August 2021

Southern Cape Interdisciplinary Fisheries Research (SCIFR) Project

Linked to the DSI/NRF South African Research Chair in Marine Ecology & Fisheries, SCIFR is a project that uses inter-and transdisciplinary approaches to understand change in the coastal region of the southern Cape and to use this knowledge towards improved sustainability on a triple bottom line.

Overarching Research Questions

- How are natural and social changes in the southern Cape shaping and interacting with marine social-ecological systems?
- More specifically, how are selected natural resources users in this area responding to global change, and how are they shaping change in their region?
- How can the knowledge of the current state of the social-ecological system be used to build a more resilient, sustainable system?

Context

Natural and human social systems are not mutually exclusive. As such, they cannot be thought of, nor worked with, separately (Ommer and Team 2007, Ommer et al. 2012). This project recognises that these systems are overlapping spheres of mutual influence that are connected through multiple inter-linkages at multiple temporal, geographic and governance scales. Studying these systems (termed social-ecological systems) requires working with multiple bodies of knowledge, several methodologies, and the expertise of stakeholders, including academics from various disciplines and natural resources users (e.g., Ommer and Team 2007).

Fisheries remain a major source of food, income, and livelihoods for millions of people worldwide, particularly those in developing countries (Garcia et al. 2003). However, past failures to recognise that the oceans form an integrated social-ecological system (Berkes et al. 2003) and the social-ecological linkages within such systems have led to a situation where ocean resources are depleted and dependent communities, negatively affected (Van Sittert 2002, Isaacs 2006, Jarre et al. 2013, Duggan et al. 2014). The southern Benguela along South Africa's western coast is no exception.

The past two decades have witnessed a suite of challenges in South Africa's fisheries following changes in both the human and biophysical spheres of the system (e.g., Van Sittert et al., 2006, Hutchings et al. 2012; Jarre et al. 2013; Mead et al. 2013; Sowman et al. 2011, 2013). These challenges include, amongst others, shifts in the distribution of various commercially significant marine resources (Howard et al. 2007; Blamey et al. 2012), increases in intra-seasonal wind and temperature variability (Reason & Hermes 2011; Moloney et al. 2013; Jarre et al. 2015), the implementation of the 1998 Marine Living Resources Act (MLRA), the commitment to implement an ecosystems approach to fisheries management (WSSD 2002), the 2000 linefish emergency declaration and the subsequent 2003/4 restructuring of the commercial handline fishery (DEAT 2005a,b), backdropped by ongoing economic challenges. The research questions focus on mounting concerns over the well-being of natural resources and resource users - particularly fish and fishers - to explore new ways of addressing these concerns.

The Benguela Current Large Marine Ecosystem (BCLME), one of four large marine ecosystem boundary current systems, is dominated by coastal upwelling. This extraordinarily productive region sustains important fisheries for Angola, Namibia and South Africa (http://www.benguelacc.org). It displays high variability and consists of four subsystems, of which the Agulhas bank off the southern Cape coast is one (Hutchings et al. 2009, Jarre et al. 2015). The research area for the Southern Cape Interdisciplinary Fisheries Research (SCIFR) project is an important but under-researched part of the social-ecological system of the Agulhas Bank. SCIFR specifically focuses on coastal fishing communities located in Witsand, Slangrivier, Vermaaklikheid, Stilbaai, Melkhoutfontein, Bitouville,

Gouritsmond and Mossel Bay along the southern Cape coast (Fig. 1). The research also includes an agricultural component that focuses on farming communities located in the Duiwenhoks and Goukou catchment areas.

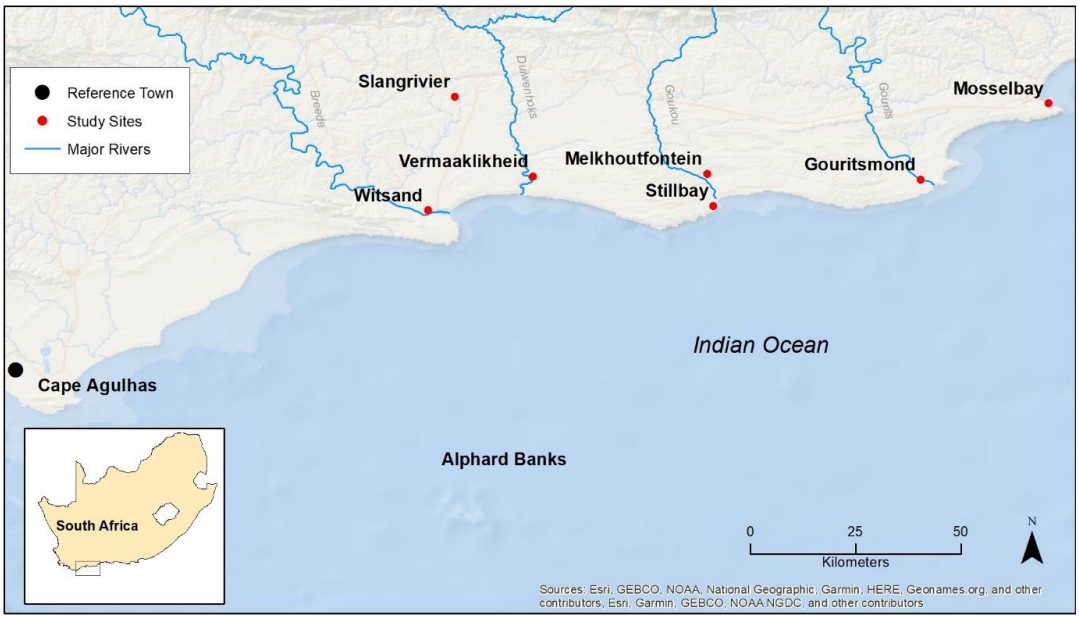

Figure 1 Map of the SCIFR research area. Mossel Bay - large urban centre situated on the coast; Bitouville - situated next to Gouritsmond at the Gourits River mouth; Melkhoutfontein - situated approximately 8 km from Still Bay on the coast, Vermaaklikheid - 7 km from the coast as the crow flies, but fishers often travel 47 km by road to launch in Still Bay; Slangrivier - situated 26 km inland as the crow flies, fishers travel 38km by road to Witsand where boats are launched at the Breede River mouth. Adopted from Gammage (2019).

Approach

Ecosystem and human well-being are often placed at risk by strategies that aim for maximal production and short-term gain. On the contrary, a resilient social-ecological system – one that can buffer against multiple stressors, or adapt or transform accordingly – is synonymous with ecological, economic and social sustainability (Berkes et al. 2003).

By approaching challenges using social-ecological systems thinking and engaging several academic disciplines as well as fishing communities, this research aims to contribute to finding viable means of working with diverse kinds of knowledge and stakeholder concerns in the region. The approach has already generated new understanding and should, in time, result in improved sustainability.

As illustrated in Fig. 2, the SCIFR project draws on broad disciplines whilst using common themes and methods. The research centres on the marine social-ecological system in the area, specifically coastal fisheries. An agricultural component of this coastal system was also incorporated to gain insight into the larger network interplay between terrestrial and marine systems.

The SCIFR project seeks to work even-handedly with different ways of knowing, recognising that no one perspective can contain the requisite expertise required to understand a complex marine social-ecological system and manage human interactions with it accordingly. Thus, rather than viewing selected natural resource users as mere data repositories, we aim to work with them as experts in their own right, alongside experts from other disciplines. Furthermore, this research aims to inform various decision-making entities at different scales to enhance resilience and sustainability in this region.

Figure 2 Framework for the SCIFR project (from Jarre et al. 2018)

Research Team

In consultation with researchers and local fishers, a range of academic disciplines have been identified to address the key SCIFR research questions. These include:

Table 1 Disciplines involved in SCIFR

nvolved in project from Phase 1 onwards	**New involvement/collaboration in Phase 2**
Knowledge co-production (fishers, school learners)	Economics
History	Environmental change management
Environmental geography	Education
Environmental & social anthropology	Performing Arts
Environmental science	Science communication
Fish(eries) biology	
Marine ecology	
Oceanography	
Structured decision support	

Highlights of progress achieved so far

How are natural and social changes in the southern Cape shaping and interacting with marine social-ecological systems? More specifically, how are selected natural resources users in this area responding to global change, and how are they shaping change in their region?

- Inshore trawl fisheries dominated the handline fishery in the southern Cape from its beginning in the early 1900s (Visser 2015).
- Historic co-dependence between inshore trawling and commercial handline fishing continues and is skewed in favour of the trawl fishery (Duggan 2018).
- The history of Still Bay as a recreational/holiday area versus Mossel Bay as a regional commercial hub feed through to the present (Visser 2015).
- Agricultural restructuring in the southern Cape already took place in the 1980s, i.e., before the first observed marine ecosystem regime shift (Ward 2018).
- The research confirmed decadal-scale environmental regime shifts in the mid-1990s and mid-2000s (Ward 2017, Lyttle 2019), corroborating local climate knowledge of farmers and fishers. While no clear trends of change over time were found in rainfall and temperature series, decadal variability was present. After the mid-2000s, the onset of autumn rainfall was found to have shifted to a month later (Ward 2018).

- There is a much lower occurrence of poaching in the southern Cape than west of Cape Agulhas, and these activities are also significantly less violent when they occur (Norton 2014).
- Drivers of change in the southern Cape's fishing-dependent communities are consistently similar across the area, with town-specific contexts influencing communities' capacity to proactively and positively respond to such change. As a result, some communities adapt, and others are coping or reacting (Gammage 2015).
- Limited trust between commercial linefish skippers hinders collaboration within their communities and with researchers and other stakeholders (Duggan 2018).
- Careful research, using various methods, with stakeholders from the southern Cape linefishery has allowed for the co-creation of a causal map that highlights the complexity of drivers of change that influence fishers' ability in the region to earn a sustainable fishery-derived income (Gammage 2019).
- Whilst adequate and appropriate access to fishery resources (access to rights) and economic challenges are foregrounded by fishers, challenges associated with increasing variability in weather, ocean conditions and fish resources are increasingly recognised (specifically when applying various problem framing methodologies that allow for the reframing of questions) (Gammage 2019).

How can the knowledge of the current state of the social-ecological system be used to build a more resilient, sustainable system?

- Overlaying farmers', fishers' and scientific bodies of knowledge on climate variability and change reduced the uncertainties associated with any single set of observations (Ward 2018).
- Knowledge disconnects concerning present versus past variability observed were broadly related to scale mismatches between fisher observations and marine data tendencies, complexities around freshwater availability, and shifting uses of natural resources. Specifically, the interplay of ocean temperatures and rainfall patterns that resulted in the folklore of "fishers are happy when farmers are sad and vice versa" has been changing (as has the abundance of linefish) and leaves this folklore less supported after the early 2000s (Ward 2018).
- Rural coastal communities need knowledge related to climate and marine change. This is possible when initiated via schools as trusted nodes in the community but needs to be contextually grounded (Duggan 2018).
- Fisheries Compliance Inspectors are unable to fulfil their mandate due, in large part, to severe management and personnel issues that have been characteristic of DAFF's Fisheries Branch (Norton 2014).
- The current formulation of marine resource laws and regulations does not adequately take into account the different motivations behind non-compliance, nor the difference in scales of non-compliance encountered in the inshore sectors. Furthermore, applying a one-size-fits-all approach to penalties can further entrench marginalisation and precarity amongst disadvantaged resource users (Norton 2014).
- A comparative social vulnerability assessment between the small-scale fishers in the southern Cape and their Brazilian counterparts reveal that despite differences in the quantitative estimates of vulnerability, fishers in both countries highlight similar drivers of changes associated with governance. Notably, the results support the development of local climate change mitigation plans (Martins et al. 2019). Climate stressors can push social-ecological systems into vulnerable states if not well integrated into adaptation strategies, which can seriously affect food and job security in the southern Cape.
- The use of structured decision-making tools in a scenario-based approach to change is suggested as an appropriate change-management approach, including with fishers who have varying formal education levels and in contexts where a multitude of uncertainties curtail day-to-day decision-making and long-term sustainability (Gammage 2019).
- Arts-based approaches can be implemented in disadvantaged communities in the region, despite the high mistrust. For example, staging a musical theatre production in collaboration with professional and community artists (Jarre et al. in prep., SCIFR & The Rainbow Exchange 2021) highlighted the general need for interventions to process trauma as one of the hurdles to proactively embracing change.

Milestones and outputs

Year	*Milestone*	*Output*
SARCHI Marine Ecology & Fisheries 1st funding cycle		
2010-2011	Preliminary work conducted in the SCIFR area through Greg Duggan's M.SocSci research	Duggan (2012)
2012	Conceptualisation of SCIFR based on GLOBEC F4 WG and the Canadian "Coasts under Stress" project	
SARCHI Marine Ecology & Fisheries 2nd funding cycle (2013-2017)		
2013	SCIFR project officially started as part of the SARCHI Marine Ecology & Fisheries, with Prof Astrid Jarre as project leader. Louise Gammage begins her MSc as SCIFR's first official student; Greg Duggan starts scoping for his PhD research; Dr Natascha Visser begins as a post-doctoral fellow. SCIFR team contributes to the 4th South African Linefish Symposium.	
2014	Marieke Norton completes her PhD research, with one field site in the SCIFR area explicitly referred to in the thesis. Catherine Ward begins her PhD research. SCIFR team contributes to the Southern African Marine Science Symposium.	Norton (2014)
2015	Louise Gammage finalises MSc and begins PhD research; Natascha Visser completes Post-doctoral research, collaborating with the GULLS project group through post-doctoral fellow Dr James Howard.	Gammage (2015) Visser (2015) Gammage et al. (2017a, b)
2016	Contributions to Benguela Symposium 2016 by SCIFR team.	Jarre et al. (2018)
2017	Contributions to Resilience 2017 Symposium by SCIFR team. Collaborative research with Ivan Martins (IO-USP, Brazil).	Martins et al. 2019
SARCHI Marine Ecology & Fisheries 3rd funding cycle (2018-2022)		
2018	Completion PhD research Greg Duggan, Catherine Ward; Dr Marieke Norton starts as Post-Doctoral research fellow (part-time), Casey Lyttle carries out MSc (minor-dissertation) research project from the African Climate and Development Masters course.	Duggan (2018) Ward (2018) Lyttle (2019)
2019	Completion PhD research Louise Gammage, she starts her post-doctoral research as a member of the SCIFR team. Begin dissemination of results and scoping of (possible) new phase with stakeholders.	Gammage (2019a,b) Gammage et al., (2019)
2020	Collaboration experiment with performing artists, staging the musical theatre production "As die See byt" in Melkhoutfontein, 4-6 Dec 2020. Dr Marieke Norton completes (part-time) Post-Doctoral research. Research on social vulnerability indicators for integrated ecosystem assessments. The first prototype was developed for the SCIFR communities. Dr Louise Gammage completes her post-doctoral research and continues as a contract researcher with EU funding.	Duggan et al. (2020), Gammage & Jarre (2020), Gammage et al. (2020), Norton (2020), SCIFR & The Rainbow Exchange NPC (2020), Sparks et al. (2020)
2021	Filming of "As die see byt", completion of a documentary on this musical theatre production, beginning of roll-out to more communities in the southern Cape in line with associated research questions.	Duggan et al. (2021), Gammage & Jarre (2021), SCIFR & The Rainbow Exchange NPC (2021), Ward et al. (*in press*)

Glossary of terms:

Adaptation: "proactive and anticipatory planning of individual or collective actions based on knowledge or experience of past or anticipated future changes and that will likely result in no regrets or sustainable social-ecological outcomes" (Bennett et al. 2014: 5).

Coastal fisheries: coastal fisheries operating in the research area include the traditional commercial handline fishery, the small-scale fishery and the inshore-trawl fishery, as well as a recreational fishery.

Communities: used in this context, we refer to communities of practise (e.g. a community of fishers or community of farmers). We acknowledge that communities are not homogenous and not necessarily geographically bound.

Interdisciplinary: Draws from different disciplines to work towards a common goal.

Natural resource users: in this context refers to fishers and farmers that form part of the social- ecological system in the coastal region of the research area (including associated catchment areas).

Resilience: Resilience is having the capacity to persist in the face of change, to continue to develop with ever changing environments. **Resilience thinking** is about how periods of gradual changes interact with abrupt changes, and the **capacity** of people, communities, societies, cultures to adapt or even transform into new development pathways in the face of dynamic change. It is about how to navigate the journey in relation to diverse pathways, and thresholds and tipping points between them. In resilience thinking, **adaptation** refers to human actions that sustain development on current pathways, while **transformation** is about shifting development into other emergent pathways and even creating new ones" (Folke, 2016:4).

Social-ecological systems: "A coupled system of humans and nature that constitutes a complex adaptive system with ecological and social components that interact dynamically through various feedbacks" (Simonsen et al. 2015).

Stakeholders: a group of people with common interests or concerns in something.

Transdisciplinary: "is the understanding of the present world through contextualisation of academic and practitioners' knowledge" (Paterson et al. 2010).

Vulnerability: "the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or stress/stressor" (Turner et al. 2003: 8074).

Acronyms

BCLME: Benguela Current Large Marine Ecosystem

DAFF: Department of Agriculture, Forestry, and Fisheries

DEAT: Department of Environmental Affairs

MLRA: Marine Living Resources Act (No 18 of 1998)

SCIFR: Southern Cape Interdisciplinary Fisheries Research project

WSSD: United Nations' World Summit on Sustainable Development

References

A. Direct SCIFR output

Duggan, GD. 2018. Return to the realm of the Kob kings: social capital, learning, resilience and action research in a changing fishery. PhD thesis, University of Cape Town, South Africa. http://www.eafsa.uct.ac.za/sites/default/files/image_tool/images/397/Thesis/DugganGL_2018_PhDthesis_FINAL181003.pdf .

Duggan GL, Murray G, Jarre A. 2020. Alternative seafood marketing in a small-scale fishery: barriers and opportunities in South Africa's southern Cape commercial linefishery. Maritime Studies, https://doi.org/10.1007/s40152-020-00175.

Duggan GL, Murray G, Jarre A. 2021. Learning for change: Integrated teaching modules and situated learning for marine social-ecological systems change. The Journal of Environmental Education, DOI: 10.1080/00958964.2020.1852524.

Gammage LC. 2015. Considering one's options when the fish leave. A case study of the traditional commercial handline fishery of the southern Cape. MSc Thesis. University of Cape Town, South Africa, https://open.uct.ac.za/handle/11427/15479.

Gammage LC. 2019.Development of a scenario-based approach for responding to change in fishery systems: a case study in the small-scale fisheries of South Africa's southern Cape. PhD thesis, University of Cape Town, South Africa., https://open.uct.ac.za/handle/11427/30360.

Gammage LC. 2019. Verbeelde visvangs toekomste / Imagining fishing futures. Brochure (in Afrikaans and English), SCIFR project, SA Research Chair in Marine Ecology & Fisheries, University of Cape Town. 4p.

Gammage LC, Jarre A. 2020.Using structured decision-making tools with marginalised fishers to promote system-based fisheries management approaches in South Africa. Frontiers in Marine Science 7:477. http://doi.org/10.3389/fmars.2020.00477.

Gammage LC, Jarre A. 2021. Scenario-based approaches to change management in fisheries can address challenges with scale and support the implementation of an ecosystem approach to fisheries management. Frontiers in Marine Science 8:600150. doi: 10.3389/fmars.2021.600150.

Gammage LC, Jarre A, Mather C. 2017a. A case study from the southern Cape linefishery 1: The difficulty of fishing in a changing world. S Afr. J. Sci. 113(5/6), Art. #2016-0252, 8 pp. http://dx.doi.org/10.17159/sajs.2017/20160252.

Gammage LC, Jarre A, Mather C. 2017b. A case study from the southern Cape linefishery 2: Considering one's options when the fish leave. S Afr. J. Sci. 113(5/6), Art. #2016-0254, 10 pp. http://dx.doi.org/10.17159/sajs.2017/20160254.

Gammage LC, Jarre A, Mather C. 2019. A changing fishery system: perspectives from crew in the Southern Cape's handline fishery, South African Geographical Journal, 44p. https://doi.org/10.1080/03736245.2019.1581656.

Gammage LC, Jarre A, Colburn LL, McClay PM. 2020. Developing social indicators for fishing communities of South Africa's southern Cape: initial prototyping. Report, SA Research Chair for Marine Ecology & Fisheries, University of Cape Town. 44p.

Jarre A, Shannon LJ, Cooper R, Duggan GL, Gammage LC, Lockerbie EM, McGregor ES, Ragaller SM, Visser N, Ward C, Watermeyer KE, Weller FG, Ommer RE. 2018. Untangling a Gordian knot that must not be cut: Social-ecological systems research for management of southern Benguela fisheries. Journal of Marine Systems 18: 149-159, https://doi.org/10.1016/j.jmarsys.2018.01.004.

Lyttle CT. 2019. Analysing modelled nearshore wave climate variability and change as relevant to the traditional handline fishery off the South African south coast. MSc thesis, Department of Environmental and Geographical Sciences, University of Cape Town, South Africa, https://open.uct.ac.za/handle/11427/30103.

Lyttle CT, Rautenbach C, Backeberg B, Jarre A. 2021. An analysis of high-resolution modelled wave heights along the South African south coast suggests recent deterioration of sea state. Fisheries Oceanography, DOI: 10.1111/fog.12551.

Martins IM, Gammage LC, Jarre A, Gasalla MA. 2019 Different but Similar? Exploring vulnerability to Climate Change in Brazilian and South African small-scale fishing communities. Human Ecology, https://doi.org/10.1007/s10745-019-00098-4.

Norton M. 2014. At the interface: Marine compliance inspectors at work in the Western Cape. PhD Thesis. University of Cape Town, http://hdl.handle.net/11427/12841 .

Norton, M. 2020. "Prawns, justice, and relationships of care in Stilbaai, South Africa". ICES Journal of Marine Science, https://doi.org/10.1093/icesjms/fsaa211 .

SCIFR & The Rainbow Exchange NPC. 2020. As die see byt ©". Musical theatre production. mp4 (2021). 49 mins.

SCIFR & The Rainbow Exchange NPC. 2021. The making of "As die see byt" ©. Documentary, mp4. 17 mins.

Sparks D, Jarre A, Norton M. 2020. Die toekomsblik van Melkhoutfontein / Imagining the future of Melkhoutfontein. Brochure (in Afrikaans and English) for middle-school learners. SCIFR project, SA Research Chair in Marine Ecology & Fisheries, University of Cape Town. 12 p.

Ward CD. 2018. Climate variability in social-ecological systems of the southern Cape: Integrating farming and fishing perspectives. PhD thesis, University of Cape Town, South Africa, https://open.uct.ac.za/handle/11427/30088.

Ward CD, Cundill-Kemp G, Midgley GF, Jarre A. Drawing on diverse knowledge systems to enhance local climate understanding in the southern Cape, South Africa. Ecology & Society (*in press, July 2021*).

B. References cited, other than direct SCIFR output

Bennett, N.J; Dearden, P; Murray, G; Kadfak, A. 2014. The capacity to adapt? : Communities in a changing climate, environment, and economy on the northern Andaman coast of Thailand. *Ecology & Society* 19(2): 1-20.

Berkes, F; Colding, J; Folke, C. 2003. Navigating social-Ecological Systems*: Building resilience for Complexity and Change* 1st ed. Cambridge University Press.

Blamey, L.K; Howard, J.A.E, Agenbag, J; Jarre, A. 2012. Regime-shifts in the southern Benguela shelf and inshore region. *Progress in Oceanography* 106: 80-95. DOI:10.1016/j.pocean.2012.07.001.

DEAT. 2005a. General policy on the Allocation and Management of Long term commercial Fishing rights. *DAFF*, Pretoria, South Africa

DEAT. 2005b. Policy for the Allocation and Management of Commercial Fishing Rights in the Traditional Line Fishery: 2005. *DAFF*, Pretoria, South Africa

Duggan, G., Green, L.J.F., Jarre, A. 2014 "Thinking like a fish": adaptive strategies for coping with vulnerability and variability emerging from a relational engagement with kob. Maritime Studies 13:4, 21p.http://www.maritimestudiesjournal.com/content/13/1/4.

Folke, C. 2016. Resilience. in Oxford Research Encyclopedia of Environmental Sciences. Oxford University Press, doi. 10.1093/acrefore/9780199389414.013.8

Garcia, S.M; Zerbi, A; Aliaume, C; Do Chi T; Lasserre, G. 2003. The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook. *FAO Fisheries Technical Paper.no.443. Rome, FAO.* 71.

Howard J.A.E; Jarre A; Clark A.E; Moloney C.L. 2007. Application of the sequential t-test algorithm for analysing regime shifts to the southern Benguela ecosystem. African Journal of Marine Science 29: 437 – 451.

Hutchings, L; Roberts, M.R; Verheye, H.M. 2009. Marine environmental monitoring programmes in South Africa: a review. South African Journal of Science 105 (April): 94-102.

Hutchings, L.; Jarre, A.; Lamont, T.; van den Berg, M.; Kirkman, S.P. 2012. St Helena Bay (southern Benguela) then and now: muted climate signals, large human impact. African Journal of Marine Science. 34(4):559–583. DOI: 10.2989/1814232X.2012.689672.

Isaacs, M. 2006. Small-scale fisheries reform: Expectations, hopes and dreams of a better life for all.*Marine Policy* 30(1): 51-59. DOI:10.1016/j.marpol.2005.06.010.

Jarre, A.; Ragaller, S.M.; Hutchings, L. 2013. Long-term, ecosystem-scale changes in the southern Benguela marine pelagic social-ecological system: interaction of natural and human drivers. Ecology and Society. 18(4):55.

Jarre, A; Hutchings, L; Kirkman, S.P; Kreiner, A. Tchipalanga, P; Kainge, P; Uanivi, U, Van der Plas, A; Blamey, L.K; Coetzee,J; Lamont, T; Samaal, T; Verheye, H.M; Yemane, D; Axelsen, B.E; Ostrowski, M; Stenevik, E.K, Loeng H. 2015. Synthesis: Climate effects on biodiversity, abundance and distribution of marine organisms in the Benguela. *Fisheries Oceanography* 24 (Suppl. 1): 122 -149.

Mead, M; Griffiths, M.H; Branch, G.M; McQuaid, C.D; Blamey, L.K; Bolton, J; Anderson, R.J; Dufois,F. Rouault, M; Froneman, P.W; Whitfield, A.K; Harris, L.R; Nel, R; Pillay, D; Adams, J.B. (2013) Human- mediated drivers of change - impacts on coastal ecosystems and marine biota of South Africa. *African Journal of Marine Science* 35(3): 403-425.

Moloney, C.L; Fennessy, S.T; Gibbons, M.J; Roychoudhurye, A; Shillington, F.A; von der Heyden, S.P; Watermeyer, K.E. 2013. Reviewing evidence of marine ecosystem change off South Africa. *African Journal of Marine Science* 35(3): 427-448.

Ommer, R.E. and Team. 2007. Coasts under stress: restructuring and social-ecological health. McGill-Queen's University Press, Montreal, Canada.

Ommer, R.E; Perry, I.R; Murray, G; Neis,B. 2012. Social-Ecological dynamism, knowledge, and sustainable coastal marine fisheries. *Current Opinion in Environmental Sustainability,* 4(3), pp. 316 - 322.

Paterson, B; Isaacs, M; Hara, M; Jarre, A; Moloney, C.L. 2010. Transdisciplinary co-operation for an ecosystem approach to fisheries: A case study from the South African sardine fishery. *Marine Policy* 34: 782-794.

Simonsen, S.H; Biggs, R; Schlüter, M; Schoon, M; Bohensky, E; Cundill, G; Dakos, V; Daw, T; Kotschy, K; Leitch, A; Quinlan, A; Peterson, G; Moberg, F. 2015. *Applying resilience thinking: Seven principles for building resilience in social-ecological systems*. Stockholm Resilience Centre, Cambridge University Press: 1-11.

Sowman, M; Hauck, M; van Sittert, L; Sunde, J. 2011. Marine protected area management in South Africa: new policies, old paradigms. *Environmental Management* 47(4): 573-583. DOI:10.1007/s00267-010-9499-x.

Sowman, M; Scott, D; Green, L.J.F; Hara, M.M; Hauck, M; Kirsten, K; Paterson, B; Raemaekers, S; Jones, K; Sunde, J; Turple, J.K. 2013. Shallow waters: social science research in South Africa's marine environment. *African Journal of Marine Science* 35:3, 385 – 402.

Turner, B.L., Kasperson, B.E., Matsone, P.A., McCarthy, J.J. , Corell R.W.,, Christensen, L., Noelle Eckley, N., Kasperson, J.X., Luerse, A., Martello, M.L., Polskya, C. , Pulsipher, A., Schiller, A. 2003. A framework for vulnerability analysis. Proceesings of the National Academy of Science (PNAS) 100:14, 8074-8079. DOIi:10.1073/pnas.1231335100.

van Sittert, L; Branch, G; Hauck, M; Sowman, M. 2006. Benchmarking the first decade of post- apartheid fisheries reform in South Africa. *Marine Policy* 30(1): 96-110. DOI:10.1016/j.marpol.2005.06.012.

van Sittert, L. 2002 Those who cannot remember the past are condemned to repeat it: comparing fisheries reforms in South Africa. *Marine Policy* 26: 295-305.

WSSD. 2002. Johannesburg Plan of Implementation. UN Doc. A/CONF.199/20. Resolution II, Annex. 1–6.
