The hits and misses of Namibia’s attempt to implement the Ecosystem Approach to Fisheries (EAF) Management

Johannes A. Itembenbu, Victoria N. Erasmus, Uatjavi Uanivi, Dietlinde Nakwaya, Richard R. Horaeb, Ester Nangolo, Festus P. Nashima, Theopolina K. Iita and Osmund Mwandemele

*Department of Fisheries and Aquatic Sciences, University of Namibia, Henties Bay, Namibia; 5Sam Nujoma Marine and Coastal Resources Research Centre, University of Namibia Sam Nujoma Campus, Henties Bay, Namibia; 6National Marine Information and Research Centre (Natmirc), Ministry of Fisheries and Marine Resources, Swakopmund, Namibia; 7Grants Management and Projects Services, University of Namibia, Windhoek, Namibia

ABSTRACT

Ecosystem Approach to Fisheries (EAF) management is a concept aimed at the conservation and sustainable use of the entire ecosystem. While EAF is a noble approach, its implementation has been challenging. Although Namibia has committed to the implementation of EAF, only limited assessment has been done of Namibian fisheries management processes and instruments concerning EAF. A qualitative assessment was done to ascertain if the Namibian fisheries management processes and instruments conform to the EAF principles. Namibian fisheries management processes and instruments largely conform to the EAF principles, although there are notable areas needing improvements. The conformities were pronounced in the total allowable catch setting, rebuilding depleted stocks, minimizing bycatch, and fishing impact minimization. The polluter pays, and user pays principles were also applied. Areas that were found lacking in this study included setting the indicators for EAF and ecosystem integrity. The assessment also noted the absence of guidelines for the precautionary approach principle and a transparent policy for quota and right allocation processes. The strategies for managing transboundary fish species are also not formulated. Overall, this assessment showed the complexities and challenges that Namibia and other countries need to overcome to implement EAF successfully.

Marine waters off Namibia

The marine waters off Namibia are some of the richest in the world as a result of the Benguela Current, which is a nutrient-rich current that occurs between 5° S; 12° E off Cabinda in Angola to the Nelson Mandela Metropole (Port Elizabeth) on the south coast of South Africa at 34° S; 26° (Hutchings et al. 2009) (Figure 1). Two warm-water regimes that border the Benguela Current Large Marine Ecosystem (BCLME) make it unique amongst the world’s eastern boundary upwelling systems (Hutchings et al. 2009). The Benguela current’s main characteristics include the equatorward flow and high levels of wind-driven coastal upwelling that brings nutrient-rich deep water to the surface (Nelson and Hutchings 1983). Other features include the periodic intrusion of warm Angola Current water from the north (Gammelsrod et al. 1998; West, Jansen, and Stuut 2004), occasional hydrogen sulfide eruptions, and red tides (Weeks et al. 2004; Brüchert, Currie, and Peard 2009). The Lüderitz upwelling cell divides the system into two distinctive regions, the northern Benguela region and the Southern Benguela region (Shannon 1985; Duncombe Rae 2005). The northern Benguela region is characterized by intense upwelling throughout most of the year (Campillo-Campbell and Gordoa 2004). Off Namibia, upwelling is strong during the colder months (June–August), with a seasonal effect of a well-defined temperature cycle (Gordoa, Masó, and Voges 2000). The influence of the upwelling regime is on average between 150 and 200 km wide; however, the filamentous mixing area may extend up to 625 km offshore (Campillo-Campbell and Gordoa 2004).

Biologically, the Benguela Current ecosystem is one of the most productive regions of the world’s oceans, supporting large commercial fisheries (Shannon 1985; Hutchings et al. 2009; Veitch, Penven, and Shillington 2009). The primary production–zooplankton–pelagic fish–demersal fish energy pathway dominate the current with the pelagic and demersal fish as important planktivores and secondary consumers, respectively (Heymans and Baird 2000). Significant changes have occurred in the system, including spatial changes in the distribution of small pelagic fish (Shannon et al. 2003; Shannon and Cury 2004) and increases in biomass of other species such as jellyfish (Flynn et al. 2012; Roux et al. 2013) and gobies (Utne-palm et al. 2010).
The commercial fisheries supported by the Benguela current off Namibia include hake (*Merluccius capensis* and *M. paradoxus*), monkfish (*Lophius vomerinus* and *L. vaillanti*), Cape horse mackerel (*Trachurus capensis*), sardine (*Sardinops sagax*), Deep-sea red-crab (*Chaceon maritae*), rock lobster (*Jasus lalandii*), snoek (*Thysites atun*), kob (*Argyrosomus inodorus* and *A. coronus*), West Coast Steenbras (*Lithognathus auret*) and Cape fur seals (*Arctocephalus pusillus pusillus*) as well as species of sharks and tunas (MFMR 2017). Namibian fisheries play an important role in terms of employment, foreign exchange earnings, and government revenue. About 16,800 individuals are employed in the fishing industry, and it averaged about N$10 billion in FOREX earnings to Namibia annually during 2012–2016, making it the second most important FOREX earner after mining (MFMR 2017).

In Namibia, single-species fisheries management actions have been taken to ensure sustainable management of fisheries resources. There is, however, a common understanding among fishery managers and scientists that new alternative approaches are needed to manage fisheries resources at ecologically sustainable harvest levels. Recognizing the need for management approaches based on integrated ecosystem considerations, fisheries management, authorities have considered the need to implement an ecosystem approach to fisheries (EAF) management (Garcia et al. 2003; Roux and Shannon 2004; Garcia and Cochrane 2005; Cochrane et al. 2009). This paper qualitatively assesses the Namibian fisheries management processes and instruments toward ascertaining the possible hits and misses concerning their conformity to EAF principles.

## Fisheries management in Namibia

Before independence in 1990, fishing off Namibia was openly accessed without limit and regulations governing the harvest of marine resources, which led to overfishing and subsequent collapse of some fisheries, particularly the sardine fisheries (Oelofsen 1999). After independence, the state’s sovereign ownership of marine resources was proclaimed as per the Namibian Constitution (Article 100 of The Constitution of the Republic of Namibia, 1990). The then newly independent state also claimed the 200 nautical miles Exclusive Economic Zone (EEZ) under the United Nations Law of the Sea Convention (UNCLOS, 1982). The Namibian Constitution required that the state adopts policies aimed at “the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future” (Article 95(l) of the Namibian Constitution). Since the Namibian fisheries were considered overfished or depleted because of overexploitation by foreign fleets, the state at
independence prioritized enacting laws and regulations toward the recovery of marine resources (Oelofsen 1999; Iyambo 2001).

The mandate to implement these policies and laws for the conservation and sustainable utilization of marine resources was given to the Ministry of Fisheries and Marine Resources (MFMR). One of the laws implemented to drive the sustainable management of fisheries resources included the Fisheries Act (Act 29 of 1992), which is now repealed and replaced by the Marine Resources Act (Act No. 27 of 2000) and its subsequent regulations. These regulatory frameworks included introducing total allowable catches (TACs) for all commercially exploited species to control harvest levels, thus ensuring that fishery resources are managed sustainably. It also regulated the allocation of rights and quotas on most species and fishing vessel licensing. Harvesting of the TAC-controlled fisheries is by way of acquiring fishing rights by the participating individuals/companies as per the Marine Resources Act (Act No. 27 of 2000). The process involves evaluating available data and information through fishery-specific working groups, stock assessments, determination of the TAC based on best scientific and socioeconomic information, and the presentation of the findings to the managers and the Marine Resources Advisory Council. These presentations ultimately form part of the basis for fisheries management recommendations that include TACs, size limit, area and seasons closure, and gear restriction. Once the cabinet sets the TAC for a particular fishing season, the Minister of Fisheries and Marine Resources allocates the fishing quotas to individual rights-holders to fish with licensed vessels, as per the quota allocation guidelines stipulated in the Marine Resources Act (Act No. 27 of 2000, as amended). The management measures are enforced through monitoring, control, and surveillance (MCS), while the state collects the resource rent through levies, fees, and taxes. Bycatch fees are also charged to any rights-holder who catches and lands a resource for which no right to catch has been allocated.

In addition to national laws, Namibia is also a signatory to several international conventions, including the Rome Declaration on the Implementation of the Code of Conduct for Responsible Fisheries at the Food and Agriculture Organization of the United Nations (FAO 1995), the Declaration on Responsible Fisheries in the Marine Ecosystem (FAO 2001), the Convention on Biological Diversity (Biodiversity Convention 1992) and Benguela Current Convention (2013). According to the Namibian Constitution, international law and international agreements ratified by Namibia become part of Namibia’s law (Article 144 of the Namibian Constitution). These international agreements, therefore, commits Namibia to adopt EAF. Although fisheries management in Namibia is predominantly single-species oriented (Roux and Shannon 2004), attempts have been made to pave the way for the implementation of EAF (Paterson and Petersen 2010).

**Ecosystem approach to fisheries management (EAF)**

Ecosystem Approach to Fisheries is considered an integrated management approach that promotes conservation and sustainable use of the entire ecosystem (Turrell 2004; Morishita 2008). There are many definitions of EAF, often leading to misunderstandings of what EAF entails (Morishita 2008). EAF aims to engage all stakeholders to plan, develop, and manage fisheries in a way that considers the needs of the current generation without compromising the ability of future generations to also benefit from such resources (Roux and Shannon 2004). The concept is also widely championed because it holistically considers multifaceted linkages across human and natural systems, identifies conflicts and synergies between different ecosystem services and openly evaluates both direct and indirect effects of fishing activities on marine ecosystems (Cowan et al. 2012). Additionally, the attractiveness of EAF is also because it is not narrowly limited to management considerations alone but can cover issues like development, planning, food safety, and others matching the breadth of the FAO Code of Conduct (Garcia et al. 2003).

Although EAF is a noble approach, the information demands, policy focus, and structural arrangement make its implementation challenging (FAO, 2016). Its viability is also dependent on political, economic, and social factors, including equitable distribution of resources, costs and benefits, support from citizens, protection of vulnerable species and habitats, rights and responsibilities, allocation and equity, environmental protection, and a transparent framework (FAO, 2016). Additionally, long-standing fisheries management issues like illegal, unreported, and unregulated (IUU) fishing, weak administration, under-funded research, reduction of fishing pressure, and user rights also need to be addressed for the successful implementation of EAF (Garcia and Cochrane 2005). Therefore, the development of ecological, social, and economic indicators and reference points are fundamental to support the implementation of EAF by providing information on the state of the ecosystem, the extent and intensity of effort or mortality, and the progress of management concerning objectives (Garcia and Cochrane 2005; Jennings 2005).
The assessment of the implementation of EAF is considered a challenge because of a lack of developed assessment methods. Attempts to devise ways to assess the implementation of EAF include FAO Technical Guidelines for responsible Fisheries (FAO 2003), EAF policy proposal (Ward et al. 2002), and the Ecological risk assessment (ERA) (Fletcher 2005). In Southern Africa, the ERA methods have been used to assess the EAF implementation (Paterson and Petersen 2010), while in Namibia, in particular, it has been used to assess EAF implementation for hake, mid-water fishery and small pelagics (Petersen et al. 2010). Although these assessments provided important information, less was done to understand EAF implementation from the fisheries management processes and instruments’ perspectives.

The methodological approach

In this study, Namibia’s conformity to EAF was ascertained by qualitatively assessing EAF implementation in Namibia against a set of 14 criteria (Table 1) based on the principles from Garcia et al. (2003) and adapted to reflect aspects of the country’s fisheries management processes. The clarity of the EAF principles was enhanced by being considered together with their stated objectives (Garcia et al. 2003). The aspects of the Namibia fisheries management processes and instruments that correspond (and those not corresponding) with the specific EAF principles were identified (Table 1) and discussed.

Results and discussion

The hits of Namibian fisheries management processes and instruments concerning EAF

This study aimed at qualitatively ascertaining if the Namibian fisheries management processes and instruments conform to the EAF principles (Table 1). The results showed some conformities to the EAF principles. The conformities were more pronounced in areas related to ecosystem wellbeing, the basis of setting the single species TAC, the rebuilding of depleted stocks, and the minimization of bycatch. The Polluter Pays and User-pays principles were also fairly covered by fisheries management processes and instruments. The Namibian Constitution came into force in 1990, and one of its provisions requires the state to implement policies that ensure the maintenance of ecosystems, essential ecological processes, and biological diversity (Article 95). EAF, therefore, derives its significance from the supreme law of Namibia. The above has also resulted in some of the regulatory frameworks having some aspects of EAF, including fisheries management instruments and processes implemented following the Marine Resources Act (MRA) (25 of 2000, and its regulations). National Biodiversity Strategies and Action Plans (2001–2010, 2013–2022) have also been formulated to provide the foundation for sustainable management and use of biodiversity in the country (MET 2014).

The sustainability of fisheries resources (Table 1, Principle 2), which include both human and ecosystem wellbeing, is the core of EAF (Garcia and Cochrane 2005). The TACs of commercially exploited fish species in Namibia are determined based on the best available science as per section 38 (1) of the MRA. Therefore, this assessment of commercially exploited species conforms to the EAF principles that are concerned with resource scarcity, maximum acceptable fishing level, and maximum biological productivity (Table 1, Principle 2). The above is also demonstrated by the fact that one of the Namibian fisheries (hake) has recently been certified by the Marine Stewardship Council (MSC) as sustainably managed after undergoing rigorous review (Jones et al. 2020).

Overfishing is recognized as a leading environmental and socioeconomic issue and adopting EAF may assist in addressing it (Worm et al. 2009). In Namibia, fishing moratoriums on fisheries that are considered overfished, like the sardine and orange roughy fishery, are implemented (Kainge et al. 2020), which shows that the management processes consider the impact reversibility of the fishing (Table 1, Principle 4). The impact of fishing is additionally minimized through area restriction, which restricts trawling within the 200 m depth zone (Oelofsen 1999; Kirchner, Kainge, and Kathena 2012) and season closures for fisheries like hake (Kathena et al. 2018). Although these areas and season restrictions are mainly for protecting juvenile fish and spawning (Kathena et al. 2018), their effects go beyond their main objectives, resulting in the minimization of fishing impacts (e.g., on benthic habitats), which is in line with EAF principles (Table 1, Principle 3). Fisheries restricted areas, like the Namibian 200 m depth zone, are considered as Other Effective Area-based Conservation Measures (OECMs), which are known to be useful for biodiversity conservation although they are not protected areas (Petza et al. 2019). Other fisheries management measures like Namibian Islands’ Marine Protected Area (NIMPA) aim to protect the breeding of seabird species (Government Notice 316 of 2012) and minimize fishing impacts. Marine Protected Areas are known to effectively safeguard habitats from fishing impacts (Langton et al. 2020).

Regarding minimizing bycatches (Table 1, Principle 6), Namibia has implemented various measures, including minimum mesh size regulations (MRA regulations) and the fact that a fee is payable in respect of bycatches of commercially exploited fish (MRA regulations). These measures disincentivize fishers from
Table 1. The assessment of the EAF principles and their corresponding objectives (modified from Garcia et al. 2003) concerning Namibian fisheries Management processes and instruments.

| EAF Principles | Principle Objectives | Coverage by the Namibian fisheries Management processes and instruments |
|----------------|----------------------|------------------------------------------------------------------------|
| 1. Ecosystem Well-being | - To maintain the productivity of ecosystems for present and future generations, conserving critical habitats, reducing pollution and degradation, minimizing waste, and protecting endangered species | • Article 95 (l) of the Namibian Constitution. |
| | | • The Namibian Islands’ Marine Protected Area (NMPA) by Regulations relating to Namibian Islands Marine Protected Area (Government Notice 316 of 2012) |
| | | • Marine Pollution Contingency plan implemented(2017). |
| | | • Marine spatial Planning work has been conducted and aims to consider various marine ecosystem spaces for multiple species (Finke et al. 2020a). |
| | | • Indicators to track ecosystem health/wellbeing are lacking or not well articulated in the Namibian fisheries management processes. |
| | | • The Environmental Management Act (No. 7 of 2007 and its EA regulations) is in place. |
| | | • Namibia’s Second National Biodiversity Strategy and Action Plan (2013–2022) drafted. |
| | | • Total Allowable catches (TAC) of exploited species determined based on the best available science as per section 38 (l) of the Marine Resources Act (MRA) 25 of 2000. |
| | | • MRA has not specified measures for the protection of the marine ecosystem at the same standing as TAC. |
| | | • The MFMR does not carry out targeted ecosystem research. |
| | | • Hake fisheries have been certified by the Marine Stewardship Council as sustainable (Jones et al. 2020). |
| | | • Dedicated biomass surveys of various commercially important species are conducted annually. However, there are no dedicated ecosystem research surveys. |
| | | • There are area restrictions (no trawling is permitted in less than 200 m depth) |
| | | • There are also season closures for some fisheries like hake (October). |
| | | • Namibian Islands’ Marine Protected Area (NIMPA) for the protection of seabird species breeding is place. |
| 2. Resource Scarcity, Maximum Acceptable Fishing Level and Biological Productivity | - To assess the limits of the resources and the conditions for its maintenance (research). - To regulate the fishery’s extractive capacity to match removals and maintain critical ecosystem processes and structures. - To allow catch levels (or fleet sizes) compatible with maintaining an ecologically viable stock at an agreed level (e.g., above MSY) or range of levels, with an acceptable probability that the setup is viable. | • Namibia is a signatory to the Convention for Biological Diversity(CBD) |
| | | • Importation or introduction of alien species is regulated by Aquaculture Act 18 of 2002. |
| | | • Article 95 (l) of the Namibian Constitution. N policy guidelines have been drafted on the maintenance of important ecological processes. |
| | | • There are no specified measures for protecting Ecologically and Biologically significant areas (e.g., EBSA). BCC working exists for regional identification and consideration of EBSA issues. |
| | | • Research is needed on other species which are not commercially exploited. Currently, research is mostly directed toward commercially important species. |
| | | • Relatively good long-term bio-ecological and environmental data available, but they not well integrated into operational management measures. This data could be developed into indicators to track ecosystem integrity. |
| | | • A person may not discard any marine resources harvested or taken as bycatch during harvesting for commercial purposes (MRA regulations). |
| | | • Fee payable is in respect of bycatches of commercially exploited but not for all bycatches (MRA regulations). |
| | | • Measures to reduce Incidental Bycatch of Seabirds bycatch implemented (Paterson et al. 2017) |
| | | • Minimum mesh sizes are specified in the regulations (MRA regulations). |
| 3. Impact minimization | - To minimize the impact of fishing operations on the structure, productivity, function, and biological diversity of the ecosystem. | • The management objectives of the Namibia fisheries management body aim to rebuild the previously depleted stock |
| | | • The timeframe for rebuilding is not well-defined |
| | | • The fishing moratoriums for sardine and Orange Roughy fisheries are in place to allow for the rebuilding and recovering of their stocks. |
| 4. The rebuilding of Resources and Impact Reversibility | - To plan for and implement within the mandatory time frames a rebuilding strategy for exploited stock(s) which are below the agreed reference points. - To restore populations of harvested species at levels that can produce the maximum sustainable yield | • Namibia is a signatory to the Convention for Biological Diversity(CBD) |
| | | • Importation or introduction of alien species is regulated by Aquaculture Act 18 of 2002. |
| | | • Article 95 (l) of the Namibian Constitution. N policy guidelines have been drafted on the maintenance of important ecological processes. |
| | | • There are no specified measures for protecting Ecologically and Biologically significant areas (e.g., EBSA). BCC working exists for regional identification and consideration of EBSA issues. |
| | | • Research is needed on other species which are not commercially exploited. Currently, research is mostly directed toward commercially important species. |
| | | • Relatively good long-term bio-ecological and environmental data available, but they not well integrated into operational management measures. This data could be developed into indicators to track ecosystem integrity. |
| | | • A person may not discard any marine resources harvested or taken as bycatch during harvesting for commercial purposes (MRA regulations). |
| | | • Fee payable is in respect of bycatches of commercially exploited but not for all bycatches (MRA regulations). |
| | | • Measures to reduce Incidental Bycatch of Seabirds bycatch implemented (Paterson et al. 2017) |
| | | • Minimum mesh sizes are specified in the regulations (MRA regulations). |
| 5. Ecosystem Integrity | - To maintain the biodiversity of biological community, habitat, species and genetic levels and ecological processes that support biodiversity and resource productivity. | • The management objectives of the Namibia fisheries management body aim to rebuild the previously depleted stock |
| | | • The timeframe for rebuilding is not well-defined |
| | | • The fishing moratoriums for sardine and Orange Roughy fisheries are in place to allow for the rebuilding and recovering of their stocks. |
| 6. Species Interdependence | - To minimize bycatch and discards. | • Namibia is a signatory to the Convention for Biological Diversity(CBD) |
| | | • Importation or introduction of alien species is regulated by Aquaculture Act 18 of 2002. |
| | | • Article 95 (l) of the Namibian Constitution. N policy guidelines have been drafted on the maintenance of important ecological processes. |
| | | • There are no specified measures for protecting Ecologically and Biologically significant areas (e.g., EBSA). BCC working exists for regional identification and consideration of EBSA issues. |
| | | • Research is needed on other species which are not commercially exploited. Currently, research is mostly directed toward commercially important species. |
| | | • Relatively good long-term bio-ecological and environmental data available, but they not well integrated into operational management measures. This data could be developed into indicators to track ecosystem integrity. |
| | | • A person may not discard any marine resources harvested or taken as bycatch during harvesting for commercial purposes (MRA regulations). |
| | | • Fee payable is in respect of bycatches of commercially exploited but not for all bycatches (MRA regulations). |
| | | • Measures to reduce Incidental Bycatch of Seabirds bycatch implemented (Paterson et al. 2017) |
| | | • Minimum mesh sizes are specified in the regulations (MRA regulations). |

(Continued)
### Table 1 (Continued).

| EAF Principles                        | Principle Objectives                                                                 | Coverage by the Namibian fisheries Management processes and instruments                                                                 |
|---------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 7. Institutional Integration          | To ensure that fisheries management takes account of interactions with other types of uses of the ecosystem. | - Marine spatial planning initiative has produced recommendations (Finke et al. 2020a) but not yet implemented.                       |
|                                       |                                                                                      | - Inputs from the fishery management body are sought before decisions affecting the marine ecosystem are taken (e.g., mining license, coastal development). |
|                                       |                                                                                      | - Fisheries Observed Agency does observation of harvesting, handling, and processing of marine resources                              |
|                                       |                                                                                      | - The efforts are made to deter Illegal Unreported and Unregulated Fishing (IUUF) through Monitoring, Control, and Surveillance (MCS). |
|                                       |                                                                                      | - MOU with Angola, but regional MCS plans are not fully implemented.                                                                    |
|                                       |                                                                                      | - Important fish stocks are jointly monitored, assessed, and managed through the implementation of adaptive fisheries management plans for priority shared fish resources. based on the ecosystem approach to fisheries (EAF) principle(Kainge et al. 2020) |
|                                       |                                                                                      | - Namibia is a signatory to BCC that considers transboundary issues (Kainge et al. 2020) but not regional fisheries management (e.g., TAC for shared stock) |
|                                       |                                                                                      | - No targeted ecosystem research survey is in place.                                                                                   |
|                                       |                                                                                      | - Fisheries management is still single species oriented instead of the multispecies management approach.                                 |
|                                       |                                                                                      | - The inter-ministerial committees exist but lack legal standing.                                                                     |
| 8. Uncertainty, Risk, and Precaution   | To improve research to understand ecosystems better, take measures that account for complexity and dynamics, are robust to uncertainty, and give attention to transboundary impacts. | - Bycatch fees implemented                                                                                                             |
|                                       |                                                                                      | - Regulations from the Prevention and Combating of Pollution of the Sea by Oil Act 6 of 1981 are in place.                                 |
|                                       |                                                                                      | - The National Marine Pollution Contingency                                                                                              |
|                                       |                                                                                      | - Plan based on the potential polluter pays principle in place.                                                                        |
|                                       |                                                                                      | - Fee payable for vessel license, for recreational fishing permit and quota                                                            |
|                                       |                                                                                      | - The Income Tax Act (24 of 1981) in place.                                                                                              |
|                                       |                                                                                      | - The precautionary principle and precautionary approach guidelines are not drafted.                                                   |
| 9. Compatibility of Management Measures| To promote collaboration between subnational or national authorities (as relevant) to ensure that measures taken under different jurisdictions converge toward common objectives. |                                                                                                                                      |
| 10. The Polluter Pays Principle (PPP)  | To ensure the polluter should bear the cost of the measures needed to ensure that the ecosystem is and remains in an acceptable state. |                                                                                                                                      |
| 11. The User Pays Principle (UPP)      | Users should pay for the exclusive privilege granted to them to use a public resource. The principle can be implemented through payments for licenses or quotas or through taxes. |                                                                                                                                      |
| 12. The Precautionary Principle and Precautionary Approach | The precautionary approach should be widely applied, and that where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation. |                                                                                                                                      |
| 13. Subsidiarity, Decentralization and Participation | To increase the direct involvement of stakeholders in decision-making. |                                                                                                                                      |
| 14. Human wellbeing and Equity         | To establish and preserve intergenerational, intragenerational, cross-sectoral, cross-boundary and cross-cultural equity.               | - Various working groups with stakeholders exist for fisheries management purposes.                                                    |
|                                       | - To contribute to the need for fishers, indigenous communities, and those dependent on the fishery.                                 | - A Marine Resources Advisory Council, with representations of various stakeholders, advises the minister on fisheries management decision is in place. |
|                                       |                                                                                      | - There are no working groups with external stakeholders for the rights and quota allocation process.                                  |
|                                       |                                                                                      | - Rights and quota allocation criteria consider equity, but there are no ascertainable objective procedures to ensure transparency.         |
|                                       |                                                                                      | - Namibia is a signatory to BCC, but no regional TAC for the shared stocks is implemented.                                                |
|                                       |                                                                                      | - No well-developed artisanal fishing to make marine resources accessible and affordable at a household level (Sowman and Cardoso 2010a). |
|                                       |                                                                                      | - Namibianisation policy is in place.                                                                                                 |
catching commercial valuable bycatches species. The bycatch reduction measures also include those aimed at reducing incidental bycatch of seabirds, making Namibia one of the few countries to have implemented these regulations (Paterson et al. 2019). A 98.4% reduction in seabird bycatch mortality was reported in the Namibian hake demersal trawl and longline fisheries (Da Rocha et al. 2021). Additionally, no one can discard any marine resources harvested or taken as bycatch during harvesting for commercial purposes in Namibia (MRA regulations). The discard ban is in line with the EAF principles, a standard currently being introduced in other regions like the EU (Morfin et al. 2017). A discard ban is also known to increase the economic incentive for switching to better gear (Batsleer et al. 2016).

The conformity to the EAF principles that deal with ecosystem integrity (Table 1, Principle 5) is aided by legal instruments, like the constitutional provision and MRA, which include the consideration of the protection of biodiversity, habitat, species, genetic variation, and ecological processes that support both biodiversity and resource productivity. The conformity is also being aided by other measures from the Aquaculture Act (18 of 2002), which regulate the importation or introduction of alien species in Namibia. The Environmental Management Act (EMA) (No. 7 of 2007) is another supporting instrument that aims to promote the sustainable management of the environment and natural resources by establishing principles for decision-making on matters affecting the environment. All developments, including fisheries sector activities, are expected to undergo Environmental Impact Assessment (EIA) as designated by the EMA Act (and its EIA regulations), which allows for the identification of positive and adverse impacts of proposed development prior to a decision of implementation (Glasson, Therivel, and Andrew 2013). Namibia is a signatory to the Convention for Biological Diversity (CBD) that aims to manage the entire ecosystem, reflecting her commitment to ecosystem integrity principles.

For the fisheries management process to conform to the EAF principle of institutional integration (Table 1, Principle 7), it needs to account for interactions with other types of uses and users of the ecosystem (Garcia et al. 2003). Efforts toward this are reflected in projects like the Marine Spatial Planning (MSP) initiative that has made important recommendations, which, if implemented, will ensure the consideration of various users of the ocean spaces in decision-making processes (Finke et al. 2020a). There are also inter-ministerial committees that consist of representatives from different sectors like mining, environments, fisheries and have responsibilities to advise on decisions that have cross-sectoral issues. The marine phosphate mining consideration, which included critical inputs from various ocean space users, including mining, environment, and fisheries sectors, is a prime example (Finke et al. 2020b). The fact phosphate mining is still on hold (as of March 2021) because of questions from the fisheries sector on its possible impact on fishing grounds and spawning areas of commercially harvested species demonstrates the influence of various sectoral inputs on decisions with cross-sectoral impact. The institutional integration is also demonstrated by the involvement of other institutions like the fisheries observer agency, which has the role of observing the harvesting, handling, and processing of marine resources and related operations and recording data concerning such operations. All fishing vessels in Namibian waters are by law required to have an observer onboard (MRA regulations). Information provided by the fisheries observer agency has led to the successful apprehension, prosecution, and fining of Illegal, Unreported, and Unregulated (IUU) vessels and associated criminals in Namibia (Sjöstedt and Sundström 2015).

In terms of risk consideration (Table 1, Principle 8), scientific recommendations for TACs of commercially important species include some risk consideration through testing various projections with varying assumptions (i.e., natural mortality, recruitment variability) in the stock assessment models (Kirchner, Kainge, and Kathena 2012). As a signatory to the BCC, major commercial species’ transboundary risks are also considered through regional harmonizing of research and management planning (Hamukuaya, Attwood, and Willems 2016).

In terms of the Polluter Pay and User Pay Principle (Table 1, Principle 10 and 11), they are well pronounced in fisheries management processes and instruments. These include the bycatch fees that the fishers incur by catching non-target species, which has been demonstrated to be effective in reducing bycatches in other regions (Pascoe et al. 2010). Namibia has also implemented a National Marine Pollution Contingency Plan based on the potential polluter pays principle (National Planning Commission 2017). Other regulatory frameworks include the Prevention and Combating of Pollution of the Sea by Oil Act (6 of 1981), which imputes liability for loss, damage, or costs caused by the discharge of oil on owners of any ship or tanker or offshore installation. Some fees like vessel license fees, recreational fishing permits and quota fees are also payable (as per MRA) and ensure that those utilizing the resources pay for the exclusive privilege granted to them. The Income Tax Act (24 of 1981) also ensures that companies that are involved in fishing operations pay the tax that contributes to the state revenue.

There are working groups with representatives of stakeholders from the fishery industry and government officials in terms of stakeholder’s involvement.
in decision-making (Table 1, Principle 13). At some of the working groups, the fisheries scientists and economists present data/information used as a basis for fisheries management decisions. The final advice to the minister on fisheries management decisions is also done by the Marine Resources Advisory Council (MRAC), which is a statutory body (Section 24 of MRA). Stakeholders represented in MRAC include workers’ union representatives, the fishing industry, scientists, lawyers, and economists. The above demonstrates some level of conformity with the subsidiarity, decentralization, and participation principles of EAF.

The misses of Namibian fisheries management processes and instruments concerning EAF

Although some conformities to EAF principles by Namibian fisheries management processes and instruments have been observed (Section 5.1 above), some areas are still not covered or lacking the expected level of conformity. These include aspects related to the setting of the indicators of EAF, the necessity of dedicated ecosystem research surveys to address ecosystem issues, institutional integration, the guidelines for the precautionary approach principle, ecosystem integrity, and the transparency of quota allocation processes (Table 1). Although Namibia is a signatory to the Benguela Current Convention (BCC), the strategies for managing transboundary issues and shared fish stocks are not well defined in terms of joint management plans and enforcement within the BCC framework. Namibia also has gazetted MOU (Proclamation No. 22) with Angola aimed at combining efforts (financial and human capital) in the management of shared stocks, which is still not fully implemented.

In terms of ecosystem wellbeing (Table 1, Principle 1), the indicators to track ecosystem health/wellbeing are lacking or not well articulated in Namibia fisheries management processes and instruments. Although there is a relatively long term (>20 years) comprehensive environmental (and fisheries) monitoring data (trends fish biomass, trophic data, environmental parameters like temperature, oxygen, plankton) which could be useful in the application of EAF, it is not fully utilized, and very few of these data are considered for EAF-targeted management processes like understanding the feedbacks between fisheries and ecosystem productivity. The available data can be used to derive EAF indicators on the state of the ecosystem, the extent and intensity of effort or mortality, and the progress of management concerning EAF objectives (Jennings 2005). Although the EMA Act (and its regulations) have been implemented, fishing as an activity (including trawling and other fishing methods) is not included in the discretionary list of activities that require an environmental clearance certificate. This comprises the ability to develop other environmental-related indicators toward monitoring and reducing the fishing impact on the ecosystem. Most of the indicators and management reference points developed are single-species oriented or only cover the commercially valuable species (e.g., Kirchner, Kainge, and Kathena 2012). For example, while the bycatch fee is payable for commercial value species, no fees are payable for noncommercial species caught as bycatches.

The conformity to EAF principles on resource scarcity and maximum biological productivity (Table 1, Principle 2) also appears compromised because there are no specified measures for the protection of the marine ecosystem with the same legal standing as those for the protection of commercially exploited species. This can be attributed to the fact that the research surveys are mostly conducted to assess commercially important species, hence the absence of data-driven ecosystem management measures. Therefore, research is needed to collect ecosystem data and that of non-target species to ascertain their sustainability and cover issues like food-web interaction, which are essential for a successful EAF implementation. The ecosystem-focused research can assist with deriving measures for protecting the non-target species and maintaining ecosystem integrity, including drafting applicable guidelines for multispecies and precautionary approach fisheries management. Although Article 95 (l) of the Namibian Constitution stresses the importance of maintaining critical ecological processes, and there are efforts to identify biologically significant areas (e.g., EBSA) through BCC working groups, no clear policy guidelines have been drafted or implemented.

In terms of institutional integration (Table 1, Principle 7), the implementation of the marine spatial planning initiative (Finke et al. 2020a) is imperative. This will help make sure that fisheries management decisions account for interactions with other types of uses of the ecosystem. Institutional integration needs to be implemented at both the national and regional levels. The fact that Namibia is a signatory to BCC will help consider transboundary issues, which can include regional TAC for shared stocks and regional MCS implementation. This will ensure that fisheries management measures are dynamic, adaptive, and robust to uncertainty and can account for the dynamics of transboundary impacts. Climate change is one of the factors that create uncertainty in fisheries management approaches. A vulnerability assessment conducted for Namibian fisheries indicated that existing institutional arrangements to address climate change vulnerability and adaptation are not adequate; and will not effectively adjust to potential damage or respond to climate change consequences (Iitembu et al. 2019).

A concerted effort is also needed concerning collaboration between sub-national or national bodies like
the fisheries-environment-mining committee that considered phosphate mining (Finke et al. 2020a). The existing inter-ministerial committees that give inputs on fisheries’ issues are good initiatives; however, some of these bodies lack authority as they are not established by any legal instrument like an Act of parliament. Improvement of these bodies’ legal standing can contribute to improving the quality and authority of their advisory inputs into decision-making processes.

Based on the human wellbeing and equity principle (Table 1, Principle 14), this study found the Namibian fisheries management processes and instruments lack transparency and equity concerning rights and quota allocation. Transparency and equity can be promoted, for example, if external stakeholders participate in the rights and quota allocation process. Although the MRA regulations specify a set of criteria for right and quota allocation, they are not objectively verifiable. In the early 1990s, the first post-independence government instituted a presidential inquiry into the allocation of fishing quotas and a more transparent quota, and right allocation through a judicial process was recommended but was never implemented (Manning, 1998). Transparency is an essential pillar of sustainable development and good governance (Clark, Ardron, and Pendleton 2015). Enhanced transparency would also help the country to implement objectively ascertainable rights and quota allocation procedures, which consider intergenerational, intragenerational, cross-sectoral, cross-boundary, and cross-cultural equity (Table 1, Principle 14). In terms of contribution to human wellbeing, this can be ascertained by assessing how fishery affects indigenous communities, communities that are dependent on or affected by the fishery, and how fishery contributes to the demands of consumers and the need for fishers (Fletcher et al. 2005). Although Namibianisation policy is in place, less is understood of how it contributes to the wellbeing of the indigenous community and the local fishers to derive the highest possible benefit from the fishery. Concerning recreational fisheries, human wellbeing is also not adequately covered as, for example, the artisanal fishery is not well-developed to make marine resources accessible and affordable at a household level (Sowman and Cardoso 2010).

Conclusion

The Namibian fisheries management systems, to a large extent, conform to the EAF principles (Table 1), especially in areas related to ecosystem wellbeing, the basis of setting the single species TAC, rebuilding of depleted stocks, and minimization of bycatch. Policy frameworks to ensure that the polluter and user pays are also implemented. Areas that this study found to not be adequately covered include setting the indicators of EAF, the necessity of dedicated ecosystem research surveys to address ecosystem issues, institutional integration, the guidelines for the precautionary approach principle, ecosystem integrity, and the transparency of quota allocation processes. The processes for managing transboundary issues and shared fish species are not well defined and may compromise some EAF principles. However, further ongoing analysis, evaluations, and reflections are still needed to track the effectiveness and practical implementation of EAF based on the policy instruments discussed in this study.

Acknowledgments

The authors wish to thank the University of Namibia and the Ministry of Fisheries and Marine Resources for their in-kind contributions to his project. The manuscript has also benefited from the insightful comments and suggestions from two anonymous reviewers.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Johannes A. Ittembu http://orcid.org/0000-0003-4349-3135

References

“Aquaculture Act (18 of 2002).” (last accessed 9 April 2021). Available at https://laws.parliament.na/cms_documents/aquaculture-eb08198d95.pdf

Batsleer, J., A. D. Rijnsdorp, K. G. Hamon, H. M. J. Van Overzees, and J. J. Poos. 2016. “Mixed Fisheries Management: Is the Ban on Discarding Likely to Promote More Selective and Fuel-efficient Fishing in the Dutch Flatfish Fishery?” Fisheries Research 174: 118–128.

Benguela Current Convention (2013). (last accessed 9 April 2021). Available at http://www.internationalwatersgovernance.com/uploads/1/3/5/2/13524076/benguela_convention_english.pdf

Brüchert, V., B. Currie, and K. R. Peard. 2009. “Hydrogen Sulphide and Methane Emissions on the Central Namibian Shelf.” Progress in Oceanography 83 (1–4): 169–179. doi:10.1016/j.pocean.2009.07.017.

Campillo-Campbell, C., and A. Gordoa. 2004. “Physical and Biological Variability in the Namibian Upwelling System: October 1997 – October 2001.” Deep-Sea Research 51 (1–3): 147–158. doi:10.1016/s0272-7714(03)00601.

Clark, N. A., J. A. Ardron, and L. H. Pendleton. 2015. “Evaluating the Basic Elements of Transparency of Regional Fisheries Management Organizations.” Marine Policy 57: 158–166. doi:10.1016/j.marpol.2015.03.003.

Cochrane, K. L., C. J. Augustyn, T. Fairweather, D. Japp, K. Kilongo, J. Ittembu, N. Moroff, et al. 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. doi:10.1080/08920750902851187.
Cowan, J. H., J. C. Rice, C. J. Walters, R. Hilborn, T. E. Essington, J. W. Day, and K. M. Boswell. 2012. “Challenges for Implementing an Ecosystem Approach to Fisheries Management.” Marine and Coastal Fisheries 4 (1): 496–510. doi:10.1080/19425120.2012.690825.

Da Rocha, N., S. Oppell, S. Prince, S. Matjila, T. M. Shaanika, C. Naomab, O. Yates, et al. 2021. “Reduction in Seabird Mortality in Namibian Fisheries following the Introduction of Bycatch Regulation.” Biological Conservation 253: 108915. doi:10.1016/j.biocon.2020.108915.

Duncombe Rae, C. M. 2005. “A Demonstration of the Hydrographic Partition of the Benguela Upwelling Ecosystem at 26°40’S.” African Journal of Marine Science 27 (3): 617–628. doi:10.2989/18142320509504122.

Environmental Management Act (EMA). (No. 7 of 2007), (last accessed 9 April 2021). Available at https://laws.parliament.na/cms_documents/environmental-management-act-9ba722d979.pdf

FAO. 1995. “Code of Conduct for Responsible Fisheries.” Rome, FAO, p 41.

FAO. 2001. “Report of the Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem. Reykjavik, Iceland.” Fish. Rep. 658: 135.

FAO. 2003. “Fisheries Management 2. The Ecosystem Approach to Fisheries.” FAO Technical Guidelines for Responsible Fisheries 4 (Suppl. 2): 112.

FAO. 2016. “A How-to Guide on Legislating for an Ecosystem Approach to Fisheries.” FAO EAF-Nansen Project Report No 27. Rome, Italy.

Finke, G., K. Gee, A. Kreiner, M. Amunyela, and R. Braby. 2020b. “Namibia’s Way to Marine Spatial Planning – Using Existing Practices or Instigating Its Own Approach?” Marine Policy 121: 104107. doi:10.1016/j.marpol.2020.104107.

Finke, G., K. Gee, T. Gxaba, R. Sorgenfrei, V. Russo, D. Pinto, S. E. Nsiangango, et al. 2020a. “Marine Spatial Planning in the Benguela Current Large Marine Ecosystem.” Environmental Development 36: 100569. doi:10.1016/j.envdev.2020.100569.

Fletcher, W. J. 2005. “The Application of Qualitative Risk Assessment Methodology to Prioritize Issues for Fisheries Management.” ICES Journal of Marine Science 62 (8): 1576–1587. doi:10.1016/j.icesjms.2005.06.005.

Fletcher, W. J., J. Chesson, K. J. Sainsbury, T. J. Hundloe, and M. Fisher. 2005. “A Flexible and Practical Framework for Reporting on Ecologically Sustainable Development for Wild Capture Fisheries.” Fisheries Research 71 (2): 175–183. doi:10.1016/j.fishres.2004.08.030.

Flynn, B. A., A. J. Richardson, A. S. Brierley, D. C. Boyer, B. E. Axelsen, L. Scott, N. E. Moroff, P. I. Kainge, B. M. Tjizoo, and M. J. Gibbons. 2012. “Temporal and Spatial Patterns in the Abundance of Jellyfish in the Northern Benguela Upwelling Ecosystem and Their Link to Thwarted Pelagic Fishery Recovery.” African Journal of Marine Science 34 (1): 131–146. doi:10.2989/1814232X.2012.675122.

Gammelsrod, T., C. H. Bartholomae, D. C. Boyer, L. L. Filipe, and M. J. O’toole. 1998. “Intrusion of Warm Surface Water along the Angolan-Namibian Coast in February–March 1995. The 1993 Benguela Nino.” South African Journal of Marine Science 19 (1): 41–56. doi:10.2989/0257098784126719.

Garcia, S., A. Zerbi, C. Aliauame, T. Do Chi, and G. Lasserre (2003) “The Ecosystem Approach to Fisheries. Issues, Terminology, Principles, Institutional Foundations, Implementation, and Outlook.” FAO Fisheries Technical Paper, No. 443, 71 p.

Garcia, S. M., and K. L. Cochrane. 2005. “Ecosystem Approach to Fisheries: A Review of Implementation Guidelines.” ICES Journal of Marine Science 62 (3): 311–318. doi:10.1016/j.icesjm.2004.12.003.

Glasson, J., R. Therivel, and C. Andrew. 2013. Introduction to Environmental Impact Assessment. 2nd ed. London: Taylor and Francis Group.

Gordoa, A., M. Masó, and L. Yoges. 2000. “Monthly Variability in the Catchability of Namibian Hake and Its Relationship with Environmental Seasonality.” Fisheries Research 48 (2): 185–195. doi:10.1016/S0165-7836(00)00160-0.

Government Notice 316 of 2012. (last accessed 9 April 2021). Available at http://www.lac.org.na/laws/annoREG/Marine%20Resources%20Act%202012%20of%202000%20-%20Regulations%202012-316.pdf

Hamukuya, H., C. Attwood, and N. Willemse. 2016. “Transition to Ecosystem-based Governance of the Benguela Current Large Marine Ecosystem.” Environmental Development 17: 310–321. doi:10.1016/j.envdev.2015.06.013.

Heymans, J., and D. Baird. 2000. “A Carbon Flow Model and Network Analysis of the Northern Benguela Upwelling System, Namibia.” Ecological Modelling 126 (1): 9–32. doi:10.1016/S0304-3800(99)00192-1.

Hutchings, L., C. D. Van Der Lingen, L. J. Shannon, R. J. M. Crawford, H. M. S. Verheye, C. H. Bartholomae, A. K. Van Der Plas, et al. 2009. “The Benguela Current: An Ecosystem of Four Components.” Progress in Oceanography 83 (1–4): 15–32. doi:10.1016/j.pocean.2009.07.046.

Iitembu, J., A. K. Ortega-Cisneros, K. L. Cochrane, and W. H. H. Sauer. (2019). Enhancing climate change resilience in the Benguela Current Fisheries Systems – Small Pelagic Fisheries and Rock Lobster Fisheries. Namibian National Report submitted the Benguela Current Commission(BCC), Swakopmund, Namibia.

“Income Tax Act (24 of 1981),” (accessed 9 April 2021). Available at https://laws.parliament.na/cms_documents/income-tax-odee34e9ed.pdf

Iyambo, A. 2001. “A Decade of Namibian Fisheries Science: An Introduction by the Honourable Minister of Fisheries and Marine Resources of Namibia.” South African Journal of Marine Science 23: 1–4.

Jennings, S. 2005. “Indicators to Support an Ecosystem Approach to Fisheries.” Fish and Fisheries 6 (3): 212–232. doi:10.1111/j.1467-2979.2005.00189.x.

Jones, H., J. Gascoigne, R. Cook, D. Japp, and K. Collinson (2020) Marine Stewardship Council (MSC) Public Certification Report Namibia Hake Trawl and Longline Fishery. Hampshire.

Kainge, P., S. P. Kirkman, V. Estevão, C. D. Van Der Lingen, U. Janivi, J. N. Kathena, A. Van Der Plas, et al. 2020. “Fisheries Yields, Climate Change, and Ecosystem-based Management of the Benguela Current Large Marine Ecosystem.” In Environmental Development doi:10.1016/j.envdev.2020.100567.

Kathena, J. N., D. Yemane, N. Bahamon, and T. Jansen. 2018. “Population Abundance And Seasonal Migration Patterns Indicated By Commercial Catch-per-unit-effort Of Hakes (Merluccius capensis and M. paradoxus) in the northern Benguela Current Large Marine Ecosystem.” African Journal of Marine Science 40 (2): 197–209. doi:10.2989/1814232X.2018.1476264.

Kirchner, C. P. Kainge, and J. Kathena. 2012. “Evaluation of the Status of the Namibian Hake Resource (Merluccius Spp.) Using Statistical Catch-at- Age Analysis.” Environment for Development 52. www.jstor.org/stable/resrep14967.
Langton, R., D. A. Stirling, P. Boulcott, and P. J. Wright. 2020. “Are MPAs Effective in Removing Fishing Pressure from Benthic Species and Habitats?” Biological Conservation 247: 108511. doi:10.1016/j.biocon.2020.108511.

“Marine Resources Act (Act No. 27 of 2000),” (last accessed 9 April 2021). Available https://laws.parliament.na/cms_documents/marine-resources-e0d61e1d5a.pdf

“The Memorandum of Understanding between the Government of Namibia and Angola (Proclamation No. 22),” (accessed 9 April 2021). Available at http://www.lac.org.na/laws/2015/5785.pdf

Manning, P.R. 1998. Managing Namibia’s Marine Fisheries: Optimal Resource Use and National Development Objectives. London: London School of Economics and Political Science.

MET. 2014. “National Biodiversity Strategies and Action Plans (2001-2010, 2013-2022),” (last accessed 9 April 2021). Available at https://www.met.gov.na/files/files/Namibia%e2%80%99s%20Second%20National%20Biodiversity%20Strategy%20and%20Action%20Plan%20(NBSAP%2020%)%202013-%202022.pdf

MFMR(2017) “The Strategic Plan of the Ministry of Fisheries and Marine Resources - 2017-18/2021-22.” Windhoek, Namibia.

Morfin, M., S. Méhault, H. P. Benoît, and D. Kopp. 2017. “Narrowing down the Number of Species Requiring Detailed Study as Candidates for the EU Common Fisheries Policy Discard Ban.” Marine Policy 77: 23–29. doi:10.1016/j.marpol.2016.12.003.

Morishita, J. 2008. “What is the Ecosystem Approach for Fisheries Management?” Marine Policy 32 (1): 19–26. doi:10.1016/j.marpol.2007.04.004.

National Planning Commission. 2017. “National Marine Pollution Contingency Plan.” (Accessed 9th April 2021). Available at https://www.giwacaf.net/site/assets/files/1612/plan_na_en.pdf

Nelson, G., and L. Hutchings. 1983. “The Benguela Upwelling Area.” Progress in Oceanography 12 (3): 333–356. doi:10.1016/0079-6611(83)90013-7.

Oelofsen, B.W. 1999. “Fisheries Management: The Namibian Approach.” ICES Journal of Marine Science 56 (6): 999–1004. doi:10.1006/jmsc.1999.0537.

Pascoe, S., J. Innes, D. Holland, M. Fina, O. Thébaud, R. Townsend, J. Sanchirico et al. 2010. “Use of Incentive-based Management Systems to Limit Bycatch and Discarding.” International Review of Environmental and Resource Economics 4 (2): 123–161. doi:10.1561/101.00000032.

Paterson, B., and S. L. Petersen. 2010. “EAF Implementation in Southern Africa: Lessons Learnt.” Marine Policy 34 (2): 276–292. doi:10.1016/j.marpol.2009.07.004.

Paterson, J. R. B., O. Yates, H. Holtzhausen, T. Reid, K. Shimooshili, S. Yates, B. J. Sullivan, and R. M. Wanless. 2019. “Seabird Mortality in the Namibian Demersal Longline Fishery and Recommendations for Best Practice Mitigation Measures.” Orxy 53 (2): 300–309. doi:10.1017/S0030060517000230.

Petersen, S., B. Paterson, J. Basson, N. Moroff, J.-P. Roux, A. Johann, and G. D’Almeida. 2010. Tracking the Implementation of an Ecosystem Approach to Fisheries in Southern Africa. WWF South Africa Report Series – 2010/ Marine/001.

Petza, D., C. Chalkias, N. Koukourouvi, M. Coll, V. Vassilopoulou, P. K. Karachle, V. Markantonatou, A. C. Tsiklis, and S. Katsanevakis. 2019. “An Operational Framework to Assess the Value of Fisheries Restricted Areas for Marine Conservation.” Marine Policy 102: 28–39. doi:10.1016/j.marpol.2019.01.005.

“Prevention and Combating of Pollution of the Sea by Oil Act (6 of 1981),” (accessed 9 April 2021). Available at https://laws.parliament.na/cms_documents/prevention-and-combating-of-pollution-of-the-sea-by-oil-b3a9e62dc3.pdf

Roux, J., C. D. Lingen, M. J. Van Der, Gibbons, N. E. Moroff, L. J. Shannon, A. D. M. Smith, and P. M. Cury. 2013. “Jellyification of Marine Ecosystems as a Likely Consequence of Overfishing Small Pelagic Fishes: Lessons from the Benguela.” Bulletin of Marine Science 89 (1): 249–284. doi:10.5343/bms.2011.1145.

Roux, J., and L. J. Shannon. 2004. “Ecosystem Approach to Fisheries Management in the Northern Benguela: The Namibian Experience.” African Journal of Marine Science 26 (1): 79–93. doi:10.2989/18142320409504051.

Shannon, L. J., C. L. Moloney, A. Jarre, and J. G. Field. 2003. “Trophic Flows in the Southern Benguela during the 1980s and 1990s.” Journal of Marine Systems 39 (1–2): 83–116. doi:10.1016/S0924-7963(02)00250-6.

Shannon, L. J., and P. M. Cury. 2004. “Indicators Quantifying Small Pelagic Fish Interactions: Application Using a Trophic Model of the Southern Benguela Ecosystem.” Ecological Indicators 3 (4): 305–321. doi:10.1016/j.ecolind.2003.11.008.

Shannon, L. V. 1985. “The Benguela Ecosystem: 1. Evolution of the Benguela, Physical Features and Processes.” Oceanography and Marine Biology: 23: 105–182.

Sjöstedt, M., and A. Sundström. 2015. “Coping with Illegal Fishing: An Institutional Account of Success and Failure in Namibia and South Africa.” Biological Conservation 189: 78–85. doi:10.1016/j.biolcon.2014.09.014.

Sowman, M., and P. Cardoso. 2010. “Small-scale Fisheries and Food Security Strategies in Countries in the Benguela Current Large Marine Ecosystem (BCLME) Region: Angola, Namibia and South Africa.” Marine Policy 34 (6): 1163–1170. doi:10.1016/j.marpol.2010.03.016.

The Constitution of the Republic of Namibia. 1990. (last accessed 9 April 2021). Available at https://laws.parliament.na/cms_documents/namibian-constitution-e774d13246a.pdf

The Convention on Biological Diversity (Biodiversity Convention, 1992). (last accessed 9 April 2021). Available at http://www.pngcepa.com/wp-content/uploads/2018/07/CBD-Convention.pdf

Turrell, W. R. 2004. “The Basis of the “Ecosystem Approach” to Fisheries Management.” Norrkoping, Sweden: EuroGOOS Publication.

Utne-palm, A. C., A. G. V. Salvanes, B. Currie, S. Kaartvedt, G. E. Nilsen, V. A. Braithwaite, J. A. W. Stecyk, et al. 2010. “Trophic Structure and Community Stability in an Overfished Ecosystem.” Science 329 (5989): 333–336. doi:10.1126/science.1190708.

Veitch, J., P. Perven, and F. Shillington. 2009. “The Benguela: A Laboratory for Comparative Modeling Studies.” Progress in Oceanography 83 (1–4): 296–302. doi:10.1016/j.pocean.2009.07.008.

Ward, T., D. Tarte, E. Hegler, and K. Short. 2002. Ecosystem-Based Management of Marine Fisheries Policy Proposals and Operational Guidance of Marine Capture Fisheries,80. WWF- Australia, Sydney.

Weeks, S. J., B. Currie, A. Bakun, and K. R. Peard (2004) “Hydrogen Sulphide Eruptions in the Atlantic Ocean off Southern Africa: Implications of a New View Based on
SeaWiFS Satellite Imagery.” *Deep-Sea Research Part I: Oceanographic Research Papers*, 51, 153–172.

West, S., J. H. F. Jansen, and J. B. Stuut. 2004. “Surface Water Conditions in the Northern Benguela Region (SE Atlantic) during the Last 450 Ky Reconstructed from Assemblages of Planktonic Foraminifera.” *Marine Micropaleontology* 51: 321–344.

Worm, B., R. Hilborn, J. K. Baum, T. A. Branch, J. S. Collie, C. Costello, M. J. Fogarty, et al. 2009. “Rebuilding Global Fisheries.” *Science* 325: 578–585.