Exchange tables.
Listen together for patterns and insights	Main ideas of each table are shared with the larger group in between discussions.
Share collective discoveries	The "harvest". Graphic facilitation.

On the first day, the World Café methodology was used throughout the entire day to get fishers from the different communities to interact. In line with the World Café design principles set out above (Table 4), the conference room at the Struisbaai Public Library was slightly transformed to look less formal and more hospitable, with five tables randomly placed around the room. Each table had four chairs, a tablecloth, a piece of flipchart paper and different coloured crayons and pens to encourage participants to doodle during their discussion. The two graphic designers hired to capture the workshop in a drawing were set up in the corner of the room, out of the way, but still visible to everyone.

3.4 Data Analysis

3.4.1 Analysis of quantitative data

Quantitative data gathered in the cloud-based server (Salesforce) was analysed to monitor the use of the mobile app by the fishers and their acceptance of the technology. Data gathered on ODK and stored in the cloud-based server includes:

- the version of the mobile app;
- date of submission;
- GPS coordinates;
- the landing site;
- a few information regarding the weather, such as wind direction and strength, sea condition, current direction and strength;
- fisher name;
- fisher gender and age;
- type of permit;

- boat type;
- owner and skipper of the boat;
- crew number;
- engine capacity;
- time of start and end of fishing trip;
- species caught;
- costs involved, such as fuel, oil, bait, harbour fees and others;
- number of local and outside boats in the area; and
- a separate section for comments.

For the purpose of this research, the some of these quantitative data was analysed to reinforce what the participants said in the interviews, and evaluate the utility, acceptance and uptake of the mobile app by the fishers of Lambertsbaai and Struisbaai (Objective 3). In this regard, pivot tables and charts were generated in Microsoft Excel 2011 to illustrate the frequency of use of the app, and frequency of use of the specific features of the app requested by the fishers themselves during the first workshop. Charts were also created to reinforce some of the fisher's concerns in their communities, such as competition with outside boats and the unpredictable nature of their jobs.

Data analysis was kept anonymous and the fishers did allow me to look into their catch data.

3.4.2 Analysis of qualitative date

Qualitative date was sourced from interviews, the focus group, participatory observation during workshops, and the recorded communication (What'sApp) between the fishers currently using the Abalobi app.

A What'sApp group was created on August 10th, 2015 for the Lambertsbaai fishers and on August 24th, 2015 for the Struisbaai fishers. The aim of the What'sApp group was to allow fishers using the app within the community to communicate with each other, with the monitor, community manager and us (UCT team) regarding issues with their devices, concerns and anything else relevant to the project. Although most of the conversations amongst the fishers were in Afrikaans, transcripts of conversations from August 2015 until March 8th, 2016 for Lambertsbaai and February 15th, 2016 for Struisbaai were translated into English and some key

challenges and opportunities – as highlighted by the fishers themselves – were identified.

Another source of qualitative data is a detailed diary of events maintain by both myself and Dr. Serge Raemaekers, containing the details of all difficulties encountered and communicated to us (social and technological). All observations and interviews were input into Microsoft Word for safekeeping. Communication recorded on the What'sApp groups of Lambertsbaai and Struisbaai were transcribed into Microsoft Word and translated from Afrikaans into English. Notes taken during workshops (participatory observation) were recorded in the researcher's notebook and did not warrant transcription into Microsoft Word.

In order to identify emerging themes, the transcripts of the What'sApp conversations were coded. The three codes used where challenges (CH), opportunities (OPP) and unrelated matter (UM).

3.5 Limitations

Every method has its strengths and weaknesses. Several researchers have, for example, noted the limitations involved with using observations as a tool for data collection. DeWalt and DeWalt (2002) note that male and female researchers often have access to different information, since they tend to have access to different people, and settings. Being one of the very few female researchers working on the Abalobi project that statement definitely had some merit. Fishers were not always comfortable talking to me and often rather direct their concerns and questions to another researcher present – although that might not be gender related, since fishers had previously known some of the other researchers present.

According to Schensul, Schensul, and LeCompte (1999), several things can determine whether the researcher is accepted in the community, including one's appearance, ethnicity, gender, and class. A lack of trust and the community's discomfort with having an outsider present can often result in the researcher not being included in activities. Exclusion can be manifested in many ways, including the community's use of a language that is unfamiliar to the researcher. Although that was not the case for this research, the language barrier between the researcher and the fishers proved to be a much bigger challenge than predicted.

The majority of workshops were conducted in English, but the idea was always for participants to feel as comfortable as possible and feel free to reply and

participate in their mother tongue if necessary. As it turned out, participation from fishers was mostly in Afrikaans and since the majority of other participants present understood Afrikaans, translations were infrequent. Interviews were conducted in English for the most part. A translator was present at all interviews with fishers to help translate the questions and their answers when needed. Unfortunately, since interviews were not recorded, some comments might have been lost in translation. The workshop was conducted in English by the researcher, however, fishers shared their thoughts and comments in Afrikaans and most subsequent discussions were in Afrikaans, which greatly compromised the researcher' understanding of the issues currently concerning fishers with regards to the themes discussed during the focus group.

Another limitation when conducting observations is researcher bias. Researcher bias is one of the aspects of qualitative research that has led to the view that qualitative research is subjective, rather than objective (DeWalt & DeWalt, 1998). Some qualitative researchers believe that one cannot be both objective and subjective, while others believe that the two can coexist, that one's subjectivity can facilitate understanding the world of others. Ratner (2002) notes that when one reflects on one's biases, he/she can then recognize those biases that may distort understanding and replace them with those that help him/her to be more objective. In this way, the researcher is being respectful of the participants by using a variety of methods to ensure that what he/she thinks is being said in fact matches the understanding and opinion of the participant. Using different approaches to data collection and observation leads to richer understanding of the social context and the participants therein, another reason why a mixed method approached was chosen for this particular study.

Schensul, Schensul, and LeCompte (1999) further suggest that the quality of the observation also depends upon the skill of the researcher to observe, document, and interpret what has been observed. It is therefore crucial for the researcher to make accurate observation field notes without imposing preconceived categories from the researcher's theoretical perspective during the early stages of the research process, and why attending the first workshop in both the communities of Lambertsbaai and Struisbaai as nothing more than an observer was so important.

Chapter Four

Research Results

4.1 Introduction

This chapter presents the findings from the qualitative and quantitative data collected in the fishing communities of Lambertsbaai and Struisbaai. The overall aim of the research was to determine if a mobile application could foster the co-production of fisheries knowledge and stimulate the co-management of fisheries, keeping in mind the pending implementation of the new small-scale fishing policy. The interviews were used to build a profile of the fishers involved in the piloting of the Abalobi app as well as serve as a first assessment of their individual technological difficulties and concerns regarding the formalization of the app and involvement of the Department of Agriculture, Fisheries and Forestry (DAFF). The focus group was used with the intention of understanding the opportunities, concerns and uncertainties around the formalization of the Abalobi app at every stage of a regular fishing trip. Participatory observations were undertaken throughout all data collection events and workshops related to Abalobi, and the quantitative data sourced from Salesforce was used to reinforce and validate the results from the interviews.

4.2 Qualitative data

The qualitative data collected during the course of this research included 12 key informant interviews, a 2-day focus group, the transcripts of 6 months' worth of conversations (What'sApp) between the fishers of Lambertsbaai and Struisbaai, and the researcher's personal notes taken during workshops (participatory observation). A detailed diary of events was also kept to track changes and updates to the app itself and phones (Table 5) and any relevant issues and conflicts encountered during the pilot phase of the Abalobi app by the fishers and researchers (Table 6). A small set of quantitative data was extracted from the interviews in order to build a profile of the fishers and monitors currently using the Abalobi app (Table 7 and Table 8).

Table 5. The progress of the ABALOBI app - technology

	Lambertsbaai	Struisbaai
August 2015	ABALOBI app launched during a 2-day workshop. What'sApp group created.	What'sApp group created.
September 2015	Fishers asked for a joint What'sApp group. Abalobi Family What'sApp group created.	ABALOBI app launched during a 2-day workshop. Calculator added from the beginning.
December 2015	ODK updated to 1.6v. New form with input from fishers Windfinder app downloaded on all phones. Unlocked gallery and calculator	
January 2016	SF1 needs updating – done by Nico and Serge	ODK updated to 1.6v. New form with input from fishers Windfinder app downloaded on all phones. SF1 needs updating – done by Stuart and Serge
February 2016		Telegram downloaded on all phones. What'sApp deleted.
April 2016	SF1 needs updating – done by Nico and Serge	SF1 needs updating – done by Stuart and Serge
May 2016	SMS notifications enable. Updated FISHER LOG (added pike, gurnard, and snoek heads to bait list).	SMS notifications enable. Updated FISHER LOG (added pike, gurnard, and snoek heads to bait list).

Table 6. Issues and conflicts encountered during the pilot phase of the ABALOBI app

	Lambertsbaai	Struisbaai
August 2015	Monitors only record the catch of the 5 fishers involved in the pilot.	Monitors only record the catch of the 5 fishers involved in the pilot.
September 2015	Asked fishers to record no fishing days. Miscommunication on What'sApp between Serge and one of the fishers. Monitors record the catch of all boats.	Asked fishers to record no fishing days.
October 2015		Monitor records the catch of all boats.
November 2015	One of the fishers left the pilot. He disappeared from Lambertsbaai	
December 2015	Some issues with the caretaker. Two fishers cannot go to sea because their boats are not on the IR list, even though both have IR permits. So they cannot record	
May 2016		Struisbaai exchange

4.2.1 Participatory observation

Participatory observations of real time implementation were conducted during all the workshops I attended with the fishers in Lambertsbaai and Struisbaai, as well as during the interviews and focus group. Observations were directed towards understanding the current challenges faced by small-scale fishers in Lambertsbaai and Struisbaai as well as evaluating the utility and acceptance of the mobile fisher logbook by the fishers and catch data monitors involved in the pilot phase of the Abalobi app.

During the app launching workshop in both communities it was clear from the participants' body language and reaction to some of the questions that the ownership of the app was very important, fishers needed to know and be assured that the

information collected with Abalobi app would belong to them and it would be up to them to decide who else had access to it. Even after explaining to all participants how the app works and where the information is stored, and reinforcing that the information entered cannot be modified in any way, many fishers still looked skeptical, in particular the older fishermen present.

Fishers in both communities were particularly interested in the possibility of using the Abalobi app as a safety at sea tool. In Lambertsbaai, participants seemed very confident using a smartphone and learned to use the app quickly, while the Struisbaai fishers found it more difficult. The opportunities surrounding the use of the app also differed between the two fishing communities – fishers from Struisbaai were particularly interested in using it to record the number of recreational boats fishing in their area during season while fishers from Lambertsbaai seemed very excited about the possibility of having GPS at sea. In Lambertsbaai, fishers wanted to be able to include the names of crewmembers on the app so they would not feel excluded from the process.

Participants' mistrust of DAFF was evident at the beginning, as they seemed very concerned about where the data goes and who sees it. This mistrust is still evident today, although fishers seem comfortable enough with the Deputy Director of Small-Scale Fisheries currently working on the Abalobi app.

Participatory observations made during the months prior to the interviews and focus group helped direct some of the questions and focus the discussions of the focus group on issues that are relevant to the fishers.

4.2.2 Interviews

Results of the interviews conducted with fishers involved in the pilot of the Abalobi app, as well as catch data monitors currently employed by JAYMAT using the app and the community manager of each fishing community, illustrate that all respondents were Coloured, and all, with the exception of one monitor in Lambertsbaai, were male. The table below (Table 7) illustrates the profile of the Lambertsbaai and Struisbaai fishers interviewed while Table 8 illustrates the profile of the catch data monitors of Lambertsbaai and Struisbaai interviewed.

Table 7. Profile of the fishers interviewed in the communities of Lambertsbaai and Struisbaai

Gender breakdown	7 out of 7 male
Race breakdown	7 out of 7 Coloured[5]
Average age	47.4 years
Language spoken at home	7 out of 7 Afrikaans
Average number of people per household	4.7
Own a personal smartphone	14.3%

Results from the interviews with the fishers currently piloting the Abalobi app indicate that they are heavily dependent on fishing activities for their income needs, something that could be extrapolated to the entire small-scale fishing community of Struisbaai Noord (Parker, 2013) and Lambertsbaai (Nthane, 2015). All respondents (7/7) indicated that all of, or close to 100% of their income comes from fisheries related activities. The education level of the fishers interviewed in Lambertsbaai and Struisbaai is relatively low. Although 6 out of 7 respondents have attended and completed primary schooling, none completed high school and none have pursued any form of tertiary education, although 3 out of 7 had some sort of skills training course – such as skipper ticket or pre-sea course. Of the seven fishers interviewed, four currently have an Interim Relief permit while three have a Traditional Line Fish (TLF) rights, and all are qualified skippers.

Of the seven fishers interviewed, five use the Abalobi app to record their catches frequently (every time they fish). The remaining two were having boat issues and not fishing, hence the reason for not using the app. The majority were very comfortable using ODK and What'sApp but reported not using Salesforce, because it takes too long for the graphs to load and the data displayed is often not up to date. When asked regarding the sharing of information, fishers from Lambertsbaai said they would be very comfortable sharing their catch records with other fishers, while fishers from Struisbaai were not comfortable with it. With regards to sharing the information on the app with DAFF, only two fishers reported being comfortable with

[5] South African racial classification is still based on the Apartheid era racial divisions (Black, White, Coloured, Indian, Asia). The Coloured population is a group of people generally regarded as mixed race, descended from slaves, indigenous Khoisan, other black people and European settlers (van Sittert, Branch, Hauck, & Sowman, 2006)

it, while four fishers reported not being comfortable and one fisher was not comfortable answering the question and chose not to reply.

At the time of the interviews, there were a total of nine fishers using the app in Lambertsbaai and Struisbaai, but unfortunately one fisher from each community was unavailable to be interviewed. Three catch data monitors and the two community managers were also interviewed. All three monitors interviewed currently work for JAYMAT and have been environmental monitors with JAYMAT for the last three years.

Table 8. Profile of the monitors interviewed in the communities of Lambertsbaai and Struisbaai

Gender breakdown	2 out of 3 male
Race breakdown	3 out of 3 Coloured
Average age	36
Language spoken at home	3 out of 3 Afrikaans
Average number of people per household	3.3
Own a personal smartphone	2 out of 3

The community managers in Lambertsbaai and Struisbaai have been involved with the Abalobi app since its conception and are therefore very committed to the project. Both managers are ex-fishers and have a good relationship with the current fishers of the community. The manager of each community was responsible for choosing the five fishers who would participate in the initial pilot phase of the Abalobi app. Both based their decision on a variety of reasons, including fisher's age, reliability of their vessel, and fishers that go to sea often targeting a wide range of species, as oppose to fishing only the most profitable species such as lobster and yellowtail. The managers were crucial as the first point of communication/contact with the fishers regarding any issues related to Abalobi – be it technological or not. More importantly, fishers were comfortable enough communicating their concerns and uncertainties to the managers, as they were more accessible and part of the fishing community.

4.2.3 What'sApp conversations

In Lambertsbaai, major challenges highlighted in the What'sApp group included boat problems – leaks, broken motors, issues with their boat registration – bad weather, which is particularly worrisome and challenging for small-scale fishers due to safety reasons, some minor technology issues – no 3G in the area, phone battery flat – and illegal catches by other fishers. Not many opportunities were highlighted by the fishers during these conversations, however they did ask for a joint What'sApp group with fishers from Struisbaai in order to share ideas for the future. The joint What'sApp group called "Abalobi Family" was created on September 14th 2015.

In Struisbaai, challenges highlighted in the What'sApp group by the fishers included the decreasing price of fish, bad weather – not as challenging in Struisbaai since most fishers use "chukkies", some minor technology issues – phone battery flat, forms not sending – the allocation of quotas, and competition with outside boats (both commercial and recreational when the yellowtail is running). Fishers from Struisbaai hope to record numbers and other relevant data regarding outside boats on the Abalobi app to, in future, pressure government authorities to relook at the commercial line-fishery and focus on traditional fishers.

The table in section 4.2 listing the issues and conflicts encountered during the pilot phase of the ABALOBI app (Table 6) was created based on information compiled from those What'sApp conversations. The interview data and What'sApp conversations were particularly useful in identifying key issues for discussion during the focus group held on May 5th and 6th 2016.

4.2.4 Focus group

A summary of the discussions from the World Café, highlighting the main findings and including the drawings made by the two graphic designers can be found in the sections below.

4.2.4.1 At sea

At sea, small-scale fishers in Lambertsbaai and Struisbaai are particularly concerned about safety (Question 1A). The weather can be unpredictable and even though 100% of the fishers interviewed have a GPS on their vessel, only 28.5% have a Vessel Monitoring System (VMS) that allows fisheries regulatory organizations to track and

monitor the activities and location of fishing vessels. Even though the issue of safety at sea is evident in both communities, it is clearly a more concerning and urgent matter for Lambertsbaai fishers, who possess much smaller boats and weaker motors.

Another concern identified by the participants (Question 1A) was the matter of competition and marketing, which often starts at sea. Commercial fishers with faster boats are able to reach the fishing banks faster, fish more and return to harbour earlier, selling their catch for a much higher price. The local IRP and TLF fishers have to settle for whatever price the formal buyer is willing to offer upon their return. Also, due to the high cost of fuel and other fees involved (harbour fees, payment of crewmembers, bait), often the price of going fishing alone is not covered by the sale of their catch, forcing small-scale fishers to take loans and live in constant debt.

Fishers in Lambertsbaai and Struisbaai are aware of climate change and have experienced its effects. Changing fish patterns has also been identified as a major concern (Question 1A) during the focus group. Commonly sought species, such as the yellowtail in Struisbaai and snoek in Lambertsbaai, arrive at unpredictable times and places, putting small-scale fishers at a great disadvantage when compared to larger commercial boats with access to many more fisheries technological advancements.

With regards to Question 1B, participants suggested that some sort of satellite tracking device be integrated into Abalobi, combined with a radio system so fishers can communicate at sea regarding fishing spots, illegal activities, weather, and set a market price for their catch.

The photo below (Photo 1) illustrates the main issues identified by the fishers during the focus group, as portraited by the two graphic designers present.

Photo 1. "At sea" concerns and issues

4.2.4.2 Landing site and market

At the landing site and regarding the empowerment of small-scale fishers in the market, participants identified competition with other fishing sectors and the relation with the middlemen or "langanas" as main concerns (Question 2A). Local market dynamics can have a major impact on a small-scale fisher's income and yet very little is documented on the local market dynamics in Lambertsbaai and Struisbaai. Competition with other fishing sectors, be it the commercial linefishery or recreational, directs and affects the market. Bigger and faster vessels (commercial linefishery) fish more and arrive faster back at the landing site to sell their catch, flooding the market and forcing small-scale fishers to settle for a lower price.

Participants identified a need to get better organized as co-ops as a way to empower themselves in the market. Within the co-ops they would be able to get greater control of prices and share infrastructure, such as fridges, trucks, etc. Lastly, small-scale fishers' current relationship with the "langanas" is prejudicial and one-sided. In order to empower themselves and get a better price for their catch, fishers would ideally control their own market, setting prices within their co-ops and directly connecting to retailers and consumers.

With regards to Question 2B, participants saw the potential of the Abalobi app to work in their favour and suggested that the app should also include market information regarding prices from other fishing areas, apart from allowing them to connect and interact with retailers and consumers. Another suggestion was to look at a possible artisanal fisher brand, which would increase the value of their catch as well as stimulate job opportunities within the women and youth.

The photo below (Photo 2) illustrates the main issues identified by the fishers with regards to the landing site and market, as portraited by the two graphic designers present.

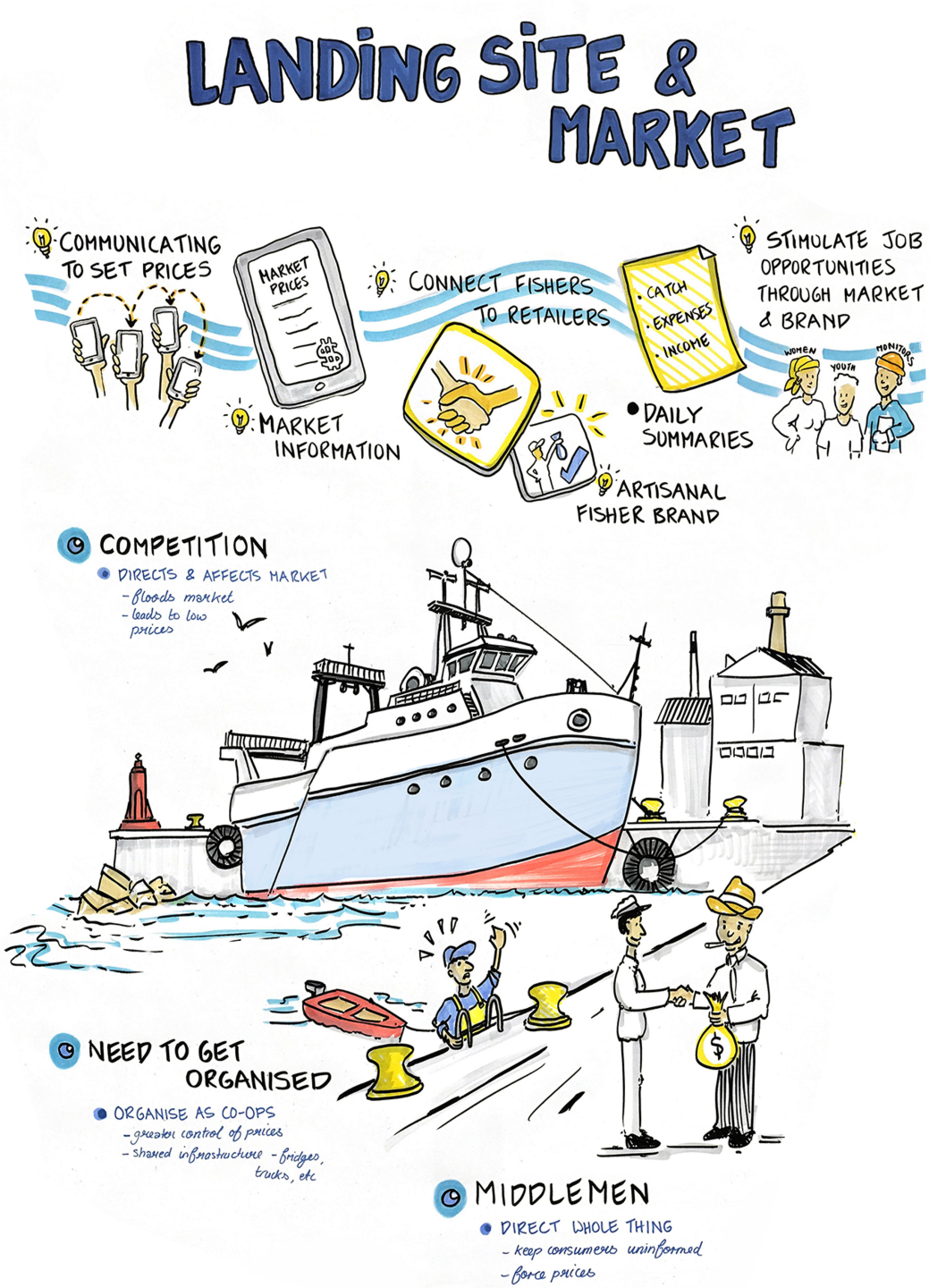

Photo 2. Landing site and market concerns

4.2.4.3 Livelihood and community upliftment

Within their fishing communities, participants said the current status quo perpetuates marginalization, such as the consumption of drugs by the youth, high rates of unemployment, prostitution, child labour, poaching and crime. Fishers struggle to keep the issues of work at work and a bad day at sea often results in a bad day at home as well. Even though the challenges faced by fishers within the community are many, during this particular session, participants were more interested in discussing how the Abalobi app can help mitigate some of those challenges.

Suggestions and ideas of how the Abalobi app could help included the involvement of women and the youth in the market, training the youth around technology, and a few ideas related to tourism and food. Given the proper training, material and opportunity, fishers currently piloting the app could be responsible for training other fishers, adding to the legitimacy of the app and broadening its reach.

Many participants mentioned how the Abalobi app gives them a "credible voice". All catch data is recorded and cannot be modified, giving them tangible proof to approach either government or retailers and make their case, be it for better prices for their catch or permits and higher quotas.

Participants also envisioned a few tourism opportunities, involving local restaurants and embracing a "from hook to cook" mindset, which could boost tourism in their fishing communities and create more opportunities for women and the youth in the process. The need for better management and the support of their local government is not overlooked by the fishers, and that was the theme of the last session of the focus group.

The photo below (Photo 3) illustrates the main challenges within the community itself identified by the fishers during the focus group, as portraited by the two graphic designers present.

Photo 3. Challenges faced by the community

4.2.4.4 Governance

The participants' relationship with government, specifically DAFF, has always been tense and based on mistrust. Considering the implications of the new small-scale fishing policy, it was crucial to address some of the underlying issues and try to identify the opportunities of working with government, and how the Abalobi app can empower fishers to participate in the co-management table. At this point of the focus group, participants were visibly tired and the discussion was not as lively as expected, but some interesting opportunities were highlighted by the fishers and the use of the Abalobi app to help achieve those is recognized.

Participants recognized the app as a tool to close the gap between scientific knowledge and local knowledge. According to one of the older fishers from Lambertsbaai, now he is the scientist. Their local knowledge, not usually recognized by government, is now recorded and can be used as valid information at the co-management table to determine size limits, what species should be part of the basket of species, and how much of it should be allocated to small-scale fisheries.

Fishers also see the app as a possible tool to help government positively identify *bona fide* small-scale fishers. According to some of the participants, a lot of the "so-called" small-scale fishers only fish during lobster or yellowtail season (high value species) and should not be considered for the same rights and permits as the fishers who fish year round.

Lastly, participants see an opportunity to use the catch information recorded on the app to access much-needed funds, such as taking a loan through a bank, to fix or even upgrade their motors, allowing them to go farther out and fish for longer. The information recorded on the Abalobi app could also be used to show retailers interested in buying their catch exactly how much they can provide per week or month.

The photo below (Photo 4) illustrates the main issues with regards to the current governance of small-scale fisheries identified by the fishers during the focus group, as portraited by the two graphic designers present.

Photo 4. Governance issues

4.2.4.5 Conclusion

The first day of the focus group ended soon after the last session. Fishers were visibly tired after a long day of discussions. The participants from Kleinmond left immediately as they still had a long drive back home. On Friday morning, May 6th, fishers from Lambertsbaai and Struisbaai came back together at the Struisbaai Public Library to go over the complete drawing made by the two graphic designers during the discussion of the day before. We finished the 2-day workshop/focus group by going over the initial agenda and making sure every item had been discussed and dealt with.

The photo below (Photo 5) illustrates the entire journey of the Abalobi fishers, as portraited by two graphic desginers during the one day focus group.

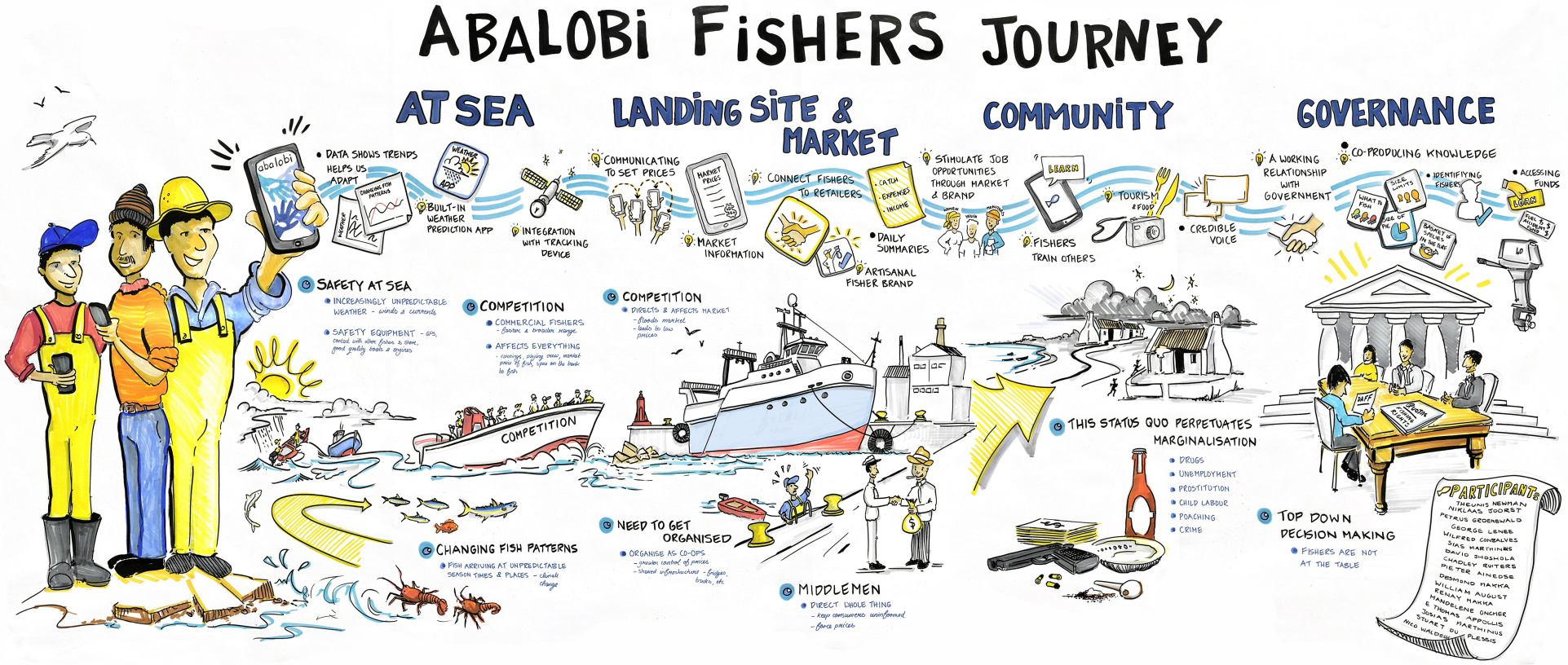

Photo 5. Abalobi fishers' journey - complete drawing

4.3 Quantitative data

Quantitative data gathered in the cloud-based server (Salesforce) was compiled into a Microsoft Excel 2011 datasheet and used to complement what was said by the participants during the interviews (see section 4.2.2) and evaluate the utility, acceptance and uptake of the mobile fisher logbook by the fishers of Lambertsbaai and Struisbaai (Objective 3). Since the beginning of the pilot phase, the Abalobi app had two different versions (1.5v and 1.6v), therefore the variables plotted in some of the graphs below are only available from December 2015, when ODK was updated to version 1.6v on the participants' phones (see Table 3 for more details).

4.3.1 Frequency of use

The frequency of use of the Abalobi app by the participant fishers of Lambertsbaai and Struisbaai was plotted to assess their acceptance of the mobile app and uptake of the technology. Figure 2 illustrates the frequency of use of the app during its first version (1.5v), while Figure 3 illustrates the frequency of use of the app after the installation of the updated version (1.6v), which included some of the features asked for by the fishers themselves, such as costs involved during a fishing trip, and reasons for not going out to sea.

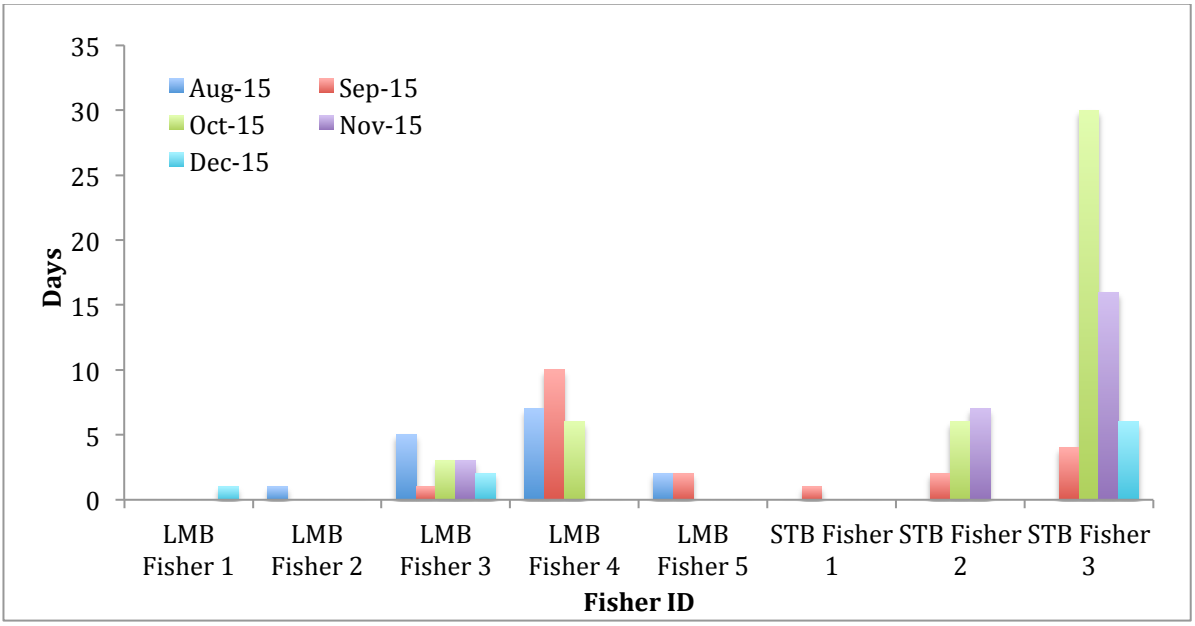

Figure 2. Frequency of use of the Abalobi app (1.5v)

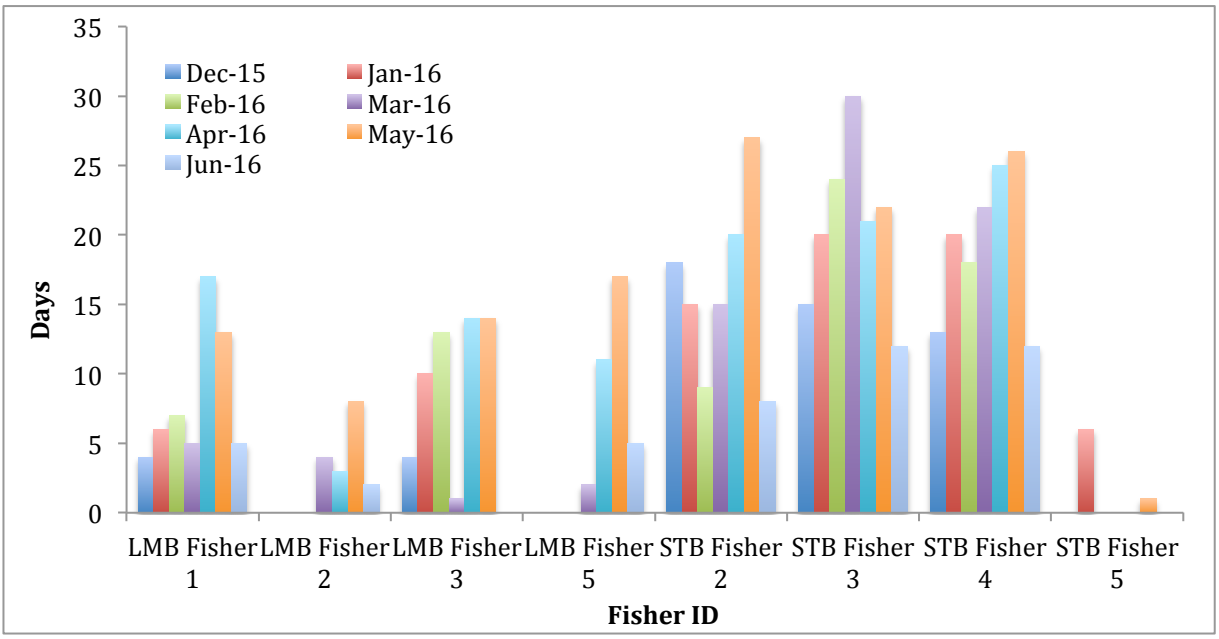

Figure 3. Frequency of use of the Abalobi app (1.6v)

The frequency of use of the app was fairly low at the beginning and dramatically increased from December 2015 on. This coincides with the WCRL fishing season in Lambertsbaai, which opened in mid-November 2015 and closed at the end of March 2016 (http://www.daff.gov.za/daffweb3/Home/aid/429) and the Yellowtail season in Struisbaai, which peaked between February and March 2016. As stated in Table 6, one fisher from Lambertsbaai disappeared in November 2015 (LMB Fisher 4) hence there is no record registered for him from then on. LMB Fisher 2 and LMB Fisher 5 had issues with their boat registration and could unfortunately not go out to sea during most of the WCRL season. They did however record no fishing days (as requested by us in November 2015). STB Fisher 1 struggled with the technology and did not use the app, although he is keen on the project and participated in all workshops and meetings. STB Fisher 5 also struggled with the technology and would record his catch with the help of the field manager only.

The most striking feature illustrated by the above charts is the difference in frequency of use between fishers from the two participating communities. Fishers from Struisbaai used the app more frequently than the fishers in the West Coast. Although not certain, this difference in frequency of use could be due to the fact that the three Struisbaai fishers using the app more frequently were already comfortable

working with a smartphone and therefore had no issues with the technology itself, while the younger Lambertsbaai fishers had boat issues and were therefore not fishing regularly.

The frequency of use of the app by the monitors of each fishing community was also analysed to determine their acceptance of the technology. Based on the graph below (Figure 4), monitors from Lambertsbaai recorded more than the monitor from Struisbaai. It is important to mention here that there are two monitors in Lambertsbaai sharing the use of the tablet and Abalobi app to record as many boats as possible. The catch of boats arriving back at the landing site after 4pm was usually recorded on the following day, and the monitors used the "comment" function on the app to make a note of that. In Struisbaai there is only one main monitor using the tablet. He often lets other monitors use it but the dynamic is not the same as in Lambertsbaai. This might account for some of the differences in frequency of use of the app by the monitors illustrated below.

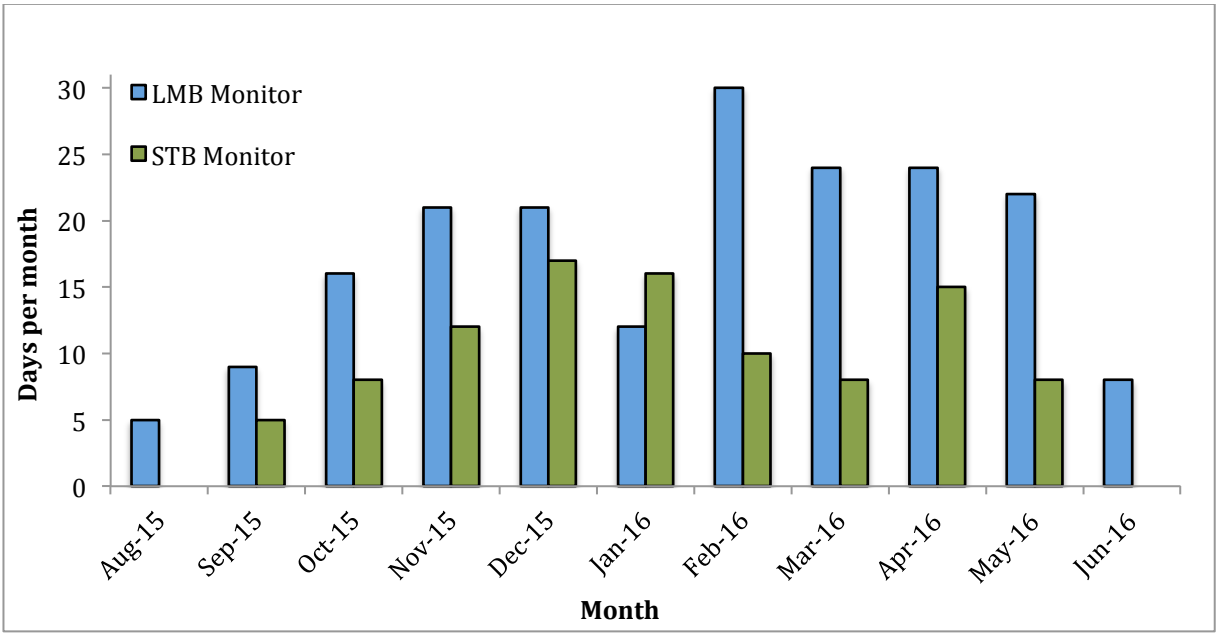

Figure 4. Frequency of use of the Abalobi app by the monitors (1.5v and 1.6v)

4.3.2 No fishing days

Fishing can be a very unpredictable activity and "no fishing days" can be a valuable source of information. Fishers participating in the pilot phase of the Abalobi app were asked to record "no fishing days" from October 2015. Data regarding such days were first recorded in December 2015. The graphs of frequency of use above represent the

count of days in which the app was used but do not differentiate between fishing and no fishing days, hence the importance of the table below (Table 9).

Table 9. Record of "no fishing days"

Month/Landing site	Went fishing?	
	Yes	**No**
December 2015	**21**	**36**
Lambertsbaai	2	7
Struisbaai	19	29
January 2016	**30**	**46**
Lambertsbaai	2	20
Struisbaai	28	26
February 2016	**31**	**39**
Lambertsbaai	0	14
Struisbaai	31	25
March 2016	**43**	**35**
Lambertsbaai	0	11
Struisbaai	43	24
April 2016	**44**	**67**
Lambertsbaai	0	45
Struisbaai	44	22
May 2016	**47**	**81**
Lambertsbaai	1	51
Struisbaai	46	30
June 2016	**22**	**22**
Lambertsbaai	0	12
Struisbaai	22	10
TOTAL	**238**	**326**

During the period of December 2015 – June 2016, fishers from Lambertsbaai and Struisbaai recorded 238 fishing days compared to 326 "no fishing days".

On "no fishing days", fishers were further asked to record their reason for not going out to sea (Figure 5). As illustrated on the table below, bad weather was by far the most common reason recorded. The striking difference between Struisbaai and Lambertsbaai can be attributed to the difference observed in the frequency of use of the app itself.

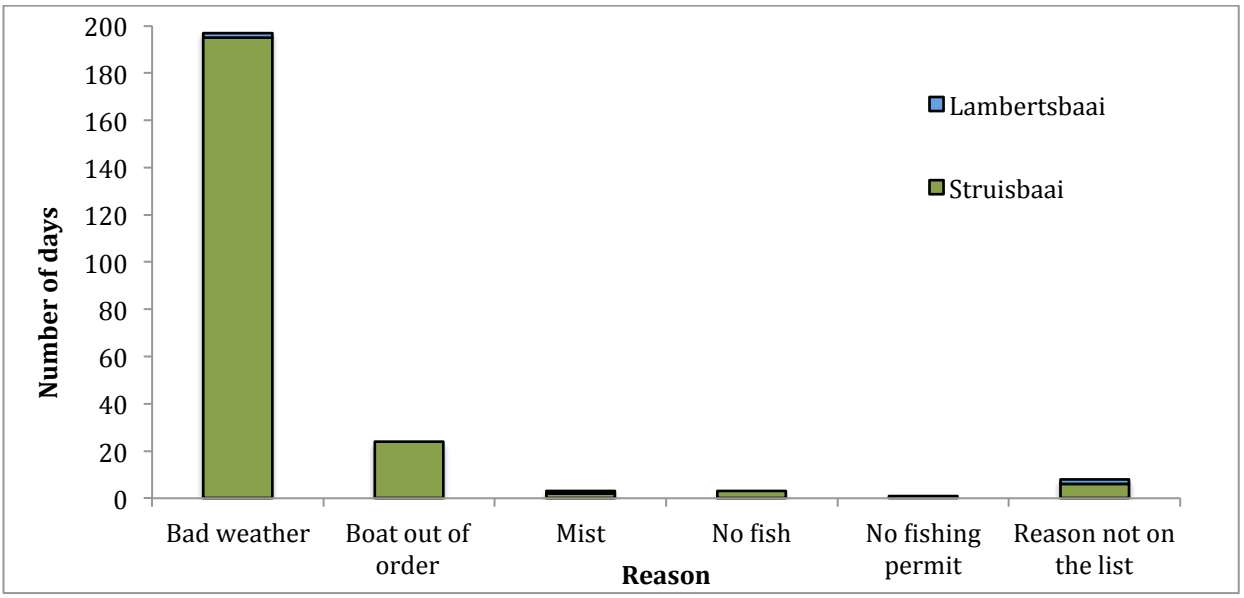

Figure 5. Reasons for not fishing

4.3.3 Costs

During the very first workshop in Lambertsbaai, when the Abalobi app was formally launched, participating fishers were asked to think about possible functions they would like to have on the app which would help them on their day-to-day fishing activities. Being able to record all the costs involved in going out to sea was one of those functions. The feature was added to the new version (1.6v) and made available to fishers from December 2015 (Lambertsbaai) and January 2016 (Struisbaai). In order to evaluate the uptake of the "costs" function, the below graph (Figure 6) was generated.

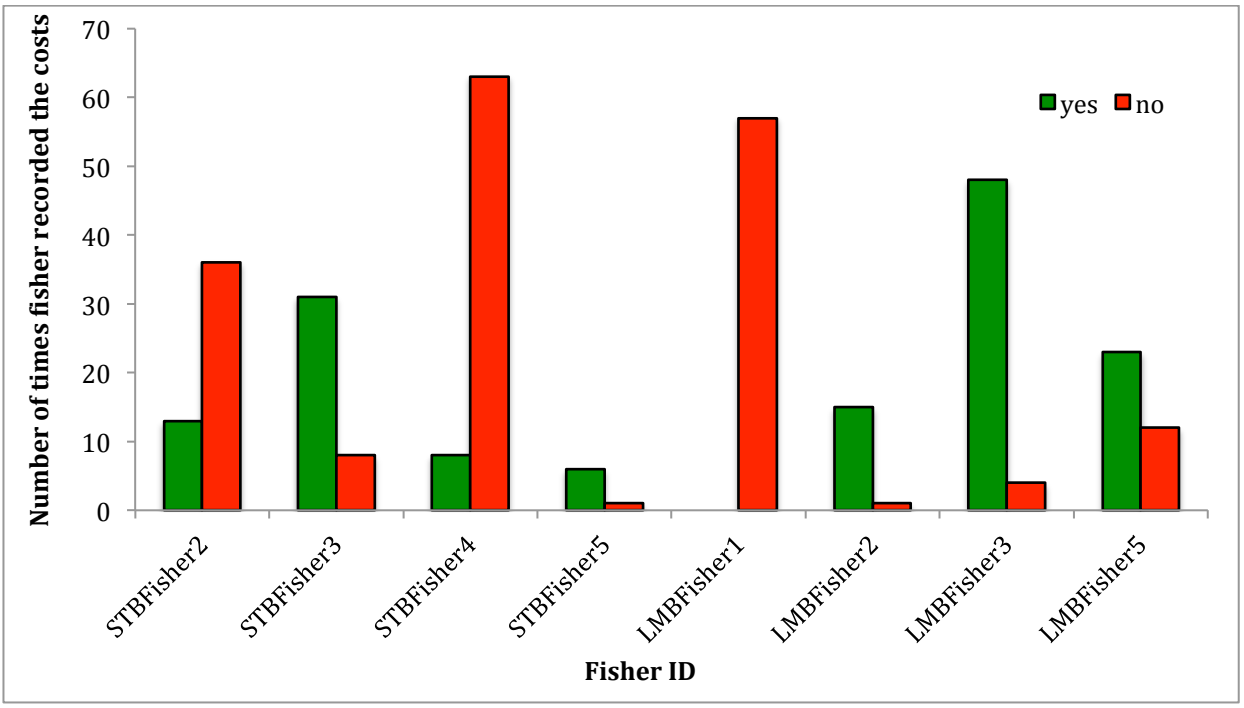

Figure 6. Frequency of use of the "costs" function on the Abalobi app (1.6v only)

From the graph above it is distinguishable that fishers from both communities used the function, but fishers from Lambertsbaai recorded their costs more often than fishers from Struisbaai. This would make sense, considering they were the ones that asked for the function to be included in the app and were therefore keen to use it. It is important to note here that most fishers did not take their phones out to sea, instead, all data was usually recorded upon their return to the landing site or later at home. It is possible that by then fishers did not remember their exact costs and hence decided not to use the function. Another possibility would be that because their costs were fairly similar every day, fishers opted to not record them every time they went out to sea. The data above only represents "fishing days".

4.3.4 Outside boats

The issue of competition with outside commercial and recreational boats was highlighted many times during the course of this research. It is a particularly worrisome issue during yellowtail and WCRL season, when "outsiders" invade the waters of Struisbaai and Lambertsbaai and local small-scale fishers struggle to fish their quota. The function to record the number of local, sport (recreational) and outside ski boats (commercial) observed was therefore made available for fishers and

monitors from the first version of the Abalobi app (1.5v). The graph below (Figure 7) illustrates the number of boats of the different sectors recorded by the fishers of Lambertsbaai and Struisbaai from August 2015 until mid-June 2016. The following figure (Figure 8) illustrates the number of boats of the different sectors recorded by the monitors of Lambertsbaai and Struisbaai from December 2015 to mid-June 2016. The graphs below do not differentiate between boats recorded in Lambertsbaai and Struisbaai.

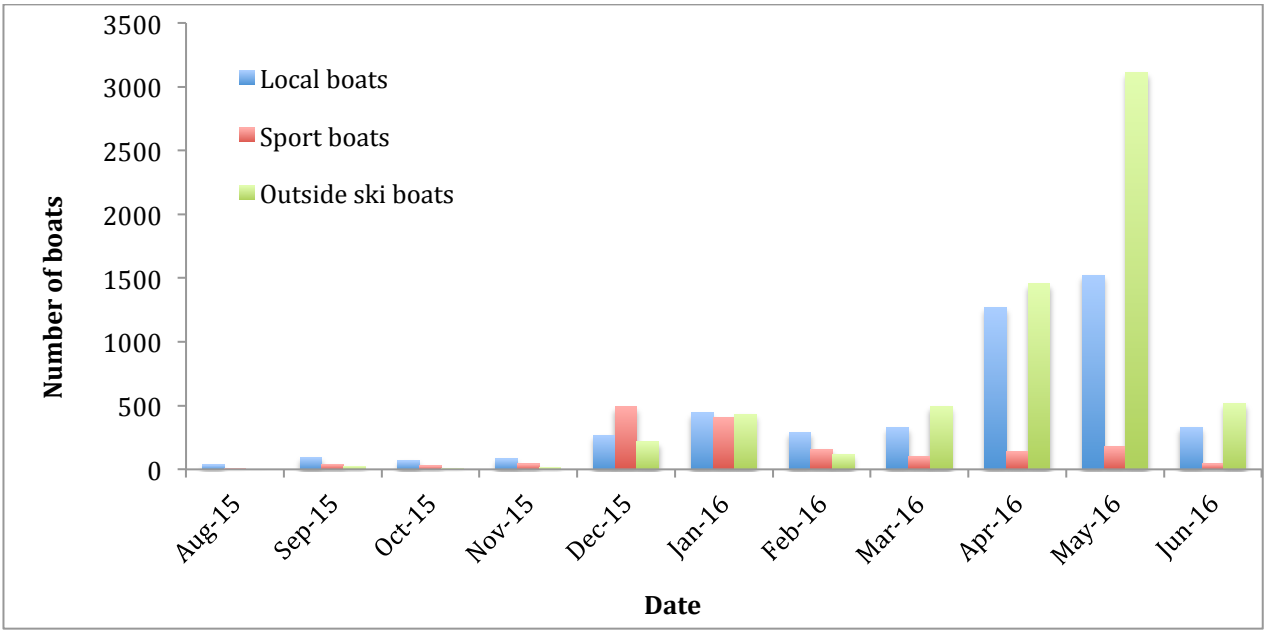

Figure 7. Different fishing sectors recorded by the fishers

Both fishers and monitors recorded similar data. The number of outside ski boats recorded starts increasing from March 2016 and the number of sport boats peaked in December, most likely due to the school holidays and WCRL season in Lambertsbaai. The main fishing season in Struisbaai occurs during the summer months, from November to April. The fishing season generally starts around October/November and peaks in December/January, when yellowtail, cape salmon, kob, silverfish and shark are most abundant and the main species harvested (Parker, 2013). During peak holiday seasons (December/January and March/April), sport boats flood the Struisbaai harbour and the fishing banks, targeting the same species as the local fishers who are at a disadvantage due to slower and older boats (Parker, 2013). This is consistent with the data illustrated by both graphs of the number of boats of

the different fishing sectors recorded by fishers and monitors of Lambertsbaai and Struisbaai.

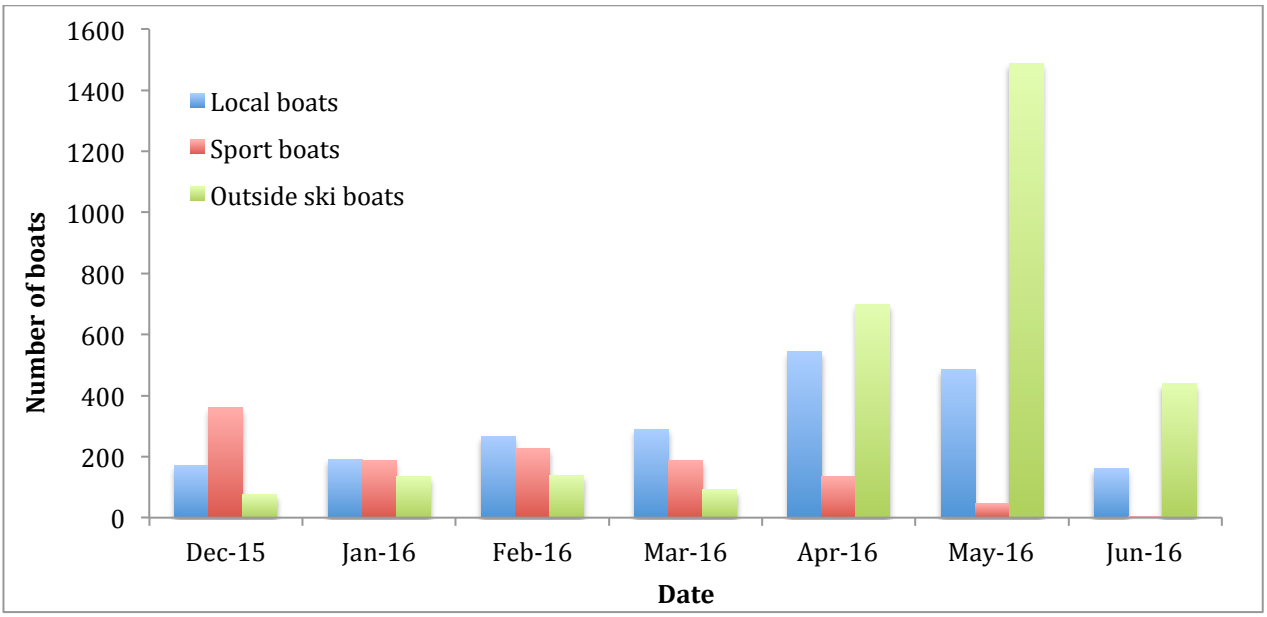

Figure 8. Different fishing sectors recorded by the monitors

4.4 Conclusion

This chapter described the results that were obtained from the interviews, focus group, quantitative data obtained from the cloud-based server, and personal notes. The results of the research show that small-scale fishers of Lambertsbaai and Struisbaai are heavily dependent on marine resources for their income and livelihood needs. Results also show that fishers from these communities are still somehow marginalized and currently have many challenges and difficulties threating their livelihoods and quality of life, many of which will be discussed in the next chapter.

Regarding the acceptance and uptake of the Abalobi app, participating fishers from Lambertsbaai and Struisbaai are keen on the project and understand the opportunities a tool like that could bring about, but many are still a bit skeptical and mistrustful of government involvement, which is expected but could prevent the app from being successful in the long run. Older fishermen struggled with the technology, and more capacity building and training should be considered in the future, an issue that will also be further discussed in the next chapter.

Chapter Five

Discussion

5.1 Introduction

It has been highlighted in previous chapters that: 1) the management of South African fisheries has been focused on a top-down conventional approach and favoured the development of a large-scale commercial fishery, 2) small-scale fisheries have been historically marginalized in the country, and 3) there is a clear need to change management approaches and involve small-scale fishers in resource monitoring and compliance. South Africa's government's realization of the need to change management approaches puts the country in a leading position to employ innovative management measures, ensuring the successful management of small-scale fisheries by the fishers themselves, in partnership with fisheries authorities, as advocated in the new Small-Scale Fishing Policy.

Taking into account South Africa's history and previous marginalization of small-scale fishers, the pending implementation of the Small-Scale Fishing Policy needs to address the above concerns in order to be well received by the small-scale fisher community. The gap between scientific knowledge (fisheries authorities) and local knowledge (fishers themselves) is one of the major challenges affecting the successful management of small-scale fisheries. The co-management of small-scale fisheries envisaged on the new policy has the potential to mitigate this particular issue but will require adequate capacity building for all stakeholders participating in the co-management process in order to be effective and positive. The mobile app described in this thesis (Abalobi) is a tool with the potential to support this capacity-building need if supported and accepted by both small-scale fishers and fisheries authorities. Small-scale fishers currently using the Abalobi app hold a lot of legitimacy and credibility to the data they collect. They trust it. Much more than they trust government's data. The data collected by the fishers can also be regarded as credible and robust by scientists. Furthermore, the effective implementation of the Small-Scale Fishing Policy depends heavily on reliable and accessible data to further manage the small-scale fishing sector in South Africa. Mobile phones are currently the most widespread and affordable information technology available worldwide and therefore an appropriate tool to use.

This chapter discusses the research findings in relation to the broader literature informing the study, focusing on the opportunities, concerns and uncertainties of formalizing the Abalobi app as a management tool for small-scale fisheries (Objective 4), as identified by the fishers and data catch monitors of Lambertsbaai and Struisbaai.

5.2 Challenges linked to ICT4Fisheries

Given their past history of marginalization, small-scale fishers are often skeptical, with reason, when it comes to supporting new endeavours and projects, such as the Abalobi app and the new SSFP. A crucial objective of this study (Objective 4) was to identify and assess the concerns surrounding the use of the Abalobi app and its possible formalization as a management tool in light of the pending implementation of the SSFP. The following section explores in more detail the main concerns identified by the fishers of Struisbaai and Lambertsbaai participating in the Abalobi app pilot phase. Data recorded by the monitors, even during the pilot phase, had already been shared with DAFF as this is part of their job description, therefore monitors did not have major concerns regarding the app's formalization. Recommendations and ideas on how to overcome some of the challenges linked to the ICT4Fisheries can be found on the last chapter (Chapter 6) of this thesis.

5.2.1 Ownership

In addition to the various regulations restricting the movement of small-scale fishers, what they catch and how they catch it, the small-scale fishery is also governed by mechanisms to ensure compliance. At the end of each fishing day, right holders are required to record the catch landed by their crew in a DAFF issued "Catch Data Submission". Also referred to as the "Blue Book", the catch returns call for various details, compelling right holders to specify the different species caught on a particular day, the approximate volume of fish landed and the location of harvest. Right holders are obliged to submit their blue books to a representative of the department on the 15th of each month. Based on this system, which has been in operation for years, fishers are collecting data regarding the status and health of fish stocks and their activities for government, as a measure of compliance. Data is owned by DAFF.

From the workshops, interviews and focus group discussion, it was clear that the issue of ownership of the data collected on the Abalobi app was of great

importance to the participating fishers. Of the fishers interviewed, 2 out of 7 said they were very comfortable sharing their catch information with DAFF, while 4 out of 7 said they would not be comfortable and one fisher (LMB Fisher 3) was uncomfortable with the question and preferred not to answer. The co-management of fisheries prescribed in the new SSFP means that fishers will finally have a say regarding some of the decisions affecting their main source of income and livelihoods. Owning their catch data empowers fishers to fully participate in decision-making processes, as they are also bringing something valuable to the table – reliable data.

Data collected and linked to modules within the Abalobi app (catch, ecological indicators, fisher profiles, socio-economic baselines, co-operative sales and revenue) is owned by the person or entity that collected it, and will only be made available to stakeholders involved in the app and on a user-defined basis. In addition, the sharing of confidential information with other stakeholders will be on a case-by-case basis (Raemaekers et al., 2016). During the focus group, the last theme discussed was the issue of governance, more specifically, the opportunities the co-management of small-scale fisheries with DAFF and the monitors could bring about. Fishers talked about using the Abalobi app to close the gap between local knowledge and scientific knowledge, and how the data collected with the app could possibly be used to direct the TAC of the species targeted by them. Fishers are therefore willing to share the information gathered through the Abalobi app with the fishing authorities, but only through a co-management approach which ensures their ownership of the data.

Taking into account the limited information available regarding small-scale fisheries in the country, and DAFF's limited budget to employ more monitors and scientists dedicated to closing the gap in the data, the Abalobi app has the potential of being an ideal citizen science tool, as it covers all four dimensions described by Cnaan et al. (1996): it is voluntary; citizen scientists do not receive any monetary compensation, activities are carried out by organizations or individuals, and the intended beneficiaries (government and fishers) are widespread. Unlike many citizen science projects however, which use participants to collect data for the project, with Abalobi, fishers/users own the data and choose to share it with DAFF due to the benefits to all parties. Due to the high interest from the fishers' side to participate, many of the limitations of citizen science, such as the accuracy of the data and the citizen's ability to master the methods employed, can be easily overcome with capacity building and community involvement.

5.2.2 Capacity building

The vulnerability of small-scale fisher communities locally and internationally can be significantly reduced through various developments and improvements, such as increased access to capital, education and awareness, capacity building and increased communication and involvement in decision-making processes (Béné et al., 2007). Capacity development was described by Macfadyen and Huntington (2004) as "the process by which individuals, groups, organizations, institutions, and societies develop their abilities – both individually and collectively – to set and achieve objectives, perform functions, solve problems and to develop the means and conditions required to enable this process" (p. 1). For the purpose of this research, emphasis is placed on individual capacity building of small-scale fishers.

Building capacity is regarded as a crucial aspect in ensuring that fisheries legislation, policies and management aimed at assisting small-scale fisher communities is effectively implemented and enforced (Béné et al., 2007). If local communities are to be shouldered with responsibilities that they are not capable of carrying out due to lack of knowledge, resources or information, the co-management prescribed in the SSFP will not be successful (Pomeroy, Cinner, Nielsen, & Andrew, 2011; Sverdrup-Jensen & Nielsen, 1998). The empowerment and proper capacity building of small-scale fishers is therefore necessary before the implementation of the new SSFP can be carried out.

According to Parker (2013), the fishing community of Struisbaai feels despondent and powerless in terms of influencing policies and management decisions that will affect their livelihoods. Nevertheless, they live in hope of bettering their circumstances and often resist plans that would negatively impact their community. While it was already determined that the active participation of fishers and the incorporation of local knowledge in decision-making can reduce fishers' vulnerability, it is important to note that none of those will work without the proper capacity at the individual, community, organizational and institutional level (Parker, 2013).

Fisheries management's failure to conserve resources has often been blamed on fishers' lack of power and importance in management, resulting in their having little influence in the political arena (Berkes et al., 2001). Participation in decision-making processes would become easier and the ability to influence positive outcomes greater if fishers felt confident that they were supported by constituency, with the proper institutional platform (Berkes et al., 2001), thus stressing the need to build

local institutional and individual capacity. Capacity building in vulnerable fishing communities should focus on strong leadership and be based on the needs and aspirations of the small-scale fisher community itself, as opposed to outside agendas and pressures, and with the appropriate assistance and support from fishing authorities (Béné et al., 2007).

There is an urgent need for training on how to establish and manage a co-operative, on how to establish their own markets and support in engaging with the local municipality to ensure that the fishers' needs are reflected in the IDPs of municipalities before the formal implementation of the SSFP (Sunde, 2016). Although the SSF Directorate intends to provide a measure of capacity building through their service providers and on-going field support, the capacity of the Directorate itself is limited, hence the need to partner with civil society organizations, such as Masifundise and the Abalobi project, to fill this gap (Sunde, 2016).

Small-scale fishers of Lambertsbaai and Struisbaai identified the lack of capacity within their communities as a current obstacle, preventing them from influencing government decisions regarding fishing rights allocations, quotas, fishing locations, and more. One of the long-term objectives of the Abalobi app is to build capacity among decision-makers, so that they can use the data gathered through to the app to inform decision-making. The Abalobi project hopes to equip fishers and community associations with the tools and capacity for effective and transparent management of catch allocations, sales and benefit sharing. The pilot phase of the app is being accompanied by rigorous capacity building and training workshops specifically designed for local fishers, community field assistants, and DAFF personnel.

Across the entire SSF sector, the historical power relations together with the marginalization and exclusion of small-scale fishers from access to marine resources and participation in the management of these resources has left the sector struggling for their livelihoods (Sunde, 2016) and uncertain about the future. Some of these uncertainties were particularly relevant for this research and are further discussed in section 5.4.

5.3 Opportunities

Garcia and Charles (2007) describe the fishery system as a plexus of subsystems that exists within a broader natural and human system and is therefore affected by the global environment, economy and society. Management of this system needs to be interdisciplinary and integrated, involving scientists as well as the interactions between all stakeholders, in order to effectively address all fisheries management and governance issues. Similarly, the opportunities of formalizing the Abalobi app as a management tool identified by government, scientists and fishers themselves need to be taken into consideration in order for the app to be effective and the co-management of small-scale fisheries foreseen in the new SSFP to be possible. There is no co-management yet, and the data collected by small-scale fishers using the Abalobi app has not yet been used at the co-management table, however, a key ingredient for it to be sucessful, namely trust and credibility, has already been observed.

The term co-management refers to an approach to resource management that supports the participation and input of resource users in management and decision-making processes (Jentoft, McCay, & Wilson, 1998). The approach covers a range of possible partnerships between resource users, government and other stakeholders by which the decision-making is shared in order to effectively manage the natural resource (Hauck & Sowman, 2003). The co-management of fisheries has been showed to enhance the gathering of data, resource protection against environmental damage, enforcement of regulations, and the move towards more inclusive decision-making (Berkes et al., 2001). The adoption of the co-management approach on the new SSFP could enhance the role of fishers, fisher communities and fisher organizations, enabling their concerns to be heard and dealt with together. The data and information provided by the fishers could result in the improvement of decisions and would ensure the legitimacy of the management system itself, as well as significantly reduce conflicts between fishers and the fishing authorities (Hara, 2003; McConney & Charles, 2009).

The following section will explore in more detail some of the main opportunities of formalizing the Abalobi app, as identified by the fishers of Lambertsbaai and Struisbaai, taking into account the pending implementation of the new SSFP and broader literature informing the study (see Chapter Two).

5.3.1 Safety at sea

Fishing is probably the most dangerous occupation in the world. According to the FAO, roughly 30 million fishermen are working aboard four million fishing vessels operating in capture fisheries, of which 98 percent are vessels under 24m in length not covered by any international rules and regulations (FAO, 2010). Small-scale fishers are particularly vulnerable to the dangers posed at sea. The chukkies used in Struisbaai are considered a safety hazard by the fishers themselves and fishers of Lambertsbaai often struggle with leaks in their boats and problems with the motors. Safety at sea for fishers should be addressed not only through government activities, such as regulations and guidelines, but also through grassroots activities by always being an integral part of projects related to fisheries livelihoods, coastal vulnerability, climate change and integrated coastal management. A participatory approach to the issue and the involvement and commitment of local fishing communities is crucial for the success of any safety measure (FAO, 2010).

One of the main themes of the focus group discussion conducted on May 5th 2016 was the challenges faced by the fishers at sea, and the issue of safety was repeatedly brought up. The weather in both study sites can often be unpredictable and even though 100% of fishers interviewed have a GPS on their vessel, only 28,5% have a Vessel Monitoring System (VMS).

In South Africa, the Department of Agriculture, Forestry and Fisheries (DAFF) is responsible for maintaining the South African Vessel Monitoring System (VMS) and stipulates which vessels are required to have one on board. The VMS is primarily a Monitoring, Control and Surveillance (MCS) tool used to ensure that the provisions of the Marine Living Resources Act, permit conditions and international legislation are met. The South African VMS has been in operation since March 2000, with currently more than 1527 vessels on the database (http://www.daff.gov.za/daffweb3/ Branches/Fisheries-Management/Monitoring-Control-and-Surveillance/ FISHPVESSELS). However, the use of a VMS is only mandatory for inshore commercial line fisheries and not for fishers currently on an Interim Relief Permit (IRP), who would greatly benefit from having one on board from a safety point of view but cannot afford their high cost – anything between R3, 700 and R8, 000 plus R300 airtime/month (Isaacs & Pointer, 2010).

In the Northern Cape, with support from the local district municipalities of Porth Nolloth and Hondeklipbaai, the Coastal Livelihoods Foundation, a registered

non-profit company concerned with the upliftment of small-scale fishing communities, has successfully implemented a community-based vessel tracking system to enhance safety at sea. The system consists of a computer-based radio station receiving and monitoring the GPS positions of vessels from mobile VHF maritime radio units. Small-scale fishers in Port Nolloth and Hondeklipbaai are supplied with these units when they leave for a fishing trip, after which the unit is returned to the radio station. Fishers in these two communities have united around the safety system and taken responsibility for their own safety and that of their fellow fishers. Since its commission, no lives have been lost at sea.

One of the long-term objectives of the Abalobi project is to enhance safety-at-sea and reduce the electronic requirement of fishers. This capability is currently being co-developed with the small-scale fishers, and will need to be coordinated with established organizations such as the South African Maritime Safety Authority (SAMSA) and National Sea Rescue Institute (NSRI). Work is currently underway to integrate the system used in the Northern Cape with the Abalobi app and develop a live map of vessel activity (Raemaekers et al., 2016), which would enable fishers to access distance logs and keep track their fishing activities.

These extra features of the app add incentives for the fishers to use all of Abalobi, especially the logbook, and thus safety at sea can potentially be an entry point towards stimulating the co-manegement of the fishery and the participation of small-scale fishers.

5.3.2 Market dynamics

Studies showed that small-scale fishers' vulnerability is exacerbated by shocks and trends within their immediate environment, such as competition with other fishing sectors, limited power in local market structures, limited gear, and lack of access to educational and transport infrastructure, as well as some external factors, such as climate change, and broader governance and institutional processes (Parker, 2013; Raemaekers & Sowman, 2015).

According to Charles (2001), "market" is the process by which fish is bought and sold, and a crucial activity in any fishery. The theory of supply and demand is the foundation of any fish market. A good system is where no one controls the quantities supplied and demanded and cannot influence the prices of fish, and there is the free exchange of information and knowledge between all stakeholders in the fishery

system (Charles, 2001). As it so happens, markets never actually follow this ideal situation, and conflicts arise as a result of an unbalanced value chain. In developing countries, the cash amount received by fishers for their catch is significantly less than the final retail price of the fish. Contractual constraints between fishers and buyer represent another complicating factor, leaving fishers obligated to a specific buyer, this changing the market interactions from supply and demand to a monopoly controlled solely by the buyer (Charles, 2001).

Trade and post-harvest activities have the potential to significantly contribute to poverty alleviation and food security for small-scale fishers (Béné et al., 2007), but issues of power and conflict within the local markets prevent fishers from assessing this resource and have serious implications for livelihood outcomes. At present, fishers have no negotiating power with the buyers, and no knowledge of the day-to-day market prices of fish. As a result, fishers are unaware if they are getting a fair price for their catch and often feel cheated by the buyer, which further impairs the relationship between fisher and marketer/buyer and the market dynamics.

The influx of outside boats (migratory fishers) fishing in Struisbaai and Lambertsbaai during the holiday season also negatively affects the market. Since their vessels are faster and better (usually ski boats), they arrive faster at the fishing banks and are the first back at the landing site. Once the market is saturated, the price of fish drops dramatically and the local fishers have no power to contest it. This illustrates that currently, in the majority of small-scale fishing communities, the buyer tends to hold a great degree of control over the local fishers and the market (Parker, 2013). Overall, the local market dynamics in Struisbaai and Lambertsbaai do not benefit the local community or provide any opportunity for increased income for fishers. These types of social interactions can often support or reduce the community's ability to improve their livelihoods, through issues of trust and reciprocity. As stated by Campbell (1999), relationships between fishers and buyers, or fishers and outside fishers, are important for the small-scale fisheries market.

In Lambertsbaai, small-scale fishers are obliged to enter into agreements with the exporting companies in order to sell their quota of WCRL, which severely limits their power over the quota allocations, and requires a lot of "overhaul if fishers are to be released from their debasing position as mere debt-ridden servants of the exporting companies" (Nthane, 2015, p. 61). The new policy predicts that fishers will be able to export their own lobster under their own recognizable label, marketing not only the

product but also their history and livelihoods as small-scale fishers. However, until DAFF provides the capacity for fishers to do so, this prediction is nothing but a dream. In the meantime, fishers will remain bound to established apartheid-era export companies. A significant stumbling block in this process is the need for government to take a tougher stance to deter the influence of a monopolistic capital (Sowman et al., 2014).

Many efforts around improving the livelihood of small-scale fishers have focused on pursuing alternatives to increase their income by reducing the role of the middlemen. The new SSFP itself proposes far-reaching reforms in the small-scale fishing sector aimed at granting the fishers greater autonomy in the management of their resources, as well as post-harvest selling and marketing (Nthane, 2015). Charles (2001) points out however, that it is important for such efforts to incorporate a good understanding of all complexities within the fishery system and community involved in order to be truly effective.

Facilitating the day-to-day operational management of the local fisheries by individual fishers, community monitors and co-operative management structures, as they play an empowered role in the value chain, is an anticipated outcome of the Abalobi app. With direct market interactions, co-operatives can enter into new markets or solidify their current market positions, as well as secure traceability of the catch, increase their revenue base and explore other benefit-sharing opportunities (Raemaekers et al., 2016). A possible capability of the app, to be co-developed with the fishers, is an online fish market, where individual fishers and/or co-operatives can directly connect to buyers, be they local restaurants or holiday makers, through a spatial map with daily catches and prices. A more immediate characteristic of the app, which focuses on the co-production of knowledge, is the availability of live data regarding the fishers' catch, weather predictions, market prices and demand; and real-time tracking of the fishers and their activities at sea (Raemaekers et al., 2016). Empowering small-scale fishers in the value chain is one of the underlying objectives of the Abalobi project, and testing the ease of use and uptake of the tool is vital, as well as assessing how the app and access to information is assisting communities in making co-management decisions for the sustainable use of the local marine resources and in new market opportunities (Raemaekers et al., 2016).

5.3.3 Data and knowledge for co-management

The lack of reliable data and information about small-scale fisheries is currently one of the primary challenges facing the sector in South Africa. This lack of data is a consequence of the historical marginalization of the sector within the political economy of the governance and management of fisheries. Without reliable data regarding the health and status of fish stocks targeted by small-scale fisheries, fishers cannot demonstrate to policy makers that the sector has the potential to contribute towards food security and poverty eradication, and the commercial sector has grounds to argue against the redistribution of resources (Sunde, 2016). Furthermore, this lack of data creates an almost obvious obstacle to the successful implementation of the SSFP. In the words of Abongile Ngqongwa, DAFF SSF Fisheries Official, "in South Africa, it has been argued that, in addition to the type of management approach, lack of information has been one of the major contributing factors that saw previously disadvantaged-by-apartheid fishers being even further marginalized by a process that sought to solve the problems of imbalance" (Ngqongwa, 2015, p. 39).

Historically, fisheries management has depended on technical tools and scientific knowledge to inform decision-making. The shift to recognizing fisheries as complex systems, however, requires a broader interdisciplinary perspective that incorporates information sources gathered from a range of disciplines, such as social sciences, humanities, law and economics (De Young, Charles, & Hjort, 2008; Sowman, 2011). Furthermore, the broadening of this interdisciplinary approach to include the integration of indigenous or traditional ecological knowledge is gradually being recognized (Berkes et al., 2003; McConney & Charles, 2009). In Oceania, due to the lack of scientific knowledge in the region, there is an increasing consensus that alternative fisheries management models in which local knowledge is the main source of data and information may and should be proposed (Berkes, Mahon, McConney, Pollnac, & Pomeroy, 2001).

Traditional ecological knowledge can be defined as "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, concerning the relationship of living organisms with one another and with their environment" (Berkes, 1993, p. 8). The term "local knowledge" is more recent and practical, but fails to incorporate the historical and multigenerational facet. The local knowledge of small-scale fishers may include knowledge regarding ecological, biological, behavioural, nutritional and even

medicinal aspects of marine resources, along with oceanographic and geographic aspects of the environment (Sunde, 2016). A community's local knowledge is usually passed down verbally through generations, acquired through first hand experiences and therefore not readily available to scientists, which does not mean it does not exist. Although not necessary available in formats scientists understand, its value in supplementing and guiding scientific data can enhance the understanding and management of the small-scale fishery system. Moreover, local fishers are more likely to accept governmental policies if these are consistent with their values and practices (Sowman, 2011).

For the SSFP, which advocates a people-centred and multiple-species approach to be implemented successfully, both government and fisher organizations have identified the need to develop an integrated small-scale fisheries information management system (IMS) which co-produces knowledge by bringing together the ecological and social indicators necessary to co-manage small-scale fisheries, and monitors the progress in terms of policy objectives. This system must include a high-resolution database that accommodates micro- and fine-scale data collection and regional fishery stock assessment (Raemaekers et al., 2016), in order to start compiling reliable data regarding the status and health of fish species targeted by small-scale fisheries. The Abalobi app has the potential of being this IMS and a key tool in small-scale fisheries since the co-management committees depend on credible information in order to properly manage the sector. This would further empower fishers to responsibly manage their fishing rights and resources through well-informed decisions and compel fisheries authorities to take local knowledge into account.

Previous marginalization of small-scale fishers and the catastrophe of the Fishing Rights Allocation Process (FRAP) in 2013 contributed to the current high level of mistrust within fishing communities (Sunde, 2016), highlighting the importance of transparency of decisions through well-presented information within fisheries co-operatives in order to reduce conflict and promote cohesion in these fishing communities (Ngqongwa, 2015). In preparation for the co-management prescribed in the SSFP, small-scale fishers should be recording their own catches and fishing trips as a way to start tracking their effort and catches and properly manage their fishing rights, which would ease the burden from fisheries authorities and positively impact the co-operatives, enabling fishing communities to better

understand their sector and make informed decisions regarding their rights. An IMS like the Abalobi app can be an empowering tool for small-scale fishers, allowing them to formulate recommendations for improved management of the fisheries at a community level based on reliable information and real-time data (Ngqongwa, 2015).

5.4 Uncertainties

The future of small-scale fisheries in the country after the implementation of the new SSFP is still uncertain, which leads to a great deal of stress for small-scale fishers who depend on the sector to survive and feed their families. The section below describes the two main uncertainties observed during the course of this research, the issue with fishers' rights and permits after the implementation of the SSFP and the future of the relationship with the Abalobi team and DAFF once the policy is formally implemented.

5.4.1 Rights and permits

The existing Individual Transfer Quota (ITQ) approach used for the last fifteen years in South Africa has led to the elite capturing rights at the expense of the poor (Isaacs & Pointer, 2010). Even though the ITQ approach was introduced as a mechanism for rationalism and adapting fishing capacity to resources and not as a poverty alleviation mechanism per se, it greatly contributed to the present status quo of South African small-scale fisheries. At present, the concentration of fishing rights is in the hands of fewer more efficient producers, at the cost of social equity (Isaacs, 2011b). The fisheries department used the ITQ system to reallocate, redistribute and reform the fishing industry. They did this by allocating rights to small groups of established companies in order to achieve economic stability, and to a large group of new entrants to achieve social equity, but this created a small group of community elite who benefited, at the expense of the *bona fide* fishers, who had no rights or formed part of the interim relief permit holders (Isaacs, 2006, 2011b).

The paradigm shift in the new SSFP from the existing ITQ rights allocation to a collective rights approach started in 2005 but it was only in 2014 that small-scale fishers were recognized in the eyes of the law. The policy makes a key shift to active rights – only fishers who practice fishing as a livelihood will be issued rights. Many existing rights holders are opposed to the shift from ITQs to collective rights allocation, claiming that it will lead to inevitable competition between commercial

rights holders and small-scale fishers, both of whom harvest marine resources in the same inshore zone. Many existing right holders articulated their fears surrounding the collective allocation, stating they would prefer to remain small-scale fishers as individuals as opposed to having to be part of a legal entity or community structure. During the 2007 Equality Court case, a new allocation system was not part of the drafting process of the new policy (Isaacs & Hara, 2015).

Another issue creating confusion in fishing communities is the apparent lack of communication between governmental departments. While DAFF was in the process of legalizing small-scale fisheries by amending the Marine Living Resources Act and developing guidelines for the implementation of the new policy, in 2012 the Department of Trade and Industry (DTI) introduced the Fisheries Cluster Project, investing R11 million in providing vessels to 39 different cooperatives, aimed to increase the participation of small-scale fishing communities in the value chain (Isaacs & Hara, 2015).

Small-scale fishers from Struisbaai and Lambertsbaai are still uncertain of what will happen after the policy is formally implemented in their communities, especially with regards to fishing rights and permits, representing yet another lack of communication on the part of the government. Fishers in Struisbaai and Lambertsbaai – as well as in other small-scale fishing communities – fear that their names might not appear on the final list of fishers that DAFF pronounces for their communities, but are at the same time uncertain about applying for commercial fishing rights, as this will prevent them from being eligible for the small-scale fishing policy once it is finally implemented. Fishers are also insecure and uncertain about the new policy due to the fact that DAFF took a very long time to start the process of implementing it, and when they finally started, they began with the fishers registration and fail to communicate to the communities what their next step would be. Fishers still don't know what will be in their "basket of species" and many fishers throughout the country are still without fishing rights, as the IR only makes provision for a certain amount of fishers, leaving thousands without any rights (Masifundise Development Trust).

DAFF should secure fishing rights before the implementation of the SSFP, so as to ease some of the fishers' concerns and cresate legitimacy of the new policy. The Abalobi app can facilitate the transition to the new policy by acting as a tool through which the fisheries authority can verify fishers and identify small-scale fishing

communities, and small-scale fishers can collect important and reliable data to empower themselves in the co-management table, changing the current status quo to a more balanced one, which takes both sides into consideration and incorporates the concept of local knowledge.

5.4.2 Relationship with the Abalobi team and DAFF

Fishers participating in the pilot phase of the Abalobi app built a relationship with the Abalobi team during the course of the last year. Even though it was not explicitly mentioned during any of the interviews, participants are uncertain about the future of the app and what that would mean for them. The Abalobi app is still in its first stages of development; another five modules aimed at dealing with issues of safety, marketing, training and others are already in planning or almost ready to be tested. Fishers already using the app are encouraged to participate in any further pilots as their input during the last year has contributed to the development of the app in ways which have met with their approval. Participation is, and will always be, voluntary and their catch data will remain confidential until the day they decide to share it.

The future relationship with DAFF is another uncertainty, one that became more obvious during the course of this research. Previous interactions with government and the historical marginalization of small-scale fishers resulted in a deep mistrust of government, especially DAFF. The Abalobi app was endorsed and is currently supported by government, something crucial to its future development and success as a management tool for small-scale fisheries but worrisome for the fishers. It is crucial to build a better relationship between fishers and government during the development of the app so as to ensure that both parties benefit equally and the power to make all decisions regarding fishing rights and quota allocations is not devoid of fishers' knowledge and needs.

Chapter Six

Conclusion and Recommendations

6.1 Overview of the study

The overall aim of this research was to determine if a mobile app can foster the co-production of fisheries knowledge and stimulate the co-management of fisheries, keeping in mind the pending implementation of the new small-scale fishing policy (SSFP). To achieve this, the following four objectives were identified: 1) introduce a mobile fisher logbook in the small-scale fishing communities of Lambertsbaai and Struisbaai; 2) monitor the use of the mobile fisher logbook in those communities; 3) evaluate the utility, acceptance and uptake of the mobile fisher logbook by the fishers in Lambertsbaai and Struisbaai; and 4) understand the opportunities, concerns and uncertainties of formalizing a mobile app as a management tool for small-scale fisheries.

To meet these objectives this thesis adopted Participatory Action Research (PAR) as the underlying research methodology throughout the entire research and data collection process. This approach allowed for the interaction and partnership of the researcher (myself) and the participants (fishers, monitors, field managers, other researchers) throughout the study, without compromising the data collected and observations taken. This thesis employed qualitative research methods such as interviews, participatory observation and a focus group, to gain an understanding of the challenges faced by the small-scale fishers of Struisbaai and Lambertsbaai and assess the opportunities surrounding the introduction of a mobile application (Abalobi), designed to help transform small-scale fisheries governance and facilitate the co-management of fisheries.

The current status of South African small-scale fisheries, together with information regarding the new SSFP formulated in response to the lack of a holistic approach to fisheries policy and management, and a comprehensive background and

context of the two study sites were covered in Chapter Two, and provided the theoretical foundations of this research. The findings of the study were interpreted keeping in mind some key concepts explored in the literature review regarding the history of South African small-scale fisheries, as well as the concept of citizen science and the use of similar technologies in small-scale farming and fishing in the African continent.

6.2 Recommendations

The new Small-Scale Fishing Policy (SSFP) is fairly comprehensive in its assessment of the livelihoods context of small-scale fishers and implementation challenges (DAFF, 2012). Nonetheless, the policy's function is not to "…spell out operational details" (DAFF, 2012, p. 27), or justify how the proposed co-management between the fishing authority and fishers' organizations will work in practice. The adoption of a generic management approach to the implementation that does not take into account the unique features and the historical context of fishing communities would most likely result in the failure of the policy, something that DAFF cannot afford (Ngqongwa, 2015). The new policy has the potential to address historical issues of justice, race-based oppression and resource allocation equity (Ratner, Asgard, & Allison, 2014) and the Abalobi app has the potential of facilitating this transition, however, one must not forget the immense implementation effort that would be required in order for that to be true (Sowman et al., 2014). The following recommendations highlight some key gaps in planning, which could hinder the implementation of the new policy and curb fisher's enthusiasm towards it, focusing on how the Abalobi app' design could possibly be adapted to help close those gaps in planning and increase the chances of a successful implementation.

1. Building small-scale fishers' capacity: as the implementation of the new SSFP approaches, the need to ensure that fishers have the capabilities necessary to have a significant role in managing the small-scale fisheries is an important factor to consider. A key factor to a successful co-management approach is adequate capacity building for all stakeholders participating in the process (Ngqongwa, 2015). Interventions that support fisher's existing skills and provide appropriate level education and training materials are required. These should also include consciousness and awareness-raising, to enable fishers to become aware of their

personal and political power (Sunde, 2016), and to participate in co-management decisions at the same level as the other stakeholders involved.

With the Abalobi app, both fishers and data catch monitors are capacitated to enter and interpret catch data in different formats. The app encourages fishers to keep track of their catches, expenses as well as possible fishing patterns and the incidence of other fishing sectors in the area. It's user-friendly and fairly simple design allows that fishers from all age groups are capable of using the app. Although the results of this research showed that older fishermen who never used a smartphone before struggle with the technology, it's benefits are so vast that a little more training could suffice to solve this issue. Another alternative to encourage the older age groups to use the app would be to involve the younger members of their families, fisher or not, as this would insure that they have help at home when needed, as well as encourage the younger generations to empower themselves.

2. Building democratic, transparent and accountable organizations: the new SSFP creates space for fishers to hold management structures to account for the impacts of long-term permit allocation. In order for fisher communities to benefit from the co-management of marine resources advocated in the new policy, local institutions must be created to address issues of poverty and social justice, and accommodate both marginalized poor fishers and commercial rights holders. Even though the policy development process helped fishing communities to formalize their role in the governance process, creating local management structures dedicated to poverty reduction, environmental and social sustainability and resource allocation remains a challenge. Ideally, before a system of shared decision-making, monitoring and compliance between fishers and fishing authorities can be possible, fishing communities need secure long-term rights to marine resources (Isaacs & Pointer, 2010). There is an urgent need for interventions aimed at equipping small-scale fishers with the methodologies and skills necessary to put in place checks and balances that will build legitimacy of their local co-operatives and protect them from corruption and abuse of power elites (Sunde, 2016).

The Abalobi project is contributing to the development of transparent, accountable management information systems that will enable small-scale fishing communities, such as Lambertsbaai and Struisbaai, to manage their own data and

accounting systems in accordance with the principles of good governance (Sunde, 2016).

3. Recognizing traditional knowledge: the SSFP development process has focused on bio-ecological scientific knowledge and overlooked traditional knowledge, social science and human ecology research (Isaacs & Pointer, 2010). In order to be accepted by local fishing communities and increase community participation, the policy must include other knowledge systems in the determination of fishing rights, regulation of fishing activities and allocation of quotas. Increased community participation will also heighten the awareness surrounding the benefits of effective co-management, increase the likelihood that fisheries management will be achieved in conjunction and thereby increase the efficiency of the decision-making process. In this regard, partnerships between local fisher communities and fisheries scientists should be encouraged and facilitated.

Taking into account the low levels of numeracy and literacy among poor fishing communities, government should be more directly involved in providing the support needed to ensure fishers are fully aware of the implications of any new regulation or policy. Instead of interim relief measures on an ad hoc basis, trans-disciplinary teams of scientists, social scientists, economists and fishers should be created to address issues of poverty, drawing on the traditional knowledge of the fishing communities, and feeding research into management decisions (Isaacs & Pointer, 2010).

Above all, the new SSPF should guide the management plans of local communities and be adaptable to local conditions. DAFF should secure fishers rights before the implementation of the new policy, considering a hybrid system of rights allocation. Furthermore, in order to ensure that value chain benefits are going to the local communities, a co-operative to manage the inshore resource processing and marketing should be considered, especially for the high value species (Isaacs & Pointer, 2010), such as the yellowtail and WCRL.

The Abalobi app is an integrated, transparent and participatory IMS that can stimulate the co-production of knowledge and a tool in which to compile fisher's traditional knowledge. The app encourages the co-production of knowledge by bringing together the social and ecological indicators necessary to co-manage small-scale fisheries, while at the same time monitoring progress in terms of policy

objectives. During the entire development process of the app, local fisher knowledge, experience and input was regarded as critical and the app itself went through several changes before its final version, most based on input received from the fishers of Struisbaai and Lambertsbaai.

6.3 Conclusion

The discussion of this thesis examined the opportunities, concerns and uncertainties of formalizing the Abalobi app as a small-scale fisheries management tool, as identified by the participating fishers of Struisbaai and Lambertsbaai. This dissertation highlights the current challenges faced by small-scale fishers in their day-to-day lives, such as competition with other sectors, lack of access to infrastructure, and a voice in the decision-making processes directly affecting their livelihoods, to name a few. Other factors contributing to the vulnerability of the small-scale fishing sector, such as the lack of transparency and openness in the local market dynamics and the unpredictability of the job and risks involved, were also noted. Moving forward, fishers' rights and capabilities need to be recognized; and individual and institutional capacity needs to be built, to ensure more participatory decision-making processes and improve the relationship between fishers and authorities.

Much remains uncertain about the impending fate of the small-scale fishery, and it is therefore crucial to base decisions on a grounded understanding of the realities at seas, on the coast and in the harbour and communities, based on more than just scientific knowledge. A mobile application such as the Abalobi app has the potential of bringing together various fisheries-related information and data in one comprehensive and integrated management system, making current management procedures more efficient and improving available data regarding catch effort, species size distribution, markets, fishing areas and more. The IMS can also provide DAFF with important socio-economic data regarding small-scale fishing communities, making it possible to generate a baseline of both ecological and social indicators against which to assess the Small-Scale Fishing Policy implementation and progress.

Small-scale fisheries have great potential for contributing towards poverty alleviation and food security for South Africa's marginalized communities. The challenge lies in developing and implementing policies and legislation that protect fishing rights for vulnerable communities as well as promote ecological and social

sustainability. The Abalobi app represents a possible technological tool enabling this to be possible in the long-term.

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Appendices

Appendix 1. Interview Schedule

Interview Schedule			
Date	**Interview**	**Organization/Affiliation**	**Code**
7 January 2016	Magdrie Kamfer	Catch data monitor with JAYMAT	Monitor LMB
7 January 2016	Alberto Van den Heever	Catch data monitor with JAYMAT	Monitor LMB
7 January 2016	David Shoshola	Bakkie Skipper	LMB Fisher 1
7 January 2016	Wilfred Conzalves	Bakkie Skipper	LMB Fisher 3
7 January 2016	Chadley Ruiters	Bakkie Skipper	LMB Fisher 5
7 January 2016	Nico Waldeck	Masifundise representative, project field manager in Lambertsbaai	Manager LMB
13 January 2016	Niklaas Joorst	Chukkie Skipper	STB Fisher 4
13 January 2016	Stuart du Plessis	Project field manager in Struisbaai, Cape Access representative	Manager STB
13 January 2016	Josias Adriaan Marthinus	Catch data monitor with JAYMAT	Monitor STB
13 January 2016	Sias Marthinus	Chukkie Skipper	STB Fisher 1
13 January 2016	Petrus Phillipus Groenewald	Ski boat Skipper	STB Fisher 2
13 January 2016	Theunis van der Berg	Chukkie Skipper	STB Fisher 3

Location	**Interviewed**
Lambertsbaai	2 monitors, 3 fishers and 1 community manager
Struisbaai	1 monitor, 4 fishers and 1 community manager

Appendix 2. Questionnaires

A) Fishers

Details of interview	
Date	Location
Interviewer	Number

Section 1: General		
1.1 Gender (please tick)	**1.2 Age**	**1.3 DOB**
Male Female		

1.4 What population group do you belong to? (Please tick)				
Black	Coloured	Asian/Indian	White	Other
If other, please specify:				

1.5 What language do you mostly speak at home?			
isiXhosa	Afrikaans	English	Other
If other, please specify:			

1.6 What is your level of schooling? (Please tick)	
No formal education	Incomplete Primary education
Complete Primary Education	Incomplete High School education
Complete High School education	Technical College education
University education	

1.7 Have you had any skills training courses? (Aside from Abalobi)		Yes		No
If yes, which				

1.8 How long have you been living in this community?

1.9 How many people live in your household/homestead?

1.10 What is the range of your total household monthly income?	**Season**	**Out of season**
Less than R500		
R501-R1000		
R1001-R1500		
R1501-R2000		
R2001-R3000		
R3001-R5000		
More than R5000		

1.11 How much of your income comes from fisheries related activities? (Mark appropriate)					
	All of it – close to		Most of it – close to ¾		One quarter – close to ¼ or

	100%		or 75%		25%
1.12 What other activities contribute to your total income? Please specify.					

1.13 How old were you when your involvement in the fisheries started?

1.14 Do you currently have a permit or quota?	Yes	No	Quota (tons or kg)	Did you apply but no successful
Traditional Line Fish			**n/a**	
Interim Relief			**n/a**	**n/a**
Recreational			**n/a**	**n/a**
Other				

1.15 What type of inshore fisheries activities are you involved in this year?	
Activity	Tick all that apply
Boat-owner	
Skipper	
Boat crew/assistant	
Shore-based job – paid	
Shore-based job - unpaid	
Other	

1.16 Do you have a crew that work for you (i.e. depend on you for their income)?		Yes		No
If yes, how many crewmembers do you have?				

1.17 What are your catches primarily used for? (Tick one in each applicable column)	Fish	Lobster	Mussels	Other species (specify)
To sell (everything)				
To sell (and to take small amount home)				
To eat				
To share with neighbors				

Other (specify)				

1.18 Who do you sell your catch to? (Tick all that apply)	
Community members	
Local restaurants	
Local fish shop	
Holiday makers	
Informal agents in community	
Informal agents outside the community	
Formal buyers (contract) outside village	
Formal buyers (contract) in village	
Formal processing facilities (contract)	
Formal processing facilities (contract) outside village	
Other (specify) langanas	

1.19 How many members of your household (other than yourself) are involved in fisheries-related activities?	

1.20 Are you or anyone in your household forced to fish because of lack of food?					Yes		No
If yes:	How often?		Which resource(s)?			Dou you use it just for food or for sale to convert into cash	

1.21 What kind of equipment do you have on your boat?	
GPS	
Radio	
FishFinder	
Other	

Section 2: Technology

2.1 Do you use your Abalobi phone?		Yes		No
If no, why not?				

2.2 Do you own a personal smartphone?
If yes, for how long?
What stuff (apps) do you use on your phone?

2.3 Does anyone else in your household own a smartphone?

2.4 How did you purchase your phone?	
Cash	
Contract	
Gift	
Other	

2.5 Do you find it easy to work on your smartphone?			
	Yes		No

2.6 How comfortable are you with the following apps? (Mark appropriate)	Very comfortable	Somewhat confortable	Not comfortable	Have not been using the app
ODK (recording)				
Salesforce (reporting)				
What's App (communication)				

2.7 How comfortable would you be teaching another fisher about the following apps? (Mark appropriate)	Very comfortable	Somewhat confortable	Not comfortable	Have not been using the app
ODK (recording)				
Salesforce (reporting)				
What's App (communication)				

2.8 How often do you record your catch on Abalobi? (Mark appropriate)	
Every time you fish (100% of the time)	
Most of the time (50-75% of the time)	
Sometimes (25-50% of the time)	
Never	

2.9 Did you keep a record of how much you fished before Abalobi?		Yes		No

2.10 How comfortable are you sharing the information on the app with other fishers? (Mark appropriate)	
Very comfortable	
Somewhat comfortable	

Not comfortable	
I have not been using the app	

2.11 Would you be comfortable sharing the information on the app with DAFF? (Mark appropriate)	
Very comfortable	
Somewhat comfortable	
Not comfortable	
I have not been using the app	

2.12 Regarding ODK:
What do you like about it?
What don't you like about it?

2.13 Regarding Salesforce:
What do you like about it?
What don't you like about it?

2.14 Regarding What'sApp:
What do you like about it?
What don't you like about it?

2.15 Do you go to the manager for assistance with Abalobi?			
	Yes		No

2.16 Was the training workshop good? Easy to follow?			
X	Yes		No

2.17 Was the language a problem?			
	Yes		No

2.18 Should we come more often?			
	Yes		No

Is there anything else you would like to add?

B) Managers

Details of interview	
Date	Location
Interviewer	Number

Section 1: General		
1.1 Gender (please tick)	**1.2 Age**	**1.3 DOB**
Male Female		

1.4 What population group do you belong to? (Please tick)				
Black	Coloured	Asian/Indian	White	Other
If other, please specify:				

1.5 What language do you mostly speak at home?			
isiXhosa	Afrikaans	English	Other
If other, please specify:			

1.6 What is your level of schooling? (Please tick)	
No formal education	Incomplete Primary education
Complete Primary Education	Incomplete High School education
Complete High School education	Technical College education
University education	

1.7 Have you had any skills training courses? (Aside from Abalobi)		Yes		No
If yes, which				

1.8 How long have you been living in this community?

1.9 How many people live in your household/homestead?

1.10 What is the range of your total household monthly income?	**Season**	**Out of season**
Less than R500		
R501-R1000		
R1001-R1500		
R1501-R2000		
R2001-R3000		
R3001-R5000		
More than R5000		

1.11 Are you/were you a fisher?			
	Yes		No

1.12 Which company do you currently work for? For how long?

1.13 How did you go about choosing the 5 fishers that are currently using Abalobi?

1.14 How did you get involved with Abalobi?

1.15 Do fishers come to you with problems? If yes, how often and how (phone, what's app…)?

Section 2: Technology

2.1 Do you use your Abalobi phone?		Yes		No
If no, why not?				

2.2 Do you own a personal smartphone?
If yes, for how long?
What stuff (apps) do you use on your phone?

2.3 Does anyone else in your household own a smartphone?

2.4 How did you purchase your phone?	
Cash	
Contract	
Gift	
Other	

2.5 Do you find it easy to work on your smartphone?			
	Yes		No

2.6 How comfortable are you with the following apps? (Mark appropriate)	Very comfortable	Somewhat confortable	Not comfortable	Have not been using the app
ODK (recording)				
Salesforce (reporting)				

What's App (communication)				

2.7 How comfortable would you be teaching another fisher/monitor/manager about the following apps? (Mark appropriate)	Very comfortable	Somewhat confortable	Not comfortable	Have not been using the app
ODK (recording)				
Salesforce (reporting)				
What's App (communication)				

2.8 Regarding ODK:
What do you like about it?
What don't you like about it?

2.9 Regarding Salesforce:
What do you like about it?
What don't you like about it?

2.10 Regarding What'sApp:
What do you like about it?
What don't you like about it?

2.11 Was the training workshop good? Easy to follow?			
	Yes		No

2.12 Was the language a problem?			
	Yes		No

2.13 Should we come more often?			
	Yes		No

Is there anything else you would like to add?

C) Monitors

Details of interview	
Date	Location
Interviewer	Number

Section 1: General		
1.1 Gender (please tick)	**1.2 Age**	**1.3 DOB**
Male Female		

1.4 What population group do you belong to? (Please tick)				
Black	Coloured	Asian/Indian	White	Other
If other, please specify:				

1.5 What language do you mostly speak at home?			
isiXhosa	Afrikaans	English	Other
If other, please specify:			

1.6 What is your level of schooling? (Please tick)	
No formal education	Incomplete Primary education
Complete Primary Education	Incomplete High School education
Complete High School education	Technical College education
University education	

1.7 Have you had any skills training courses? (Aside from Abalobi)		Yes		No
If yes, which				

1.8 How long have you been living in this community?

1.9 How many people live in your household/homestead?

1.10 What is the range of your total household monthly income?	**Season**	**Out of season**
Less than R500		
R501-R1000		
R1001-R1500		
R1501-R2000		
R2001-R3000		
R3001-R5000		
More than R5000		

1.11 Are you/were you a fisher?			
	Yes		No

1.12 Which company do you currently work for? For how long?

1.13 For how long have you been a monitor (including with other companies)

Section 2: Technology

2.1 Do you use your Abalobi tablet?		Yes		No
If no, why not?				

2.2 Do you own a personal smartphone/tablet?
If yes, for how long?
What stuff (apps) do you use on your phone?

2.3 Does anyone else in your household own a smartphone/tablet?

2.4 How did you purchase your tablet?	
Cash	
Contract	
Gift	
Other	

2.5 Do you find it easy to work on your smartphone/tablet?			
	Yes		No

2.6 How comfortable are you with the following apps? (Mark appropriate)	Very comfortable	Somewhat confortable	Not comfortable	Have not been using the app
ODK (recording)				
Salesforce (reporting)				
What's App (communication)				

2.7 How comfortable would you be teaching another monitor about the following apps? (Mark appropriate)	Very comfortable	Somewhat confortable	Not comfortable	Have not been using the app
ODK (recording)				
Salesforce (reporting)				
What's App (communication)				

2.8 How often do you record on Abalobi? (Mark appropriate)

Every time a boat comes in (100% of the time)	
Most of the time (50-75% of the time)	
Sometimes (25-50% of the time)	
Never	

2.9 Regarding ODK:
What do you like about it?
What don't you like about it?

2.10 Regarding Salesforce:
What do you like about it?
What don't you like about it?

2.11 Regarding What'sApp:
What do you like about it?
What don't you like about it?

2.12 Do you go to the manager for assistance with Abalobi?			
	Yes		No

2.13 Was the training workshop good? Easy to follow?			
	Yes		No

2.14 Was the language a problem?			
	Yes		No

2.15 Should we come more often?			
	Yes		No

Is there anything else you would like to add?

Appendix 3. Focus group schedule and internal protocol

Focus Group Schedule

2-day Focus Group Schedule		
Date	**Focus group participants**	**Number of participants**
5 May 2016	Fishers from Lambertsbaai, Struisbaai and Kleinmond.	20
6 May 2016	Fishers from Lambertsbaai and Struisbaai.	9

Focus Group Internal Protocol

1. Set the scene	Table (5) with 4 chairs in each (randomly placed around the room) with tablecloths. Piece of flipchart paper on each table. Pencils and crayons on each table. PowerPoint presentation on front wall. Brown paper on sidewall. Graphic designers on the front, to the right. Coffee, tea and snacks in the kitchen.
2. Participants start to arrive	Greet them at the door. Ask each participant to find someone they've never met before and sit together.
3. Introduction	Welcome Serge goes over agenda for the next 2 days. Graphic designers introduce themselves. Short explanation of World Café
4. Theme 1 – At sea	Sub question 1 on the projector 20 minutes to discuss 1 or 2 issues from the tables on cards.

	Serge places cards on brown paper while 1 person from each table (host) stands up and summarizes what was discussed at his table. Sub question 2 on the projector 20 minutes to discuss 1 or 2 ideas from each table on cards. Serge places cards on brown paper while 1 person from each table (host) stands up and summarizes what was discussed at his table. Participants switch tables (find someone that's the same height as you and sit together)
5. Coffee Break	Serve coffee, tea and snacks at each table. Short break.
6. Theme 2 – Landing site and market	Sub question 1 on the projector 10 minutes to discuss 1 or 2 ideas from each table on cards. Serge places cards on brown paper while 1 person from each table (host) stands up and summarizes what was discussed at his table. Sub question 2 on the projector 10 minutes to discuss 1 or 2 ideas from each table on cards. Serge places cards on brown paper while 1 person from each table (host) stands up and summarizes what was discussed at his table.
7. LUNCH	Participants switch tables
8. Theme 3 – Livelihood and community upliftment	Sub question 1 on the projector 10 minutes to discuss 1 or 2 ideas from each table on cards. Serge places cards on brown paper while 1 person from each table (host) stands up and summarizes what was discussed at his table. Sub question 2 on the projector 10 minutes to discuss 1 or 2 ideas from each table on cards. Serge places cards on brown paper while 1 person from each table (host) stands up and summarizes what was discussed at

	his table.
9. Theme 4 - Governance	Sub question 1 on the projector 10 minutes to discuss 1 or 2 ideas from each table on cards. Serge places cards on brown paper while 1 person from each table (host) stands up and summarizes what was discussed at his table. Sub question 2 on the projector 10 minutes to discuss 1 or 2 ideas from each table on cards. Serge places cards on brown paper while 1 person from each table (host) stands up and summarizes what was discussed at his table.
10. The end.	