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**Integrating Traditional Ecological Knowledge  
in South Africa's Small-Scale Fisheries:  
The Olifants Estuary Gillnet Fishery**

by

**Anna A. Hushlak**

A Dissertation Submitted in Partial Fulfilment of the Requirements for the  
Degree of Master of Philosophy in Environmental Management in the  
Department of Environmental and Geographical Sciences,  
University of Cape Town

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## DECLARATION

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I, **Anna Hushlak**, declare that this dissertation is my own work and has not been previously submitted in part or in whole for a degree or examination. All the sources referenced or quoted in contribution to this work or the works of others have been acknowledged and cited.

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## ABSTRACT

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Increasingly, managers and scientists are recognizing the importance of understanding small-scale fisheries as complex socio-ecological systems. As a result, managing fisheries is no longer only about managing fish but also about managing people. One mechanism for incorporating the human dimension into small-scale fishery management is knowledge integration. Through pluralising epistemologies, knowledge integration fosters participative dialogue, improves current knowledge bases, and strengthens management. While globally there is an increasing movement towards integrating traditional ecological knowledge (TEK) into small-scale fishery management, little evidence of this transition exists in South Africa. Therefore, using participant observation, participatory mapping and group discussions, and semi-structured interviews, this research explores the extent to which TEK can be integrated into the Olifants Estuary Fishery Management Process (OEFMP). Specifically, this study critically examines 1) the relationship between TEK and estuary fishing practices; 2) processes for documenting TEK; 3) the strengths/limitations of TEK; and 4) factors enabling and/or constraining knowledge integration in the OEFMP. The findings from this research provide evidence that TEK and fishing practices are co-evolving and that knowledge integration is a three-staged process. This research concludes that the initial step for knowledge integration in the OEFMP is the disassembly of the Natural Science Paradigm and the co-construction of knowledge. To pursue knowledge integration in the OEFMP, this research recommends the development of stakeholder-based, transdisciplinary, and multi-party working groups as well as furthering research via integrated methodologies.

**Key Words:** Small-Scale Fisheries (SSF) Management, Traditional Ecological Knowledge (TEK), Knowledge Integration, Olifants Estuary, Social Paradigms

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University of Cape Town

## DEDICATION

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I dedicate this work to my parents Mrs. Lynn Sveinson and Mr. Gerald Hushlak.

Thank you for always encouraging me to ask tough questions.

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We look forward to a time when **all South Africans assume shared responsibility** for maintaining the health, diversity, and productivity of coastal ecosystems in a spirit of stewardship and caring.

- White Paper for Sustainable Coastal Development



**Image 1. Oom Petrus Don, Ebenhaeser Fisher**

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## LIST OF ABBREVIATIONS

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AEC	Anchor Environmental Consultants
ANC	African National Congress
CAPE	Cape Action Plan for the Environment
CBD	Convention on Biological Diversity
CNC	Cape Nature Conservation
DAFF	Department of Agriculture, Fisheries and Forestry
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DP	Dominant Paradigm
EEU	Environmental Evaluation Unit
FAO	Food and Agriculture Organisation
GIS	Geographic Information Systems
GPS	Global Positioning Systems
IK	Indigenous Knowledge
IKSP	Indigenous Knowledge Systems Policy
ILO	International Labour Organisation
IUCN	International Union for the Conservation of Nature
LEK	Local Ecological Knowledge
LRC	Legal Resources Centre
MLRA	Marine Living Resources Act
MPA	Marine Protected Area
NEMA	National Environmental Management Act
NSP	Natural Science Paradigm
OEFMP	Olifants Estuary Fishery Management Process
OEGF	Olifants Estuary Gillnet Fishery
OEMP	Olifants Estuary Management Plan
SADC	South African Development Community
SSF	Small-Scale Fisheries
TEK	Traditional Ecological Knowledge
TILCEPA	Theme on Indigenous Peoples, Local Communities, Equity, and Protected Areas
UNEP	United Nations Environment Programme

# CHAPTER 1

## INTRODUCTION

---

### 1.1 Background

Small-scale fisheries (SSF) are integral to the provision of livelihoods for millions of people around the world. While large-scale commercial fisheries are typically capital-intensive and highly mechanised, SSF employ low technology, are labour-intensive, contribute primarily to food security, and catch is mostly sold at local markets (Berkes et al., 2001; Sowman 2006). McClanahan et al. (2009) estimate that over fifty million fishers directly rely on SSF for employment, which support another four hundred and fifty million dependents. Moreover, Berkes (2003) argues 95% of SSF in the world are in developing countries and directly contribute to food security, income, and livelihoods. Livelihoods include “the assets (natural, physical, human, financial, and social capital)... and the access to these assets (mediated by institutions) that together determine the living gained by the individual or household” (Ellis, 2000:10). In this regard, livelihoods are inextricably linked to the co-existence of fishers and their environments. Thus, scholarship is increasingly identifying SSF as complex socio-ecological systems whereby ecological, social, and governance systems are interdependent. These systems are highly non-linear and include traditional, artisanal, and subsistence fisheries (Berkes, 2003). Furthermore, SSF are heterogeneous and products of particular social, cultural, economic, and institutional contexts (McGoodwin, 2001; Defeo and Castilla, 2005; Sowman, 2011).

Despite this heterogeneity, large-scale commercial fisheries have chiefly shaped conventional fisheries management. As a result, since the 1990s several scholars have criticised the ability of conventional management to translate into SSF. This inability is largely due to the failure of conventional management to incorporate the human dimension as part of planning and decision-making. In turn, by neglecting the human dimension, conventional management ignores “the socio-economic needs of fisherfolk, livelihood issues, integrated management of coastal resources, and the potential of interdisciplinary and

participatory approaches to meet these needs” (Berkes, 2003:8). Furthermore, given that SSF are socio-ecological systems, inclusion of the human dimension is necessary to address management challenges such as regulation and enforcement as well as sustainable resource use. Therefore, recent scholarship advocates the participation of local communities to strengthen, legitimise, and enhance SSF decision-making (Jentoft et al., 1998; Pollnac and Pomeroy, 2005; Borrini-Feyerabend et al., 2006)

One mechanism for incorporating the human dimension in SSF planning and decision-making is the integration of traditional ecological knowledge (TEK) into management decisions (Berkes, 1993; Johannes, 1993; Pinkerton and Weinstein, 1995; Neis and Felt, 2000; Garcia and Charles, 2008). Generally, TEK is recognised as a combination of process and information, which blends knowledge, practice, and belief (Berkes, 1993). In this regard, TEK is “both technical knowledge of the environment as well as cultural knowledge including all social, political, economic, and spiritual aspects of local ways of life” (Pomeroy and Rivera-Guieb, 2006: 101). According to Pomeroy and Rivera-Guieb (2006), the integration of TEK into decision-making can add to SSF management by providing alternative conservation and economic strategies, contributing to local empowerment, and informing ecological research. These contributions are particularly important in developing countries such as South Africa where governments face high costs of regulation, monitoring, and enforcement (Mahon et al., 2008; Sowman, 2011).

Following the transition to democracy in 1994, fisheries management in South Africa underwent a series of national reforms aimed at addressing imbalances created by colonial and apartheid legacies. During the 1900s, colonialism, the growth of South Africa’s commercial fishing industry, and the implementation of discriminating apartheid legislation led to the marginalisation of ‘coloured’<sup>1</sup> fishers in the Western Cape (van Sittert, 2002; Sowman, 2006; Sowman et al., 2011). Under colonialism and later apartheid, South African fisheries management was highly centralised and employed a top-down approach (van Sittert, 2006; Sowman and Sunde, 2011). Therefore,

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<sup>1</sup> Different from international usage, in South Africa the term ‘coloured’ does not refer to black populations. Instead, this term covers a wide range of people predominantly descended from

as part of the post-apartheid reconstruction and development programme, the African National Congress (ANC) promised, “The upliftment of impoverished coastal communities through improved access to marine resources” (ANC, 1994: 4.5.3.2). Legislation such as the Constitution of the Republic of South Africa of 1996, the White Paper for Marine Fisheries Policy of 1997, the National Environmental Management Act of 1998 (NEMA), the Marine Living Resources Act of 1998 (MLRA), the White Paper for Sustainable Coastal Development of 2000, and the Small-Scale Fisheries Policy of 2012 made provision for co-operative environmental governance and greater inclusion of the human dimension in decision-making.

Recently promulgated, the Small-Scale Fisheries Policy promised new management frameworks, which focus on integrated and holistic approaches to human rights as well as poverty alleviation, food security, and socio-economic development (DAFF, 2012). This legislation, alongside the Indigenous Knowledge Systems Policy (IKSP) of 2004, has established a foundation for community inclusion and knowledge integration in South African fisheries management. Still, Sunde and Isaacs (2008) argue that despite the facilitation of a reform process, the inclusion of previously disadvantaged fishing communities into decision-making has been slow. Thus, despite South Africa’s commitment to participatory decision-making and knowledge integration at the policy level, little evidence of this transition exists in practice.

## **1.2 Study Area: The Olifants Estuary and Harder Fishery**

While the study area of this research is discussed in more detail in Chapter 3, Section 1.2 provides a brief overview of the Olifants Estuary so as to familiarise the reader. Situated on the western seaboard of South Africa, the Olifants Estuary is located approximately 350 kilometres north west of Cape Town, South Africa (Sowman, 2003). Given that it is roughly 36 kilometres long and 400 metres wide at its mouth, the estuary forms a unique and highly productive ecosystem, which is critical for conservation (Turpie et al., 2002; Fielding et al., 2007). In addition to its conservation value, the Olifants Estuary is home to a traditional gillnet fishery. Although traditional fishers have lived

at and around the estuary for generations, in 1925 they were forcibly relocated from its upper and fertile banks to its saline and lower reaches (Sowman, 2003; Carvalho et al., 2009). As a result of this relocation, traditional fishers are now entirely dependent on the estuary for food security, income, and livelihoods.

In 2008, Anchor Environmental Consultants (AEC) proposed a draft management plan for the estuary. This plan sought to address national conservation objectives through the establishment of a no-take Marine Protected Area (MPA) and a phasing out of the gillnet-fishery (AEC, 2008a). Considering that this proposal would eradicate traditional livelihoods of fishery dependent communities, it was highly controversial. Therefore, with assistance from the Legal Resources Centre (LRC), the Environmental Evaluation Unit (EEU), and a non-governmental organisation Masifundise, the fishers have postponed the implementation of the draft management plan and are currently negotiating one that is equitable and inclusive. Within the Olifants Estuary Fishery Management Process (OEFMP), the EEU has facilitated a Knowledge Documentation Project, which seeks to document the TEK of the Olifants Estuary gillnet fishers. Forming the first stage of this Knowledge Documentation Project, this study seeks to collect and share fisher knowledge in an attempt to contribute to planning and decision-making in the OEFMP.

### **1.3 Study Rationale and Research Question**

TEK is widely accepted as contributing to SSF decision-making by providing user information on socio-ecological systems (Pomeroy and Rivera-Guieb, 2006). Furthermore, the integration of TEK allows for local empowerment as well as greater participation of resource users in decision-making thus legitimising management (Jentoft, 2000; Cochrane, 2002; Cinner and Aswani, 2007; Sowman, 2011). Although there is a breadth of literature promoting the ability of TEK to contribute to SSF management, there are two recurring issues in evaluating its integration. First, substantial literature exists on *why* TEK and SSF management are compatible yet few studies address *how* knowledge integration should take place (exceptions include Calamia, 1999; Neis et al.,

1999; Huntington, 2000; MacKinson, 2001; Hall and Close, 2007; Raymond et al., 2010). Second, despite the necessary legislation and policy framework for knowledge integration being in place in South Africa, there is little evidence of knowledge integration occurring in South African SSF. Knowledge integration is particularly important in the Olifants Estuary where the livelihoods of traditional fishers are at risk due to miscommunication in management, a lack of transparency, and technocratic decision-making. Therefore, in an attempt to further develop understanding of knowledge integration in South African SSF management, this project seeks to answer the following question:

- To what extent can traditional and local ecological knowledge be integrated into management of the Olifants Estuary gillnet fishery?

#### **1.4 Research Aims and Objectives**

This study aims to explore the nature of TEK in the Olifants Estuary gillnet fishery as well as to identify current barriers to knowledge integration in the Olifants Estuary Fishery Management Process. In doing so, this project seeks to provide alternatives for future planning and decision-making in estuary management. In addition, this research endeavours to shed light onto a critical yet under-researched topic and to contribute to future research on knowledge integration. To address these aims, this study uses participant observation, participatory mapping and group discussions, and semi-structured interviews to employ action and applied research (refer to Chapter 4). In the context of knowledge integration in the OEFMP, the following objectives are fundamental in achieving project aims:

1. Examination of the relationship between TEK and fishing practices in the Olifants Estuary gillnet fishery;
2. Investigation and documentation of processes for collecting TEK;
3. Critical evaluation of the strengths and/or limitations of integrating TEK into the OEFMP; and
4. Exploration of factors constraining/enabling knowledge integration in the OEFMP

Specifically, Objective 1 examines what practical information contributes to TEK and how fishing practices affect this information. Objective 2 creates a foundation for this research in answering, 'how can TEK be physically recorded?' Last, Objectives 3 and 4 address the importance of integrating TEK in the OEFMP as well as examine whether knowledge integration can successfully take place.

### **1.5 Significance of Research**

While substantial research has explored why TEK is important in SSF management, little research has examined the extent to which it has been integrated and how this integration can take place in South African SSF. Therefore, through participating in the OEFMP knowledge documentation process, this study explores the practical application of knowledge integration and assists in narrowing a gap in research. Using the OEFMP, this research contributes to understanding how TEK can add to management of a South African small-scale fishery: first, by uncovering the relationship of TEK, fishing practices, and resource management; second, by identifying a practical process for collecting TEK; third, by exploring the benefits and weaknesses of integrating TEK into management decisions; and fourth, by revealing current challenges to knowledge integration and contributing to theory.

### **1.6 Research Ethics**

In order to ensure the application of ethical moral conduct, this research follows the Code for Research Involving Human Subjects developed by the University of Cape Town. Specifically, this project sought to undertake research with "scholarly integrity and excellence, social sensitivity and responsibility, and with respect for the dignity and self-esteem of the individual" (UCT, 2006: 46). In meeting these principles, this study emphasises transparency, confidentiality, objectivity, and voluntary approval (Agar, 1996). Given that this study delves in ethnoecology, it also ensures the holders of TEK decide how this research uses their knowledge. Furthermore, this study aims to

commit itself to participants and to uphold to the highest levels their trust, confidence, and knowledge. In order to ensure this commitment, this study uses Participant Consent Forms. These forms describe the nature of this research, participants' involvement, tentative risks/benefits in participation, researcher details, and includes an agreed upon participant statement (Appendix A).

## 1.7 Chapter Outlines

### *Chapter 1: Introduction*

Chapter one provides *background* information to the study and introduces the topic of knowledge integration in small-scale fishery management in general and in South Africa. This chapter presents the *study rationale* and familiarises the reader with the *research question, aims, and objectives*. Chapter 1 ends with a discussion on *research significance* and *ethics*.

### *Chapter 2: Literature Review and Theoretical Framework*

To address project objectives, Chapter 2 navigates the reader through the *definition and strengths of TEK*, as well as the *enabling instruments* and *barriers* to recognising and integrating TEK in *SSF management decisions*. This chapter also reviews the *historical* and *political context* from which South African SSF emerged. Chapter 2 concludes by identifying the *demand for empirical research* to explore the barriers and mechanisms for achieving knowledge integration in the OEFMP.

### *Chapter 3: The Olifants Estuary: Study Area*

Chapter 3 describes the *study area*. This chapter provides an overview of the *biophysical* and *socio-economic significance* of the Olifants Estuary. In addition, Chapter 3 sets the *historical context* of estuary management as well as explains transformations in estuary management.

#### *Chapter 4: Research Structure*

Chapter 4 presents the various research approaches and methods used to explore the integration of TEK into the OEFMP. This chapter presents the *research design* (qualitative), *approaches* (applied and action), *methodology* (dialectical and dialogical), *methods* (participant observation, participant mapping and group discussions, semi-structured interviews, and secondary data), as well as the *analysis* (thematic). In addition, Chapter 4 discusses *validity* and *reliability* of qualitative methods as well as study *limitations*.

#### *Chapter 5: Research Findings*

Chapter 5 describes the research *findings*. This study finds the documentation of TEK is three-staged and that TEK and fishing practices are co-evolving. In addition, Chapter 5 examines perceived strengths and limitations of TEK both in terms of its characteristics and in terms of application. Last, this chapter explores factors enabling and constraining knowledge integration in the OEFMP.

#### *Chapter 6: Discussion and Evaluation*

Chapter 6 critically examines the *project objectives* and *study findings* against the *literature review*. Furthermore, in answering the research question, Chapter 6 synthesises the four project objectives and concludes by exploring the future integration of TEK in the OEFMP.

#### *Chapter 7: Conclusion and Recommendations*

Chapter 7 revisits the overarching aims of this project as well as its objectives. This chapter summarises findings and presents *conclusions* according to project objectives. From these conclusions, this study proposes two main *recommendations*.

## *References*

Using the Harvard system of referencing (author-date), this section includes an alphabetical listing of all sources cited in this study.

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## **CHAPTER 2**

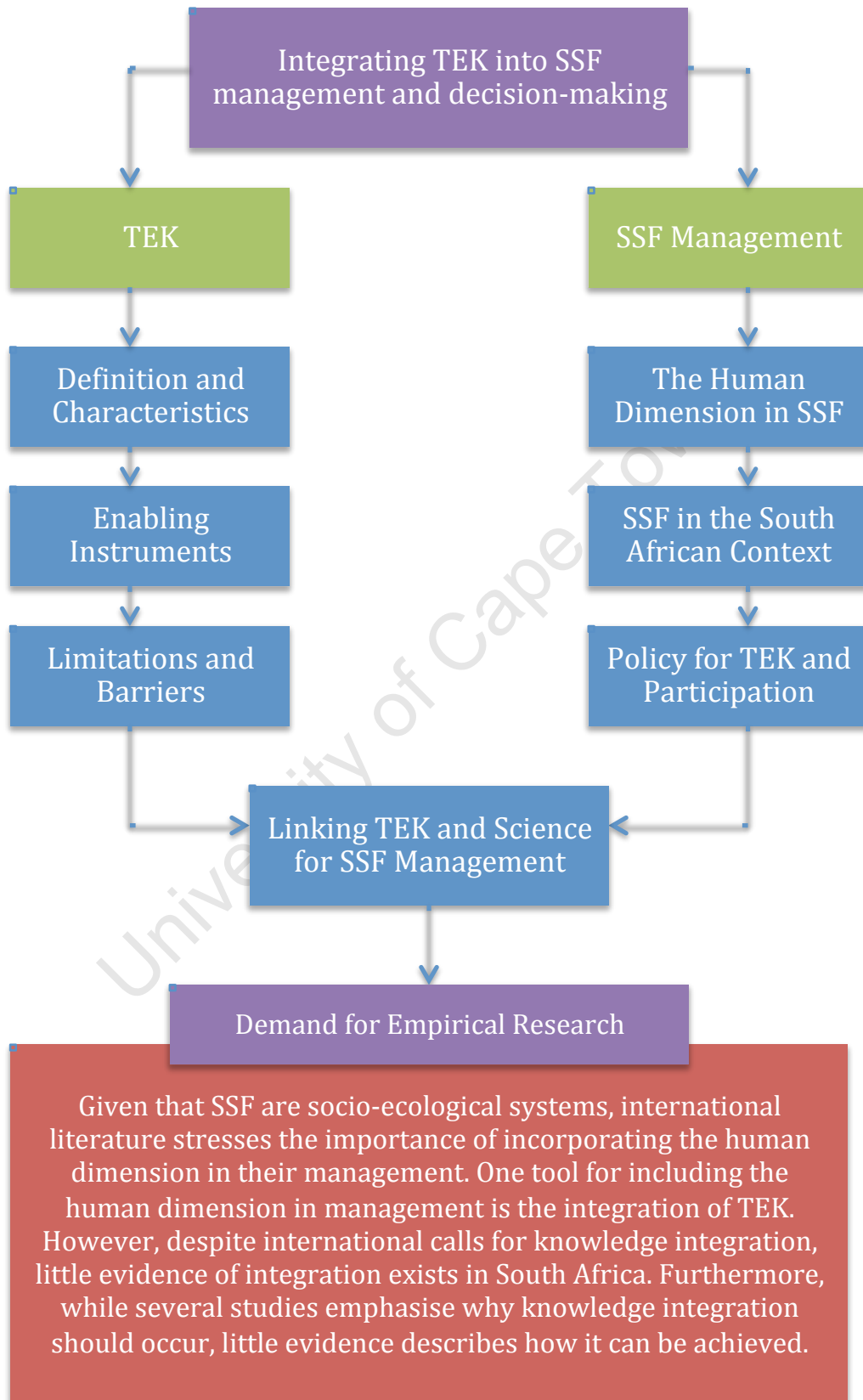
### **LITERATURE REVIEW AND THEORETICAL FRAMEWORK**

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Chapter 2 examines the concept and theoretical underpinnings of TEK particularly in the context of SSF and in relation to project objectives. The first section of this chapter discusses the philosophical origins, definition, characteristics, enabling international instruments, and barriers associated with TEK and knowledge integration. The second section of this chapter examines current issues facing SSF management and considers how the integration of TEK can contribute to improving management systems. To guide the reader, Figure 2 provides a general overview of the literature review, highlights major topics and subthemes and demonstrates the need for further empirical research.

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**Figure 1. Literature Review and Theoretical Constructs Map**



## **2.1 The Re-emergence of Traditional Ecological Knowledge in Contemporary Resource Management**

The philosophical roots of the use of alternative 'knowledges' in natural resource management lie in ethnoecology (Toledo, 2002). Ethnoecology examines how human groups view nature and how groups manage natural resources because of those views (Berkes, 1999; Barrera-Bassols and Toledo, 2005). One of the principal benefits of ethnoecology is its use of different knowledges (Neis et al., 1999; Berkes et al., 2001; Johannes et al., 2000). Just as there are many different 'sciences' that fall under the umbrella of 'Western science', so too are there variations of alternative 'knowledges'. Therefore, it is critical to define which knowledge this research intends to examine and 'what' that knowledge constitutes.

### *2.1.1 Definition and Characteristics of Traditional Ecological Knowledge*

Despite previous contestation, TEK is now widely accepted as "a cumulative body of knowledge, practice and belief, evolving through adaptive processes and handed down through generations by cultural transmission" (Berkes, 1993: 3). While various literatures use the term indigenous knowledge (IK) rather than TEK, this study concurs with several authors and views the term 'indigenous' as problematic (Gupta, 1998; Nygren, 1999; Li, 2000; Agrawal, 2002; Dove, 2006; Green, 2007; Green, 2008). The difficulty with 'indigenous' is largely due to the influence of social and political power on racial and ethnic histories. Indeed, due to the influence of social and political power, the use of 'indigenous' often becomes exclusionary. For example, within the Indigenous Knowledge Systems Policy of 2004, South African 'coloured' fishing communities, despite their intergenerational links to coastal systems, are not categorised as 'indigenous' (Green, 2008). Therefore, under the term 'indigenous knowledge' the politics of classification may discard fisher knowledge. Furthermore, Gupta (1998) challenges the use of the term 'indigenous' as it does not include the majority of the world's poor who have historical and subsistence ties to resources, but do not fit the narrow

construction of 'indigenous'. Therefore, this project uses the modern constructs of TEK whereby 'traditional' does not imply 'indigeneity', aboriginality, or stasis but rather assumes a historical, customary, and cultural continuity amongst a given community or peoples (Berkes and Folke, 1998).

In broadening Berkes' (1993) definition, this research also incorporates local ecological knowledge (LEK) in its notion of TEK. Unlike TEK, LEK does not include the temporal dimension of long-term intergenerational transmission (Berkes and Folke, 1998; Menzies and Butler, 2006). However, LEK does supplement TEK with information that otherwise may be excluded due to temporal restrictions. Given that TEK is not universal, it must be treated as heterogeneous and context dependent. Nonetheless, despite the various forms of TEK existing in practice, many of the characteristics that shape their foundations are often the same.

TEK is highly adaptive and incorporates "a combination of specific factual knowledge and practical action-oriented skills" (Antweiler, 2004: 16). In this sense, the transmission and implementation of TEK integrates information, experience, and everyday capabilities (Berkes et al., 2000; Pierotti and Wildcat, 2000; Antweiler, 2004; Berkes and Kislalioglu-Berkes 2008). Different societies have varied understandings of the natural world. Collectively, these understandings form "a repertoire of habits, skills, and styles from which members of a society construct their livelihoods" (Berkes and Kislalioglu-Berkes, 2008: 7). Furthermore, this blending of information and action provides insight into resource user behaviour and allows for a 'learning by doing' approach to situational variability (Berkes et al., 2000; Pierotti and Wildcat, 2000).

Another strength of TEK is its integration of intergenerational observation and experimentation into a cumulative and long-term body of knowledge (Gadgil et al., 1993; Ferguson and Messier, 1997; Usher, 2000; Antweiler, 2004; Menzies and Butler, 2006). Given that TEK develops from long-term observation and experimentation, it is dynamic in nature. Although embedded in customary traditions, information is constantly absorbed and tried. As such, TEK passes through various feedback mechanisms and is continuously transforming (Gadgil et al., 1993; Berkes et al., 2000; Menzies and

Butler, 2006). In this sense, holders of TEK recognise it as both knowledge of the past as well as of the present (Menzies and Butler, 2006). It is this combination of past and present accumulated into a single body of knowledge, which allows TEK to offer both historical and current understandings of environmental conditions.

In order to combine 'information and capability' as well as 'past and present', TEK is exceedingly localised and holistic. As Menzies and Butler (2006) state, TEK is location-dependent and uses highly specific information. Traditional communities often live in severe conditions and the resources upon which they depend are constantly under pressure (Pierotti and Wildcat, 2000). This pressure allows for the development of an intimate understanding of the surrounding landscape. Consequently, this understanding results in TEK being holistic and viewing the natural world as a series of embedded and interconnected systems (Ferguson and Messier, 1997; Pierotti and Wildcat, 2000; Berkes et al., 2000). Berkes et al. (2000) argue holistic thinking links social and ecological systems whereby neither system functions independently from one another. In this sense, traditional communities often view themselves as part of the natural world rather than as separate from it (Gadgil et al., 1993; Pierotti and Wildcat, 2000; Usher, 2000; Menzies and Butler, 2006).

### *2.1.2 International Instruments Promoting the Use of TEK*

Alongside the increasing focus on TEK in natural resource management, international instruments governing its protection, transmission, and use have also developed. Under Article 31 of the United Nations Declaration on the Rights of Indigenous Peoples (2007), traditional peoples have the right to, "maintain, control, protect, and develop traditional knowledge...as well as the manifestations of their sciences" (United Nations General Assembly, 2007). Similarly, Article 8(j) of the Convention on Biological Diversity (CBD) states that signatories:

Respect, preserve, and maintain knowledge...of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity (UNEP, 1992).

Furthermore, Element 2 of the CBD commits signatories to the full participation of traditional communities in the management of protected areas thus promoting equity and benefit sharing (UNEP, 1992). In a similar fashion, Convention No. 169 of the International Labour Organisation (ILO) identifies the rights of traditional peoples to consultation and participation as well as the recognition of customary ways of life (ILO, 1989).

In addition to international instruments, there are various 'soft laws' and development programmes, which guide international norms and standards of best practice (Shelton, 1999; Gorjestani, 2000; Mauro and Hardison, 2000). Examples of 'soft laws' and international programmes include the Rio Declaration of 1992, World Bank and International Union for the Conservation of Nature (IUCN) Indigenous Knowledge Programme of 1998, IUCN Theme on Indigenous Peoples, Local Communities, Equity, and Protected Areas (TILCEPA) of 2000, and the World Summit on Sustainable Development Plan of Implementation of 2002. Particularly important for South Africa, the IUCN Indigenous Knowledge Programme mainstreams the use of TEK into various fields including food security, human health, education, natural resource management, and sustainable livelihoods (Gorjestani, 2000; Steiner and Oviedo, 2004). In addition, TILCEPA promotes the protection of customary livelihoods as well as participatory governance in protected area management (IUCN, 2000). Together, international tools, 'soft laws', and knowledge integration programmes strengthen the legitimacy of TEK and remain central in enabling its integration.

### *2.1.3 Limitations and Barriers to Knowledge Integration*

Despite the many beneficial characteristics of TEK and international instruments enabling its integration, several academics have also questioned its limitations (Agrawal, 1995; Nadasdy, 1999; Smith and Wishnie, 2000;

Agrawal, 2002; Davis and Wagner, 2003; Dove, 2006; McGoodwin, 2006; Fabricius and Chalmers, 2007). First, there is an endless debate between whether traditional communities are protectors or destroyers of socio-ecological systems (Diamond, 1992; Gadgil et al., 1993; Berkes, 1999; Smith and Wishnie, 2000; Diamond, 2005). However, this project is principally concerned with what TEK is and if it can add value to SSF management. This study is not an evaluation of whether holders of TEK are exemplary conservationists, but rather whether their knowledge can lead to *greater understandings* of socio-ecological systems and thus aid SSF management.

In addition, there is also considerable discussion surrounding the methodological and epistemological challenges of knowledge integration (Agrawal, 1995; Ferguson and Messier, 1997; Duerden and Kuhn, 1998; Nadasdy, 1999; Huntington, 2000; Elgin, 2004; McGoodwin, 2006; Green, 2008; Raymond et al., 2010). Most of these debates perceive alternative knowledges and classical science as incompatible binaries. Characteristic differences between TEK and classical science certainly do exist namely qualitative versus quantitative data, long-term versus short-term observations, localised versus generalised knowledge, subjective versus objective perceptions, informal versus formal knowledge systems, practical versus hard data, and non-linear versus linear understandings of relationships (Agrawal, 1995; MacKinson, 2001; Drew, 2005; Berkes and Kislalioglu-Berkes, 2008; Raymond et al., 2010). Nevertheless, the exclusion of alternative knowledge systems due to their perceived limitations restricts the development of contributions to SSF management. Instead, through shifting existing fields of vision, differences between knowledges contribute to advancing overall understanding of fishery systems.

A second concern regarding methodology is the selection of 'experts' (Johannes, 1993; Neis et al., 1999; Davis and Wagner, 2003; Chalmers and Fabricius, 2007). In their review of twenty-two case studies on knowledge integration, Davis and Wagner (2003) identify a major methodological gap in how researchers choose local 'experts'. More specifically, Davis and Wagner (2003: 468) argue that the "absence of discussion impedes the development of methodologies sophisticated and rigorous to withstand scrutiny." Hutchings

and Lamberth (2002) demonstrate similar scepticism debating that information such as catch-and-effort estimates is often inaccurate due to the under-recording and underreporting of 'experts'.

Furthermore, there is an ethical debate surrounding the 'scientisation' and compartmentalisation of TEK. The 'scientisation' of TEK occurs when researchers attempt to mould TEK into pre-existing management plans and scientific templates (Nadasdy, 1999; Agrawal, 2002). Certain scholars warn that 'scientisation' results in the compartmentalisation and disruption of community beliefs, values, and experiences (Nadasdy, 1999; Raymond et al., 2010). Nadasdy (1999: 9) reasons that the 'scientisation' of TEK "extracts only...information which can be expressed...within the institutional framework of scientific resource management." Moreover, Green (2008) maintains that the reduction of TEK into scientific models fails to address its complexity. Specifically, 'scientisation' attempts to condense knowledge into individual paradigms, which only allow for one form of rationality (Green, 2008). Furthermore, Duerden and Kuhn (1998) affirm that the compartmentalisation of TEK into scientific frameworks results in ethical and cultural compromise.

Contrastingly, other literature supports the process of 'scientisation' as it identifies 'relevant' forms of TEK, while allowing 'irrelevant' information to "pass away" (Agrawal, 2002: 290). It is difficult to discern whether the compartmentalisation of knowledge is right or wrong as each argument holds merit. Furthermore, compartmentalisation occurs to all forms of knowledge including science (Agrawal, 1995; Elgin, 2004; Green, 2008). Within this compartmentalisation, disciplinary boundaries often limit knowledge and force knowledge constructions to remain within particular fields of vision (Kuhn, 1962; Foucault, 1965; Colby, 1991; Rosa and Machlis, 2002; Degnbol et al., 2006; Sowman, 2011). However, without compartmentalisation, there is no possibility of professional specialisation, which is equally critical in management (Degnbol et al., 2006). Thus, despite challenges to knowledge integration and the potential of 'scientisation', most literature views TEK and classical science as complementary rather than conflicting and attempts to bridge the TEK-science divide.

#### *2.1.4 Enabling Knowledge Integration: Bridging TEK and Science*

As Berkes and Kislalioglu-Berkes (2008) reveal, both TEK and classical science incorporate observations and both provide a way of knowing. In addition, both knowledges ultimately attempt to create order out of disorder and are more influential together than either approach on its own (Berkes and Kislalioglu-Berkes, 2008). Furthermore, numerous studies point out that it is near impossible to separate different knowledges (Agrawal, 1995; Capra, 1996; Elgin, 2004; Drew, 2005; Green, 2008; Raymond et al., 2010). In a similar fashion, several studies dispute the idea of a single 'universal knowledge'. Instead, these studies suggest specific contexts and questions produce knowledge (Capra, 1996; Elgin, 2004; Green, 2008; Raymond et al., 2010). In this sense, knowledge shifts from being objective to epistemic, whereby the process of questioning a problem is integral to the production of its theory (Capra, 1996). As such, knowledge is neither right nor wrong but depends on the viewer and the problem at hand.

#### *2.1.5 Disciplinary Divisions: Transdisciplinarity and Multiparty Collaboration*

In addition to bridging TEK and science, knowledge integration also requires a bridging of disciplines. Several stages of disciplinary integration exist and are often mistaken as interchangeable. Pohl and Hadorn (2008) distinguish multidisciplinary – the analysis of a problem *between* independent disciplines – from interdisciplinary – the collective and integrated analysis of a problem *across* disciplines. Emerging from a combination of multidisciplinary and interdisciplinary, transdisciplinarity moves both between and across disciplines. Specifically, transdisciplinarity calls for researchers to, “invent new science by exploring research questions at the intersection of their respective fields...and developing methodologies that can be used to reintegrate knowledge” (Gray, 2008: S124). In this regard, transdisciplinarity allows for a pluralisation of epistemologies and the existence of multiple realities (Belsky, 2002; Nicolescu, 2002; Haddorn et al., 2008).

One mechanism of applying transdisciplinarity in practice is a consensus conference. Typically associated with the assessment of new technology, consensus conferences merge technical and scientific issues with political decision-making. These conferences consist of three panels including the citizen panel, the expert panel, and the advisory panel (Andersen and Jaeger, 1999). The citizen panel is comprised of 12-15 'lay people', who learn about the issue at hand, formulate key questions, and cross-examine experts. Citizens select the expert panel, which represents a wide range of disciplinary views. Last, the advisory panel oversees the consensus conference ensuring it is transparent, inclusive, and democratic. During the conference, experts and citizens engage in debate and dialogue deconstructing and reconstructing dominant paradigms. Following discussions, the citizen panel develops recommendations for policy makers and the public (Chopyak and Levesque, 2002). In this regard, consensus conferences not only bring together knowledge from various disciplines but they also "de-monopolise expertise" (Beck, 1997: 121).

A further tool for fostering transdisciplinarity and crossing the disciplinary divide is a scenario workshop. Scenario workshops bring together a mix of actors including resource users, management, scientists, and citizens. Four future scenarios are developed based on alternative solutions, each representing a combination of participant values, to the current problem at hand (Andersen and Jaeger, 1999; Chopyak and Levesque, 2002). Guided by a facilitator, participants use 'role play' to debate scenarios, recognise barriers, and develop common visions. Andersen and Jaeger (1999: 338) argue that within scenario workshops, all forms of knowledges are crucial as they breakdown "stereotyped images" and involve multiple participants into the construction of knowledge. However, a significant challenge facing scenario workshops is the volume of preparation, planning, and facilitation required for their success (Andersen and Jaeger, 1999; Chopyak and Levesque, 2002). Despite this challenge, scenario workshops are critical in bringing together a diversity of voices, ensuring a polyphonic approach to decision-making, and allowing all participants to be 'experts'.

In addition to transdisciplinarity, several studies highlight the use of multiparty collaboration in addressing disciplinary divisions (Wood and Gray, 1991; Glicken, 2000; Bosch et al., 2003; Bouwen and Tailieu, 2004; Bouwen, 2008; Gray and Schruijer, 2010). Multiparty collaboration occurs when stakeholders facing a mutual problem engage in “an interactive process, using shared rules, norms, and structures, to act or decide on issues related to that domain” (Wood and Gray, 1991: 146). A key idea underpinning multiparty collaboration is that knowledge is simultaneously embedded as well as emergent and is thus the result of relational practice and social interactions (Bouwen and Tailieu, 2004; Gray and Schruijer, 2010). In this regard, multiparty collaboration allows for the exploration of different disciplinary constructions and provides a forum for the co-creation of knowledge via relational practice and social interaction.

## **2.2 Knowledge Integration for Addressing Crises in Small-Scale Fisheries**

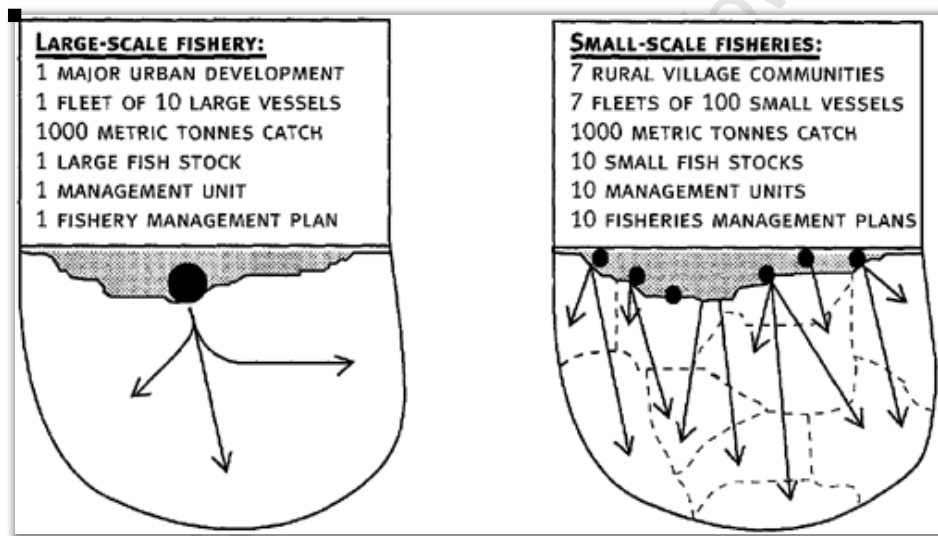
There is a general agreement amongst fisheries scholars that fisheries around the world are in crisis (Attwood et al., 1997; Jentoft et al., 1998; Ruddle, 1998; Cochrane, 2002; McClanahan et al., 2008). As Defeo and Castilla (2005) illuminate, while crises in industrial fisheries have widely been scrutinised, less work has examined those in small-scale fisheries. Unlike industrial fisheries, SSF are commonly low investment, subsistence-based, face high unemployment rates, and tend to be in developing countries (Berkes, 2003; Defeo and Castilla, 2005; Sowman, 2006). Obviously, just as industrial and small-scale fishery systems differ, their approach to management should too.

### *2.2.1 The Human Dimension in SSF Management*

In the past two decades, SSF management has undergone a significant transformation and evolution (Berkes and Folke, 1998; Jentoft et al., 1998; Ruddle, 1998; Degnbol et al., 2006; Cinner and Aswani, 2007; St. Martin et al., 2007; Garcia and Charles, 2008). Conventional fisheries management incorporates, “the uncritical use of managerial tools and concepts,

anthropocentric ethics, authoritarian political frameworks, and deterministic, control-oriented scientific worldviews” (Berkes, 2003: 6). Since the 1990s, scholars have criticised the inability of conventional management to consider the many interdependencies within SSF. As a result, scholarship no longer views SSF as predictable and controllable bio-socio-economic systems, but rather as inherently uncertain, non-linear, and fuzzy (Garcia and Charles, 2008). Figure 3 depicts the differences between large and small-scale fisheries as well as their relative complexity.

**Figure 3. Relative Complexity of Large versus Small-Scale Fisheries**  
(Berkes, 2003:8)



Given the complexity and many socio-ecological interdependencies of SSF, consideration of the human dimension needs to inform management (Pinkerton, 1989; Cincin-Sain and Knecht, 1998; Neis et al., 1999; Cinner and Aswani, 2007; St. Martin et al., 2007; Sowman, 2011). Often underlying causes of fisheries crises such as resource exploitation and environmental degradation are due to the inability of systems to adapt to social, economic, institutional, and political weaknesses (Berkes et al., 2001; Cochrane, 2002). For example, in reviewing one hundred and forty case studies across the Philippines and Indonesia, Pollnac and Pomeroy (2005) reveal that management projects fail when they do not address local concerns, livelihoods,

and well-being. Specifically, the sustainability of management plans links to user participation in planning and implementation as well as improvement in community infrastructure and living standards (Pollnac and Pomeroy, 2005). As such, fisheries management needs both a focus on handling fish as well as a focus on managing people.

One mechanism for involving the human dimension and taking a people-centred approach in SSF management is via the integration of resource users and user knowledges. Knowledge integration is particularly important in the context of developing countries where financial uncertainties of regulation, monitoring, and enforcement plague fisheries management (Mahon and McConney, 2004; Mahon et al., 2008; Sowman, 2011). Knowledge integration creates a critical source of information and support for management, community buy-in, and conservation planning (Balram et al., 2004). Furthermore, in examining SSF management in Small Island Developing States, Mahon and McConney (2004) contrast the integrated departments of developed countries to sectoral departments in developing countries. In this regard, fisheries in developing countries often face a lack of capacity, integration, and resources needed to properly manage fisheries (Mahon et al., 2008; Sowman, 2011). By integrating TEK into SSF management, developing countries boost current understandings of complex systems and user behaviour, make decision-making more inclusive, and strengthen management acceptability (Armitage et al., 2007; Mahon et al., 2008; Nursey-Bray and Rist, 2009; Almudi and Kalikoski, 2010; Sowman, 2011; Teh and Teh, 2011).

### *2.2.2 Knowledge Integration and SSF Management: TEK as Information and Practice*

Studies on the importance of knowledge integration in fisheries management are abundant (Pinkerton and Weinstein, 1995; Calamia, 1996; Berkes et al., 2000; Johannes, 2003; Murray et al., 2006; Pomeroy and Rivera-Guieb, 2006; Garcia and Charles, 2008; Capistrano, 2010; Ferse et al., 2010; Sowman, 2011). For example, in exploring Canadian Atlantic Cod and Lumpfish fisheries, Neis et al. (1999) observed TEK on taxonomy, toponomy, and stock structure with

scientific catch statistics. As a result, researchers uncovered patterns on stock distinctiveness, fishing efficiency, and spatial transformation (Neis et al., 1999). Similarly, using fuzzy logic and heuristic modelling, MacKinson (2001) merges TEK and scientific data. From this modelling, MacKinson (2001) maps linguistic expressions into numerical variables providing information on the spatial dynamic of herring shoals. Initiating a more participatory approach, Hall and Close (2007) merge community maps and maps designed via geographic information systems (GIS). The result is the production of a spatial representation of high-pressure harvest zones and management planning for the spiny lobster fishery in Turks and Caicos. Ultimately, although they are few in nature, through the use of integrated methodologies, these case studies manage to incorporate TEK into SSF planning and management.

Within knowledge integration studies, TEK contributes to SSF management by improving scientific research, furthering information, identifying new paradigms, and creating opportunities for collaboration and participation (Huntington, 2000). Furthermore, Drew (2005) adds that TEK contributes to the development of location-specific knowledge while strengthening local capacity and power sharing. In addition, TEK adds to SSF management through its system-based approach whereby system components – both human and non-human – are interdependent (Berkes, 1999; Pierotti and Wildcat, 2000; Menzies and Butler, 2006). In this light, TEK is similar to the fields of general systems thinking, complexity theory, and ecology, which promote the totality of interactions among components of a given system (Capra, 1996; Cilliers, 2000; Odum and Barrett, 2005; Folke, 2006; Heylighen et al., 2007). Given that TEK is both information and practice, it provides insight into resource use and fisher behaviour (Neis et al., 1999; Berkes, 2000; Sowman, 2011). In short, considering the complexity of SSF, TEK brings greater awareness to environmental linkages, system relationships, and social dimensions in fishery management (Drew, 2005).

## 2.3 Pursuing Knowledge Integration in South African SSF

Despite an overwhelming amount of literature documenting the benefits of knowledge integration abroad, there is little evidence of this process occurring in South African SSF. As such, in order to pursue knowledge integration in the Olifants Estuary, one must first examine the historical and political context from which its management has emerged.

### *2.3.1 Historical and Political Influences on South African Fisheries Management*

Both colonial rule and the apartheid era desecrated ideas of justice and equality within fisheries management. This desecration left behind a legacy of mistrust and division between local peoples and resource managers (Harris et al., 2002; Hauck and Sowman, 2003; Glavovic, 2006). Under colonial rule and apartheid, South African governments denied 'coloured' and 'black'<sup>2</sup> small-scale fishers access to the coastline and marine resources (Hauck and Sowman, 2001). Furthermore, structural violence and social engineering led to a dramatic disruption of customary practices and systems of governance (Harris et al., 2002; Hauck and Sowman, 2003; Sowman and Sunde, 2011). For example, policies and laws such as the Black Land Act 27 of 1913, the Development Trust and Land Act 18 of 1936, and the Group Areas Act of 1951 effectively destroyed the livelihoods of many communities dependent on coastal resources (Hauck and Sowman, 2003; Sowman et al., 2010).

The destruction of livelihoods was further exacerbated by continuous waves of industrialisation and urbanisation most notably those of the 1940s (van Sittert, 2002; van Sittert, 2003). During the interwar era, South African fisheries underwent significant reform. As van Sittert (2002: 296) theorises, "these reforms were the foundation on which the modern fishing industry was built, facilitating and financing the rise of white monopolies." Hauck and Sowman (2001) draw attention to the heavily biased allocation of resources, which favoured 'white' large-scale operators over 'black' and 'coloured' small-

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<sup>2</sup> Within South Africa, 'black' is a generic term applied to ethnic groups identified by apartheid policy as 'Indian', 'African', or 'Coloured' (Erasmus, 2001; Sowman, 2006).

scale fishers. During this period, former fishers – now without rights and livelihoods – migrated to urban centres looking for employment (van Sittert, 2002). The 1940s fisheries reform not only interrupted customary fishing practices but also created a large social welfare cast (van Sittert, 2002). In short, the reforms of colonial rule and the apartheid era led to the increasing marginalisation of small-scale fishers across South Africa.

### *2.3.2 Policy and Legal Framework for Knowledge Integration in South Africa*

Following South Africa's transition to democracy in 1994, fisheries management underwent yet another transformation. During this transition, dialogues between a diversity of coastal stakeholders were established (Glavovic, 2006). As a result, the new government enacted various policies and legislation, which attempted to address former injustices and inequalities (Wynberg, 2001; Hauck and Sowman, 2005; Glavovic, 2006, Carvalho et al., 2009). Specifically, the White Paper for Marine Fisheries Policy of 1997, the National Environmental Management Act of 1998 (NEMA), the Marine Living Resources Act of 1998 (MLRA), and the White Paper for Sustainable Coastal Development of 2000 incorporated governance, equitable participation, and benefit sharing into decision-making (Hutton and Pitcher, 1998; Branch and Clark, 2006). However, there are debates as to whether provisions within this legislation adequately address small-scale fisher rights such as equity, justice, and participation (Harris et al., 2002; van Sittert et al., 2006; Sunde and Isaacs, 2008; Sowman and Sunde, 2010; Sowman, 2011). To address concerns regarding unrecognised socio-economic and customary rights a new Small-Scale Fisheries Policy was promulgated in June 2012 following an Equality Court ruling in 2007. While the Small-Scale Fisheries Policy recognises the rights and knowledge of traditional small-scale fishers (DAFF, 2012), there is no clear implementation plan detailing how to enact it in practice.

Just as various policy and legislation calling for increased user participation has evolved in South Africa, so too has policy and legislation calling for the legitimisation of traditional knowledge. Within South Africa, international thinking and new perspectives articulated in several

international instruments influenced the law reform. For example, Article 6(4) of the 1995 Food and Agriculture Organisation (FAO) Code of Conduct for Responsible Fisheries merged TEK and Science in SSF management (FAO, 1995). Likewise, within the 2003 South African Development Community (SADC) Protocol, signatories committed to including fishers and indigenous knowledge in management. Furthermore, the 2004 Indigenous Knowledge Systems Policy of South Africa sought to, “recognise it [TEK], affirm it, develop it, and promote and protect its custodians and practitioners” (Department of Science and Technology, 2004:4). Particularly important for knowledge integration as well as customary rights, the Small-Scale Fisheries Policy has recently promised to, “Recognise the complementary value of indigenous and local knowledge.” (DAFF, 2012: 15). Overall, South Africa has committed itself to knowledge integration in resource management. Nonetheless, despite the existence of a policy and legal framework for including TEK in management, there are few successful examples of knowledge integration in fisheries in practice.

#### **2.4 Conclusion: Demand for Empirical Research**

A review of the literature recognises that there are several benefits associated with the incorporation of TEK in resource management. Despite being heterogeneous and context dependent, studies identify various common characteristics of TEK. In turn, these characteristics are integral to managing complex socio-ecological systems and incorporating the human dimension into SSF management and decision-making. Nevertheless, despite the many calls for knowledge integration in policy documents, only few studies have successfully managed to achieve integration in practice (Neis et al., 1999; MacKinson, 2001; Hall and Close, 2007; Capistrano, 2010; Lauer and Aswani, 2010).

Knowledge integration is particularly important for developing countries where fishery management is often under-capacitated and SSF are particularly vulnerable. Within South Africa, post-apartheid legislation has developed a framework for community participation and knowledge integration yet there is little evidence of this framework being put into

practice. Given that there are so few applied studies on knowledge integration, it becomes obvious that further research is required in this regard. Therefore, in order to address a discernible gap in research, this study uses the Olifants Estuary Knowledge Documentation Project to explore the extent to which TEK can be integrated into South African SSF management in practice.

University of Cape Town

## **CHAPTER 3**

### **THE OLIFANTS ESTUARY AND HARDER FISHERY: STUDY AREA**

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Chapter 3 provides a brief description of the Olifants Estuary and the study area of this research. This chapter begins with an overview of the biophysical and socio-economic significance of the Olifants Estuary, which highlights the conflict between various management objectives. Chapter 3 also discusses various stages of estuary management transformations as well as the proposed 2008 draft management plan. In conclusion, this chapter emphasises the opportunity of this study to initiate, monitor, and share TEK of the Olifants Estuary gillnet fishers via the Knowledge Documentation Project facilitated by the EEU.

#### **3.1 Biophysical and Socio-Economic Overview**

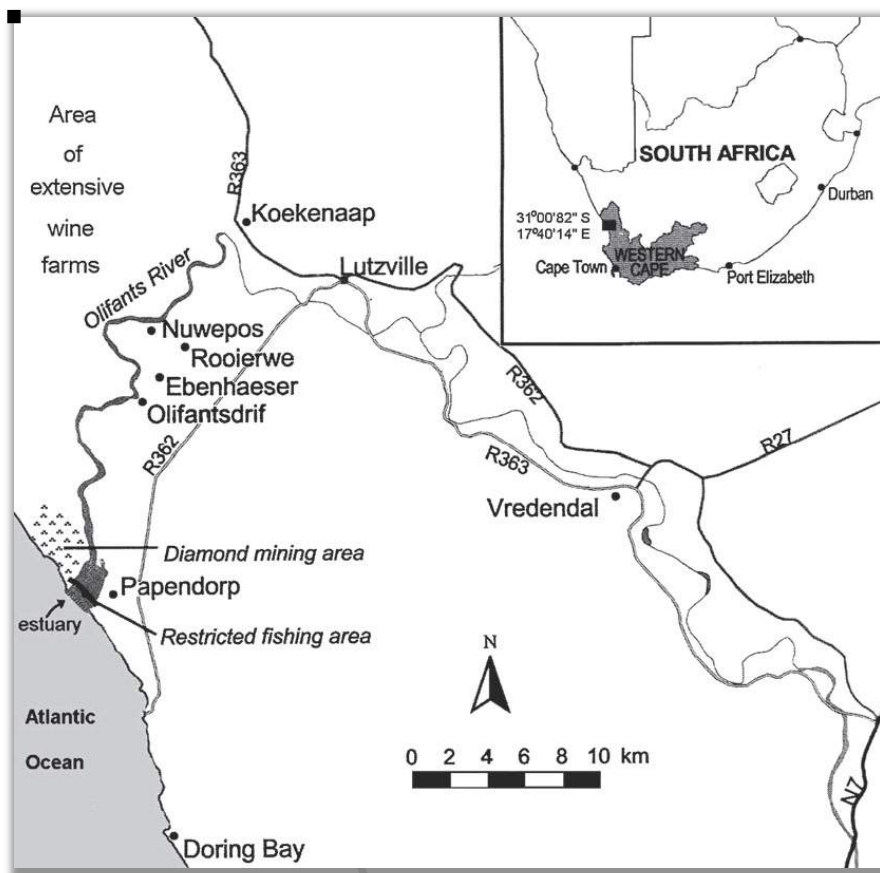
Located approximately 350 kilometres northwest of Cape Town, South Africa, the Olifants Estuary is one of only three permanently open estuaries on the west coast. Particularly important, the estuary is located within the Benguela Current, one of the most productive marine systems in the world (Cochrane et al., 2009). As the twelfth largest estuary in the country, it is a significant nursery for fresh and saltwater fish, a watercourse for migratory fresh and saltwater species, and a feeding and nesting site for bird populations (Turpie, 1995; Turpie et al, 2002). Although the estuary ranks third out of fifty South African estuaries in terms of its conservation importance (Turpie, 2004), it is equally critical in contributing to the livelihoods of the traditional gillnet fishers who have fished in its waters for over a century (Fielding et al., 2007; Sowman and Sunde, 2010).

**Image 2. The Olifants Estuary**



According to Parkington (1977), there is archaeological evidence revealing that pre-historic peoples living near the mouth of the estuary depended on its resources for survival. Furthermore, early archival records document the use of estuary resources in contributing to the livelihoods and the food security of the descendants of indigenous Khoisan peoples (Reitz, 1929; Parkington, 1977). Most notably, in 1832, the Crown granted Khoisan leader Captain Andries Louis title to land adjacent to the Olifants Estuary and around present day Lutzville (see Figure 1) (Sowman and Sunde, 2011). Despite indigenous ties to the area, under the Ebenhaeser Exchange of Land Act of 1925, the Governor General forcibly relocated the Ebenhaeser community to the infertile and saline reaches of the estuary (Sowman 2003; Carvalho et al., 2009). Under this act, Ebenhaeser was scattered into five communities including Nuwepos, Rooierwe, Ebenhaeser, Olifantsdrif, and Papendorp. Figure 1 provides an overview of present day fishing communities in the Olifants Estuary, which collectively are known as Ebenhaeser.

**Figure 2. Map of the Olifants Estuary Fishing Communities**  
(Soman, 2003: 270)



In turn, former community lands were surveyed for irrigation settlement and set aside for 'white-only' farming (Sowman et al., 2001). This resettlement dramatically increased the reliance of the Ebenhaeser community on the estuary for survival.

Since the 1920s, the communities of Ebenhaeser have faced forced removals, government-imposed permit systems, and restricted fishing areas (Sowman and Sunde, 2010; Sowman et al., 2011). While up until 1999, between eighty-five legal gillnet fishers were active in the estuary, currently management only allows forty-five fishers to fish (Carvalho et al., 2009; Sowman and Sunde, 2010). Fishing on the estuary is primarily for food and forms a key source of livelihoods for customary fishers. Sowman (2006) explains that only 43.1% of small-scale fishers along the west coast have access

to wage employment and spend more than 60% of household income on food. Within the west coast region, Turpie et al. (2006) classify the Olifants Estuary as 100% rural whereby fishing families earn between 1512-2280 Rand per household per month (Carvalho et al., 2009; Sowman and Sunde, 2010). Given the high levels of unemployment as well as food insecurity, it is obvious successful management of the Olifants Estuary is essential for the continuation of traditional communities' livelihoods and well-being.

**Image 3. Isak Pieterse, Ebenhaeser Fisher**



### **3.2 Estuary Management**

Since the early 1990s, estuary management has faced several transformations. From 1993 to 1997, Ebenhaeser fishers, supported by the Environmental Evaluation Unit (EEU) of the University of Cape Town, developed a draft co-management agreement. This agreement outlined the duties and responsibilities of fishers and the local Nature Conservation Authorities (Sowman, 2011). However, the development of the Olifants co-management agreement occurred simultaneously with the post-1994 fisheries reforms. As a result of overlaps in management frameworks, there was considerable confusion over which government department was ultimately responsible for

estuary management (Sowman, 2003). Sowman (2003: 271) explains, “this uncertainty, and lack of government involvement in, and support for, the co-management arrangements for the Olifants River hardier fishery, contributed to its collapse in 1999.”

Further complicating estuary management, currently the estuary has two primary overseers namely the Department of Environmental Affairs and (DEA) and the Department of Agriculture, Forestry, and Fisheries (DAFF). DEA facilitates estuary management planning, conservation, and national biodiversity assessments (AEC, 2008b). On the other hand, DAFF oversees fisheries management for example permitting and area restrictions, as well as the engagement of stakeholders on fishery-related issues (AEC, 2008b). Presently, both DEA and DAFF are jointly responsible for the implementation of estuaries as protected areas. In turn, the overlapping of management authorities has led to substantial miscommunication in managing the Olifants Estuary fishery.

### **3.3 The 2008 Draft Management Plan**

The confusion surrounding overlapping management authorities was demonstrated not long after the promulgation of the MLRA in 1998. Towards the end of the 1990s, increasing concern for line fish stocks resulted in restrictive fishing policies as well as government policy to phase out the Olifants Estuary gillnet fishery (Sowman et al., 2011). In addition to concern for linefish stocks and biodiversity, there was also considerable conflict between fisheries authorities, scientists, and fishers on the sustainability of the gillnet fishery and its impact on bycatch (Hutchings and Lamberth, 2002; Fielding et al., 2007). Importantly, following an analysis of data captured between 2003-2006, Fielding and Bergh (2007: 20) argue that, “closing the Olifants River gillnet fishery on the basis of the documented bycatch composition or numbers cannot be justified.” Still, as a result of growing criticism of the gillnet fishery, the Department of Environmental Affairs and Tourism (DEAT) implemented a series of rigorous policy and management measures, which reduced traditional net fishing rights (Sowman et al., 2011). Consequently, in 2007, despite the

social and traditional importance of the estuary, DEAT together with the Cape Action Plan for the Environment (CAPE) appointed consultants to develop an estuary management plan. The draft management plan saw estuary conservation as essential in contributing to the commercial and recreational fisheries along the west coast (AEC, 2008a).

In addition, the draft management vision stated the estuary offered an “unofficial wilderness sanctuary for flora, fauna, and for visitors” (AEC, 2008a: 2). As proposed by the draft management plan, this sanctuary would evolve from the development of a fourteen to eighteen kilometre long no-take Marine Protected Area (MPA) at and around the estuary (AEC, 2008a). Although the declaration of the MPA would address conservation objectives, its implementation would effectively eliminate the traditional gillnet fishery. In turn, the phasing out of the gillnet fishery would eradicate livelihoods of fishery dependent communities, heighten unemployment, and severely restrict food security (Sowman et al., 2011). Considering the historic and customary rights of Ebenhaeser fishers, as well as their dependency on the estuary for survival, the 2008 draft management plan was highly controversial. According to Sowman et al., (2011), traditional fishers doubted the validity of such a top-down decision given their historic rights to resources as well as ongoing land restitution processes. Therefore, the fishers, assisted by the EEU, LRC, and Masifundise, initiated the negotiation of an equitable and inclusive plan for estuary management.

Within these negotiations, the EEU and Masifundise have facilitated a process of documenting fisher knowledge. The aim of this process is to encourage fisher participation in the formulation, development, and implementation of the Olifants Estuary Management Plan (OEMP). Furthermore, this process attempts to apply the principles and provisions articulated in South African legislation including the Constitution, NEMA, MLRA, White Paper for Coastal Development, Small Scale Fisheries Policy, and IKSP, in practice. As part of this process, this research explores the possibility of integrating TEK into the Olifants Estuary Fishery Management Process (OEFMP) thus strengthening community participation, fisher inclusion, and estuary management.

## **CHAPTER 4**

### **RESEARCH STRUCTURE**

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Chapter 4 presents the research approach and methods used to explore the integration of TEK in the OEFMP. This chapter covers the research design, approaches as well as methods employed. Specifically, the following section discusses the use of critical theory and the implementation of applied and action research. Chapter 4 also describes the methods and their contribution to data collection: participant observation, participatory mapping and group discussions, semi-structured interviews, and secondary data analysis. This chapter concludes by discussing data analysis, validity and reliability of qualitative data, as well as research limitations.

#### **4.1 Research Design**

Rooted in interpretative research, this study employs a qualitative research design and seeks to understand, “how people interpret their experiences, construct their worlds, and what meaning they attribute to their experiences” (Merriam, 2009:5). Quantitative research, as distinct from qualitative research, examines quantities and measurements such as identifying trends and evaluating causal paths (Creswell, 2009). However, given that this study explores social behaviour and interpretive paradigms, a qualitative design is critical to the extraction of individual meaning (Creswell, 2009). In its understanding of human experiences, qualitative research is informed by the ontological and epistemological worldviews that guide interpretative research (Guba and Lincoln, 1994; Denzin and Lincoln, 1998).

The worldview employed throughout this research is critical theory, which calls for historical realist ontology as well as transactional and subjectivist epistemology (Guba and Lincoln, 1994). More specifically, this research perceives reality (ontology) to be “shaped by a congeries of social, political, cultural, economic, ethnic, and gender factors...crystallised over time” (Guba and Lincoln, 1994: 110). Additionally, this project is based on researcher and participant interactions, which create the relationship between the ‘knower’ and ‘what is known’ (epistemology). Unlike positivist and post-

positivist epistemologies, which assume objectivity and absolute truth, critical theory emphasises subjectivity. Therefore, this research considers the understanding of historical, social, cultural, and political factors as integral to knowledge integration. In turn, the exploration of these diverse factors allows for critical awareness, human emancipation, and social change (Guba and Lincoln, 1994; Flood, 2001).

#### **4.2 Research Approaches: Applied and Action Research**

Through the incorporation of both applied and action research, this study employs a multi-strategy approach. In identifying suitable research approaches, this project rules out survey-based, experimental, historical and grounded-theory research. This study considers survey-based research too narrow a focus in capturing the range of project objectives, particularly those related to interpretive paradigms. Similarly, the emphasis of experimental research on controlled variables, objectivity, and causal relationships fails to model the complexity of participants' worldviews. Historical research, although significant in understanding the evolution of social paradigms, excludes equally important contemporary paradigms. Last, given the cyclical nature of grounded theory and the time frame required to reach theoretical saturation, this research does not consider it a feasible strategy within project time constraints.

While basic research is concerned with “knowledge as an end in itself” (Patton, 2002: 224), applied research uses knowledge as a tool to expand understandings and resolutions of societal problems. In addition to applied research, this project incorporates action research, which aims for the liberation of individuals by the immediate solution to a specific problem (Patton, 2002; Creswell, 2009; Merriam, 2009). Within this study, the problem under investigation is the integration of TEK into the OEFMP. Using action research, inquiry into knowledge integration in the OEFMP engages both the participants and the researcher thus blending research and action. Ultimately, action research “intervenes in the cultural, social, and historical processes of everyday life to reconstruct not only the practice and the practitioner but also

the practice setting” (Kemmis, 2001: 92). In short, this research uses an applied strategy to identify societal paradigms and an action strategy to reconstruct the environment from which these paradigms emerge.

#### **4.3 Data Collection: Research Methodology and Methods**

Different research approaches require different methodologies. Critical theory calls for a recursive dialogic and dialectical methodology whereby discussion is central to the reconstruction of meaning (Denzin and Lincoln, 1998; Schwandt, 1998; Creswell, 2009). Interpretive theories such as critical theory examine everyday experiences to expand knowledge through the description, speculation, and pursuit of meaning (Higgs, 2001; von Zweck et al., 2008). Dialogue and discussion then compare this examination of everyday experiences (Denzin and Lincoln, 1998). In following a dialogic and dialectical methodology, this study uses the following mixed methods for data collection: participant observation, participatory mapping and group discussions, and semi-structured interviews (formal and informal). Sampling and strategy varies with each method and is discussed as subcomponents in the following section. Figure 4 provides a general overview of study objectives and associated methods.

**Figure 4. Overview of Research Objectives and Methods**



Given that this study forms a part of the ongoing Knowledge Documentation Project initiated by the EEU, its methods seek to contribute to one component

of the process as a whole. Beginning with participant observation, the following sections describe the methods of this study in more detail.

#### *4.3.1 Participant Observation*

Participant observation, defined as the describing and recording of experiences in social settings (Gans, 1999), was the starting point for this investigation. Like all methods of data collection, participant observation has certain limitations such as research intrusiveness and privacy of information (Creswell, 2009). Despite these limitations, this project used overt participant observation in its formative stages to:

- Develop an overview of current debates surrounding the use of TEK in estuary management;
- Identify various stakeholders involved in the OEFMP;
- Establish relationships with participants and create rapport;
- Experience first hand everyday fishing practices;
- Pinpoint key participants for participatory mapping and semi-structured interviews; and
- Formulate potential follow-up questions

This study integrated participant observation alongside participatory mapping and the attendance of scheduled OEFMP stakeholder meetings and workshops. Stakeholder meetings and workshops varied in size and location but principally involved key individuals and organisations. The founding meeting took place on 6 September 2011 at the office of Masifundise Development Trust in Cape Town, South Africa. Key figures from various groups involved in the OEFMP comprised this meeting and included: the EEU, Anchor Environmental Consultants (AEC), DAFF, DEAT, Coastal Links, Cape Nature, and Masifundise. The aim of this meeting was to establish a way forward in sharing knowledge for the OEFMP.

Subsequently, the preliminary workshop amongst fishers took place on 15 September 2011 at the Ebenhaeser Community Centre. Members from the communities of Papendorp, Olifantsdrif, Ebenhaeser, Rooierwe, and Nuwepos were the primary meeting attendants. This workshop established a way

forward in the process of documenting knowledge for management of the gillnet fishery. Additionally, the EEU, Masifundise, and the fishers held two subsequent meetings in preparation for the 17 November 2011 Knowledge-Sharing Workshop, which aimed to communicate fisher and scientific knowledge across parties. As the researcher was not present, data from the 17 November workshop comes from personal communication with meeting participants as well as secondary data in the form of meeting minutes. The data collected during participant observation was in the form of field notes and included both verbal and physical observations.

#### *4.3.2 Participatory Mapping and Group Discussions*

Following observations at preliminary meetings and workshops, Coastal Links – a community-based fisher organisation – selected fifteen fishers to assist with the process of documenting TEK via participatory mapping exercises and group discussions. Coastal Links identified these participants as the core group of fishers who possessed the most experience, greatest involvement, and/or longest history in the estuary (Appendix B). The fisher community considered these participants the *Groot Manne* (elders) of the community (refer to Section 5.1). Participatory mapping allowed for the:

- Collaborative development of research questions and areas of inquiry;
- Discussion of community worldviews and behaviour;
- Sharing of oral histories;
- Exploration of TEK and fishing practices; and
- Co-learning of participants and researcher

With assistance from the EEU, a series of participatory mapping sessions took place from September – November 2011. During participatory mapping sessions, participants explored key characteristics of the estuary and the fishery including the main fishing areas. Additionally, throughout the participatory mapping process researchers also observed participants' daily-fishing routines and whether TEK influenced fishing practices. Several scholars criticise participatory research for its lack of validity and its subjectivity amongst participants (Denzin and Lincoln, 1998; Creswell, 2009). Therefore,

during the three-month mapping process, three group discussions (22 September 2011, 23 September 2011, and 4 October 2011) were held to ensure that participants' statements were cross-referenced. On average, group discussions were five to six hours long and took place on river and on shore. Data collected throughout this process included field notes and estuary maps compiled through participatory mapping exercises. Data drawn in Section 5.1-Section 5.2 was from the group discussions and references the fifteen fishers identified by Coastal Links (Appendix B).

#### *4.3.3 Semi-Structured Interviews*

The next stage of this study took place via semi-structured interviews. Semi-structured interviews allowed for the use of core open-ended questions while at the same time permitting interviews to be flexible and dynamic. Intentional flexibility resulted in the generation of unforeseen ideas and themes guided by the participant rather than by the researcher. Semi-structured interviews were used to:

- Discuss individual views and constructions of TEK in depth;
- Explore perceived strengths and limitations of TEK;
- Engage natural scientists and social scientists involved in the OEFMP as well as those knowledgeable about TEK and/or estuarine fisheries;
- Gain specific and general understanding of knowledge integration in South African small-scale fisheries management; and
- Cross-compare different perceptions of similar themes

A weakness of such interviews is the potential for bias (Creswell, 2009). Therefore, to minimise bias, this research selected interviewees from various organisations specifically AEC, DAFF, DEA, EEU, Masifundise, and the University of Cape Town (Departments of Environmental and Geographic Sciences, Anthropology, Sociology, and Zoology). This study selected interviewees through purposive sampling and targeted participants based on discipline, understanding of small-scale fisheries, level of involvement with the OEFMP, and familiarity with TEK.

The interviewees fell into two main 'categories': natural scientists and social scientists. The total number of interviewees was fifteen and included interviewees from each 'category' (Appendix C). Interviews lasted between fifty to sixty minutes and consisted of a series of identical questions for natural scientists and social scientists (Appendix D). The researcher recorded and wrote notes during the interview, which were transcribed afterwards. Given that information and insights on TEK and SSF matters had also been gathered from fishers via participant observation, participatory mapping, and group discussions, they were not included in the semi-structured interviews. The researcher felt if fishers contributed to interviews, in addition to participant observation, participatory mapping, and group discussions, data would be unrepresentative and its distribution skewed.

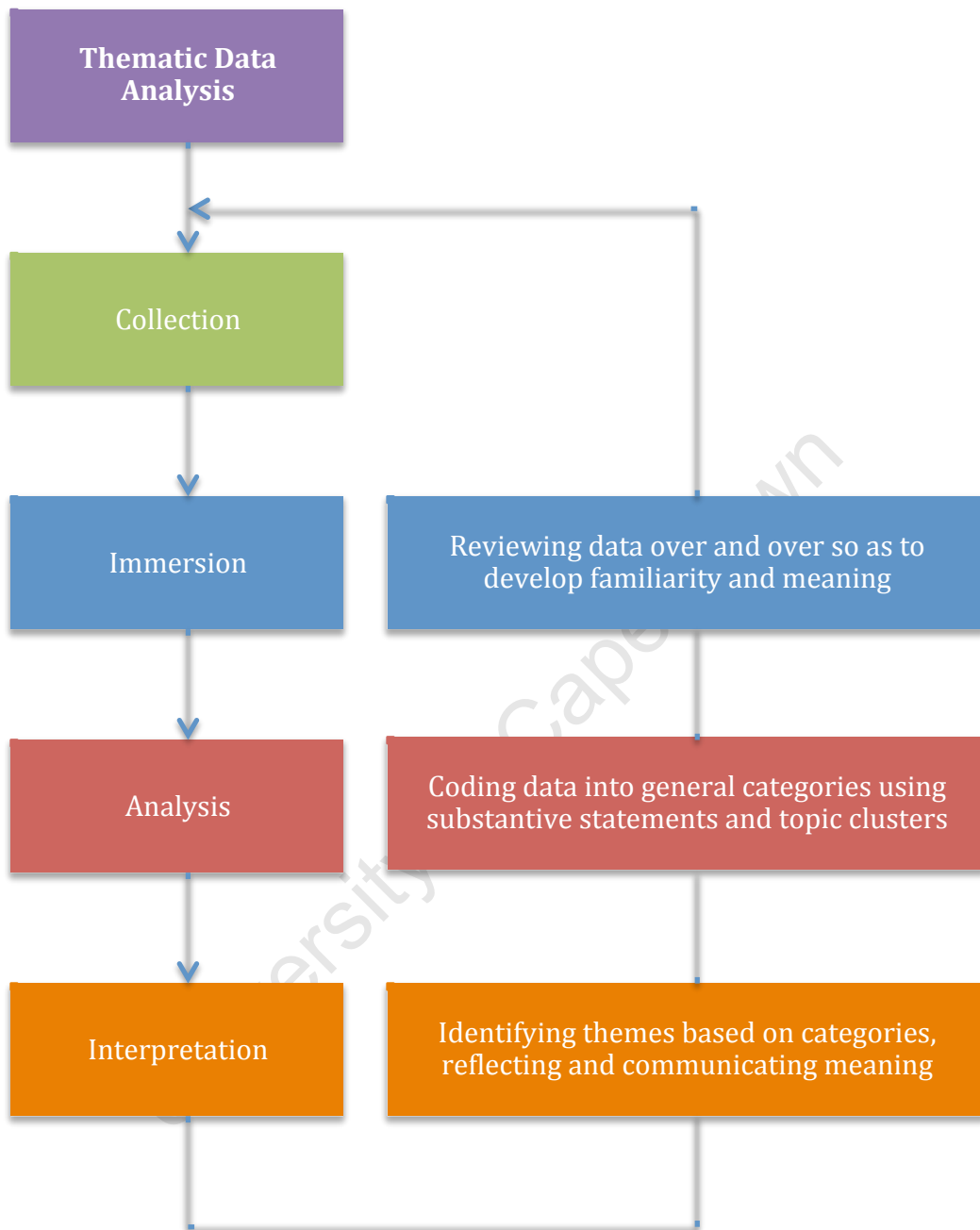
#### *4.3.4 Secondary Data Review*

This study also used secondary data to fill any remaining gaps. Secondary data cemented material collected via participant observation, participatory mapping and group discussions, and semi-structured interviews. This data consisted primarily of meeting minutes as well as published and unpublished reports by AEC and the EEU.

#### **4.4 Data Analysis: A Thematic Framework**

Creswell (2009) as well as Rossman and Rallis (2003) argue data collection and analysis are not separate processes but interdependent. Therefore, as this study was inductive in nature, it integrated emerging questions, ideas, and themes into its collection of data. Following the direction of Rossman and Rallis (2003), this research evaluated data by immersion, analysis, and interpretation. Figure 5 provides a brief overview of the three stages of data evaluation and demonstrates the simultaneous nature of data collection and analysis.

**Figure 5. Overview of Thematic Analysis Process**



Beginning with immersion, this study reviewed and re-reviewed data to develop familiarity with it and to uncover its meanings. Rossman and Rallis (2003: 284) identify immersion as “living with the data” whereby the researcher begins to know the data intimately and confidently. The researcher also asked several questions during this process, namely what was this data about? What words or ideas did participants repeat? What messages did

participants convey? In short, the immersion stage of data analysis allowed the researcher to explore data more deeply and to develop a familiarity with the material.

Following immersion, the researcher analysed data. Analysis involved deconstructing transcripts and field notes into substantive statements and rearranging statements according to emerging topics. The researcher narrowed topics into categorical clusters and organised them into coding tables. Coding tables were based on project objectives namely the relationship between TEK and fishing practices, processes for documenting TEK, strengths and/or limitations of TEK in the OEFMP, and factors enabling and/or constraining knowledge integration. The researcher viewed the process of coding as integral in arranging data into relationships, cross-referencing data, and bringing meaning to project material. Each coding table included three features: participant, code, and statement. The research also clustered codes by expected topics, unexpected topics, unusual topics, and theoretical topics. Topic clusters gave way to data interpretation, which was the final stage of the thematic analysis process.

Data interpretation allowed for the formation of “thick descriptions” (Rossman and Rallis, 2003: 288). This study developed descriptions using the experiences and perceptions of study participants. These descriptions allowed for the emergence of key themes, which eventually gave way to research findings. These themes were an attempt to capture the meaning of phenomenon and lived experience (Van Manen, 1990). During data interpretation, themes were also used to re-evaluate earlier data codes. In addition, data themes and research findings were cross-referenced via other studies, namely those examined in Chapter 2. In keeping with Rossman and Rallis (2003: 288), this study followed the hermeneutic cycle whereby it, “analysed the parts in order to see the whole,” while, “seeing the whole further illuminated the parts.”

#### **4.5 Qualitative Validity and Reliability**

While quantitative research is principally concerned with research validity, qualitative studies scrutinise research validity as well as reliability (Gibbs, 2007; Creswell, 2009). Creswell (2009) identifies qualitative validity as the accuracy of data through following specific protocols related to a methodological procedure. In order to ensure qualitative validity, this project employs methods demanded by the recursive dialogic and dialectical methodology of critical theory (refer to Section 4.3). Qualitative reliability is the congruency between a particular research approach and similar research studies (Gibbs, 2007; Creswell, 2009). In addition, Denzin (1994: 509) states that qualitative reliability is “naturalistically grounded in the worlds of lived experience and organised by a critical, interpretive theory.” Thus, in order to maintain qualitative reliability, this study follows Gibbs’ (2007) reliability procedures by describing research worldview, using multiple-approaches, triangulating data via mixed-methods, ensuring participatory fieldwork, and cross-checking codes.

#### **4.6 Facing Limitations**

As is the case with all research, this study faced certain limitations. First, given that Ebenhaeser is primarily an Afrikaans speaking community, there were occasional language barriers and data may have been misinterpreted. Nevertheless, this study addressed the language barrier using multiple translators and cross-referencing translations. Second, as mentioned in Section 4.3.3, there was the issue of possible bias or emotive answers during semi-structured interviews. Therefore, the researcher interviewed a range of participants to rectify the possibility of bias. Third, in some regards the sample size of this study was limited due to time restraints and respondents declining to be interviewed. Participants’ refusal to be interviewed was most notable amongst government managers and scientists. Kvale (1994: 164) argued, “The number of subjects necessary depends upon the purpose of a study...interview as many subjects that you find out what you need to know.” Therefore, this

project instead focused on the selection of expertise (quality) of key participants over quantity of interviewees. In doing so, this study attempted to cater not to 'generalisability' but rather to specificity, comparability, and 'contextuality' of knowledge (Kvale, 1994; Creswell, 1999). In turn, future research can use the depth (specificity, comparability, and 'contextuality') of the analysis of this study as a comparison across similar sites.

University of Cape Town

## CHAPTER 5 RESEARCH FINDINGS

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Chapter 5 identifies common themes found during participant observation, participatory mapping and group discussions, semi-structured interviews, and secondary data analysis. Themes are presented in the order of the four project objectives. The first section examines the relationship between TEK and estuary fishing practices. The second section explores the process of documenting TEK in the Olifants Estuary. The third examines the strengths and limitations of using TEK in managing the Olifants fishery. Chapter 5 concludes with the investigation of factors that are currently enabling and constraining knowledge integration in the OEFMP.

### **5.1 The Influence of TEK on Fishing Practices in the OEGF**

Participatory mapping exercises demonstrated that there was a strong link between TEK and customary fishing practices in the OEGF. Specifically, amongst participants there was a general awareness that TEK influenced fishing practices but also that fishing practices influenced TEK. For example, Fisher 5 stated, “all this knowledge builds up from our experiences.” In this light, the link between TEK and fishing practices, customary and contemporary, was cyclical, co-evolving, and adaptive in nature.

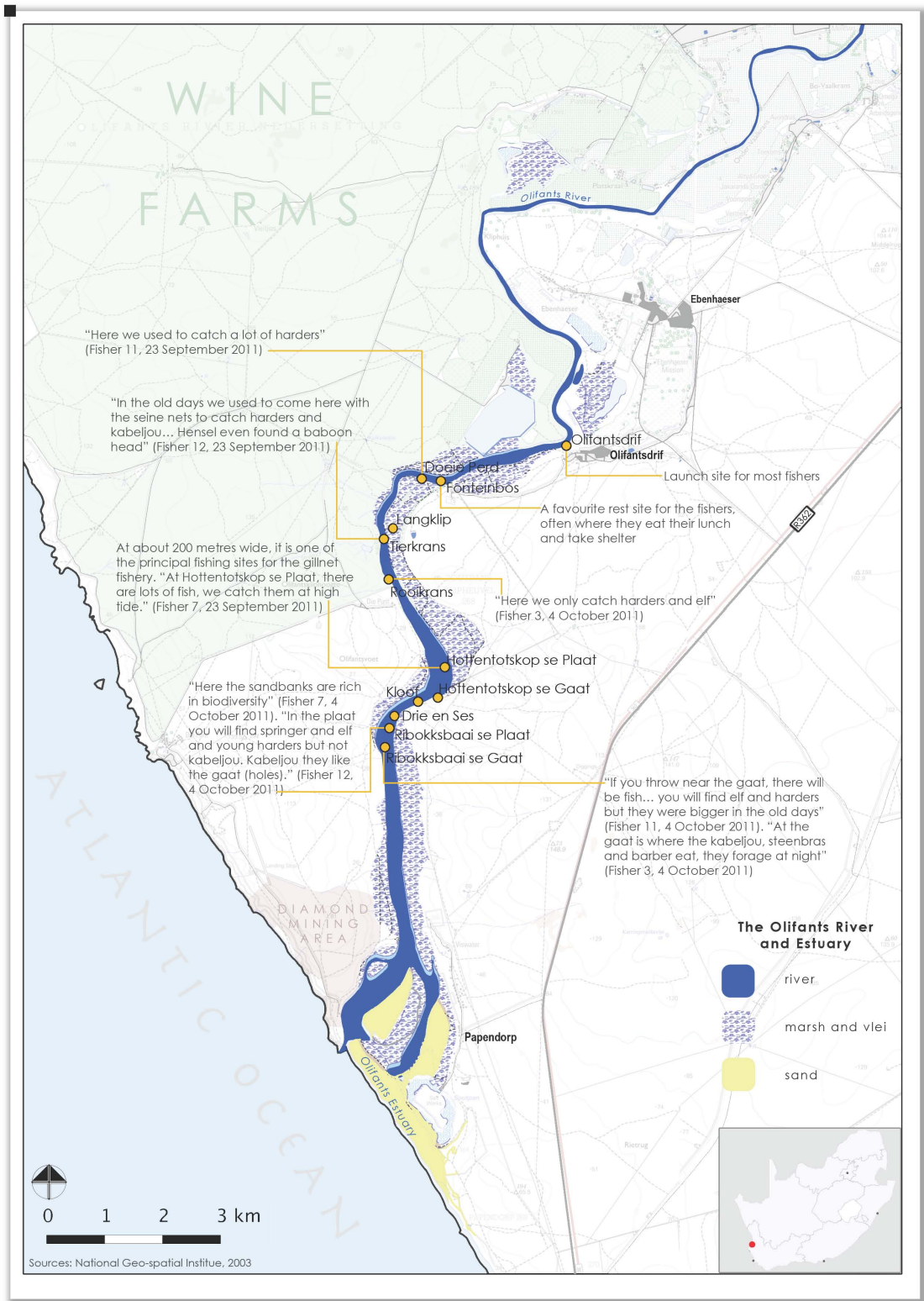
#### *5.1.1 The Influence of TEK on Fishing Practices: Estuary Characteristics*

Knowledge of estuary characteristics was subdivided into several categories beginning with knowledge of fish patterns. First, fishers discussed various aspects of the estuary system including what fish they caught, where they harvested fish, and how these patterns have changed over time. Fisher 7 confirmed, “We know the fish because we grew up with the fish.” Within the OEGF, the harder (*Liza richardsonii*) is the main target species. However, fishers also recognised twelve other species of fish that contributed to their catches including elf, hottentot, kabeljou, white steenbras, springer, and barbel. Furthermore, fishers differentiated freshwater and saltwater fish as

demonstrated by Fisher 3 who stated, “The meat of the fish is whiter if it comes from the river and it’s a different texture from the sea, you can see its veins.” Additionally, fishers predicted the age and the size of fish based on harvest locations. Fisher 12 indicated, “harders are bigger on the *plaat* (sandbanks)...the younger ones [harders] hide in the sea grass so you don’t see their shadows.”

TEK also identified areas where fishers historically found good fish catches such as *Ribboksbaai se Plaat* and *Hottentotskop se Plaat* (Figure 6). Fisher 11 confirmed, “On the sandbanks at *Hottentotskop* the springers and the harders jump together.” In addition, fishers distinguished several areas of *biodiversiteit ryk plaats* (biodiversity rich sandbanks) where “the fish come to lie, eat, and seek shelter” (Fisher 7). In this regard, TEK provided fishers with information regarding species characteristics, preferences, and behaviour. In turn, this information allowed fishers to identify customary and contemporary harvesting locations. Figure 6 provides a visual summary of key fishing areas highlighted by the *Groote Manne* during participatory mapping and group discussions.

**Figure 6. Map According to Participatory Mapping and Group Discussions**



Climate knowledge, particularly of weather and seasons, also fell under the theme of estuary characteristics. With accumulated observations of weather patterns and the influence of weather on fish, TEK allowed fishers to

forecast the productivity and timing of harvesting. Fisher 11 explained, “The fish like warm water, they run after the south westerlies blow for three days.” Similarly, Fisher 5 claimed, “the mist brings weather and the fish hide, it’s too cold for them.” Additionally, knowledge of seasonality also affected fishing practices. Fishers identified the summer months (October to April) as the most productive and having the best catches (fisher group discussion, 23 September 2011). According to Fisher 7, “in the summer the water is warmer and brings elf and kob...in late summer the fish are less and you don’t see any small ones.” Fishers attributed changes in catch to various environmental conditions including weather, water temperature, winds, tides, and fresh water flows. For example, “in June and July the river comes down and puts clean water into the estuary, there is no food for the fish and no fish” (Fisher 12). Together, knowledge of fish patterns, climate, and environmental conditions has contributed to developing a greater understanding of estuary characteristics.

#### *5.1.2 The Influence of TEK on Fishing Practices: Anthropogenic Change*

TEK of anthropogenic change also affected fishing practices in the estuary. Anthropogenic change chiefly fell into three categories: mining, recreational fishing, and agriculture. Between one another, Ebenhaeser fishers have over five hundred years of experience living off the estuary (fisher group discussion, 22 September 2011). Accordingly, the accumulated observations of human activities within the estuary have allowed fishers to identify associated system changes. Fisher 3 stated, “Scientists need to spend twenty years living on the river to see it from my eyes.” Particularly damaging are mining, recreational fishing, and agriculture, which have triggered various changes in estuary dynamics such as water flows and water quality. Due to these changes, fishers have adjusted harvesting practices to adapt to estuary transformations.

According to fishers, the presence of marine diamond mining boats anchored near the river mouth negatively affected fish behaviour. Several elders maintained that when mining boats were present, the noise and the light “scared the fish” (Fisher 12). In turn, this resulted in the adoption of alternative harvesting locations. Furthermore, increased numbers of recreational users in

the holiday periods also disrupted fishing practices. “In the summer holidays each day there are about twelve to thirteen recreational fishers with two to three rods each camping along the river” (Fisher 4). Over time, the increase in recreational users has presented growing challenges to the fishers. These challenges included restricted fishing conditions where fishers were unable to row through fishing lines, decreased contributing catches, and unmonitored harvesting of bycatch species by recreational users.

Last, increased agricultural activities alongside the river has negatively affected estuary ecology and resulted in alternative harvest locations as well as more variable harvest productivity. Emerging from generations of fishers, TEK detailed changes in water flow, eutrophication, sedimentation, and fish stocks. Fisher 7 explained, “the sandbanks are getting bigger, the water is getting less, the river is closing, it’s not as clean...agriculture is decreasing our fish.” In addition, fishers claimed that fertiliser sprayed on farms adjacent to the river was getting into the water (fisher group discussion, 22 October 2011) and “poisoning the fish” (Fisher 3).

**Image 4. Sylvester Don Discussing the Impacts of Agriculture**



Furthermore, fishers argued that the Clanwilliam Dam has had a major impact on water flow and fish catches (Image 4) (fisher group discussion, 4 October

2011). As a result of the dam, “the river has become narrower... it only opens itself if the stream comes down strong” (Fisher 10). Fishers claim that agriculture and its associated impacts have forced them to fish further from their homes and in the lower reaches of the estuary (fisher group discussion, 23 September 2011). In this regard, knowledge of anthropogenic change, coupled with growing understanding of estuary characteristics, has led fishers to adapt alternative harvesting locations.

## **5.2 Knowledge Documentation: A Three-Staged Process**

In exploring Objective 2, this project used participant observation, participatory mapping, and group discussions to follow a three-staged process for documenting TEK. In order, these stages were identifying knowledge parameters, collecting knowledge, and disseminating knowledge.

### *5.2.1 Documenting TEK: Identification*

The first stage in the process of documenting TEK in the Olifants Estuary was the identification of knowledge parameters. During the 15 September 2011 community meeting, fishers developed a series of questions they considered necessary to answer in order to understand the fishery and the estuary using TEK (Table 1). These questions established a general guideline of what information was essential versus what information was erroneous in the development of a fishery management plan. Questions fell into categories such as climate, environmental change, and fishing patterns, which allowed participants to pinpoint key knowledge themes. In turn, the identification stage highlighted parameters considered important by fishers for estuary management.

### *5.2.2 Documenting TEK: Collection*

This project employed participatory mapping as both a method and a process. Specifically, participatory mapping served as an instrument to gather

knowledge and as a process within which knowledge amongst researchers and participants was co-produced. In order to gather TEK and to answer the questions proposed by fishers, researchers worked collaboratively with the *Groote Manne*. Together, with the use of an overhead projector and laminated aerial photographs, participants identified important fishing areas and provided local names of key fishing locations in the estuary. Using stickers, these areas were marked and verified through three consecutive group discussions (22 September 2011, 23 September 2011, and 4 October 2011). In the following sessions (every two weeks from September to November 2011), researchers and participants navigated the river (Image 5) and confirmed coordinates of identified areas using Global Positioning Systems (GPS) (Appendix E).

**Image 5. Group Discussion with the *Groote Manne***



### *5.2.3 Documenting TEK: Dissemination*

The final stage in the documentation of TEK was knowledge-sharing and information dissemination. Following the collection of TEK, the EEU and Masifundise initiated a fisher-scientist workshop on 17 November 2011 at the Ebenhaeser Community Centre. During this workshop, both fishers and

scientists involved in the OEFMP exchanged and shared knowledge accumulated during the collection stage of knowledge documentation. Before the workshop, participants agreed that this process would focus specifically on knowledge-sharing rather than management solutions.

Despite significant interest and involvement of the *Groot Manne* in the participatory mapping sessions and group discussions, only ten fishers were present during the workshop, the reasons for which were not clear (Participant 11). In addition, “although the facilitator attempted to create an environment conducive for the exchange of information, there were clearly tensions between the fishers and the group of scientists” (Participant 11). Participant 3 similarly expanded, “certain inputs by the scientists were accompanied by technical graphs and tables which were in most cases, difficult for the fishers to follow.” In addition, while there was agreement on the number of permit holders and most productive fishing seasons, there was extensive debate surrounding the catch, effort, and catch-per-effort of the gillnet fishery. Specifically, given that fishers were no longer submitting ‘blue books’ (catch effort data) to fishing authorities, they questioned the basis of scientific estimates as well as where and when data on estimates originated from. Table 1 provides a comparative analysis of data presented during the first Knowledge-Sharing Workshop.

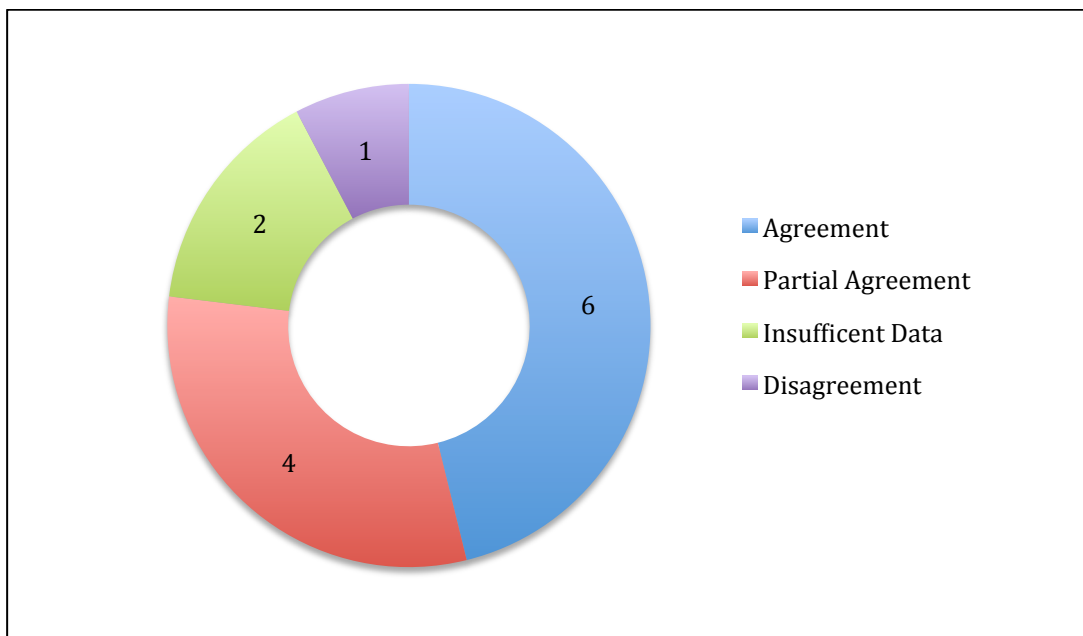
**Table 1. Knowledge-Sharing Workshop: Answers to Fishers' Questions**  
Summarised from 17 November 2011 Meeting Minutes (Appendix F)

Question	Answer According to TEK	Answer According to Science	Agreement/Disagreement
1. What fish species do fishers mainly catch in the Olifants Estuary?	<ul style="list-style-type: none"> <li>• Harders, elf, white steenbras, springer, barbel, kob, leervis, white stumpnose, gurnard, strepie, moggel, kurper, St. Joseph shark</li> </ul>	<ul style="list-style-type: none"> <li>• 20 species - 12 of which are listed by the fishers, remaining 8 unlisted</li> <li>• Most important species are harders (<i>Liza richardsonii</i>) and elf (<i>Pomatomus saltatrix</i>)</li> </ul>	Partial Agreement <ul style="list-style-type: none"> <li>• Agreement on 12 species listed by fishers however, fishers did not list remaining 8 species identified by scientists</li> </ul>
2. What are the main areas in which fishers catch harders?	<ul style="list-style-type: none"> <li>• <i>Die Baaken</i> (river mouth)</li> <li>• <i>Ribboksbaai</i> (lower reaches)</li> </ul>	<ul style="list-style-type: none"> <li>• River mouth</li> <li>• Lower reaches of the estuary</li> </ul>	Agreement
3. Where do contributing catches spawn?	<ul style="list-style-type: none"> <li>• Harders, elf, and kob spawn in the sea</li> </ul>	<ul style="list-style-type: none"> <li>• Harders, elf, and kob spawn in the sea, but the estuary is an important nursery for juveniles</li> </ul>	Agreement
4. When are the most productive fishing months?	<ul style="list-style-type: none"> <li>• The summer is the best season for catching harders and elf (October to April) but also when bycatch is highest</li> <li>• Lower catch in winter as freshwater flushes river</li> </ul>	<ul style="list-style-type: none"> <li>• Most fish (including bycatch) are caught in the summer</li> <li>• However, highest catch per fisher occurs from April-May and in December</li> </ul>	Agreement
5. How has the catch of harders and bycatch species changed over time?	<ul style="list-style-type: none"> <li>• Substantial changes in catch: decreasing variation in species, decreasing size, and decreasing quantities</li> </ul>	<ul style="list-style-type: none"> <li>• Total catch of harders has declined by 85% since the 1880s</li> <li>• Recruitment of elf has declined by 40% and white steenbras recruitment has declined by 80%</li> </ul>	Partial Agreement <ul style="list-style-type: none"> <li>• Agreement on decreased variation, physical size, and quantities of stocks</li> <li>• Disagreement on timeline of decline and severity of decline</li> </ul>
6. What impact do seals have on the fishery and how has this changed over time?	<ul style="list-style-type: none"> <li>• Increasing number of seals in the estuary especially 'rogue' seals</li> <li>• Seals bite holes in nets, steal catch, and eat large numbers of fish</li> </ul>	<ul style="list-style-type: none"> <li>• Seals are an increasing challenge for fishers however, seals are also a necessary component in regulating fish stocks</li> </ul>	Agreement
7. What are anthropogenic impacts on the estuary aside from the gillnet fishery?	<ul style="list-style-type: none"> <li>• Mining: increasing sedimentation, changing water flows, closing water channels</li> </ul>	<ul style="list-style-type: none"> <li>• Mining: inspection trenches alongside river impact water flow</li> </ul>	Partial Agreement <ul style="list-style-type: none"> <li>• Agreement on trenches and channels</li> <li>• Disagreement on severity of impacts</li> </ul>
	<ul style="list-style-type: none"> <li>• Agriculture: increasing water demands, less water flow, increasing pesticides and nutrients in river, reducing numbers of fish</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture: reducing water flow, narrowing estuary mouth, reducing fish habitat, reducing water quality, reducing fish numbers</li> </ul>	Agreement

Question	Answer According to TEK	Answer According to Science	Agreement/Disagreement
	<ul style="list-style-type: none"> <li>Recreational Users: increasing numbers of unmonitored recreational anglers, more bycatch being caught, interfering with fishers, e.g. tangled nets and noise</li> </ul>	<ul style="list-style-type: none"> <li>Recreational Users: not substantial influence, e.g. one fisher catches the same amount of bycatch as eight anglers per year</li> </ul>	Disagreement
8. What are environmental impacts on the fishery?	<ul style="list-style-type: none"> <li>Plankton: provides food for the fish however, when there is a red tide at sea fish retreat into the estuary</li> </ul>	<ul style="list-style-type: none"> <li>Scientists did not answer</li> </ul>	Insufficient Data as Scientists did not Answer
	<ul style="list-style-type: none"> <li>Water Characteristics: harders like the warm water, they follow the South Easterlies</li> </ul>	<ul style="list-style-type: none"> <li>Water Characteristics: South Easterlies cause upwelling and lower the temperature of the sea. . .harders prefer warm water and move into the estuary with the drop in sea temperature</li> </ul>	Agreement
9. What is the catch, effort, and catch-per-unit effort of the gillnet fishery?	<ul style="list-style-type: none"> <li>Numbers of permit holders have decreased over time and as a result, so has catch</li> <li>Currently there are 45 gillnet permit holders of which 15-20 holders fish every day (community elders)</li> <li>Fishers face decreasing catches and are generally inactive for 5 months of the year (winter)</li> </ul>	<ul style="list-style-type: none"> <li>Despite the decline in permit holders, total annual catch has remained constant over the years and net length has increased</li> <li>Catch per fisher is higher in winter than summer</li> <li>Estimated that 120 tons of harders and 10 tons of bycatch are landed within the estuary each year</li> </ul>	Partial Agreement <ul style="list-style-type: none"> <li>Agreement on number of permit holders and impact of seasonality on catch rates</li> <li>Disagreement on catch-per-unit effort, reliability of scientific data, and influence of fishers on harder stocks relative to commercial fisheries</li> </ul>
10. What is the life history of harders and by-catch species and how does the fishery affect this?	<ul style="list-style-type: none"> <li>Fishers did not answer</li> </ul>	<ul style="list-style-type: none"> <li>Harders are breed at two years of age (24-28cm)</li> <li>Harders are caught at an age of two whereas elf is captured at six months or less</li> <li>Gillnets trap faster growing fish, which results in a genetic predisposition for slower growth</li> <li>Bycatch species are caught when they are juveniles before they can reproduce</li> </ul>	Insufficient Data as Fishers did not Answer

Despite controversies surrounding fishing pressure and the impacts of gillnets on the Olifants Estuary, the most unexpected finding to emerge from this workshop was not individual data but instead patterns of collective agreement. Figure 7 illustrates the various levels of agreement between TEK and science.

**Figure 7. Agreement Breakdown of Knowledge-Sharing Workshop Questions**



With the majority of answers in the form of Agreement or Partial Agreement, the Knowledge-Sharing Workshop did manage to discredit recurring arguments of knowledge incompatibility. However, despite the many parallels between TEK and scientific knowledge that arose during the workshop, disagreement on catch effort, the use of gillnets, and reliability of scientific data obstructed the process overall.

### **5.3 Strengths of TEK in the OEFMP**

In examining the impact of TEK on the OEFMP, the following sections will explore 1) perceived contributions of TEK to management; and 2) perceived limitations of TEK to management. Both sections investigate recurring themes

highlighted by natural and social scientists during the semi-structured interviews.

### *5.3.1 Beneficial Characteristics of TEK: Exposed, Localised, and Holistic*

Discussed by 73% of natural and social scientists, exposure to the resource was the highest perceived beneficial characteristic of TEK. Given that “researchers may only be there a couple times during the year whereas fishers are there every day” (Participant 6), the focus on exposure was expected. Additionally, as TEK incorporated daily observations, Participant 3 considered it “very high resolution.” Participants 5, 8, 13, and 14 agreed with Participant 10 who explained, “TEK is accumulated observation and experience over time.” This accumulated observation led to a “deep knowing” of the estuary (Participant 8) and for TEK to be “organic” (Participant 15). Participant 1 confirmed this finding and stated that “fishermen are on the ground and they see the resource everyday whereas scientists do not.” In this sense, participants viewed TEK as providing a heightened familiarity of the estuary.

With 53% of interviewees stressing the need for management to have area specific information, familiarity with the local environment was also a significant benefit of TEK. Considering, “the person who knows the system better is the one who lives the variability of the system,” (Participant 5). Participants 3, 5, 8, and 11 argued TEK enhanced awareness of environmental change. Participants 3, 6, and 10 further highlighted the need for highly localised information. Participant 3 described, “It [TEK] is highly specific to a particular location,” and is beneficial as, “it comes from daily involvement with the resource.” Furthermore, Participants 3, 4, 8, 10, 11, and 15 perceived TEK to provide an intimate understanding of the estuary as, “By virtue of physically being in a particular place over a particular time there is a relationship developed with that place” (Participant 8). In this sense, TEK contributed to “taking decisions on a small geographical scale as...it reflects the experiences of people who fish in that area and also what occurs” (Participant 7).

The last major perceived benefit of incorporating TEK into management of the OEGF was its holistic nature. Forty per cent of participants stated that

TEK offered a wider and systemic approach to examining the estuary. Specifically, “The value of TEK is that it is the whole package, it does not divorce management from the ecological, but instead examines the whole human and ecological system” (Participant 3). Unlike conventional ways of thinking, “TEK has a wider definition than science in terms of what constitutes and what is included as knowledge” (Participant 2). In this regard, by integrating TEK in management stakeholders in the OEFMP have “a more accurate reflection of the system as a whole” (Participant 10).

### *5.3.2 Benefits in the Application of TEK: Increases Participation, Strengthens Management, and Broadens Perspectives*

In addition to the three principal perceived beneficial characteristics of TEK (exposed, localised, holistic), there were also three supposed benefits in its application. These benefits were the encouragement of participation, the strengthening of management, and the broadening of perspectives. Amongst participants, 67% of interviewees considered TEK as a vehicle for encouraging participation and instrumental in implementing a successful management plan. Participants 1, 3, 7, 8, 9, 10, 11, 14, and 15 emphasised the role of TEK in developing a dialogue, sense of trust, and way forward in managing the Olifants Estuary. As stated by Participant 7, “the more you involve communities the better, if you can do it effectively, it [TEK] would certainly make a contribution to management.” Similarly, Participant 9 identified TEK as a means of fostering “collaboration, exposure to different groups, identification of shared objectives, and mutual understanding.” According to Participant 3, “knowledge integration is an opportunity for participation...it is the entry point for successful management.” Interviewees affirmed participation was critical for SSF management (Participants 1, 3, 5, 6, 7, 8, 9, 10, 11, 14, and 15). Specifically, 67% of participants suggested TEK was a mechanism for improving needed participation.

Closely related to participation and discussed in 60% of interviews, the second significant benefit in the application of TEK was its ability to strengthen management. As explained by Participant 7, “if you are working with local people and treat their inputs with contempt, you will not get cooperation or

compliance.” Similarly, “TEK comes from the resource users, management cannot exclude them as they are critical in its success” (Participant 10). In agreement with Participant 10, Participant 14 stated that TEK encourages “inclusion and community buy-in.” Significantly, one of the emergent themes throughout the interviews was the role of TEK in strengthening management through its understanding of fisher behaviour. For example, Participant 2 stated, “science faces limited time and resources, it cannot capture everything...TEK adds enormously to understanding of fisher preferences.” From this perspective, a close relationship between perceived benefits of TEK and data emerged from the relationship between TEK and fishing practices (refer to Section 5.1).

Moreover, this parallel was further expanded upon by Participant 7 who stated, “we [management] are underfunded and we almost don’t have the means for the basics,” thus TEK could, “legitimise management as it sits in the reality of the community” (Participant 3). Participant 14 added, “In South Africa we simply don’t have enough scientists.” In this regard, Participant 3 confirmed that, “TEK could help management to understand social aspects not available to science.” Participant 1 perceived the role of TEK in understanding fisher behaviour to be critical as, “Science struggles to understand the social and we [scientists] need more indicators of the human dimension in managing the resource.” In 67% of interviews, participants proposed that TEK was a mechanism with which to explore social and behavioural patterns strengthening and legitimising estuary management.

The last benefit discussed by 50% of interviewees was a broadening of stakeholder perspectives. Participant 2 confirmed, “TEK is valuable in widening perceptions and in thinking in new ways.” Furthermore, Participants 1, 7, 8, 10, and 11 argued TEK could assist conventional management methods. As explained by Participant 7, “TEK could provide feedback and guide new areas of research such as the development of hypotheses and investigatory leads as well as provide better access to data.” Participant 10 affirmed, “There are gaps in scientific knowledge that TEK is well placed to fill...it allows for a different form of interrogation.” Given that TEK was described as, “pockets of

information whose movement grows over time” (Participant 8), its application was perceived to contribute to an adaptive and broad shift in thinking.

#### **5.4 Limits of TEK in the OEFMP**

The perceived limitations of TEK in the OEFMP followed a similar pattern to the perceived benefits, namely limitations were seen to occur both characteristically as well as in application.

##### *5.4.1 Limiting Characteristics of TEK: Subjectivity, Validity, and Isolation*

The single most debated limitation of TEK in contributing to SSF management was its perceived subjectivity. While 100% of participants discussed subjectivity, how respondents discussed this issue warrants closer examination. More specifically, 67% of interviewees (Participants 1, 2, 3, 5, 6, 7, 8, 12, 13, and 14) criticised TEK as being subjective whereas 33% of interviewees (Participants 4, 8, 10, 11, and 15) criticised *both* TEK and science as subjective. This study attributed the debate of ‘subjectivity’ amongst interviewees to disciplinary background as is discussed in Section 5.6. Among interviewees who perceived TEK to be subjective, the consensus was, “TEK often has alternative aims” (Participant 6). Perceived aims ranged from: TEK being a power card and political instrument (Participants 3 and 7), a mechanism for addressing immediate needs (Participants 1, 5 and 7), and a tool for maximizing catch and competitive advantage (Participants 1, 10, 13, and 14). Additionally, Participant 10 described TEK as “anecdotal” and “subject to the influence of memory.” In short, critics of TEK perceived it to be personal, heterogeneous, and variable depending on each holder (Participants 1, 3, and 5).

The second limiting characteristic of TEK was its perceived lack of validity. Emerging from interview responses, participants agreed validity was the ability of data to be tested and verified. Forty per cent of interviewees linked validity with scientific fact (Participants 1, 2, 7, 12, 13, and 14). Participant 12 stated an obvious example of the relationship between validity

and fact exclaiming, “I don’t debate fact. I debate perception.” Similarly, Participant 1 explained, “there may be different ways of investigating problems but there is only one type of truth. Fact is fact.” Nonetheless, amongst most interviewees, there was a distinction between knowledge and fact. Participant 2 rationalised, “knowledge is not necessarily factual...it is information that has been acquired through personal experience or experience of others.” Likewise, Participant 13 described knowledge as “part fact and part experience.” In 40% of interviews participants emphasised that TEK lacked the validity ensured via the scientific process. Specifically, Participant 2 claimed that TEK “differs from the scientific process, which calls for establishment of a hypothesis, testing, verification, and the use of evidence.” As a result, 40% of respondents stated that TEK was limited in contributing to the OEFMP as it lacked validity.

Last, 20% of participants indicated that TEK was isolated and failed to take into account present-day information (Participants 1, 6, and 13). Participant 1 reasoned, “traditional knowledge continues but it is not necessarily being informed by other knowledges...traditional value shouldn’t exist strictly because it’s traditional, it should be evolving.” Participant 6 added, “TEK may lag behind and as such, what may have been sustainable in the past, may not be sustainable in the future.” Similarly, Participant 13 claimed that, “it [TEK] may have contributed to understanding the fishery in the past but things have changed tremendously in terms of the resource...it doesn’t apply the altered dynamics.” Furthermore, Participant 6 concluded, “TEK may not always have the experience or the willingness to address change.” Contrastingly, Participant 14 stated that TEK took into account too much change and “doesn’t rely on traditional management anymore...it incorporates any new concept there is.” In sum, Participants 1, 6, and 13 felt TEK was limited as it failed to incorporate recent information.

#### *5.4.2 Limits in the Application of TEK: Methodology, Scales, and Lack of Precaution*

According to 60% of participants one of the most significant challenges emerging from the application of TEK was its methodology. Participants

expressed concerns about methods of collecting, verifying, and integrating data (Participants 1, 2, 6, 7, 9, 10, 12, 13, 14 and 15). Participant 1 described, "Observations are only what they [fishers] can see, their knowledge doesn't take into account what they can't see." Similarly, Participant 2 agreed, "TEK is based on a limited sample size." Participant 13 warned, "data collected is rubbish...there is no supervision, no monitoring." Moreover, "observations are influenced by recall bias whereby negative experiences are filtered out and knowledge is positively skewed" (Participant 2). This recall bias caused TEK to be "crooked" (Participant 13). In this regard, rather than perceiving TEK as the combination of accumulated observation, experience, and practice, 36% of participants (1, 2, 6, 7, and 12) saw TEK as observation alone.

Interviewees also disputed whether the observations of TEK could be verified and compared. Specifically, Participant 2 criticised, "while science offers the best possible explanation in a set of circumstances, a layperson accepts information at face value." Furthermore, several participants believed TEK did not translate into management (Participants 6, 7, 9, 10, 13, and 14). For example, Participant 9 stated, "The challenge is synthesising and translating data into a comparable form." Similarly, Participant 13 added, "it [TEK] is not the right kind of data." Participants also referenced the challenge of translatability in decision-making where, "the problem is when you are looking for hard data to make hard decisions" (Participant 9). Furthermore, Participant 14 explained, "it's not that this data [TEK] doesn't exist, it's that we need to get better at capturing it in a way that can be used for management decisions." The perceived weakness of observation in data collection, verification, and translation led to collective doubt amongst Participants 6, 7, 9, 10, and 14 in methods of synthesizing TEK into the OEFMP.

The second limitation in the application of TEK was conflicting management scales. While participants perceived TEK as highly exposed and localised, it was also seen to be exceptionally context specific. Although 53% of participants expressed specificity as positive, 47% of participants perceived specificity as a limitation in reference to management scales (Participants 3, 5, 7, 8, 10, 11, and 12). For example, Participant 7 speculated, "you can't manage a national stock by simply using local observations." For others such as

Participant 5, scale arose as an issue of legislation whereby “fisheries are under national competence and by law we cannot devolve management of fisheries to local people.” Nevertheless, despite a conflict between local and national scales in the application of TEK, Participant 8 concluded, “knowledge integration is difficult to do at different levels, but at least its recognition is a start.”

The final limiting factor in the application of TEK in the OEFMP was its perceived lack of precaution. While science “errs on the side of caution,” 27% of interviewees maintained that TEK “moves in the opposite direction” (Participant 2). Participant 5 concurred, “We must be cautious with TEK, we don’t know its intention or the aim.” Furthermore, 20% of participants were concerned with the perceived limited ability of TEK to evolve. The isolation of TEK, combined with its perceived incapacity to deal with change, led Participants 2, 6, and 12 to argue TEK lacks precaution and is “dangerous” (Participant 2).

## **5.5 Factors Enabling the Use of TEK in the OEFMP**

Through participant observation and semi-structured interviews, recurring factors enabling the use of TEK in the OEFMP emerged. Unexpectedly, Section 5.5 as well as Section 5.6 diverged from the main literature on this topic and investigated several neglected factors. In exploring enabling factors, Section 5.5.1 discusses communication, congruency, joint understanding, and co-learning.

### *5.5.1 Communication, Congruency, Joint Understanding, and Co-Learning*

Sixty seven per cent of interviewees discussed communication as the dominant factor enabling knowledge integration. Nonetheless, throughout the interviews communication meant different things to different participants. For some, communication was a ‘buzzword’ mentioned as an enabling factor but not specifically expanded upon (Participants 1 and 5). For others (Participants 2 and 7), communication was associated with consultation whereby “we need to have management that is scientific but rigorous and consultative” (Participant

7). In this regard, Participants 1, 2, 5, and 7 perceived communication as advisory whereby feedback was typically one-way.

Several participants (Participants 3, 4, 8, 9, 10, 11, and 15) criticised the typical practice of 'communication as consultation', arguing instead for communication as dialogue. While communication as consultation resulted in one-way feedback, communication as dialogue resulted in two-way feedback. Participant 11 explained, "communication as consultation forces communities into preconceived paradigms set by national and global priorities rather than local needs." Instead, "We need meaningful and facilitated dialogue where communication isn't just based on inclusion but also on participation" (Participant 10). Similarly, Participant 9 suggested, "there needs to be equal weighting of issues regardless of position." Exploring communication as a process, Participant 8 stressed the importance of "bringing people together and engaging them through talks about talks." Participant 9 confirmed, "By simply trying to do it [communicate], even if we don't achieve it, we're embarking on a process that is equally as valuable as the end result." In this sense, several participants believed communication was not only about the result, but also about the process (Participants 3, 8, 9, 11, and 14).

Mentioned by 47% of interviewees, the second factor enabling knowledge integration was congruency (Participants 1, 5, 7, 8, 9, 10, and 11). These participants described congruency as the overlaps, similarities, and general compatibility between science and TEK. Unexpectedly, despite earlier arguments on the limitations of TEK, certain participants contradicted their previous statements (Participants 1, 7, 9, and 10). For example, Participant 1 began, "fishers are notoriously superstitious..." and continued, "There is no tool kit to verify whether their knowledge is 'superstition' or 'truth'." However, later in the interview Participant 1 claimed, "there is a huge amount of congruence between science and TEK." Similarly, Participant 5 remarked that "TEK is used in different ways depending on what they [fishers] are trying to accomplish," however went on to suggest, "there is congruence between common and similar aims across TEK and science."

The conflicting opinions surrounding methodology, objectivity, and congruency led to an interesting point. Similarly to communication,

participants interpreted congruency differently. This resulted in questioning not only whether congruency exists between knowledges but also *where* it exists. Here, two subtle but important answers emerged: the need for congruency in process as well as congruency in aims. For example, Participant 9 stipulated the need for congruency to “merge, synthesize, and compare data.” Similarly, Participant 10 stated that, “congruency allows for the testing of knowledge through similar frameworks.” In this regard, Participants 9 and 10 demonstrated the importance of congruency in the process of gathering data. On the other hand, Participant 8 affirmed that, “both science and TEK are trying to understand the resource but for different reasons... scientists are interested in conservation, fishers are interested in survival.” Contrary to Participants 9 and 10, Participant 8 was instead concerned with congruency in aims. In sum, participants perceived both the recognition and achievement of distinctive forms of congruency – process and aims – as an important factor in enabling knowledge integration in the OEFMP. Despite recognising the need for congruency however, participants did not discuss how it could actually be achieved.

Closely related to congruency, is the issue of joint understanding of knowledge systems as enabling knowledge integration in the OEFMP. Forty seven per cent of participants described joint understanding as “an overlap between different knowledges” (Participant 5) and “mutually reinforcing communication” (Participant 8). Participants also perceived joint understanding to, “reinforce shared aims and objectives” (Participant 9) while “recognising the strengths of other knowledges and the limitations of our own” (Participant 10). Convincingly, Participant 4 suggested, “We need to ask people like myself – the experts – to forget our knowledge and to sit with a marginalised poor person and say, ‘let’s do something together.’” More importantly, in order to ensure joint understanding, Participant 8 argued, “We must physically move together through a space in the spirit of collaboration.” In this sense, interviewees perceived communication and joint understanding as engaging and participatory, “encouraging people to be aware of other ways of knowing” (Participant 4).

Lastly, 40% of respondents emphasised the importance of co-learning in advancing knowledge integration in the OEFMP. While participants described joint understanding as mutual recognition of different views, they explained co-learning as mutual recognition of *unified* views. For certain participants, co-learning was associated with ‘unlearning’ (Participants 4, 8, and 11). Interviewees described ‘unlearning’ as “leaving our baggage at the door and seeing knowledge with unbiased eyes” (Participant 8). Amongst interviewees, ‘unlearning’ typically led to co-learning, which meant “understanding different knowledges – what they are, what they bring – and ensuring a dialogue between those who believe traditional knowledge is important and those who dismiss it” (Participant 7). In this regard, stakeholders in the OEFMP needed to “get people together, build relationships, unlearn, and co-learn” (Participant 8). Co-learning, combined with joint understanding, congruency, and communication were all identified as critical factors in enabling knowledge integration in the OEFMP.

## **5.6 Factors Constraining the Use of TEK in the OEFMP**

The most interesting findings to emerge from the semi-structured interviews were in relation to the identification of factors constraining knowledge integration in the OEFMP. These factors were disciplinary biases, historical legacies, and power dynamics. Particularly unexpected was the influence of disciplinary biases on knowledge integration and the various perspectives of ‘power’ amongst participants.

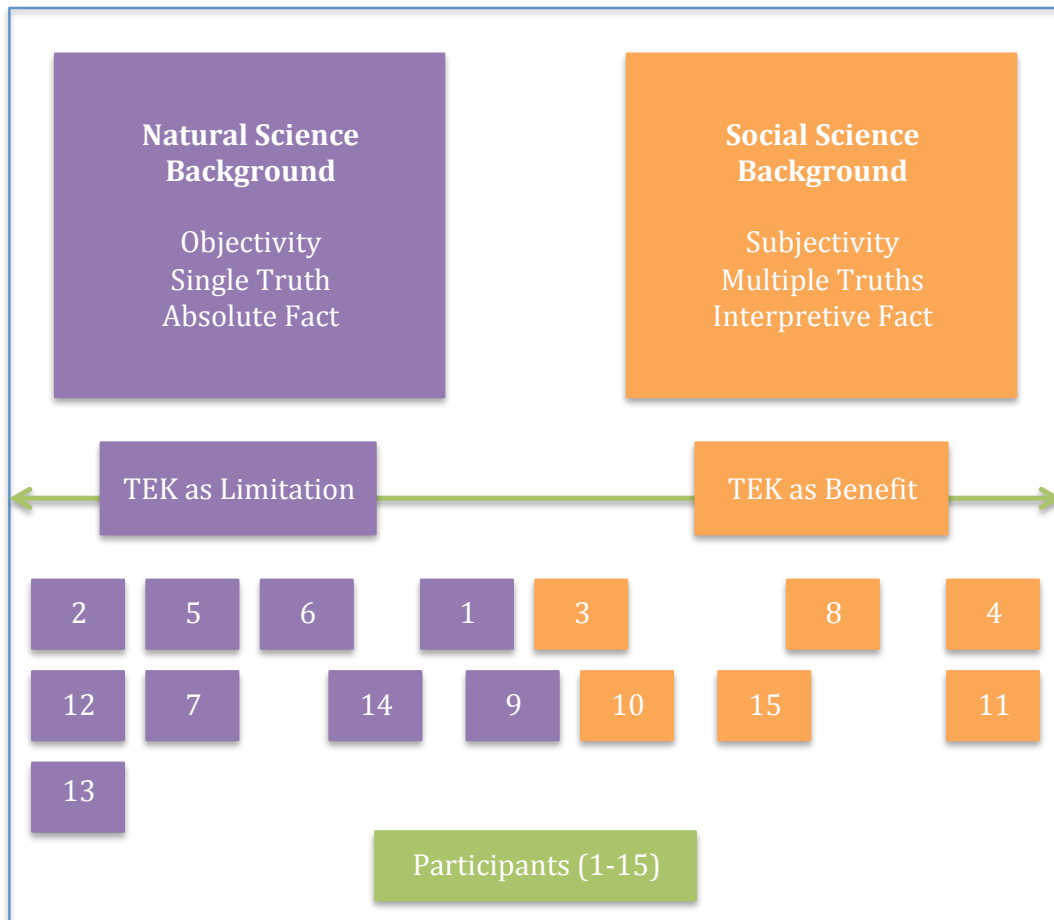
### *5.6.1 Disciplinary Biases, Historical Legacies, and Power Dynamics*

One hundred per cent of respondents agreed that, “a big part of the problem is disciplinary bias” (Participant 2). Good-humouredly, Participant 13 commented, “for natural scientists, myself included, fish are more important than people... for social scientists, it’s the other way around.” Consequently, disciplinary backgrounds became an important discussion point in interviews. Natural scientists tended to perceive TEK as a limitation in managing the OEGF

and stressed the need to ensure objectivity as well as to identify 'single truth' and fact. For example, Participant 5 believed, "social sciences and TEK are not objective enough...they put a personal direction on things." Likewise, Participant 13 argued, "social scientists argue local knowledge comes from a history of sustainable resource use... but traditional systems don't apply anymore, there is greater pressure than ever before." In addition, Participant 14 asked, "social scientists don't always grasp the biological issues... what they say in theory is great but how do we apply it in practice?" Within interviews, it could be said that by criticising the objectivity of social scientists, participants from scientific backgrounds discredited their own objectivity. Amongst natural scientists, Participant 12 summarised the general disciplinary view on knowledge integration stating, "I see only one type of knowledge...the facts already exist...TEK must be documented and tested if it's to be considered factual."

On the opposite extreme, social scientists stressed the importance of TEK in managing the Olifants Estuary and affirmed, "knowledge is a construction, there is nothing like absolute fact" (Participant 4). Additionally, social scientists (Participant 4, 8, 10, 11, and 15) perceived knowledge to be "a result of experiences and how experience is interpreted" (Participant 15). Participants 3, 4, 8, and 11 believed the 'scientisation' of TEK was problematic and warned, "the forcing of TEK into scientific systems does not acknowledge its complexity" (Participant 8). In this regard, social scientists suggested, "science conflates knowledge and overpowers the right to multiple truths" (Participant 4). Given the weight of subjectivity in the development of 'truth' and 'fact', social scientists maintained that TEK was important as it provides a more balanced approach to management (Participants 4, 8, and 11). Relative to their disciplinary backgrounds, Figure 8 summarises the varying degrees of opinions on knowledge integration amongst Participants 1-15.

**Figure 8. Range of Disciplinary Biases amongst Interview Participants**



Highlighted by Participant 15, one of the principal barriers to knowledge integration was “the unwillingness [of stakeholders] to consider interdisciplinary perspectives.” The link between knowledge integration and interdisciplinarity also emerged in Figure 8. Specifically, through exposure to interdisciplinary fieldwork and research, Participants 1, 3, 9, 10, and 14 held more ‘neutral’ views than participants who worked strictly within their own disciplinary silos.

In addition to disciplinary biases, 73% of participants claimed historical legacies, namely colonialism and apartheid, constrained knowledge integration in the OEFMP. Participant 1 reasons, “You cannot take fishers who were deprived of basic education due to the political situation in South Africa and expect them to know basic biology or ecology.” Similarly, Participant 14 challenged, “Our history...apartheid and the movement of people, separated

communities from their customs.” Participant 4 continued, “You think apartheid is over, it’s not...the practice of marginalising knowledge and excluding ‘others’ based on difference, that is apartheid.” Agreeing with Participants 1 and 4, several interviewees suggested remnants from the colonial and apartheid eras as major blockages to integrating knowledges in the OEFMP (Participants 3, 8, 10, 11, 14, and 15).

Unexpectedly, opinions on historical legacies amongst respondents diverged in relation to legacy ‘time frames’. Specifically, some interviewees understood historical legacies to be in the past with residual impacts. On the other hand, certain respondents viewed historical legacies to be in the present with ongoing impacts. For example, Participant 1 affirmed, “the legacies of apartheid and poor education systems impacted fishing communities...fishers were literally starved of knowledge.” In this case, Participants 1, 7, and 9 believed the legacies of apartheid and colonialism and their residual impacts were historic. In addition, the view of fishing communities being deprived of basic education also contributed to participants’ perceptions of TEK as lacking validity and not following the scientific process (Participants 1, 2, 7, 12, and 13).

On the other hand, Participant 8 responded, “knowledge integration is playing itself out on the ground within a messy and overlapping framework of history, politics, economics, and power.” Participant 4 agreed with Participant 8 challenging, “post-colonial states have carried on in the same vein as colonialism, saying to communities, ‘you guys know nothing about management’.” Unfortunately, the continuation of historical legacies has left the OEFMP to “inherit historical prejudices” (Participant 10). Within these inherited prejudices, Participants 3, 4, 8, 11, and 15 argued, “there is a level of racism, whereby disciplinary hierarchy as well as racial and class hierarchies reinforce one another” (Participant 4). Thus, 33% interviewees perceived racial tensions, intensified by ongoing historical legacies, to further hinder knowledge integration in the OEFMP.

Fifty three per cent of respondents identified power dynamics as the third factor constraining knowledge integration in the OEFMP. However, within interviews participants held various conceptualisations of ‘power’. For

example, Participant 4 associated 'power' with knowledge and ideology stating, "We have two issues really – high modernism and technocracy." Contrastingly, Participant 8 paralleled 'power' with politics and political objectives maintaining that, "the use of TEK in management is a power card, a political tool of 'good will'." On the other hand, Participant 3 contradicted Participant 8 declaring, "TEK has become a sort of 'power card' and political instrument used by traditional communities." Unexpectedly, several participants disputed that power dynamics were always in the hands of 'government' or 'management' but tilted in favour of community aims (Participants 1, 2, 5, 6, and 10). Ultimately, participants identified power dynamics as a barrier to knowledge integration. However, amongst interviewees there was no clear consensus as to what 'power' was or whom 'power' favoured.

### **5.7 Summary of Findings**

In conclusion, Chapter 5 presented evidence on 1) the influence of TEK on estuary fishing practices; 2) the process of documenting TEK in the OEFMP; 3) the strengths and limitations of TEK in the OEFMP; and 4) the factors enabling and constraining its integration. Table 2 provides a visual summary of the findings of Chapter 5.

**Table 2. Summary of Project Findings According to Research Objectives**

OBJECTIVES	FINDINGS
To examine the relationship between TEK and fishing practices	TEK and fishing practices were co-evolving <ul style="list-style-type: none"> <li>• Knowledge of estuary characteristics</li> <li>• Knowledge of human activities</li> <li>• These two areas of knowledge affected harvest locations, times, and productivity</li> </ul>
To investigate processes for documenting TEK	Three-staged process in documenting knowledge <ul style="list-style-type: none"> <li>• Identifying knowledge parameters</li> <li>• Collecting knowledge</li> <li>• Disseminating Knowledge</li> </ul>
To critically evaluate strengths/limitations TEK in the OEFMP	Perceived strengths of TEK <ul style="list-style-type: none"> <li>• Beneficial characteristics: exposed, localised, holistic</li> <li>• Benefits in application: increases participation, strengthens management, broadens perspectives</li> </ul> Perceived limitations of TEK <ul style="list-style-type: none"> <li>• Limiting characteristics: subjectivity, validity, isolation</li> <li>• Limits in application: methodology, management scales, lack of precaution</li> </ul>
To explore factors enabling/constraining the use of TEK in the OEFMP	Enabling factors <ul style="list-style-type: none"> <li>• Communication, congruency, joint understanding, and co-learning</li> </ul> Constraining factors <ul style="list-style-type: none"> <li>• Disciplinary biases, historical legacies, power dynamics</li> </ul>

As Table 2 demonstrates, this study found that TEK and fishing practices were co-evolving. Specifically, TEK affected harvest locations, times, and productivity, which in turn also affected TEK. While exploring the relationship of TEK and fishing practices, knowledge was documented in three stages: identification of knowledge parameters (formation of fishers’ questions), collection of knowledge (participatory mapping), and dissemination of knowledge (Knowledge-Sharing Workshop).

The second component of this study examined benefits of TEK namely that it is exposed, localised, and holistic, as well as increases user participation, strengthens management, and broadens perspectives. This research also identified perceived limitations of TEK namely its subjectivity, validity,

isolation, as well as its methodology, scale, and lack of precaution. Ultimately, communication, congruency, joint understanding, and co-learning supported the integration of TEK into the OEFMP. Despite these enabling factors, disciplinary biases, historical legacies, and power dynamics continue to hinder knowledge integration.

## **CHAPTER 6**

### **DISCUSSION AND EVALUATION**

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Chapter 6 synthesises and discusses findings in relation to the literature and project objectives. To begin, this chapter explores the relationship between TEK, fishing practices, and fisheries management in the OEFMP context. The subsequent section analyses the documentation of TEK as a multi-staged process, comparing it to similar processes in the literature. Next, this chapter critically examines the strengths and limitations of TEK both in general and within the context of the OEFMP. Chapter 6 also explores factors constraining as well as enabling knowledge integration within the Olifants Estuary and concludes with an evaluation of the process of integrating TEK in the OEFMP.

#### **6.1 The Relationship of TEK and Fishing Practices**

Berkes (2009) explains TEK is both information and process. Specifically, knowledge generation is adaptive and transforms alongside experiences and observation (Pierotti and Wildcat, 2000; Antweilier, 2004; Menzies and Butler, 2006). Berkes' (2009) interpretation of knowledge as information and process parallels the findings of this study whereby TEK and fishing practices are co-evolving. Within the OEGF, fisher knowledge blends information and capability with past and present experiences. In turn, the co-evolution of knowledge and practices provides insight into resource use and system behaviour.

##### *6.1.1 Exploring TEK, Fishing Practices, and Resource Use*

The relationship between TEK and fishing practices is particularly important in managing the Olifants Estuary as it shapes coastal resource use and system behaviour (Cinner and Aswani, 2007; Berkes and Kislalioglu-Berkes, 2008; Sowman et al., 2011). For example, knowledge on estuary characteristics and human activities affects harvesting location, timing, and productivity. In turn, harvesting practices similarly influence the development of TEK. This study finds a multitude of equivalent relationships throughout the literature ranging across Pacific Island coral reefs (Calamia, 1996; Berkes et al., 2001), South East

Asian tropical nearshore fisheries (Johannes, 1999), and New Zealand seabird harvesting (Moller et al., 2009). Together, these studies as well as this research demonstrate that the continuous adaptation of TEK to fishing practices – and vice versa – provides insight into resource use, human dimensions, and system behaviour. Neis et al. (1999) suggest knowledge gathered during harvesting contributes to high-resolution information on seasonal and directional fish movements, movement patterns, and fish abundance. Similarly to the study by Neis et al. (1999), within the OEGF knowledge of the impact of seasonality, winds, and changing water flows impacts harvest locations and timing, which in turn affects resource use. Moreover, according to Sowman and Sunde (2011), agriculture in the area has considerably influenced estuary dynamics through unrestricted water use, cultivating on riverbanks, depositing materials in the estuary, and building dams. These findings parallel TEK on anthropogenic change in the estuary. In this regard, not only can TEK provide insight into resource use and system behaviour, but it can also contribute to estuary research and management.

#### *6.1.2 The Influence of TEK and Fishing Practices on the OEFMP*

Drew (2005) argues that the practical application of knowledge forms the foundation for effective SSF management. For example, in a study on knowledge integration in Bang Saphan Bay, Thailand, Anuchiracheeva et al., (2003) maintain TEK is essential in ensuring the long-term legitimacy of management. Pinkerton (2003) adds that fishers who do not trust scientific data informing management are likely to be uncooperative and noncompliant. A clear example of Pinkerton's (2003) argument is fishers' scepticism of scientific estimates on total catch and bycatch during the 17 November Knowledge-Sharing Workshop. Despite 77% of questions being in agreement, disagreement relating to scientific data on catch effort undermined the workshop and significantly stalled the management process. Several interviews echo the concerns of Neis et al. (1999) and emphasise the importance of 'community buy-in' in legitimising management (Participants 1, 2, 5, 3, 10, 11, and 14). Furthermore, given that high regulation, monitoring,

and enforcement costs challenge management effectiveness (Mahon and McConney, 2004; Mahon et al., 2008; Sowman, 2011), community buy-in and fisher inclusion is particularly important in the Olifants Estuary. Participant 11 reasons that the integration of TEK “balances human rights with ecological needs, allowing for ongoing negotiations within management.” Furthermore, TEK contributes to limited data, particularly in regards to social behaviour (Participants 2, 3, 7, 10, 11, and 14). In turn, not only does the co-evolution of TEK and fishing practices provide information on resource use and social behaviour, but also if integrated, it can legitimise data and management (fisher group discussion, 22 September 2011).

## **6.2 Documenting TEK: A Multi-Staged Process**

The documentation of TEK for the OEFMP is a multi-staged process, which parallels similar studies found in the literature (Johannes, 1993; Calamia, 1999; Neis et al., 1999; Huntington, 2000; Berkes and Turner, 2006; Raymond et al., 2010). Although stages vary from context to context, several overarching processes emerge. The following section discusses the knowledge documentation processes relative to those applied in this research: identification, collection, and dissemination.

### *6.2.1 Stage 1: Identification of Parameters*

The first stage in knowledge documentation is the identification of parameters considered to be important by fishers, which establish guidelines for knowledge collection (refer to Section 5.2.1). The identification stage of this study closely parallels Johannes’ (1993) strategies for integrating TEK in environmental impact assessment. Specifically, both studies emphasise the importance of developing a framework for investigation. While this research uses participative research and community-based questions in developing guidelines, Johannes (1993: 34) instead identifies “four frames of reference.”

In environmental impact assessment Johannes (1993) describes taxonomic, spatial, temporal, and social frames of reference. The taxonomic

frame examines local language such as species names, as well as the importance of species to community livelihoods (Johannes, 1993; Drew, 2005). Next, the spatial frame collects information on the spatial distribution of animate and inanimate resources according to local users. As select case studies demonstrate (Anuchiracheeva et al., 2003; Hall and Close, 2006; St. Martin et al., 2007), participatory mapping exercises and GIS are critical in communicating spatial accessibility across knowledges. The third frame of reference Johannes (1993) suggests is temporal where TEK is used to identify significant events and associated biological changes in system dynamics such as the impacts of lunar cycles on spawning. Last, the social frame of reference assesses how traditional peoples perceive and manage their resources because of TEK (Johannes, 1993).

Although this study did not set out to use Johannes' (1993) four terms of reference, during the identification and collection stages, researchers and fishers covered various aspects of these frames. Specifically, the questions developed and answered during the 17 November Knowledge-Sharing Workshop (refer to Section 5.2.3) largely addressed the taxonomy, spatial and temporal frames of the OEGF. While the social aspects of the fishery were not explicitly covered during the workshop, these aspects were explored during the participatory mapping sessions and group discussions. In this sense, although applying different approaches, both studies attempt to address similar uncertainties. This observation reiterates a significant point: there is no single process for documenting knowledge, but rather the process is highly context specific and situation-dependent. While there may be common parameters or frames of reference identified by participants and the literature, the methods by which these parameters are addressed differ from study to study.

### *6.2.2 Stage 2: Collection of TEK*

Invariably, methods for collecting TEK will differ in each context. Influences such as time, funding, resources, and participants affect the methods researchers employ to gather TEK. Several academics promote various

methods including, semi-structured interviews (Neis et al., 1999; Huntington, 2000; Usher, 2000; MacKinson, 2001), questionnaires (Huntington, 2000), and collaborative workshops (Huntington, 2000; Raymond et al., 2010). Still, other literature remains concerned with the 'scientisation' and 'compartmentalisation' of TEK (Nadasdy, 1999; Agrawal, 2002; Green, 2008). In general, scholarship emphasises documentation methods that are participative, dialogical, and collaborative to allow for flexibility and fluidity in research (Neis et al., 1999; Huntington, 2000; Raymond et al., 2010).

In ensuring a documentation method that meets this criteria, this study used participatory mapping and group discussions as forums where fishers who, "typically don't have a voice in management" (Participant 11), could be heard. Given that interviewees identified communication, joint understanding, congruency, and co-learning as central to knowledge integration, participatory research allowed for the collaborative development of areas of inquiry as well as discussion of fisher worldviews. Specifically, one of the critical themes fishers emphasised during these sessions was that their concerns were not being addressed (fisher group discussion, 22 September 2011). Fisher 3 stressed, "Sustainability is important to us too... if this generation does not pass choices to the next generation, what is the third and fourth generation going to do?" In this regard, participatory research explored fisher concerns and contributed to the process of 'communication as dialogue' (Participants 3, 8, 9, 10, 11, and 14).

### *6.2.3 Stage 3: Dissemination of Information*

The final stage in the documentation of TEK was the dissemination of information via knowledge-sharing. According to Huntington (2000), workshops allow for the mutual learning of participants and the engagement of alternative perspectives and epistemologies. In this regard, the Knowledge-Sharing Workshop encouraged participants to address conflicting worldviews as well as to recognise power dynamics and imbalances (Interviewees 1, 2, 3, 4, 5, 6, 8, 10, 11, and 14). Nonetheless, one of the major challenges of the Knowledge-Sharing Workshop was not recognising power imbalances but

*addressing* them. Specifically, Participants 3, 10 and 11 argue the facilitator of the 17 November Workshop did not adequately equalize participant roles or contributions. Yuki (2009: 50) warns that, “one of the greatest challenges for leadership at all levels...is to create the type of conditions that encourage, facilitate, and sustain a favourable level of innovation and collective learning.” In reference to the Knowledge-Sharing Workshop, Participant 11 emphasised that, “fishers were unable to participate fully in the workshop as the facilitator did not understand the complex history of the whole process.” Participant 3 agreed and stated that, “the language of the workshop was not carefully managed...there was no platform for sharing.”

Nevertheless despite some concerns regarding the facilitator’s inability to “equal the playing fields” (Participant 10), the 17 November Workshop was evidence of the potential bridging of the OEFMP TEK-science divide. Furthermore, the workshop provided an environment for fishers to be heard and to address their exclusion from previous planning and decision-making (AEC Meeting Minutes, Appendix F). With 77% of workshop participants’ answers Agreeing or Partially Agreeing (refer to Figure 7), the Knowledge-Sharing Workshop contradicted arguments criticising the incompatibility of knowledges (Capra, 1996; Elgin, 2004; Green, 2008, Raymond et al., 2010). Specifically, rather than attempting to categorise any knowledge in a particular form, workshop participants recognised TEK and science as products of different domains and epistemologies. Although the way in which participants will respond to this recognition in the greater management process remains uncertain, the Knowledge-Sharing Workshop forms an important first step in facilitating knowledge integration in the OEFMP.

### **6.3 The Strengths and Limitations of TEK**

While this study and the majority of literature identify similar strengths and limitations of TEK, several concerns surrounding epistemology arise in this discussion. In turn, these concerns negatively influence the direction of knowledge integration in the OEFMP. Therefore, in addition to evaluating

concurrent strengths, the following sections also address concerns surrounding perceived limitations of TEK.

### *6.3.1 Benefits of TEK: Characteristics and Application*

The beneficial characteristics that participants identify in this study reflect those found in the literature (Berkes and Folke, 1998; Sillitoe, 1998; Pierotti and Wildcat, 2000; Drew, 2005; Turner and Berkes, 2006; Lauer and Aswani, 2010; Sowman, 2011). For example, both study participants and the literature emphasise the importance of fishers' day-to-day exposure to the estuary as a contribution to management (Participants 1, 3, 6, 5, 8, 10, 14, and 15). Moreover given that, "we [fishers] don't 'work' on the river, we live on the river and we were raised on the river" (Fisher 13), the localisation of TEK provides a deeper and more high-resolution understanding of the estuary (Participants 3, 4, 8, 19, 11, and 15). Last, the perception of TEK as holistic (Participants 2, 3, 8, 10, and 11) presents TEK as both "a way of life and of being in the world" (Participant 8). Fishers expressed a similar sentiment and described themselves not as separate from the river, but as part of it (fisher group discussion, 4 October 2011).

Across the literature, TEK has several practical benefits. The first benefit discussed is the ability of TEK to provide new biological and ecological insights, which result from the daily interaction of users and resources (Calamia, 1999; Berkes et al., 2000; MacKinson, 2001; Drew, 2005). This strength corresponds to participant responses stating that TEK "allows for investigative leads" (Participant 7) and "adds to an overall knowledge base" (Participant 10). Specifically, as "science faces limited time and resources" (Participant 7), TEK on estuary characteristics and anthropogenic change contributes to eliminating the "current lack of system knowledge" (Participant 3).

The second practical benefit is the ability of TEK to include rules and norms affecting resource management (Calamia, 1999; Berkes et al., 2000; Pierotti and Wildcat, 2000; Lauer and Aswani, 2010). However, whereas a link between TEK and customary fishing practices certainly exists, within the OEGF particular customary rules guiding management have largely eroded (fisher

group discussion, 23 September 2011). Historically, customary rights and access systems determined who harvested and when harvesting occurred as well as how the community divided resources (fisher group discussion, 22 September 2011). Certain interviewees argue the disintegration of customary management is due to the external influence of historical legacies such as apartheid, fisheries reforms, state-imposed regulation, and commercial fisheries (Participants 1, 2, 3, 6, 7, 10, 14, and 15). Despite this erosion, there are still 'good manners principles' in place such as sharing daily catch with community households facing high levels of food insecurity (fisher group discussion, 22 September 2011). Furthermore, the co-evolution of TEK and estuary fishing practices provides information on the social aspects of the fishery unavailable to science and management (Participants 3, 7, 10, 11, and 15).

The third practical benefit of TEK found within the literature is the contribution of TEK to protected area conservation (Johannes, 1998; Calamia, 1999; McClanahan et al., 2006; Nursey-Bray and Rist, 2009; Almudi and Kalikoski, 2010; Ferse et al, 2010; Teh and Teh, 2010). Not only does TEK provide ecological insights for conservation and marine spatial planning (Participant 1, 2, 5, and 7) but it also reinforces conservation through inclusiveness and community buy-in (Participants 1, 3, 7, 10, 11, 14, and 15). The importance of TEK in protected area conservation is especially important in the OEFMP where conflict surrounding proposals to zone the river as well as restrictions on the gillnet fishery continue to erode its management. Given the history of top-down and centralised decision-making in management of the Olifants Estuary, fishers feel their knowledge gives them a voice in planning and management (fisher group discussion, 4 October 2011). Furthermore, Participant 11 claims, the integration of TEK "allows for ongoing negotiated tensions and trade-offs for all sides...this develops the potential for reconciliation." In addition, Participant 13 emphasises that, "Fisher experience is an important component in ensuring participatory involvement of local communities [in management]."

### *6.3.2 Limitations of TEK: Characteristics and Application*

In their evaluation of environmental management projects across the United Kingdom, Solomon Islands, and Australia, Raymond et al., (2010) identify three significant challenges to knowledge integration. These challenges are ontological, epistemological, and application-based (Raymond et al., 2010). Specifically, ontological challenges arise from the categorisation and classification of knowledge across various continuums such as local versus generalised knowledge or formal versus informal knowledge (Agrawal, 1995; Raymond et al., 2010). Next, epistemological challenges arise from conflicting perceptions of what ‘defines’ knowledge and how knowledge is constructed (Nadasdy, 1999; Elgin, 2004; Green, 2008). Last, challenges in application occur due to differences in ‘power’ (Nadasdy, 1999; Elgin, 2004; Green, 2008; Raymond et al., 2010).

In this regard, the perceived limitations of TEK link to the challenges Raymond et al. (2010) explore. Specifically, the perceived characteristic limitations of TEK – subjectivity, validity, and isolation – are largely products of epistemological divisions reinforced through disciplinary biases. In turn, these “perceptions influence opinions of...‘universal truth’, what counts as evidence, and ultimately which forms of knowledge are believed to be valid” (Raymond et al., 2010: 1770). While epistemological opinions are largely subjective, the practical limitations of TEK, namely its methodology, require further examination.

One of the principal concerns amongst interviewees is the method of observing, synthesizing, and translating TEK into the OEFMP. Similarly, existing studies question the “ability of local resource users to detect, understand, interpret, and respond to ecological change” (Lauer and Aswani, 2010: 986). MacKinson (2001) explains fisheries science largely dismisses TEK as anecdotal and as a result, TEK remains absent from SSF management. Scepticism of ‘experts’ and the perceived lack of empirical reliability of observations further compound criticisms of TEK (Johannes, 1993; Neis et al., 1999; MacKinson, 2001; Davis and Wagner, 2003). During interviews, certain participants questioned the reliability of fishers’ observations as well as the

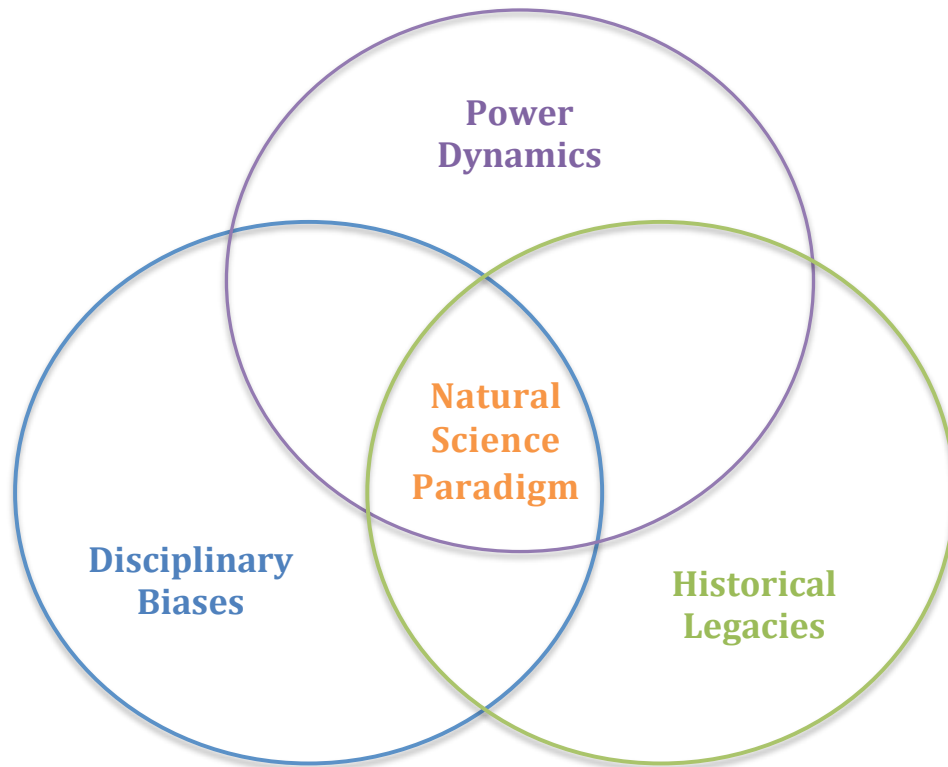
ability to translate their knowledge into management (Participants 1, 2, 6, 7, 9, 10, 12, and 13). Paradoxically, workshop participants from scientific backgrounds dismissed similar scepticism of scientific reliability expressed by fishers during the 17 November Workshop. Still, Participant 7 affirmed, “It is difficult to get any kind of relevant data from fishers as it’s not part of their worldview to collect data in that [scientific] way.” In addition, Participant 13 criticised that TEK is “rubbish” and “crooked.” Interestingly, Participant 4 challenged this perception and debated, “We learn through observations... Socrates sat and observed, he didn’t learn in a lab so why do we now dismiss that?”

To address methodological concerns Duerden and Kuhn (1998) suggest the first step is to identify the focus of the application of TEK in each particular context. For instance, within the OEMFP is TEK applied in the formative stages of the management process as an investigative lead? Or is TEK applied throughout the process as a contribution to local participation in management? As applications of TEK vary, so to does the way in which its information is used. Thus, in order to begin to address methodological differences stakeholders in the OEFMP must first identify the framework for which TEK is being applied (Duerden and Kuhn, 1998). Once this framework is identified, TEK and science can be used to re-enforce and to verify one another (Participant 3, 9, 14, and 15). The aim of knowledge integration is not to use individual knowledges on their own but to incorporate multiple knowledges into planning and decision-making (Neis et al., 1999; MacKinson, 2001; Hall and Close, 2007; Lauer and Aswani, 2010). Therefore, uncertainties in data generated via TEK should be evaluated by similar data acquired by science and vice versa, which would address methodological reservations. In this light, the largest obstacle to knowledge integration in the OEFMP appears not to be a product of the incompatibility or perceived limitations of TEK, but rather a product of dominant paradigms.

#### **6.4 Factors Constraining Knowledge Integration: The Dominant Paradigm**

Dominant paradigms (DP) form the principal roots of resistance to knowledge integration in the OEFMP. DP are representative of societal assumptions of the interaction between human nature and nature itself (Kuhn, 1962; Foster-Carter, 1976; Colby, 1991; Bennett et al., 2001). These paradigms ask different questions about human-nature relationships, evaluate evidence in distinct ways, and have their own preferred management solutions (Colby, 1991). Additionally, the collective influence of order-conflict approaches, culture, power, and class largely affect paradigms (Belsky, 2002; Humphrey et al., 2002). Within the OEFMP, several paradigms exist amongst stakeholders and their spatial boundaries are hard to define. Nevertheless, with regards to knowledge integration the Natural Science Paradigm (NSP) dominates. This study reveals that the NSP emerges from the combination of the constraining factors specifically disciplinary biases, power dynamics, and historical legacies. Figure 9 offers a visual representation of the relationship between the constraining factors and the development of the NSP, which the following sections discuss in further detail.

**Figure 9. Relationship of Constraining Factors and Natural Science Paradigm**



In evaluating literature, it is apparent there is no universally agreed on construction of knowledge. According to Raymond et al. (2010: 1767), conflicting constructions “create confusion and misunderstanding when attempting to integrate different forms of knowledge.” Therefore, in order to achieve knowledge integration in the OEFMP, it is integral to understand the dominant paradigm from which the construction, valorisation, and marginalisation of knowledge emerges.

#### *6.4.1 The Effect of Disciplinary Biases on the NSP: Constructing Knowledge*

Disciplinary biases negatively affect the development of the NSP by creating a particular framework within which knowledge is constructed. For example, participants who identify themselves as natural scientists define knowledge

through scientific process, objectivity, factuality, and absolute truth (Participants 1, 2, 5, 6, 7, 12, and 13). Participant 1 confirms, “Knowledge supported by evidence is factual. It should be objective, aims and beliefs can vary, but not the facts.” On the other hand, participants who identify themselves as social scientists associate knowledge with social constructs, individual interpretations, subjectivity, and multiple truths (Participants 3, 4, 8, 10, 11, and 15). Participant 4 explains, “Knowledge is a whole continuum, a broad area, a lived experience.” In this light, disciplinary biases contribute to the NSP by entrenching particular constructions and appropriations of knowledge (Colby, 1991; Nicolescu, 2002; Rosa and Machlis, 2002; Raymond et al., 2010; Sowman, 2011).

Furthermore, ‘trained incapacities’ influence these constructions of knowledge (Rosa and Machlis, 2002). Trained incapacities are the result of overspecialisation in a specific field and produce a limited range of perceptions (Kuhn, 1962; Foucault; 1965; Nicolescu, 2002; Rosa and Machlis, 2002; Degnbol et al., 2006; Sowman et al., 2011). Moreover, resistance to alternative knowledges in fisheries management is often a result of ‘tunnel visions’ acquired via overspecialisation (Rosa and Machlis, 2002; Degnbol et al., 2006). Within the OEFMP, tunnel visions manifest in participants’ perceived benefits and limitations of TEK. For example, trained incapacities constrain natural scientists from identifying the characteristic benefits of TEK as exposed, localised, and holistic (Pierotti and Wildcat, 2000; Menzies and Butler, 2006; Berkes and kislalioglu-Berkes, 2008). In the same vein, trained incapacities also limit the ability of social scientists to recognise the characteristic limitations of TEK namely its subjectivity, validity, and isolation (Nadasdy, 1999; Davis and Wagner, 2003; Diamond, 2005).

Trained incapacities also result in a polarisation of perceptions and reinforce disciplinary divisions amongst estuary stakeholders. Disciplinary polarisation is seen by Participant 5 who claims that, “social scientists interrupt the overall process...their role must be limited.” Contrastingly, Participant 11 believes, “natural scientists and management are doing the bare minimum...this process is not about ‘participation’ but polluted consultation.” Within this study, natural scientists attempt to evaluate social scientists

through a natural science lens and vice versa. In turn, as Participants 5 and 11 demonstrate, the doubting of opposite disciplines fortifies disciplinary polarisation. Participant 3 claims that, “Within the Olifants, there is a greater divide between social and natural scientists than between scientists and fishers...differences must be resolved between disciplines... we’re not helping the community.” Crucially, Evely et al. (2008: 52) recognise that knowledge integration requires “participants to be aware of their own and other’s philosophical and epistemological positions.” If epistemological awareness amongst participants does not exist, disciplinary polarisation and trained incapacities systemically reinforce disciplinary division and impair the construction of knowledge.

#### *6.4.2 The Effect of Power Dynamics on the NSP: Valorising Knowledge*

Power dynamics are also central to the development of the NSP. While disciplinary biases influence the construction of knowledge, power dynamics establish what knowledge participants – and OEFMP stakeholders – consider valuable. Participant 4 explains, “If you are not considered knowledgeable you have no right to determine how something happens.” In fisheries management, there is a hierarchy of knowledges. Within this hierarchy, fisheries management recognises scientific knowledge as ‘all mighty’ whereas TEK is irrational and ignorant (Murdoch and Clark, 1994; Nygren, 1999). These perceptions of TEK are consistent with views of several participants who identify TEK as a power card, superstitious, folkloric, ineffective, political, and uninformed (Participants 1, 2, 3, 5, 7, 12, 13 and 14). Various scholars argue the hierarchical classification of knowledge reinforces vertical social structures, results in the ‘scientisation’ of TEK, and encourages technocratic decision-making (Gupta, 1998; Nygren, 1999; Degnbol et al., 2006; Dove, 2006; Green, 2008). Furthermore, the hierarchical classification of knowledge and its dismissal of TEK results in fishers feeling excluded, ignored, and discounted (fisher group discussion, 4 October 2011).

Contrastingly, various participants, which interestingly are all natural scientists, feel power dynamics in South African SSF are increasingly de-

centralised and horizontal rather than vertical (Participants 1,2, 5, 6, 7, 9, and 14). Amongst these participants, the perceived decentralisation of power dynamics is largely related to recent legislation promoting increased user participation and stakeholder involvement in planning. Certain authors echo this sentiment, praising the emergence of equity, representation, and participation in management of South African fisheries (Hutton and Pitcher, 1998; Branch and Clark, 2006). Nonetheless, although several legal mechanisms for shifting power dynamics exist such as provisions in the NEMA and the MLRA, various SSF literature views the practical implementation of these tools as limiting (Hauck and Sowman, 2001; Wynberg, 2001; Harris et al., 2002; van Sittert, 2002; Green, 2007; Sunde and Isaacs, 2008; Sowman et al., 2011). Green summarises (2007: 137), “the valorisation of knowledge depends all the more heavily on who is in power.” Participant 4 explains, “A ‘hard fact’ [according to science] is a political decision to say I’m going to look at these issues and not others...it is conflating one knowledge over another.” Given that the conflation of knowledge appears to be ongoing within South Africa, it is not surprising that power dynamics and in particular the hierarchical classification of knowledge, are central to its valorisation.

#### *6.4.3 The Effect of Historical Legacies on the NSP: Marginalising Knowledge*

The final factors influencing the NSP are historical legacies. Although a wide-ranging category, the most recurring historical legacies discussed by participants are colonialism, apartheid, and technocratic decision-making. Controversially, 43% of participants believe that the effects of colonialism and apartheid to be influential today (Participants 3, 4, 8, 10, 11, and 15). More specifically, participants deliberate whether the current government has dealt with residual impacts of colonialism and apartheid including inherited prejudices, racial tensions, power dynamics, limited capacity, and poor education systems (Participants 1, 3, 4, 8, 10, and 11). In this sense the “marginalisation of knowledge is not a new issue... in South Africa we’ve come full circle” (Participant 4). Van Sittert (2002), Isaacs (2006), and Sowman et al.

(2010) parallel participants' sentiments, recognising that since the 1950s, the NSP has remained largely in place.

Decision-making in South African fisheries has always been highly technocratic. Both Participants 7 and 9 stress the historic relationship between natural sciences and fisheries management, which "was largely strengthened by apartheid" (Participant 9). Several participants believe the separation and isolation of the South African scientific community from the international scientific community under apartheid resulted in an increased dependency of science on management and vice versa (Participants 4, 7, 8, 9, and 11). Sowman et al. (2011: 574) parallel participants affirming, "In an effort to depoliticise, the fisheries state management was recast in the discourse of science." Furthermore, despite the 1990s fisheries reform, fisheries management still excludes small-scale fishers from decision-making leaving natural scientists to continue to run fisheries bureaucracy (van Sittert, 2002). In a similar fashion, Batterbury et al. (1997) argue knowledge marginalisation often results from "historic experience and scientific information...amplified according to the perceived needs and agendas of past regimes and societies." This continued blurring of natural science and fisheries management reiterates the systematic dismissal of knowledge highlighted by Participant 4. In short, within South African SSF, historical legacies have reinforced the NSP and resulted in the cyclical marginalisation of TEK.

### **6.5 Factors Enabling Knowledge Integration: Disassembling the NSP**

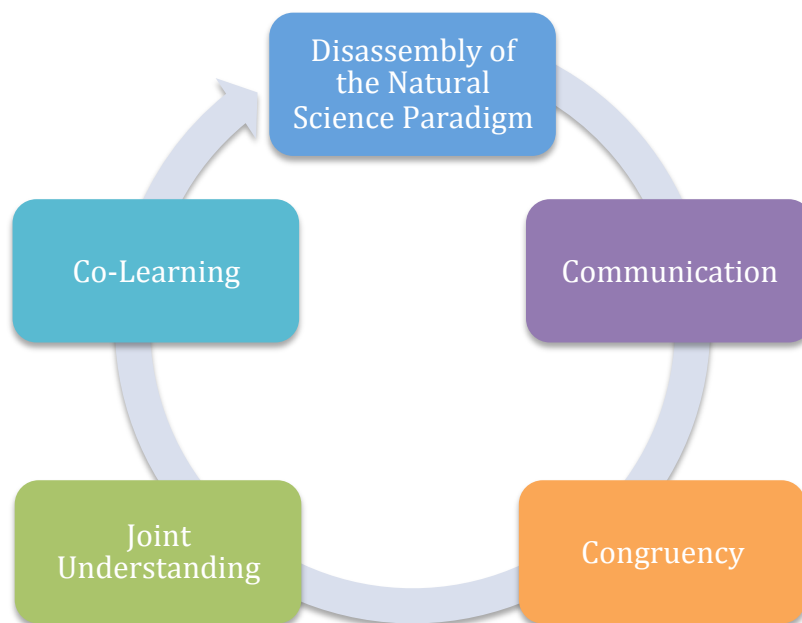
Sunderlin (1995) and Beskil (2002) ascertain that the identification of paradigmatic assumptions is fundamental in moving from paradigm isolation towards paradigm integration. Furthermore, Kuhn (1962) and Foster-Carter (1976) maintain that although dominant paradigms always exist, paradigms are not necessarily permanent. Within the OEFMP, the NSP has an obvious influence on the construction, valorisation, and marginalisation of knowledge. As such, the first step in achieving knowledge integration is to disassemble the NSP. This disassembly requires the development of "communality in the lived and enacted diversity of ideas, interests, actions, and purposes" (Bouwen and

Taillieu, 2004: 144). Just as the constraining factors manufacture the NSP, the enabling factors, namely communication, congruency, joint understanding, and co-learning, contribute to its disassembly.

### 6.5.1 Communication, Congruency, Joint Understanding, and Co-Learning

According to Bruckmeier and Tovey (2008), knowledge and knowledge paradigms are social products and their reconstruction occurs through social interaction. In the OEFMP, social interaction requires communication, congruency, joint understanding, and co-learning. Furthermore, interaction must be dialogical, transparent, and inclusive (Participants 3, 4, 8, 9, 10, 11, and 15). Figure 10 illustrates the cyclical relationship of communication, congruency, joint understanding, and co-learning to the disassembly of the NSP.

**Figure 10. Relationship of Enabling Factors to the Disassembly of the NSP**



The process of communication must be participative, continuous, and interactive (Glicken, 2000; Rowe and Frewer, 2000; Bosch et al., 2003; Gray 2005; Borrini-Feyerabend et al., 2006). This interpretation of communication

differs from earlier literature where it “was designed to consult, involve, and inform the public” (Smith, 1993: 66). According to Participant 11, “prior to stakeholder engagement, decisions and objectives are already set by national objectives...this is not meaningful dialogue.” Instead, new approaches to communication such as communicative rationality emphasise dialogue as a means of reaching more reasoned, collaborative, and consensus-based decisions (Habermas, 1984; Jentoft and McCay, 1995; Gray, 2005; Kooiman and Bavinck, 2005; Borrini-Feyerabend et al., 2006). Through the process of meaningful and participative communication, “actors contribute from their particular frames...in an effort to develop some form of communality” (Bouwen and Taillieu, 2004: 145). In turn – via dialogue not dictation – communality leads to the development of congruency and joint understanding.

In addition to communication, congruency and joint understanding also contribute to the disassembly of the NSP. Achieving congruency in management aims and objectives “levels the playing field” (Participant 11) and supports meaningful participation (Participants 9, 10, and 14). Furthermore, congruency encourages the mutual recognition of different views and identifies sticking points between participant frameworks (Pinkerton, 1989; Charles, 1992; Bosch et al., 2003; Kooiman and Bavinck, 2005; Pomeroy and Rivera-Guieb, 2006). In addition to congruency, joint understanding fosters an atmosphere of trust, openness, and reciprocity via the collective re-examination of individual lenses (Bosch et al., 2003; Gray, 2005; Bruckmeier and Tovey, 2008; Raymond et al., 2010). Moreover, joint understanding uses the sticking points identified through congruency and widens participants’ frameworks. In turn, broadened frameworks allow for information exchange and the co-construction of shared perceptions (Bouwen and Taillieu, 2004). Together, congruency and joint understanding encourage a widening of participant perspectives and foster an opportunity for co-learning.

The last factor to assist in disassembling the NSP is co-learning. Co-learning “results from participants learning from one another in the process of communication and mutual exposure to new information” (Bosch et al., 2003: 110). Due to the NSP and the hierarchical classification of knowledge, learning within the OEFMP has typically been one way and has moved from ‘expert’ to

'user'. Co-learning counteracts conventional management strategies through focusing on the dissemination of knowledge – irrespective of its classification – across parties. In turn, the dissemination of knowledge allows for mutual knowledge generation (Bosch et al., 2003). Furthermore, co-learning provides a forum for answering as well as generating questions using transdisciplinary and multi-level frameworks (Belsky, 2002). Within the OEFMP, co-learning “takes an adaptive approach to knowledge” (Participant 4) and if applied in future, “can reconcile different paradigms” (Participant 10). Through co-learning, learning shifts from being a one way to a two way process. This two-way feedback decreases resistance to disassembling the NSP and instead supports the co-production and future integration of knowledge in the OEFMP.

## **6.6 The Future of Knowledge Integration in the OEFMP**

The disassembly and reassembly of dominant paradigms allows for the co-construction and integration of traditional ecological knowledge in the OEFMP. While this study forms a link in the EEU Knowledge Documentation Project and sought to initiate, monitor, and track the process of knowledge integration in the OEFMP, whether this integration will be successful remains unclear. Furthermore, although the process of knowledge integration in management of the Olifants Estuary is advancing, its progress is gradual due to dominant paradigms. In addressing conflict on knowledge integration, various case studies emphasise the use of transdisciplinary cooperation and multiparty collaboration as mechanisms to practically apply the enabling factors (Calamia, 1996; Zingapan and de Vera, 1999; MacKinson, 2001; Borrini-Feyerabend et al., 2006; Murray et al., 2006; Evely et al., 2008; Almudi et al., 2010; Capistrano, 2010; Ferse et al., 2010; Lauer and Aswani, 2010). Although this study instigated the process of knowledge integration in the OEFMP, the future of integration is largely dependent on putting communication, congruency, joint understanding, and co-learning into practice.

### *6.6.1 Transdisciplinarity: Consensus Conferences and Scenario Workshops*

Conventional management frameworks compartmentalised disciplines into individual communities of specialists who have little interaction with one another outside of their own community (Nicolescu, 2002; Rosa and Machlis, 2002; Degnbol et al., 2006; Gray, 2008). Participant 4 suggests “the problem we have is that we are still in our disciplinary silos... the world is not sectoralised, we tend to forget that...we must understand the whole context.” Likewise, Participant 10 deliberates that “if starting the Olifants process again, there needs to be some means of reconciling conflicting paradigms.” In this regard, within the OEFMP the bridging of disciplinary divisions and the implementation of enabling factors is critical to the future of knowledge integration.

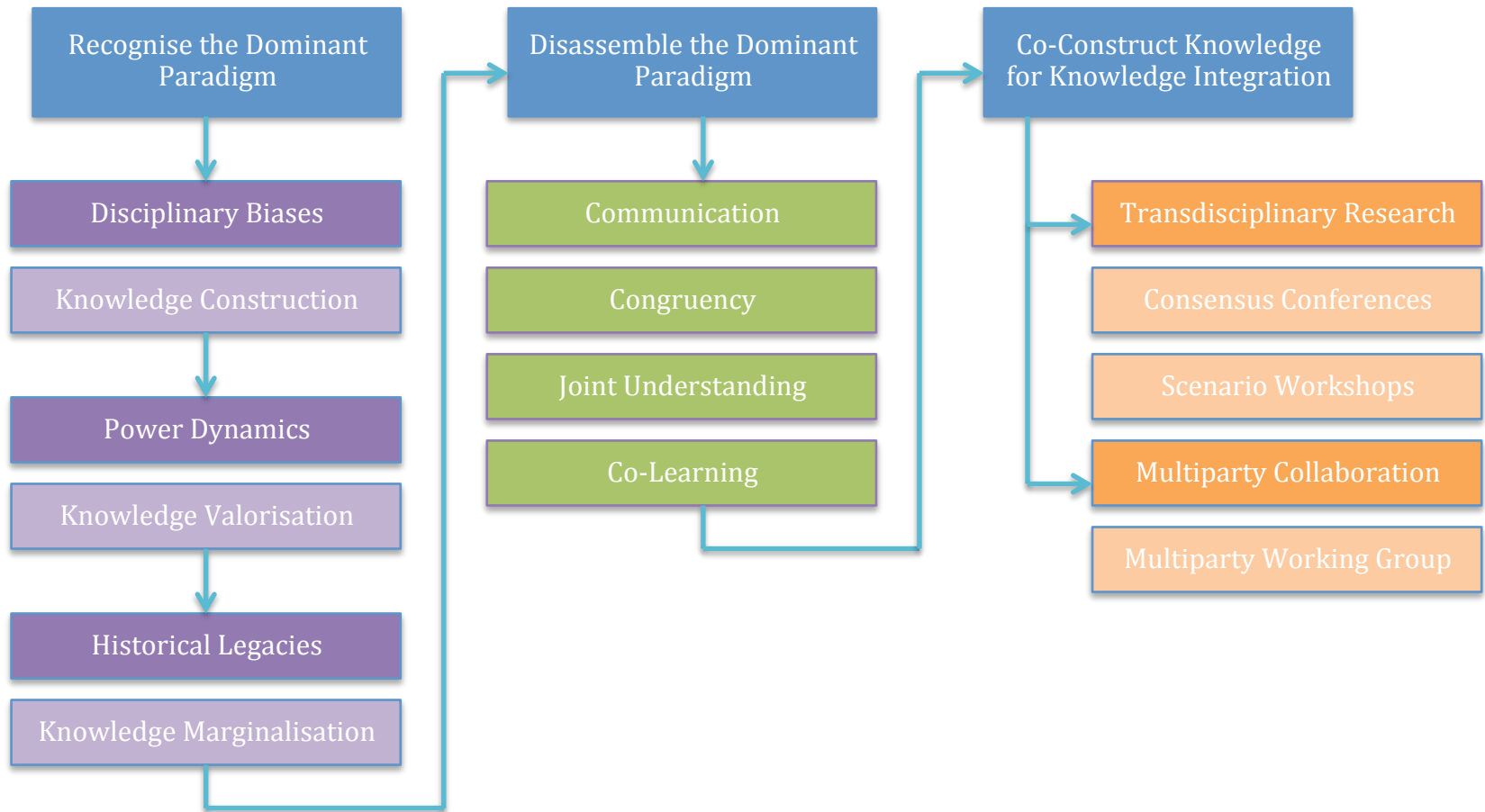
Two mechanisms for enacting the enabling factors in practice are consensus conferences and scenario workshops (refer to Section 2.1.5). First, through incorporating various stakeholders such as customary fishers and recreational fishers into a citizen panel, a consensus conference would address uneven power dynamics (Participants 3, 4, 8, 11, and 15), while providing a forum for transdisciplinary debate and dialogue. Second, scenario workshops would encourage fishers, social scientists, and natural scientists to explore future options for estuary planning and management but on an “equal playing field” (Participant 11). Together consensus conferences and scenario workshops would ensure the inclusion of multiple stakeholders as well as conflicting views. In turn, through fostering meaningful dialogue across disciplines and knowledges, consensus conferences and scenario workshops would decentralise expertise and allow for the co-construction of knowledge.

### *6.6.2 Multiparty Collaboration: A Multi-Party Working Group*

The third mechanism contributing to the enabling factors and knowledge integration is multiparty collaboration. According to Gray and Schruijer (2010), two of the principal obstacles to collaboration are divergent aims and perceived or real differences in power as is currently the case in the OEFMP

(Participants 1, 2, 3, 4, 7, 8, 10, 11, 12, and 15). Therefore, one tool for addressing divergent aims and power dynamics in achieving multiparty collaboration is the development of multiparty working groups. For example, if developed within the OEFMP, the incorporation and inclusion of stakeholders from various organisations including DAFF, DEAT, EEU, Cape Nature, Masifundise, and Coastal Links, would allow for the establishment of shared aims and objectives, meaningful dialogue, clear terms of reference, and the redistribution of roles (Participants 5, 6, 8, 9, 10, and 11). According to Participant 3, “We have reached a point where we need to recognise what the best possible approach is given where we are going and where we have been...workshops allow for collaboration and participation.” Furthermore, a multiparty working group eliminates “mistrust and suspicion” (Participant 11), while fostering, “feedback, exposure, and arguments from different spheres” (Participant 9). The inclusion of various stakeholders – particularly local communities – in knowledge generation is critical in SSF management (Pomeroy and Rivera-Guieb, 2006; Pomeroy et al., 2007; Nursey-Bray and Rist, 2009; Ferse et al., 2010). Through its focus on collective participation, an OEFMP multiparty working group would ensure a diversity of voices in the co-production of knowledge. Figure 11 provides an illustrative summary of the process of disassembling the NSP and co-constructing knowledge uncovered in the discussion of this study.

**Figure 11. Overview of the Knowledge Integration Process**



## 6.7 Summary of Discussion and Evaluation

Chapter 6 critically assessed the findings of this study in relation to relevant literature and case studies. First, this chapter explored the co-evolution of TEK and fishing practices and its impact on shaping resource use and system behaviour. Next, this chapter investigated knowledge documentation as a three-staged process including identification, collection, and dissemination. The third component evaluated in this chapter was the strengths and limitations of TEK, which closely paralleled the literature (Berkes and Folke, 1998; Sillitoe, 1998; Pierotti and Wildcat, 2000; Drew, 2005; Turner and Berkes, 2006; Lauer and Aswani, 2010; Sowman, 2011). The majority of perceived limitations were a result of epistemological or methodological divisions. While several studies discussed methodological divisions (Duerden and Kuhn, 1998; Neis et al., 1999; MacKinson, 2001; Hall and Close, 2007; Cinner and Aswani, 2010), the disassembly of the dominant paradigm addressed epistemological concerns. Together, disciplinary biases, power dynamics, and historical legacies merged to form the NSP. In turn, the NSP dictated the construction, valorisation, and marginalisation of knowledge in the OEFMP. Therefore, the concluding section of Chapter 6 investigated mechanisms with which to disassemble the NSP specifically via communication, congruency, joint understanding, and co-learning. Given the Knowledge Documentation Project is ongoing, this section suggested transdisciplinarity and multiparty collaboration as mechanisms to ensure an inclusive and polyphonic approach to achieve knowledge integration in the OEFMP.

## **CHAPTER 7**

### **CONCLUSION AND RECOMMENDATIONS**

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There were two overarching aims of this research. First, this study aimed to explore current barriers to the integration of TEK in management of the Olifants Estuary. Second, this research aimed to contribute to the provision of alternatives for future planning and decision-making in the OEFMP. So as to achieve these aims, this study sought to:

1. Examine the relationship between TEK and fishing practices in the Olifants Estuary;
2. Investigate and document processes for collecting TEK within the OEFMP;
3. Critically evaluate the strengths and/or limitations of integrating TEK into the OEFMP; and
4. Explore factors constraining/enabling knowledge integration in the OEFMP

The first section of Chapter 7 returns to research objectives and provides a summary of research findings and conclusions. The second section of this chapter offers recommendations for the continuation and progression of this study. Last, Chapter 6 reflects on the contributions of this project to research.

#### **7.1 Conclusions**

In revisiting research objectives and findings, the following section presents four principal conclusions: 1) TEK contributes to management through influencing resource use, fishing practices, and fisher behaviour; 2) knowledge documentation requires an identification, collection, and dissemination stage; 3) perceived strengths and limitations of TEK are products of epistemologies; and 4) the future of knowledge integration in the OEFMP is dependent on the disassembly of the Natural Science Paradigm.

### *7.1.1 Conclusion 1: TEK and Estuary Fishing Practices as Co-Evolving*

This study identified a close link between TEK and fishing practices. Specifically, TEK and fishing practices were co-evolving whereby TEK existed as both information and process. For example, whereas TEK emerged from fishing practices, fishing practices also emerged from TEK. Specifically within the OEFMP, TEK on estuary characteristics and human activities affected location, timing, and productivity of harvest practices. Importantly, given that there is a lack of scientific information on social patterns in the OEFMP, this project concludes that TEK contributes to management through influencing resource use and fisher behaviour and thus forms an integral part of the management process.

### *7.1.2 Conclusion 2: Knowledge Documentation as a Three-Staged Process*

While there were no universal guidelines for documenting TEK, there were several recurring findings. First, documenting TEK was a three-staged process, which included the identification, collection, and dissemination of knowledge. Specifically, this research concludes knowledge documentation requires an identification of parameters considered important to resource users, participative methods of collection, and a forum for collaborative knowledge-sharing. Second, researchers must be mindful of the identification of experts, the 'scientisation' of knowledge, and the selection of facilitators.

### *7.1.3 Conclusion 3: Strengths and Limitations of TEK*

This research evaluated several perceived strengths and limitations of TEK in both its characteristics and application. Participants recognised TEK as exposed, localised, and holistic as well as that as increasing participation, strengthening management, and broadening stakeholder perspectives. Contrarily, identified limitations saw TEK as subjective, lacking validity, and isolated. Additionally, findings indicated that certain participants – particularly

those from natural sciences – perceived TEK as having inadequate methodology, conflicting management scales, and lacking necessary precaution. Linked to the strengths and weakness of TEK, the third conclusion of this project is whereas participants’ perceptions of strengths and limitations in the application of TEK are methodological-based; perceptions of its characteristics are largely epistemological. Therefore, the most influential constraint to knowledge integration was not the limitations of TEK but rather factors constraining how it was perceived and valued by participants.

#### *7.1.4 Conclusion 4: Constraining and Enabling Factors*

Emerging from disciplinary biases, power dynamics, and historical legacies the fourth and most significant conclusion to materialise from this study surrounds the surfacing of the dominant paradigm. Through affecting the construction, valorisation, and marginalisation of knowledge, the Natural Science Paradigm (NSP) was the largest obstacle to knowledge integration. Importantly, communication, congruency, joint understanding, and co-learning facilitated its disassembly. In hindsight, Objective 4 influenced the entire direction of this research. Without first disassembling the NSP and re-constructing knowledge, findings are locked in a point of stasis. For example, ‘what the impacts of TEK on fishing practices are’ (Objective 1) or ‘how TEK is documented’ (Objective 2) is insignificant if participants do not recognise TEK as a legitimate form of knowledge. In turn, the fourth conclusion of this project is only by disassembling the NSP and co-constructing knowledge, can TEK be integrated into the OEFMP.

## **7.2 Recommendations and Future Research**

Combining the four conclusions examined in Section 7.1 the subsequent section highlights two recommendations of this research.

### *7.2.1 Recommendation 1: A Transdisciplinary and Multiparty Working Group*

Conclusion 3 argued while there are some methodological weaknesses of TEK, its perceived strengths and limitations are largely products of conflicting epistemologies. In this regard, Conclusion 4 (the construction, valorisation, and marginalisation of knowledge) encompassed Conclusion 3 and stressed the need to disassemble the NSP to achieve knowledge integration. From Conclusions 3 and 4, this study recommends the development of a stakeholder-based, transdisciplinary, and multiparty working group. The benefits of this working group would be the examination of knowledge between and across disciplines as well as the facilitation of horizontal dialogue rather than vertical dictation. This working group should comprise members of various key organisations and various disciplines including Coastal Links, Masifundise, EEU, Cape Nature, DAFF, and DEA. In addition, carefully selected facilitators should lead discussions and interactions should involve the physical interfacing of knowledges.

### *7.2.2 Recommendation 2: Future Research via Integrated Methodologies*

Conclusion 1 emphasised the ability of TEK as information and process to contribute to management through influencing resource use, human dimensions, and fisher behaviour. This is particularly important in the OEFMP where management costs are high and where little information exists on social practices. Once a multiparty working group has been established, this study recommends the furthering of knowledge integration research through the development and application of community maps in estuary spatial planning. However, to address methodological constraints identified by participants in Conclusion 2, this project suggests community maps be incorporated alongside scientific data sets using geographic information systems (GIS). The integration of methodologies would contribute to current gaps in knowledge of the estuary and provide more holistic information sets for estuary planning and management. Furthermore, through integrating methodologies, the knowledge

documentation process would be more transparent, participative, and inclusive.

### **7.3 Contribution to Knowledge**

The literature review made it obvious there is a substantial gap between *why* SSF management should integrate TEK and *how* this integration can actually take place. To address this gap, this research contributed to emerging literature on the application of knowledge integration in South African SSF. Although this research was only one study, the richness of material uncovered via participatory mapping and group discussions, participant observation, and semi-structured interviews is essential in initiating similar studies in SSF across the country. This richness is particularly important as it distinguishes the influence of disciplinary biases, historical legacies, and power dynamics on the development of dominant paradigms. In effect, this research creates a particular framework with which to recognise and reconstruct dominant paradigms (refer to Figure 11). In turn, these frameworks are essential in contributing to the integration of TEK not only in the OEFMP, but also in small-scale fisheries across South Africa.

## REFERENCES

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- Acheson, J.M. (2006) Institutional Failure in Resource Management. *Annual Review of Anthropology*, 35(1): 117-134.
- Agar, M. (1996) *The Professional Stranger: An Informal Introduction to Ethnography*. San Diego: Academic Press.
- Agrawal, A. (1995) Dismantling the Divide between Indigenous and Scientific Knowledge. *Development and Change*, 26(3): 413-439.
- Agrawal, A. (2002) Indigenous Knowledge and the Politics of Classification. *International Social Science Journal*, 54(173): 287-297.
- Almudi, T. and D.C. Kalikoski (2010) Traditional Fisherfolk and No-Take Protected Areas: The Peixe Lagoon National Park Dilemma. *Ocean and Coastal Management*, 53(5-6): 225-233.
- Anchor Environmental Consultants (AEC) (2008a) *Draft Olifants Estuary Management Plan*. Cape Town: University of Cape Town.
- Anchor Environmental Consultants (AEC) (2008b) *Olifants Estuary Situational Assessment*. Cape Town: University of Cape Town.
- Anchor Environmental Consultants (AEC) (2009) *Olifants Estuary Management Plan*. Cape Town: University of Cape Town.
- Anchor Environmental Consultants (AEC) (2011) *Olifants Estuary Management Plan Stakeholder Meeting*. [Meeting Minutes] (17 November 2011).
- African National Congress (ANC) (2004) *The Reconstruction and Development Programme (RPD), a policy framework*. Johannesburg: Umanyamo Publications.
- Andersen, I.E. and B. Jaeger (1999) Danish Participatory Models: Scenario Workshops and Consensus Conferences: Towards More Democratic Decision-Making. *Science and Public Policy*, 26(5): 331-340.
- Antweiler, C. (2004) Local Knowledge Theory and Methods: An Urban Model from Indonesia (In Bicker, A., Sillitoe, P. and J. Pottier (eds) *Investigating Local Knowledge: New Directions, New Approaches*. Aldershot: Ashgate Publishing Ltd. pp. 1-34).
- Anuchiracheeva, S., Demaine, H., Shivakoti, G.P. and K. Ruddle (2003) Systematizing Local Knowledge Using GIS: Fisheries Management in Bang Saphan Bay, Thailand. *Ocean and Coastal Management*, 46(11-12): 1049-1068.

- Armitage, D., Berkes, F. and N. Doubleday (eds) (2007) *Adaptive Co-Management: Collaboration, Learning, and Multi-Level Governance*. Vancouver: University of British Columbia Press.
- Attwood, C.G., Harris, J.M. and A.J. Williams (1997) International Experience of Marine Protected Areas and their Relevance to South Africa. *South African Journal of Marine Science*, 18(1): 311-332.
- Balram, S., Dragičević, S. and T. Meredith (2004) A Collaborative GIS Method for Integrating Local and Technical Knowledge in Establishing Biodiversity Conservation Priorities. *Biodiversity and Conservation*, 13(3): 1195-1208.
- Barrera-Bassols, N. and V.M. Toledo (2005) Ethnoecology of the Maya: Symbolism, Knowledge and Management of Natural Resources. *Journal of Latin American Geography*, 4(1): 9-41.
- Batterbury, S., Forsyth, T. and K. Tomson (1997) Environmental Transformations in Developing Countries: Hybrid Research and Democratic Policy. *The Geographic Journal*, 163(2): 126-132.
- Beck, U. (1997) *The Reinvention of Politics: Rethinking Modernity in the Global Social Order*. Cambridge: Blackwell Publishers.
- Belsky, J.M. (2002) Beyond the Natural Resource and Environmental Sociology Divide: Insights from a Transdisciplinary Perspective. *Society & Natural Resources*, 15(3): 269-280.
- Bennett, E., Neiland, A., Anang, E., Bannerman, P., Rahman, A.A., Huq, S., Bhuiya, S., Day, M., Fulford-Gardiner, M. and W. Clerveaux (2001) Towards a Better Understanding of Conflict Management in Tropical Fisheries: Evidence from Ghana, Bangladesh and the Carribean. *Marine Policy*, 25(5): 365-376.
- Berkes, F. (1993) Traditional Ecological Knowledge in Perspective. (In Inglis, J.T. (ed), *Traditional Ecological Knowledge: Concepts and Cases*. Ottawa: International Development Research Centre. pp. 1-9).
- Berkes, F. (1999) *Sacred Ecology: Traditional Ecological Knowledge and Natural Resource Management*. Philadelphia: Taylor and Francis.
- Berkes, F. (2003) Alternative to Conventional Management: Lessons from Small-Scale Fisheries. *Environments*, 31(1): 5-20.
- Berkes, F. (2009) Indigenous Ways of Knowing and the Study of Environmental Change. *Journal of the Royal Society of New Zealand*, 39(4): 151-156.

- Berkes, F. and J. Colding (eds) (1998) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge: Cambridge University Press.
- Berkes F. and M. Kislalioglu-Berkes (2008) Ecological Complexity, Fuzzy Logic, and Holism in Indigenous Knowledge. *Futures*, 41(1): 6-12.
- Berkes F. and N. Turner (2006) Knowledge, Learning, and the Evolution of Conservation Practice for Social-Ecological System Resilience. *Human Ecology*, 34(4): 479-494.
- Berkes, F., Colding, J. and C. Folke (2000) Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications*, 10(5): 1251-1262.
- Berkes, F., Mahon, R., McConney, P., Pollnac, R.C. and R.S. Pomeroy (2001) *Managing Small-Scale Fisheries: Alternative Directions and Methods*. Ottawa: International Development Research Centre.
- Bornman, T.G., Adams, J.B. and G.C. Bate (2008) Environmental Factors Controlling the Vegetation Zonation Patterns and Distribution of Vegetation Types in the Olifants Estuary, South Africa. *South African Journal of Botany*, 74 (4): 685-695.
- Borrini-Feyerabend, G., Johnston, J. and D. Pansky (2006) Governance of Protected Areas. (In Lockwood, M., Worboys, G. and A. Kothari (eds) *Managing Protected Areas: A Global Guide*, London: IUCN. pp. 116-146).
- Bosch, O.J.H., Ross, A.H. and R.J.S. Beeton (2003) Integrating Science and Management through Collaborative Learning and Better Information Management. *Systems Research and Behavioral Science*, 20(2): 107-118.
- Botsford, L.W., Castilla, J.C. and C.H. Peterson (1997) The Management of Fisheries and Marine Ecosystems. *Science*, 277(5325): 509-515.
- Bouwen, R. (2001) Developing Relational Practices for Knowledge Intensive Organizational Contexts. *Career Development International*, 6(7): 361-369.
- Bouwen, R. and T. Taillieu (2004) Multi-Party Collaboration as Social Learning for Interdependence: Developing Relational Knowing for Sustainable Natural Resource Management. *Journal of Community and Applied Social Psychology*, 14(3): 137-153.
- Branch, G.M. and B.M. Clark (2006) Fish Stocks and their Management: The Changing Face of Fisheries in South Africa. *Marine Policy*, 30(1): 3-17.
- Bruckmeier, K. and H. Tovey (2008) Knowledge in Sustainable Rural Development: From Forms of Knowledge to Knowledge Processes. *Sociologia Ruralis*, 48(3): 313-330.

- Calamia, M. (1996) Traditional Ecological Knowledge and Geographic Information Systems in the Use and Management of Hawaii's Coral Reefs and Fishponds' High Plains. *Applied Anthropologist*, 16(2): 144-164.
- Capistrano, R.C.G. (2010) Reclaiming the Ancestral Waters of Indigenous Peoples in the Philippines: the Tagbanua Experience with Fishing Rights and Indigenous Rights. *Marine Policy*, 34(3): 453-460.
- Capra, F. (1996) *The Web of Life: A New Scientific Understanding of Living Systems*. New York: Anchor Books.
- Carvalho, A.R., Williams, S., January, M. and M. Sowman (2009) Reliability of Community-Based Data Monitoring in the Olifants River Estuary (South Africa). *Fisheries Research*, 96(2-3): 119-128.
- Chalmers, N. and C. Fabricius (2007) Expert and Generalist Local Knowledge about Land-cover Change on South Africa's Wild Coast: Can Local Ecological Knowledge Add Value to Science? *Ecology and Society*, 12(1): 10.
- Charles, A.T. (1992) Fishery Conflicts: A Unified Framework. *Marine Policy*, 16(5): 379-393.
- Chopyak, J. and P. Levesque (2002) Public Participation in Science and Technology Decision Making: Trends for the Future. *Technology in Society*, 24(1-2): 155-166.
- Cilliers, P. (2000) Knowledge, Complexity and Understanding. *Emergence*, 2(4): 7-13.
- Cincin-Sain, B. and R.W. Knecht (1998) *Integrated Coastal Zone and Ocean Management: Concepts and Practices*. Washington, DC: Island Press.
- Cinner, J. and S. Aswani (2007) Integrating Customary Management into Marine Conservation. *Biological Conservation*, 140(3-4): 201-216.
- Clark, B.M., Hauck, M., Harris, J.M., Salo, K. and E. Russell (2002) Identification of Subsistence Fishers, Fishing Areas, Resource Use and Activities Along the South African Coast. *South African Journal of Marine Science*, 24(1): 425-437.
- Cochrane, K.L. (2002) A Fishery Manager's Guidebook: Management Measures and their Application. *Food and Agriculture Organization Fisheries Technical Paper*, No. 424. Rome: Food and Agriculture Organization.
- Cochrane, K.L., Augustyn, C.J., Fairweather, T., Japp, D., Kilongo, K., Iltembu, J., Moroff, N., Roux, J.P., Shannon, L., Van Zyl, B. ad F. Vaz Velho (2009) Benguela Current Large Marine Ecosystem – Governance and

- Management for an Ecosystem Approach to Fisheries in the Region. *Coastal Management*, 37(3-4):235-254.
- Colby, M.E. (1991) Environmental Management in Development: The Evolution of Paradigms. *Ecological Economics*, 3(3): 193-213.
- Creswell, J.W. (2009) *Research Design Qualitative, Quantitative, and Mixed Methods Approaches*. London: Sage Publications.
- Department of Agriculture, Forestry, and Fisheries (DAFF) (2012) *Policy for the Small Scale Fisheries Section in South Africa, No. 474*. Pretoria: Government Printer.
- Davis, A. and J.R. Wagner (2003) Who Knows? On the Importance of Identifying "Experts" When Researching Local Ecological Knowledge. *Human Ecology* 31(3): 463-489.
- Defeo, O. and J.C. Castilla (2005) More than one Bag for the World Fishery Crisis and Keys for Co-Management Successes in Selected Artisanal Latin American Shellfisheries. *Reviews in Fish Biology and Fisheries*, 15(3): 265-283.
- Degnol, P., Gislason, H., Hanna, S., Jentoft, S., Raakjarnielsen, J., Sverdrupjensen, S. and D. Clydewilson (2006) Painting the Floor with a Hammer: Technical Fixes in Fisheries Management. *Marine Policy*, 30(5): 534-543.
- Denzin, N.K. (1994) The Art and Politics of Interpretation. (In Denzin, N.K. and Y.S. Lincoln (eds) *Handbook of Qualitative Research*. Thousand Oaks: Sage Publications. pp. 500-515).
- Denzin, N.K. and Y.S. Lincoln (eds) (1998) Introduction: Entering the Field of Qualitative Research. (In Denzin, N.K. and Y.S. Lincoln (eds) *The Landscape of Qualitative Research: Theories and Issues*. Thousand Oaks: Sage Publications. pp. 1-34).
- Department of Science and Technology (2004). *Indigenous Knowledge Systems Policy*. Pretoria: Department of Science and Technology.
- Diamond, J. (1992) *The Third Chimpanzee*. New York: Harper Collins.
- Diamond, J. (2005) *Collapse: How Societies Choose to Fail or Succeed*. New York: Penguin Group.
- Dove, M.R. (2006) Indigenous People and Environmental Politics. *Annual Review of Anthropology*, 35(1): 191-208.
- Drew, J.A. (2005) Use of Traditional Ecological Knowledge in Marine Conservation. *Conservation Biology*, 19(4): 1286-1293.

- Duerden, F. and R.G. Kuhn (1998) Scale, Context, and Application of Traditional Knowledge of the Canadian North. *Polar Record*, 34(188): 31-38.
- Einsiedel, E.F., Jelsøe, E. and T. Breck (2001) Publics at the Technology Table: The Consensus Conference in Denmark, Canada, and Australia. *Public Understanding of Science*, 10(1): 83-98.
- Elgin, C.Z. (2004) True Enough. *Philosophical Issues*, 14(1): 113-131.
- Ellis, F. (2000) *Rural Livelihoods and Diversity in Developing Countries*. Oxford: Oxford University Press.
- Erasmus, Z. (ed) (2001) *Coloured by History, Shaped by Place: New Perspectives on Coloured Identities in Cape Town*. Cape Town: Kwela Books.
- Evely, A.C., Fazey, I., Pinard, M. and X. Lambin (2008) The Influence of Philosophical Perspective in Integrative Research: A Conservation Case Study in the Cairngorms National Park. *Ecology and Society*, 13(2): 52-68.
- Fabricius, C., Sholes, R. and G. Cundill (2006) Mobilising Knowledge for Integrated Ecosystem Assessments. (In Reid, W.V., Berkes, F., Wilbanks, T., and D. Capistrano (eds) *Bridings Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment*. Washington: Island Press. pp. 165-182).
- Fazey, I., Fazey, J.A., Salisbury, J.G., Lindenmayer, D.B. and S. Dovers (2006) The Nature and Role of Experiential Knowledge for Environmental Conservation. *Environmental Conservation*, 33(1): 1-10.
- Ferguson, M. and F. Messier (1997) Collection and Analysis of Traditional Ecological Knowledge about a Population of Arctic Tundra Caribou. *Arctic*, 50(1): 17-28.
- Ferse, S.C.A., Máñez Costa, M., Schwerdtner Máñez, K., Adhuri, D.S. and M. Glaser (2010) Allies, not Aliens: Increasing the Role of Local Communities in Marine Protected Area Implementation. *Environmental Conservation*, 37(1): 23-34.
- Fielding, P.J. and M. Burgh (2007) *The Olifants River Harder Gillnet Fishery: Analysis of Data Collected Between June 2003 and December 2006*. Report No.5/07/278. Cape Town: Environmental Evaluation Unit.
- Flood, R.L. (2001) The Relationship of 'Systems Thinking' to Action Research. (In Reason, P. and H. Bradbury (eds) *Handbook of Action Research: Participative Inquiry and Practice*. Thousand Oaks: Sage Publications. pp. 133-144).

- Folke, C. (2006) Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses. *Global Environmental Change*, 16(3): 253-267.
- Food and Agriculture Organization (FAO) (1995) *Code of Conduct for Responsible Fisheries*. Rome: Food and Agriculture Organization.
- Food and Agriculture Organization (FAO) (1998) *Integrated Coastal Area Management, Agriculture, Forestry and Fisheries*. Rome: Food and Agriculture Organization.
- Foster-Carter, A. (1976) From Rostow to Gunder Frank: Conflicting Paradigms in the Analysis of Underdevelopment. *World Development*, 4(3): 167-180.
- Foucault, M. (1965) *Madness and Civilization: A History of Insanity in the Age of Reason*. New York: Vintage.
- Gadgil, M., Berkes, F. and C. Folke (1993) Indigenous Knowledge for Biodiversity Conservation. *Ambio*, 22(2-3): 151-156.
- Gans, H.J. (1999) *Making Sense of America: Sociological Analyses and Essays*. Lanham: Rowman and Littlefield Publishers.
- Garcia, S.M. and A.T. Charles (2008) Fishery Systems and Linkages: Implication for Science and Governance. *Ocean and Coastal Management*, 51(7): 505-527.
- Gibbs, G.R. (2007) *Analyzing Qualitative Data: The SAGE Qualitative Research Kit*. London: Sage.
- Glavovic, B.C. (2000) *Our Coast, Our Future: A New Approach to Coastal Management in South Africa*. Cape Town: Department of Environmental Affairs and Tourism (DEAT) Government Printer.
- Glavovic, B.C. (2006) The Evolution of Coastal Management in South Africa: Why Blood is Thicker than Water. *Ocean and Coastal Management*, 49(12): 889-904.
- Glicken, J. (2000) Getting Stakeholder Participation 'Right': a Discussion of Participatory Processes and Possible Pitfalls. *Environmental Science and Policy*, 3(6): 305-310.
- Gorjestani, N. (2000) Indigenous Knowledge for Development: Opportunities and Challenges. (In: UNCTAD (United Nations Conference on Trade and Development) *Conference on Traditional Knowledge*. Geneva, Switzerland 30 October - 1 November 2000. Washington, DC: The World Bank. pp. 1-8).

- Gray, B. (1989) *Collaborating. Finding Common Ground for Multiparty Problems*. San Francisco: Jossey Bass.
- Gray, B. (2008) Enhancing Transdisciplinary Research through Collaborative Leadership. *American Journal of Preventive Medicine*, 35(2): S124-S132).
- Gray, B. and S. Schrujijer (2010) Integrating Multiple Voices: Working with Collusion in Multiparty Collaboration. (In Steyaert, C. and B. van Looy (eds) *Relational Practices, Participative Organizing*. Bingley: Emerald Group Publishing. pp. 121-136).
- Gray, T. (2005) Chapter I: Theorising About Participatory Fisheries Governance. (In Gray, T. (ed) *Participation in Fisheries Governance*. Dordrecht: Springer. pp. 1-12).
- Green, L. (2007) The Indigenous Knowledge Systems Policy of 2004: Challenges for South African Universities. *Social Dynamics*, 33(1): 130-154.
- Green, L. (2008) 'Indigenous Knowledge' and 'Science': Reframing the Debate on Knowledge Diversity. *Archaeologies*, 4(1): 144-163.
- Guba, E.G. and Y.S. Lincoln (1994) Competing Paradigms in Qualitative Research. (In Denzin, N.K. and Y.S. Lincoln (eds) *Handbook of Qualitative Research*. Thousand Oaks: Sage Publications. pp. 105-117).
- Gupta, A. (1998) *Postcolonial Developments: Agriculture in the Making of Modern India*. Durham: Duke University Press.
- Habermas, J. (1984) *The Theory of Communicative Action: Reason and the Rationalization of Society*. Translated from German by T. McCarthy. Boston: Beacon Press.
- Haddorn, G.H., Hoffman-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesman, U. and E. Zemp (2008) The Emergence of Transdisciplinarity as a Form of Research. (In Haddorn, G.H., Hoffman-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesman, U. and E. Zemp (eds) *Handbook of Transdisciplinary Research*. Zurich: Springer. pp. 19-39).
- Hall, G.B. and C.H. Close (2007) Local Knowledge Assessment for a Small-Scale Fishery Using Geographic Information Systems. *Fisheries Research*, 83(1): 11-22.
- Hanna, S.S. (1998) Managing for Human and Ecological Context in the Maine Soft Shell Clam Fishery. (In Berkes, F. and C. Folke (eds) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms*

- for Building Resilience*. Cambridge: Cambridge University Press. pp. 190-212).
- Hara, M. (2003) Co-management of Natural Resources: Theory and the Attendant Assumptions. (In Hauck, M. and M. Sowman (eds) *Waves of Change: Coastal and Fisheries Co-management in Southern Africa*. Lansdowne: University of Cape Town Press. pp. 14-36).
- Harris, J.M., Branch, G.M., Clark, B.M., Cockcroft, A.C., Coetzee, C., Dye, A.H., Hauck, M., Johnson, A., Kati-Kati, L., Maseko, Z., Salo, K., Sauer, W.H.H., Siqwana-Ndulo, N. and M. Sowman (2002) Recommendations for the Management of Subsistence Fisheries in South Africa. *South African Journal of Marine Science*, 24(1): 503-523.
- Harris, J.M., Sowman, M., Branch, G.M., Clark, B.M., Cockcroft, A.C., Coetzee, C., Dye, A.H., Hauck, M., Johnston, A., Kati-Kati, L., Maseko, Z., Salo, K., Sauer, W.H.H., Siqwana-Ndulo, N. and J. Beaumont (2002) The Process of Developing a Management System for Subsistence Fisheries in South Africa: Recognizing and Formalizing a Marginalized Fishing Sector in South Africa. *South African Journal of Marine Science*, 24(1): 405-424.
- Hauck, M. and M. Sowman (2001) Coastal and Fisheries Co-management in South Africa: An Overview and Analysis. *Marine Policy*, 25(3): 173-185.
- Hauck, M. and M. Sowman (eds) (2003) *Waves of Change: Coastal and Fisheries Co-management in Southern Africa*. Lansdowne: University of Cape Town Press.
- Hauck, M. and M. Sowman (2003) Co-management of Marine Resources in South Africa. (In Hauck, M. and M. Sowman (eds) *Waves of Change: Coastal and Fisheries Co-management in Southern Africa*. Lansdowne: University of Cape Town Press. pp. 38-60).
- Hauck, M. and M. Sowman (2005) Coastal and Fisheries Co-management in South Africa: Is there an Enabling Legal Environment. *South African Journal of Environmental Law and Policy*, 12(1): 1 -21.
- Heylighen, F., Cilliers, P. and C. Gershenson (2007) Philosophy and Complexity. (In Bogg, J. and R. Geyers (eds) *Complexity, Science and Society*. Oxford: Radcliffe Publishing. pp. 117-134).
- Higgs, J. (2001) Charting Standpoints in Qualitative Research. (In Byrne-Armstrong, H., Higgs, J. and D. Horsefall (eds) *Critical Moments in Qualitative Research*. Oxford: Butterworth Heinemann. pp. 44-66.)
- Hobbs, N.T. (2003) Challenges and Opportunities in Integrating Ecological Knowledge across Scales. *Forest Ecology and Management*, 181 (1-2): 223-238.

- Humphrey, C.R., Lewis, T. and F.H. Buttel (2002) *Environment, Energy and Society: A New Synthesis*. New York: Wadsworth Press.
- Hutchings, K. and S.J. Lamberth (2002) Bycatch in the Gillnet and Beach-Seine Fisheries in the Western Cape, South Africa, with Implications for Management. *South African Journal of Marine Science*, 24(1): 227-241.
- Hutton, T. and T.J. Pitcher (1998) Current Directions in Fisheries Management Policy: a Perspective on Co-Management and its Application to South African Fisheries. *South African Journal of Marine Science*, 19(1): 471-486.
- International Labour Organisation (ILO) (1989) The Indigenous and Tribal Peoples Convention of 1898. (C169). International Labour Standards Department: United Nations.
- International Union for the Conservation of Nature (IUCN) (2000) Theme on Indigenous Peoples, Local Communities, Equity, and Protected Areas. International Union for the Conservation of Nature: United Nations.
- Isaacs, M. (2006) Small-scale Fisheries Reform: Expectations, Hopes and Dreams of "A Better Life for All". *Marine Policy*, 30(1): 51-59.
- Jentoft, S. (1989) Fisheries Co-management: Delegating Government Responsibility to Fisherhmen's Organizations. *Marine Policy*, 13: 137-154.
- Jentoft, S. (2000) The Community: A Missing Link of Fisheries Management. *Marine Policy*, 24 (1): 53-59.
- Jentoft, S. and McCay, B.J. (1995) User Participation in Fisheries Management: Lessons Drawn from International Experiences. *Marine Policy*, 19(3): 227-246.
- Jentoft, S., McCay, B.J. and D.C. Wilson (1998) Social Theory and Fisheries Co-management. *Marine Policy*, 22(4-5): 423-436.
- Johannes, R.E. (1993) Integrating Traditional Ecological Knowledge and Management with Environmental Impact Assessment. (In Inglis, J.T. (ed) *Traditional Ecological Knowledge: Concepts and Cases*. Ottawa: International Development Research Centre. pp. 33-39).
- Johannes, R.E. (1999) The Case for Data-Less Marine Resource Management: Examples from Tropical Nearshore Fisheries. *Trends in Ecology and Evolution*, 13(6): 243-245.
- Johannes, R.E., Freeman, M.M.R and R.J. Hamilton (2000) Ignore Fishers' Knowledge and Miss the Boat. *Fish and Fisheries*, 1(3): 257-271.

- Jones, P.J.S. (2009) Equity, Justice and Power Issues Raised by No-Take Marine Protected Area Proposals. *Marine Policy*, 33(5): 759-765.
- Kemmis, S. (2001) Exploring the Relevance of Critical Theory for Action Research: Emancipatory Action Research in the Footsteps of Jürgen Habermans. (In Reason, P. and H. Bradbury (eds) *Handbook of Action Research: Participative Inquiry and Practice*. Thousand Oaks: Sage Publications. pp. 91-102).
- Kooiman, J. and M. Bavinck (2005) The Governance Perspective. (In: Kooiman, J., Bavinck, M., Jentoft, S. and R. Pullin (eds) *Fish for Life: Interactive Governance for Fisheries*. Amsterdam: Amsterdam University Press. pp. 11-25).
- Kvale, S. (1994) Ten Standard Objections to Qualitative Research Interviews. *Journal of Phenomenological Psychology*, 25(2): 147-174.
- Kuhn, T.S. (1962) *The Structure of Scientific Revolutions*. Chicago: The University of Chicago Press.
- Lauer, M. and S. Aswani (2010) Indigenous Knowledge and Long-term Ecological Change: Detection, Interpretation, and Responses to Changing Ecological Conditions in Pacific Island Communities. *Environmental Management*, 45(5): 985-997.
- Legal Resources Centre (LRC), Environmental Evaluation Unit (EEU) and Masifundise Development Trust (MDT) (2009) *Proceedings from Oral Histories Recorded with community Members of Ebenhaeser*, Ebenhaeser Community Hall.
- Li, T.M. (2000) Articulating Indigenous Identity in Indonesia: Resource Politics and the Tribal Slot. *Comparative Studies in Society and History*, 42(1): 149-179.
- Mackinson, S. (2001) Integrating Local and Scientific Knowledge: An Example in Fisheries Science. *Environmental Management*, 27(4): 533-545.
- Mahon, R. and P. McConney (2004) Managing the Managers: Improving the Structure and Operation of Small Fisheries Departments, Especially in SIDS. *Ocean and Coastal Management*. 47(9-10): 529-535.
- Mahon, R., McConney, P. and R. Roy (2008) Governing Fisheries as Complex Adaptive Systems. *Marine Policy*, 32(1): 104-112.
- Mauro, F. and P.D. Hardison (2000) Traditional Knowledge of Indigenous and Local Communities: International Debate and Policy Initiatives. *Ecological Applications*, 10(5): 1263-1269.

- McClanahan, T.R., Castilla, J.C., White, A.T. and O. Defeo (2008) Healing Small-Scale Fisheries by Facilitating Complex Socio-Ecological Systems. *Reviews in Fish Biology and Fisheries*, 19(1): 33-47.
- McConney, P., Mahon, R., and R. Pomeroy (2008) Coastal Resource Co-Management in the Caribbean. (In Armitage, D., Berkes, F. and N. Doubleday (eds) (2007) *Adaptive Co-Management: Collaboration, Learning, and Multi-Level Governance*. Vancouver: UBC Press. pp. 105-124).
- McGoodwin, J.R. (2006) Integrating Fishers' Knowledge into Fisheries Science and Management. (In Menzies, C.R. (ed) *Traditional Ecological Knowledge and Natural Resource Management*. Omaha: University of Nebraska. pp. 174-192).
- Menzies, C.R. (ed) (2006) *Traditional Ecological Knowledge and Natural Resource Management*. Omaha: University of Nebraska.
- Menzies, C.R. and C. Butler (2006) Introduction: Understanding Ecological Knowledge. (In Menzies, C.R. (ed) *Traditional Ecological Knowledge and Natural Resource Management*. Omaha: University of Nebraska, pp. 1-17).
- Merriam, S.B. (2009) *Qualitative Research: A Guide to Design and Implementation*. San Francisco: John Wiley & Sons.
- Moller, H., O'Blyver, P., Bragg, C., Newman, J., Clucas, R., Fletcher, D., Kitson, J., McKechnie, S. and D. Scott (2009) Guidelines for Cross-Cultural Participatory Action Research Partnerships: a Case Study of a Customary Seabird Harvest in New Zealand. *New Zealand Journal of Zoology*, 36(3): 211-241.
- Murdoch, J. and J. Clark (1994) Sustainable Knowledge. *Geoforum*, 25(2):115-132.
- Murray, G., Neis, B. and J. Petter Johnsen (2006) Lessons Learned from Reconstructing Interactions between Local Ecological Knowledge, Fisheries Science and Fisheries Management in the Commercial Fisheries of Newfoundland and Labrador, Canada. *Human Ecology*, 34(4): 549-571.
- Nadasdy, P. (1999) The Politics of TEK: Power and the "Integration" of Knowledge. *Arctic Anthropology* 335(1-2): 1-18.
- Neis, B. and L.F. Felt (eds) (2000) *Findings our Sea Legs: Linking Fishery People and their Knowledge with Science and Management*. St John's: ISER Books.

- Neis, B., Felt, L.F., Haedrich, R.L. and D.C. Schneider (1999) An Interdisciplinary Methods for Collecting and Integrating Fishers' Ecological Knowledge into Resource Management. (In Newell, D. and R. Ommer (eds) *Fishing Places, Fishing People: Traditions and Issues in Canadian Small-Scale Fisheries*. Toronto: University of Toronto Press. pp. 217-238.)
- Nicolescu, B. (2002) *Manifesto of Transdisciplinarity*. Translated by K.C. Voss. New York: State University of New York Press.
- Nursey-Bray, M. and P. Rist (2009) Co-management and Protected Area Management: Achieving Effective Management of a Contested Site, Lessons from the Great Barrier Reef World Heritage Area (GBRWHA). *Marine Policy*, 33(1): 118-127.
- Nygren, A. (1999) Local Knowledge in the Environment-Development Discourse: From Dichotomies to Situated Knowledges. *Critique of Anthropology*, 19(3): 267-288.
- Odum, E. and G.W. Barrett (2005) *Fundamentals of Ecology*. 5<sup>th</sup> ed. Belmont: Thomson/Brooks Cole.
- Parkington, J. (1977) Soaqua: Hunter-Fisher-Gatherers of the Olifants River Valley Western Cape. *South African Archeological Bulletin*, 32(1): 150-157.
- Patton, M. Q. (2002) *Qualitative Research and Evaluation Methods*. Thousand Oaks: Sage.
- Pierotti, R. and D. Wildcat (2000) Traditional Ecological Knowledge: The Third Alternative. *Ecological Applications*, 10(5): 1333-1340.
- Pinkerton, E. (1989) *Co-operative Management of Local Fisheries: New Directions for Improved Management and Community Development*. Vancouver: The University of British Columbia Press.
- Pinkerton, E. and M. Weinstein (eds) (1995). *Fisheries that Work: Sustainability Through Community-based Management, a Report to the David Suzuki Foundation*. Vancouver: David Suzuki Foundation.
- Pohl, C. and G.H. Hadorn (2008) Core Terms in Transdisciplinary Research. (In Haddorn, G.H., Hoffman-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesman, U. and E. Zemp (eds) *Handbook of Transdisciplinary Research*. Zurich: Springer. pp. 427-433).
- Pollnac, R.B. and R. S. Pomeroy (2005) Factors Influencing the Sustainability of Integrated Coastal Management Projects in the Philippines and Indonesia. *Ocean and Coastal Management*, 48(3): 233-251.

- Pomeroy, R.S. and R. Rivera-Guieb (2006) *Fishery Co-management: A Practical Handbook*. Cambridge: International Development Research Centre.
- Pomeroy, R.S., Parks, J., Pollnac, R., Campson, T., Genio, E., Marlessy, C., Holle, E., Pido, M., Nissapa, A., Boromthanasat, S. and N.T. Hue (2007) Fish Wars: Conflict and Collaboration in Fisheries Management in Southeast Asia. *Marine Policy*, 31(6): 645-656.
- Raymond, C.M., Fazey, I., Reed, M.S., Stringer, L.C., Robinson, G.M. and A.C. Evely (2010) Integrating Local and Scientific Knowledge for Environmental Management. *Journal of Environmental Management*, 91(8): 1766-1777.
- Reitz, D. (1929) *Commando, a Boer Journal of the Boer War*. London: Faber.
- Rosa, E.A. and G.E. Machlis (2002) It's a Bad Thing to Make one Thing Into Two: Disciplinary Distinctions as Trained Incapacities. *Society and Natural Resources*, 15(3): 251-261.
- Rossmann, G.B. and S.R. Rallis (2003) *Learning in the Field: An Introduction to Qualitative Research*. 2<sup>nd</sup> ed. London: Sage.
- Rowe, G. and L.J. Frewer (2000) Public Participation Methods: A Framework for Evaluation. *Science, Technology & Human Values*, 25(3): 3-29.
- Ruddle, K. (1998) The Context of Policy Design for Existing Community-Based Fisheries Management Systems in the Pacific Islands. *Ocean and Coastal Management*, 40(2-3): 105-126.
- Ruddle, K. (2000) Systems of Knowledge: Dialogue, Relationships, and Process. *Environment, Development, and Sustainability*, 2(3-4): 277-304.
- Schwandt, T.A. (1998) Constructivist, Interpretivist Approaches to Human Inquiry. (In Denzin, N.K. and Y.S. Lincoln (eds) *The Landscape of Qualitative Research: Theories and Issues*. Thousand Oaks: Sage Publications. pp. 221-260).
- Shelton, D. (1999) *Does the Law Matter? The Role of Non-Binding Norms in the International Legal System*. Oxford: Oxford University Press.
- Sillitoe, P. (1998) The Development of Indigenous Knowledge. *Current Anthropology*, 39(2): 223-252.
- Smith, E.A. and M. Wishnie (2000) Conservation and Subsistence in Small-Scale Societies. *Annual Review of Anthropology*, 29(2000): 493-524.
- Smith, L.G. (1993) *Impact Assessment and Sustainable Resource Management*. Harlow: Longman.

- South African Development Community (SADC) (2003) *Protocol on Fisheries*. Blantyre: SADC.
- Sowman, M. (2003) Co-management of the Olifants River Harder Fishery. (In Hauck, M. and M. Sowman (eds) *Waves of Change: Coastal and Fisheries Co-management in Southern Africa*. Lansdowne: University of Cape Town Press. pp. 270- 297).
- Sowman, M. (2006) Subsistence and Small-scale Fisheries in South Africa: A Ten-year Review. *Marine Policy*, 30(1): 60-73.
- Sowman, M. (2011) New Perspectives in Small-Scale Fisheries Management: Challenges and Prospects for Implementation in South Africa. *African Journal of Marine Science*, 33(2): 297-311.
- Sowman, M. and J. Sunde (2010) Power in Partnerships and Governance in Process: Reflections on University and Community Engagement in South Africa. In Coastal CURA (Community University Research Alliance), *People in Places: Engaging Together in Integrated Resource Management*. Halifax, Canada. 26-29 June 2010. Cape Town: University of Cape Town.
- Sowman, M., Hauck, M., van Sittert, L. and J. Sunde (2011) Marine Protected Area Management in South Africa: New Policies, Old Paradigms. *Environmental Management*, 47(4): 573-583.
- St. Martin, K., McCay, B.J., Murray, G.D., Johnson, T.R. and B. Oles (2007) Communities, Knowledge and Fisheries of the Future. *International Journal of Global Environmental Issues*, 7(2): 221- 229.
- Steiner, A. and G. Oviedo (2004) Indigenous Knowledge and Natural Resource Management. (In: The Knowledge and Learning Group, Africa Region, The World Bank, *Indigenous Knowledge: Local Pathways to Global Development*. Washington, DC: The World Bank. pp. 30-33).
- Sunde, J. and M. Isaacs (2008) *Marine Conservation and Coastal Communities: Who Carries the Costs? A Study of Marine Protected Areas and Their Impact on Traditional Small-Scale Fishing Communities in South Africa*. Chennai: International Collective in Support of Fishworkers.
- Sunderlin, W.D. (1995) Global Environmental Change, Sociology, and Paradigm Isolation. *Global Environmental Change*, 5(3): 211-220.
- Teh, L.C.L. and L.S.L. Teh (2011) A Fuzzy Logic Approach to Marine Spatial Management. *Environmental Management*, 47(4): 536-545.
- Toledo, V.M. (2002) Ethnoecology: a conceptual framework for the study of indigenous knowledge in nature. (In J.R. Stepp, F.S. Wyndham and R.S. Zargers (eds) *Ethnobiology and Biocultural Diversity*. Georgia: International Society of Ethnobiology. pp. 511-515).

- Turpie, J.K. (1995) Prioritizing South African Estuaries for Conservation: a Practical Example Using Waterbirds. *Biology Conservation*, 74(3): 175-185.
- Turpie, J.K., Adams, J.B., Joubert, A., Harrison, T.D., Colloty, B.M., Maree, R.C., Whitefield, A.K., Wooldridge, T.H., Lamberth, S.J., Taljaard, S. and L. Van Niekerk (2002) Assessment of the Conservation Priority Status of South African Estuaries for Use in Management and Water Allocation. *Water South Africa*, 28(2): 191-206.
- Turpie, J.K., Goldin, J., Lamberth, S.J. and W.J. Mullins (2006) *Socio-Economic Implications of Changes in Freshwater flows in the Olifants/Doring Catchment*. Report to Southern Water/DWAF. Pretoria: Department of Water Affairs Government Printer.
- United Nations Environment Programme (UNEP) (1992) Convention on Biological Diversity. Nairobi: United Nations Environment Programme.
- United Nations General Assembly (2007) United Nations Declaration on the Rights of Indigenous Peoples. New York: United Nations General Assembly.
- University of Cape Town (UCT) (2006) *Faculty of Humanities Guide to Research Ethics Research on Human Subjects*. Cape Town: University of Cape Town.
- Usher, P.J. (2000) Traditional Ecological Knowledge in Environmental Assessment and Management. *Arctic*, 53(2): 183-193.
- van, Manen, M. (1990) *Researching Lived Experience: Human Science for an Action Sensitive Pedagogy*. London, Ontario: Althouse Press.
- van Sittert, L. (2002) "Those Who Cannot Remember the Past are Condemned to Repeat it": Comparing Fisheries Reform in South Africa. *Marine Policy*, 26(4): 295-305.
- van Sittert, L. (2003) The Tyranny of the Past: Why Local Histories Matter in the South African Fisheries. *Ocean and Coastal Management*, 46(1-2): 199-219.
- van Sittert, L., Branch, G., Hauck, M. and M. Sowman (2006) Benchmarking the First Decade of Post-Apartheid Fisheries Reform in South Africa. *Marine Policy*, 30(1): 96-110.
- von Zweck, C., Paterson, M. and W. Pentland (2008) The Use of Hermeneutics in a Mixed Methods Design. *The Qualitative Report*, 13(1): 116-134.

- Wiber, M., Berkes, F., Charles, A., Kearney, J. (2004) Participatory Research Supporting Community-Based Fishery Management. *Marine Policy*, 28(6): 459-468.
- Wynberg, R. (2001) *A Review of Key Issues Facing the Management of Marine and Coastal Systems and Resources in South Africa*. Pretoria, South Africa: Department of Environmental Affairs and Tourism (DEAT) Government Printer.
- Yuki, G. (2009) Leading Organizational Learning: Reflections on Theory and Research. *The Leadership Quarterly*, 20(1): 49-53.
- Zingapan, K. and D. de Vera (1999) Mapping the Ancestral Lands and Water of the Calamian Tagbanwa of Coron, Northern Palawan. (In PAFID (Philippine Association for Intercultural Development), *Conference on NGO Best Practices*. Davao City Philippines, 1999. Quezon City: Philippines).

**APPENDIX A  
SAMPLE CONSENT FORM**

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**University of Cape Town  
Faculty of Sciences**

**Title of Research Project:**

Integrating Traditional Ecological Knowledge in South African Fisheries

Name of **Principal Researcher:** Anna Hushlak

Department: Environmental and Geographical Sciences, UCT

Telephone: 021.685.0529

Email: [anna.hushlak@uct.ac.za](mailto:anna.hushlak@uct.ac.za)

**Name of Participant:** \_\_\_\_\_

**Nature of Research:** Mini dissertation to be completed in partial fulfilment of M.Phil in Environmental Management degree at UCT.

**Research Objectives:**

- To highlight the strengths and/or limitations of using traditional ecological knowledge in small scale fishery management
- To identify factors enabling and/or hindering the use of traditional ecological knowledge in small scale fishery management

Note: the Olifants Estuary is being examined as a case study

**Participant's Involvement:**

What's involved: 30-45 minute semi-structured interview

Risks: Potential increase in OEMP tensions

Benefits: Potential decrease in OEMP tensions

Payment: Voluntary

- I agree to participate in this research project.
- I have read this consent form and the information it contains and had the opportunity to ask questions about them.
- I agree to my responses being used for education and research on condition my privacy is respected, subject to the following:
  - I understand that my personal details may be included in the research/will be used in aggregate form only, so that I will not be personally identifiable
- I understand that I am under no obligation to take part in this project.
- I understand I have the right to withdraw from this project at any stage.

Signature of Participant: \_\_\_\_\_

Name of Participant: \_\_\_\_\_

Signature of person who sought consent: \_\_\_\_\_

Name of person who sought consent: \_\_\_\_\_

Signature of principal researcher: \_\_\_\_\_

Date: \_\_\_\_\_

**APPENDIX B**  
**LIST OF PARTICIPATORY MAPPING AND GROUP DISCUSSION**  
**PARTICIPANTS**

Fisher	Approximate Years on River
Saartjie Afrika	60
Oom Hansie	60
Sylvester Don	19
Gas Blankenberg	35
Oom Andries Cloete	55
Gerard Don	40
Hensel Don	20
Cornelius Don	50
Fred Don	48
Dawid Don	40
Oom Petrus Don	30
Isak Pieterse	30
Mervin Afrika	10
Oom Sekkie	25
Aguls Blankenberg	35

**APPENDIX C**  
**LIST OF INTERVIEW PARTICIPANTS**

<b>Participant</b>	<b>Discipline</b>	<b>Position</b>	<b>Interview Date</b>
1	Natural Sciences	Consultant	13 March 2012
2	Natural Sciences	Consultant	13 March 2012
3	Social Sciences	Researcher	14 March 2012
4	Social Sciences	Researcher	16 March 2012
5	Natural Sciences	Management	16 March 2012
6	Natural Sciences	Management	19 March 2012
7	Natural Sciences	Management	19 March 2012
8	Social Sciences	Researcher	23 March 2012
9	Natural Sciences	Researcher	23 March 2012
10	Social Sciences	Researcher	17 April 2012
11	Social Sciences	Consultant	2 May 2011
12	Natural Sciences	Management	6 September 2011
13	Natural Sciences	Researcher	5 July 2012
14	Natural Sciences	Consultant	11 July 2012
15	Social Sciences	Researcher	9 July 2012

## APPENDIX D INTERVIEW QUESTIONS

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### 1. Background/Descriptive Questions:

- a. Age
- b. Level of Education
- c. Country of Education
- d. Degree/Discipline
- e. Courses
- f. Current Occupation
- g. Involvement with OEFMP

### 2. Opinion/Value Questions:

#### a. Challenges in South African SSF management

- i. Currently, do you feel that small-scale fisheries in South Africa are being successfully managed? Why or why not?
- ii. What would you identify as common management challenges in managing the Olifants Estuary?
- iii. What do you feel are potential solutions in addressing the challenges? What is needed?
- iv. Large amount of literature highlights the role of co-management in addressing fishery crises... do you think co-management has a place in the Olifants Estuary?
- v. What role(s) do you feel communities should/should not play in OE management?
- vi. Role of traditional/local knowledge?

#### b. Perceptions of 'Knowledge'

- i. How would you define knowledge?
- ii. What are some of the benefits of adapting alternative knowledge lenses?
- iii. How would you describe traditional/local ecological knowledge?
- iv. What factors influence our understanding of knowledge?

#### c. Integrating TEK in SSF Management/TEK as a means of Addressing Management Challenges

- i. Do you feel TEK has a role in the OEFMP?
- ii. How does TEK contribute/take away from management?
- iii. Why do you think TEK has not yet been integrated into the OEFMP? Should it be?
- iv. What are ways to enable the use of TEK in SSF mgmt.?
- v. In what direction do you see South Africa moving in terms of integrating different knowledges in SSF management?

**APPENDIX E**  
**PARTICIPATORY MAPPING COORDINATES**

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Fishing Area	Coordinates
Olifantsdrif	31:606:42S, 018:227:58E
Fonteinbos	31:61:205S, 018:204:83E
Doeie Perd	31:611:76S, 018:201:28E
Langklip	31:619:49S, 018:196:09E
Tierkrans	31:621:118S, 018:194:44
Rooikrans	31:627:41S, 018:195:43E
Hottentotskop se Plaat	31:640:90S, 018:205:86E
Hottentotskop se Gaat	31:645:62S, 018:204:68E
Kloof	31:646:32S, 018:201:09E
Drie en Ses	31:648:59S, 018:196:74E
Ribokksbaai se Plaat	31:650:47S, 018:195:82E

**APPENDIX F**  
**17 NOVEMBER 2011 KNOWLEDGE-SHARING WORKSHOP MEETING**  
**MINUTES**

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**OLIFANT'S ESTUARY INTEGRATED MANAGEMENT PLAN**

**GILLNET FISHERY TASK TEAM**

**Report on the knowledge exchange between the fishing and scientific community**

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**Venue:** Ebenhaeser  
**Date:** 17 November 2011  
**Time:** 10:30 – 15:30

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**Attendance**

Ebenhaeser Gillnet Fishery Community Task Team  
Joshua Cox - Masifundise  
Nico Waldeck – Masifundise  
Cecil Prinsloo? – Observer  
Merle Snowman - UCT  
Jackie Sunde - UCT  
Serge Raemarkers – Env. Eval. Unit  
Steve Lamberth – DAFF Gillnet Fishery Scientist  
Ken Hutchings – Anchor Environmental  
Jess Sterley – Anchor Environmental (minutes)  
Stef Snel – Mediator

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**Agenda**

Discussion of questions laid out, about the Oliphant's Gillnet Fishery, by the fishing community and the scientific community, in order to exchange knowledge about the fishery.

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**Introduction**

The mediator introduced himself and welcomed everyone to the meeting. It was highlighted that the questions raised by the community and the scientists were similar. It was therefore probable that the information, from both sides, about the aspects of the fishery could be enhanced and agreed upon.

*The meeting structure followed the layout of the questions asked and where applicable the questions were combined and are discussed below.*

**Question 1: What fish species occur in the Olifants Estuary and of these which species are mainly caught?**

Community:

The fish that they catch include: harders, elf, white steenbras, leervis, white stumpnose, gurnard, streepie, kob, st joseph sharks, barbel, springer.

(This list consists of 12 species however a few others that are caught by the gillnet fishermen may not have been mentioned at the meeting)

Scientists:

There are 40 known species in the estuary 20 of which are caught by the community. These 20 species include the species listed by the community. Of the 20 species caught by the fishermen only five of these species are caught on a regular basis, three of which are classified as by-catch. The top contributing species to the catch are harders followed by elf. The smaller fish not caught by the nets, which include the gobies and the herring, are an important food source for the birds and the fish that occur in the estuary. Some of the species not caught by the fishermen are invasive species that were introduced to the estuary by man.

(clarification on the species can be found in the paper *Bycatch in the Gillnet and Beach-seine Fisheries in the Western Cape, South Africa, with implications for management*, K. Hutchings and S. Lamberth 2002.)

**Question 2: How are the fish distributed in the estuary and in what areas of the estuary are the different species caught?**

Community:

The fish move higher up the estuary during summer but they are unable to move past the bridge. In the past they were able to catch fish in the upper reaches of the estuary. Today, the harders are caught mainly between Die Baaken and Ribok Baai.

Scientists:

Most of the harders are caught in the lower regions of the estuary, closer to the mouth.

**Question 3: Where and when do these fish species spawn?**

Community:

The fish do not lay their eggs in the estuary with the exception of the fresh water fish. The fish that they catch come into the estuary from the sea.

Scientists:

In agreement with the fishermen that the fish species the fishes catch that utilize the estuary do not spawn in the estuary, however, the estuary is an important nursery ground for these fish species particularly those caught as by-catch. The estuary provides protection and food for the juveniles, which live in the estuary for about 2yrs before they migrate back to the sea. The example of the male barbel was given, which is a mouth brooder. (The community was aware of this brooding behaviour)

#### **Question 4: What are the seasonal changes of the fishery with regard to recruitment, catch rate (of both harders and by-catch species) and the catch composition?**

Community:

Elf enter the estuary during August when they arrive with the smaller harders.

Their knowledge is that during winter fewer harders are caught than in summer, due to the conditions of the estuary. In winter the water is cleaner, which the fish do not like, as the system is flushed by freshwater. The stronger currents in the estuary also make it harder to catch the fish as the nets are not able to stay upright. Find however that the highest individual catches of harders occur from May to September.

Fish catches are not the same every year and five years ago the catches of harders were higher than today.

By-catch is higher in summer but, this is hard to avoid as these species run with the harders, particularly the elf. In winter there is not a lot of by-catch. Increased by-catch occurs from August and consists mainly of elf which runs with the smaller harders. Kob does occur in the by-catch but this consists mainly of the smaller fish as the nets do not reach the depths of the larger kob. Larger kob are usually caught during low tide when the nets reach the depth where this species occur.

Scientists:

There is a 3-7 year cycle of dry and wet periods in the country. During the dry periods the fishermen are able to catch more fish as a result of less fresh water flow and greater salt water penetration. However, during these periods recruitment (immigration of juveniles) into the estuary is low due to the lack of fresh water which is required for the juveniles to find the estuaries. As a result of lower recruitment there is a reduction in the stock. In other words the drier periods are better suited to the fishermen but not suited for stock recruitment.

Research agrees with the community that during the summer months there are more fish in the system and that more fish, on the whole, are caught during summer, however, the highest catches of harders per fisherman occur in April – May and Dec.

It is agreed that the majority of the by-catch occurs in summer with elf contributing to the majority of this catch. White steenbras, however, are usually caught during the winter months.

#### **Question 5: How has the catch of harders and the by-catch species changed over the years?**

Community:

In the past fishermen caught more harders than today but in more recent times catches have not changed over the years.

Scientists:

It is well known by all, including fishing communities, that nature changes all the time. As a result of this it is necessary that management and scientist have long term data sets, but this is only valuable if we have the history of the fishery as it will indicate how the fishery has changed over time. Historical data also provides information on what the original stocks were like, before fishing started. From the 1880's we can see that the catch of harders has declined by approximately 85%.

Although by-catch make up a small percentage of the total catch it has to be kept in mind that the natural abundance of harders in the system is much higher than the by-catch species so the small percentage of catch is quite important. In the past there was a higher abundance of the by-catch

species than there is found today. The recruitment of elf into the estuary has declined by 40% and white steenbras has declined by 80%, the same applies to the harders.

#### **Question 6: What impact do the seals have on the fishery and has this changed over time?**

Community:

In the past there were fewer seal in the area as they were an exploited species. Since they were declared a protected species their numbers have increased and now they move into the estuary more frequently. There are an isolated number of seals that impact on the fishery. These seals tear holes in the nets to get to the fish and their presence usually scare the fish away.

The community is aware that the problem seals can be shot but they are not sure who is responsible for doing the shooting.

Scientists:

The seals have always been a problem for the gillnet fishermen. It was agreed that the problem seals can be shot but only by Cape Nature rangers or by the fisheries compliance officers and not members of management. It was however stressed that the seals are needed to keep the fish stocks healthy and that an attitude of “shoot all the seals” should be avoided. (Fishermen agreed with this statement)

#### **Question 7: What are the anthropogenic impacts on the estuary and the fishery, aside from the gillnet fishery?**

##### **a. Mining**

Community:

There were channels on the north side of the mouth that were open in the past, but through mining activity these have closed. They were opened at one stage but have filled again so that during low tide the channels are closed and at high tide it is not possible to row their boats over it. The sheaths used by the mining sector are also an issue as they scare the fish away.

Scientists:

The only real concern from the mining sector at the moment is the inspection trenches that are dug along the river banks. These are usually left open which increases the sediment runoff into the estuary due to erosion of these trenches. Fish may also get trapped in these trenches. It is illegal for the mining sector to leave these trenches open, however, due to the lack of law enforcement in the area they are not held accountable.

##### **b. Agriculture**

Community:

The farming community in the area has increased over the years. In the past they only occurred in the river valley but have now spread out of the valley and on the ridges. This spread of the farmed land has increased the water demands on the river and as a result less water comes down the river. The pumps used by the farmers to fill their dams also impact the fishery as they do not have screens on the intake pipe, as a result the fish are sucked up in to the farmer's

dams. The farmers have also released pesticides into the river which kills the fish. All of these issues reduce the number of fish in the estuary system.

Scientists:

There are a number of impacts along the entire river system that restrict the water flow of the river, keeping in mind that impacts higher up on the river have impacts on the lower reaches of the system. Some of these impacts include construction of infrastructure, such as bridges and dams, farming communities, which need water for their crops and live stock and the diversion of water for the cities. All of these impacts have reduced the water flow of the estuary so that today there is approximately 30% less water flowing into the system, with more of the impact seen in summer. The reduction in water flow has resulted in the narrowing of the estuary system which has therefore reduced the habitable area for fish. (The narrowing of the estuary was also noted by the community)

The estuary's water quality is also a concern as this too impacts on the habitable areas for fish. The farming community not only releases pesticides into the system, as noted by the community, but also release fertilisers in to the estuary which results in the nutrification of the estuary. The increase in nutrients in the estuary, particularly in summer when these are concentrated due to lower water flow, increases the plant production, particularly of algae. During the day these plants produce oxygen but at night when they respire they use up all the oxygen in the water so that it becomes anoxic. As a result the fish are unable to live in these areas of the estuary. As noted by the community, all these impacts reduce the number of fish in the system.

### c. Recreational Anglers

Community:

There are a large number of recreational anglers that fish on the estuary particularly in the holiday seasons. These anglers are not monitored and the areas they fish in usually interferes with the gillnet fishermen. The community claims that the recreational anglers catch more of the by-catch species than the gillnet fishery do and therefore the gillnet fishery can not have the same impact on these species.

Social Scientists:

We need to understand the impacts of both the net fishery and the recreational fishery in order to get the bigger picture and then be in a position to make a comparison.

Scientists:

All aspect of the fishery is considered and this includes the recreational anglers. It is apparent to the science community that the recreational angling fishery needs to be monitored, a process which occurred in 1995 and again in 2010, but on this occasion not on the Olifants Estuary. In considering the impacts of the recreational anglers compared to gill net fishers in west coast estuaries, it was found that, over a year, one gillnet catches the same amount of by-catch species as eight anglers in a year. In comparison to the gillnet fishery that lands approximately 10tons of by-catch species a year, recreational anglers only land about two tons of these species a year. (The community did not agree with this finding)

**d. Other recreational activities such as motor boats**

Community:

The presence of motorised boats, particularly during the holiday season, impacts on the fishery. The noise made by the motors scares the fish away and in some cases the nets have become entangled in the motors.

**Question 8: What are the environmental impacts, with the exception of water flow, on the fishery?**

**a. Plankton**

Community:

This provides the fish with food however when there is a red tide at sea this drives the fish into the estuary.

**b. Water characteristics**

Community:

The fish usually appear after the South Easterlies have blown for approximately three days. During this period the fishermen monitor the movement of the "dark water", sea birds, the currents and the tides for conditions that signal the presence of fish in the area. In general there are more fish in the warmer water.

Scientist:

Fishermen prefer the warmer water in the estuary system when sea temperatures drop. There is generally a temperature difference of 5°C between the estuary and the sea. The South Easterlies cause upwelling in the sea, lowering water temperatures.

**Question 9: What is the catch, effort and catch-per-unit effort of the gillnet fishery?**

Community:

At present there are 45 gillnet permit holders in the community but six years ago there used to be 60 gillnet fishermen. As a result in the decline of permit holders there has been a decline in the total catch. There are however, between 15 and 20 of these permit holders that fish every day. This core of fishermen consists mainly of the older members of the community however there has been renewed interest from the younger members of their families. The rest of the permit holders are mainly younger members of the community which supplement their income with the gillnet fishery and subsistence West Coast Rock Lobster (crayfish) fishery.

Social Scientists:

Not many of the fishermen fish during winter as the fishermen claim that it is not worth the effort. For five months of the year the majority of the fishermen are inactive.

Scientists:

On average a gillnet fishermen fishes five days every month, but there are more fishermen during summer than winter. Despite the decline in the number of permit holders the total annual catch has remained the same over the years and the length of the nets used has increased. With respect to catch-per-unit-effort, however, catch per fishermen seems to be higher in winter.

From the Olifants estuary it is estimated that 120tons of harders and 10tons of by-catch are landed a year. The rest of the areas on the West Coast, combined, land an estimate of 600tons of harders a year which implies that the catch from the Olifants River is the biggest contributor to the total harders catch. When one considers that this estuary contributes to 30% of the estuarine habitat on the West Coast the full impact of this fishery is put into perspective.

### *Comments:*

#### *Community:*

1. What time frame of data is the estimation based on as from 1990 the community were not issued with permits or catch log books to complete, they were only issued with permits again in 2001?

*Scientists' response: The data used to make the estimates comes from a range of data sets but the majority comes from catch log books submitted by the fishermen. Despite the claims that catch books were not submitted the Department of Fisheries has a list of permit holders that regularly submit their catch books.*

*Anchor comment: It should be kept in mind that the science only works when the information provided by the fishermen is accurate; this means that all fishing excursions should be recorded especially when there was no catch.*

2. Why has there been no feed back from management about the catch rates of this fishery as this issue could have been rectified sooner?

*Scientists' response: Feed back from the science department of Fisheries has occurred, however, we can not speak on behalf of the management department of Fisheries.*

3. What about the impact of the trawlers on the fishery and why are they not being restricted?

*Scientists' response: The purse seine fishery for harderss on the West Coast closed in the early1980's. Three vessels experimentally caught harderss in the inshore waters of St Helena Bay but it was closed because they had a massive impact on the stocks. The demersal trawlers on the west coast do not fish the inshore as they do not target the same species; there is a very clear line between the inshore and the offshore fisheries. on the west coast.*

*Anchor response: The trawlers can not be blamed as they do not catch the same fish and they have their own set of management regulations.*

**Social Scientists:**

1. In protecting the estuary should we not be looking at all other impacts and in respect of the impacts from other fisheries is it necessary to close the estuary to the gillnet fishery?

*Anchor response: The initial management plan did not consider closing the fishery but implement a reserve that would be 12km long, an area that would cover parts of the fished area. The reserve was suggested both as a conservation measure to protect vulnerable by-catch species and as a fishery management tool as a benefit for the fishermen both within the estuary and along the entire west would take place due to improvements in the stock status of harders.*

2. An understanding of all impacts on the line fishery are needed before a management plan can be developed that has the least impact on the communities livelihoods.

*Scientists' response: There is an understanding of all the information needed but it is not perfect. Decisions will have to be made without all the information.*

3. Do we know the percentage impact the Olifants gillnet fishery has on the individual by-catch species stock? This is important to know as this will provide an indication of the responsibility the community needs to take on.

*Scientists' response: This is known but it would need to be calculated.*

**Scientists:**

1. There are a number of impacts on the harders stocks, however, the gillnet fishery has the largest impact. It should also be noted that the scientists and management are not trying to get the stocks to their original state but to 40% of the pristine stock. This is the optimum level for the fishery and the fishermen as it allows for a productive fishery. If the stocks fall below 30% the productivity declines as there are not enough individuals in the population to reproduce and sustain the fishing pressure.

**Question 10: What is the life history of the harders and the by-catch species and how is this impacted on by the fishery?**

Scientists:

Harders are caught at an average age of two, elf and white steenbras however are vulnerable to capture from an age of six months or less. This means that the by-catch species are caught when they are still juveniles (babies), at an age before they can breed. Harders breed at an age of two years or at a size of 24-28cm, total length, however, the nets select the faster growing fish. This implies that over time the

fishery has applied a selection pressure for fish with the genetic predisposition for slower growth. It has been shown that the fish in the south coast estuaries grow faster than those in the west coast estuaries where net fishing pressure is high (although environmental conditions will also play a role. In the management of this fishery the potential future yield needs to be considered not the absolute landed weight, particularly for the by-catch species that use the estuary as a nursery.

#### *Comments:*

#### *Community:*

1. The scientist do not see the practicality of the gill nets, they do not catch the small fish all the time.

*Anchor response: The issue is that when the little fish are caught, they are often damaged in the nets and are not returned. It is the catch of these that are of concern as it is enough to impact on the stocks.*

#### **General comments**

##### Community:

1. Need to monitor all aspect of the environment, such as water flow, not just the fish, due to the influence it has on the fishery.
2. The fishing community felt that they were not heard or considered in the previous management plan for the fishery. They felt that by joining the last forum they would had have to accept a plan that they had no input on and this was not in their best interests. They would like to resolve the plan for the fishery before they accept the management plan for the estuary. There is an understanding that the estuary and the fishery need to be managed and they want to be part of the process. This is particularly important if regulations are to be implemented and abided by.

##### Scientists:

1. It was stated that the scientists are not blaming the fishermen for the depletion of the stocks, this was done along time ago, yet the fishermen seem to blame all the other fishing sectors. What the scientists want is unity in order to protect the stocks so that they are more productive for the benefit of all current and future fishers.
2. The development of a forum and a management plan is essential as it will deal with many of the issues and concerns raised by the community. It should also be noted that the management plan can be adapted as the needs of the community change. The Breede Estuary Forum was used as an example of the potential of a forum and management plan.

##### Social Scientists:

1. It seems that over the last 10 years the landed number of fish has not changed and therefore the fishermen could not have had an impact as there has been no change.

*Anchor response: The Estuary has changed from a fish source to a sink in other words, rather than providing a nursery habitat and supplying fish to the marine environment, any fish that enter the estuary from the sea are fished out before they can add to the productivity of the entire stock. This has happened over decades, not just the last few years- the baseline data to compare current catch rates to are missing.*

## Meeting closure

Joshua Cox suggested that for the next meeting the community and scientists come up with possible management solutions for the fishery, these can then be compared and discussed in order to generate a plan that suites both the community and the resource.

It was decided that the next meeting would be held in February 2012 and that Joshua Cox would be responsible for organizing this meeting.

It was highlighted that there was a need for the involvement of top management in this process to approve of the management plan, despite the efforts from Joshua Cox to get them involved there had yet to be a response. It was asked that Steve Lamberth try to press the urgency of the issue.

The mediator thanked all who attended the meeting.

The meeting closed at 15:30.



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