SAEON Elwandle Node

Science Plan: 2016 – 2018

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Introduction

The Elwandle Coastal Node will focus its research activities in 2016 – 2018 in four main areas (referred to as Themes), i.e. 1) Algoa Bay Sentinel Site, 2) National Estuaries Network, 3) MPA Network and 4) National Coastal Temperature Network (Figure 1). The projects nested within these networks are discussed in more detail below.
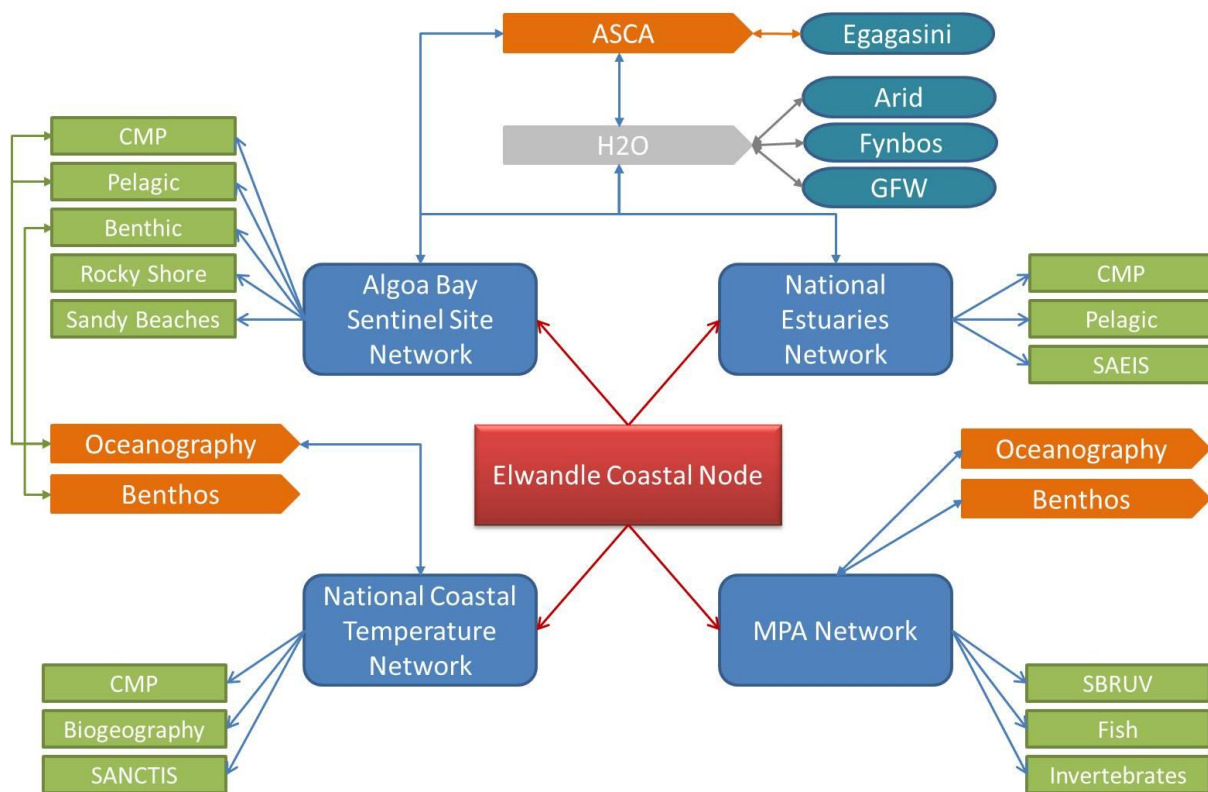

Figure 1. *Organogram of science activities at the Elwandle Coastal Node*

Theme 1: Algoa Bay Sentinel Site Network

The coastal environment is the main point of interaction between humans and oceans. Coastal regions are physically altered as we establish cities, harbours, breakwaters and canals, while natural resources are exploited for recreational, subsistence and commercial purposes. Concerted efforts to effectively manage human impact on coastal ecosystems worldwide are muted by an ever increasing demand for resources and services, and South Africa is no exception. Our 3 000 km coastline is intersected by six major metropolitan areas, each of which hosts at least one commercial port trading goods ranging from minerals and metals to consumables and harvested marine resources. As cities and industries grow, so do the many pressures they impose on the coasts they occupy. Consistently observing variation in key physical and biological attributes of the coastal ocean is one way with which our predictive capability of the long-term implications of human interventions in these environments can be improved. For this very purpose, SAEON Elwandle Coastal Node in conjunction with the Egagasini Offshore Node, set out in 2007 to establish South Africa's first comprehensive long-term coastal observatory in Algoa Bay.

The initial consultative process held with the marine science community of South Africa, suggested sites of intensive observation and research focus (termed sentinel sites) to be established in all three major marine bioregions. The Elwandle Coastal Node instead opted for a phased approach whereby resources and effort could be directed to establishing the first sentinel site (Algoa Bay) within the warm-temperate bioregion, where the node was based. In so doing, the efficacy of the concept could be tried and tested before rolling out in other bioregions.

Algoa Bay has been the focus of research for more than 40 years. As such, SAEON was able to build an observation network upon a strong baseline of existing data. Some of these research activities were maintained in the long-term that enabled SAEON to link into existing programmes, or re-establish those previously terminated. Algoa Bay hosts a range of habitats, including sandy beaches, rocky shores, subtidal reefs and soft bottom habitats, islands and estuaries. These being in close proximity to a vast metropolitan area, several marine outfalls, two commercial ports, a vibrant fisheries industry and upcoming aquaculture activities meant there was excellent research potential to examine anthropogenic impacts on the coastal environment in the long-term. The expansion of the Addo Elephant National Park (AENP) to include a marine protected area was underway at the time, placing our observations in demand with conservation planners and policy makers during the planning phase, while it will certainly remain useful for monitoring purposes once the MPA is proclaimed. From a research point of view, Algoa Bay offered a unique opportunity to examine the impact of coastal and offshore currents and other oceanographic processes on biodiversity, productivity and biogeochemistry in the short, medium

and long-term. The network involves six core long-term research and monitoring programmes, with no less than 39 in situ moorings recording on a permanent basis physical properties of the coastal ocean between Port Alfred and Oyster Bay. The data has already contributed to multiple post-graduate projects, implemented in decision-making processes by local government and other agencies and is becoming increasingly important for validating ocean and atmospheric based models.

Key questions motivating the theme
- What are the main drivers of vertical and horizontal water temperature variation in Algoa Bay and St Francis Bay?
- What are the main drivers of currents (flow and direction) in and out of Algoa Bay?
- How does Agulhas Current intrusions (warm water plumes, frontal eddies), Large Solitary Meanders (Natal Pulses) and associated oceanographic phenomena influence current flow and water temperature regimes in and around Algoa Bay?
- What are the time phases and spatial impact of warm water intrusion at the leading edge of Natal Pulses? Similarly, what are the time phases and spatial impact of cold water intrusions into the nearshore waters of Algoa Bay as Natal Pulses move south and west?
- What are the main drivers of phytoplankton diversity and biomass (chl-*a*) in Algoa Bay?
- What are the main drivers of zooplankton diversity and biomass in Algoa Bay?
- What impact does wind driven upwelling have on the lower-trophic pelagic ecosystem of Algoa Bay?
- What impact does Agulhas Current intrusions and associated oceanographic phenomena have on the lower-trophic pelagic ecosystem of Algoa Bay?
- What are the time phases and spatial impacts on plankton of episodic events such as polluted outfalls, nutrient loading, significant runoff following heavy rainfall, harmful algal blooms, and extreme (range and extent) cold or warming events?

Key beneficiaries of the science
- Researchers and students at universities, institutions, councils and agencies (NMMU, RU, UCT, UFH, UWC, CSIR, SAWS, SANHO, Bayworld)
- Conservation agencies (SANParks, Zwartkops Conservancy)
- Environmental practitioners/managers (e.g. Anchor Consultants CC)
- Municipalities and other local government agencies (Nelson Mandela Bay Metropolitan, Kouga Municipality, Ndlambe Local Municipality)
- Emergency response and rescue agencies (e.g. NSRI)

Relevant legislation that science will help serve
- National Environmental Management Act 107 of 1998
- National Environmental Management: Biodiversity Act 10 of 2004
- National Environmental Management: Integrated Coastal Management Act 24 of 2008
- National Environmental Management: Protected Areas Act 57 of 2003
- National Environmental Management: Waste Act 59 of 2008
- Marine Living Resources Act 18 of 1998
- Environment Conservation Act 73 of 1989
- National Water Act 36 of 1998

Actual/potential science collaborations
- South African Institute for Aquatic Biodiversity (SAIAB): principal partner in Sentinel Site, shared platforms, integrated field operations protocols and logistical support.
- Nelson Mandela Metropolitan University: principal research collaborator in Sentinel Site, platform host (Research Dive Unit, water quality)
- Agencies and councils (CSIR, SANHO, SAWS): data exchange, research collaboration
- Universities and institutes (RU, UCT, UFH, Bayworld): data exchange and research collaboration
- Government departments (DEA, DAFF, DoT): data exchange, integrated platforms, platform hosts

Opportunities for developing research platforms which could attract science collaborators

New deployments of moored CTDs will provide high resolution multi-parameter physical and chemical data at key locations in Algoa Bay. Deep water ADCPs (ca. 100 m) will add an extra dimension to our understanding of current movements south and west of Algoa Bay which can be linked with existing data from shallow moorings as time measurements are synchronised. Deployment of data buoys will provide near real-time data for a suite of variables.

Cross-nodal collaboration

The Algoa Bay Sentinel Site initiative is managed in partnership with Egagasini Node. Specific research orientated collaborations involve physical/biological oceanography (Dr Wayne Goschen), modelling (Dr Juliet Hermes) and benthic ecology (Dr Lara Atkinson, Dr Charles von den Meeden). Cross-nodal collaboration with the terrestrial nodes (Fynbos and GFW) was also initiated in 2014 in the Baviaanskloof catchment to coast project.

Theme 2: National Estuaries Network

South Africa is likely to experience substantial climate change in the next decades leading to a dramatic decline in biodiversity (Van Jaarsveld & Chown 2001). The predicted changes in the rate of sea-level rise, as a result of global warming, will have important impacts on the coastal zone, displacing ecosystems, altering geomorphological configurations and their associated sediment dynamics, and increasing the vulnerability of social infrastructure. Coastal wetlands (collectively comprising salt marshes, mangroves, intertidal and supratidal areas) could experience substantial losses as a result of sea-level rise. These economically valuable ecosystems are highly productive and provide a number of important functions such as flood and storm protection, waste assimilation, nursery areas for fisheries, supply of organic matter to estuarine and marine environments and nature conservation (Nicholls et al. 1999).

If coastal wetlands in general and salt marsh in particular, are to persist in the face of rising water levels, they must be able to accrete sediments at a rate such that surface elevation gain is sufficient to offset sea level rise. In the face of a global rise in sea level, understanding the response of the shoreline, the change in productivity of coastal wetlands and its impacts on faunal populations and other coastal ecosystems, to changes in sea level is a critical scientific goal to inform policy makers and managers. Tide gauge measurements from South Africa indicate that sea levels have risen by approximately 1.2 mm/year over the last three decades, similar to international estimates (Brundrit 1995). The current trend of rising sea level is expected to accelerate in the future, with recent estimates indicating a 12.3 cm rise by 2020, 24.5 cm rise by 2050 and 40.7 cm rise by 2080 (Nicholls et al. 1999; Kirwan & Murray 2007).

Warming of coastal and estuarine waters has resulted in many tropical and warm temperate neritic species extending their distributions towards higher latitudes. In many cases, the colonisation of estuarine habitats by one group of species leads directly to the decline in another group of species from those same habitats, e.g. latitudinal mangrove expansion globally has led to the retreat of salt marshes from those same systems that are experiencing global warming (Saintilan et al., 2014). There is also evidence of shrinking distributions of certain temperate species brought about by climate change on its own and, in some cases, by climate change and the added impact of overfishing (Last et al., 2011).

In addition to sea-level rise and water temperature changes, Clarke et al. (2000) estimated that runoff from rivers on the west and south coasts would decline by 11–84%, while those on the east coast would change by anything from -21% to +10%, making the percentage runoff change in southern Africa amongst the highest in the world (Arnell 1999). Changes in freshwater runoff are of significance for the marine

environment in that any reduction in flow will be translated directly to estuaries with concomitant effects on marine biota that utilise these systems (Clarke 2006). Whilst the biota in estuaries are susceptible to changing marine conditions (Adam, 2002), they are also indirectly impacted by altered riverine run-off, changes in sedimentation rates and composition, elevated nutrient concentrations and exceptional coastal storm events, all of which are showing signs of attaining new extremes in a world undergoing global change (James et al., 2013). Changing catchment run-off and nutrient imports/exports will affect not only estuarine ecosystem functioning but also the ecology of nearshore coastal habitats (Lamberth et al., 2009).

Key questions motivating the theme
- What are the freshwater quantity and quality requirements of selected estuaries?
- How are changes in freshwater quality and quantity influencing selected estuaries?
- What is the influence of sea level rise on salt marshes?
- What are the main oceanic drivers determining estuarine hydrodynamics and biodiversity patterns?
- How will changes in coastal temperatures influence estuarine productivity?
- How will future range expansions of selected biota (invasives, mangroves, etc.) influence estuarine ecosystem functioning?
- How will the increase in frequency and magnitude of extreme events (storm surges, floods, Harmful Algal Blooms, etc.) influence estuaries?

Key beneficiaries of the science
- Researchers and students at universities, institutions, councils and agencies
- Conservation agencies (SANParks, CapeNature, ECPTA, NCDENC, iSimangaliso and EKZNW)
- Municipalities and other local government agencies (Nelson Mandela Bay, Kouga, Ndlambe, City of Cape Town, Ekurhuleni, Namakwa, Bitou, Eden, Mossel Bay)
- Government Departments (DWS, DEA O&C, DAFF)

Relevant legislation that science will help serve
- National Environmental Management: Integrated Coastal Management Act 24 of 2008
- National Water Act 36 of 1998

Actual/potential Science collaborations
- South African Institute for Aquatic Biodiversity (SAIAB): Fish research in estuaries (Prof Alan Whitfield, Dr Nikki James).

- Nelson Mandela Metropolitan University: Larval fish (Prof Nadine Strydom), microalgae and macrophytes (Prof Janine Adams, Dr Pumulele Gama), geomorphology (Prof Maarten de Wit), socio-economics (Prof Hosking).
- University of Cape Town: Birds and socio-economics (Prof Jane Turpie) and seaweed (Prof John Bolton and Dr Rob Anderson)
- Rhodes University: Zooplankton (Prof William Froneman)
- CSIR: Estuarine hydrodynamics (Lara van Niekerk), water quality (Dr Susan Taljaard and Dr Brent Newman)
- Department of Water and Sanitation: Platform provision, data exchange and platform hosts (Resource Quality Services: Gerhard Cilliers and Nolusindiso Jafta)
- Other government departments (DEA, DAFF): data exchange, integrated platforms, platform hosts (Dr Alan Boyd, Dr Ayanda Matoti, Dr Stephen Lamberth)

Opportunities for developing research platforms which could attract science collaborators

Long-term datasets within estuaries are limited. Most freshwater reserve studies (Resource Directed Measures, DWS) in estuaries were and are based on limited data. Long-term datasets collected by SAEON will be invaluable not only for LTER and project specific research, but also to inform and revise RDM studies in estuaries. The *in situ* instruments measuring temperature and salinity will also enable the CSIR to produce better hydrodynamic models of selected estuaries. Numerous estuaries do not have water level gauging stations and adding these to SAEON's network of estuaries will improve our understanding of their functioning, especially in temporarily open/closed estuaries. SAEON currently has Rod Set Elevation Tables in three estuaries to measure sediment accretion and this project could be expanded to other regions as well.

Cross-nodal collaboration

Estuaries form an important environmental and socio-economic link between the catchments and the coasts and the estuarine LTER programme requires specific research orientated collaborations with Egagasini (oceanic drivers), GFW (catchments), Arid (catchments) and Fynbos (catchments) nodes to study these. Existing cross nodal collaborations exist for the Orange River estuary (Elwandle and Arid), Gamtoos and Kromme estuaries (Elwandle, Fynbos, GFW and Egagasini) and for Lake St Lucia (Elwandle and GFW). These collaborations will be expanded to other estuaries in the future.

Theme 3: South African National Coastal Temperature LTER Network (SANCTN)

Seawater temperature relates at regional and global scales to the various measures of biodiversity, and has aided our understanding of the evolution and ecology of biological assemblages. Climate modellers drive numerical simulations of Earth's climate, and check the accuracy of their projections relative to observable evidence using data on the thermal characteristics of seawater. It is therefore of paramount importance that these activities are underpinned by reliable, accurate and precise temperature datasets, whether they are static long-term climatologies, or dynamic time series from which coefficients relating to the rate of change in temperature with time can be extracted.

Existing data show that South Africa's annual mean coastal water temperatures range from 12.0 ± 0.9 °C at its north-western limit near the border with Namibia to 24.0 ± 1.9 °C on the eastern seaboard near the Mozambican border (Smit et al., 2013). Two major ocean currents influence the thermal regime along this approximately 2,700 km of coastline at a regional scale, viz. the Agulhas Current and the Benguela Current. The southward flowing Agulhas Current has an overriding effect on the east coast of South Africa along the coast of KwaZulu-Natal and over the Agulhas Bank extending from the Eastern Cape Province to the eastern portion of the Western Cape Province, a generally warm temperate biogeographical region termed the Agulhas Marine Province (sensu Spalding et al., 2007). The northward flowing Benguela Current, which forms the eastern extent of the South Atlantic Ocean gyre and which is maintained by prevailing south-easterly trade winds, influences the remainder of the Western Cape Province, particularly from the western side of the Cape Peninsula northwards to about 16 °S. The influence of the Benguela Current here defines a cool temperate thermal regime (Smit et al., 2013) that maintains the Benguela Marine Province (sensu Spalding et al., 2007). In reality, the region between Cape Agulhas and the southern tip of the Cape Peninsula is in fact an overlap region where aspects of both currents may be seen from time-to-time (Largier et al., 1992), and it is not surprising that biogeographically this region includes biotic elements from both the Benguela and Agulhas Marine Provinces (Stephenson, 1948; Bolton, 1986; Bolton and Anderson, 1997).

A major value of regionally based classifications of sea surface temperature is that temperature determines the growth and reproductive limits of marine organisms, thereby limiting where an individual species can occur. It is predominantly because of latitudinal gradients in SST along coastlines that biologists have been able to recognise more-or-less distinct biodiversity regions extending across the global oceans. The physiological underpinning (in terms of temperature dependence) of these bioregions means that they can be quantified and understood, and if combined with projections of ocean temperature zones in the future, provide indications of

where bioregions will shift to in response to the ocean's changing thermal environment. A practical implication of the relationship of marine biodiversity to temperature is systematic conservation planning, taking changing climates into account. Irrespective of the objectives of biogeographical studies or studies of climate change and variability, it is of paramount importance that the research is underpinned by reliable, accurate and precise seawater temperature datasets, whether they are static long-term climatologies or dynamic time series from which coefficients relating to the rate of change in temperature over time can be extracted.

Key questions motivating the theme
- What is the nature of the variability in coastal temperature in terms of its oceanographic drivers in space/time?
- How does mesoscale oceanic forcing influence seawater temperature properties/processes <400 m from the coastline?
- How do we relate our understanding of the thermal properties of the nearshore region to biogeographic and ecological outcomes?

Key beneficiaries of the science
- Researchers and students at universities, institutions, councils and agencies (NMMU, RU, UCT, UFH, UWC, UKZN, UZ, WSU, CSIR, SAWS, SANHO, Bayworld, ORI)
- Conservation agencies (SANParks, ECPTA, EKZNW, CapeNature)
- Environmental practitioners/managers (e.g. Anchor Consultants CC)
- Municipalities and other local government agencies (all 52 coastal municipalities)
- National Government Departments (DEA Oceans and Coast – State of the Oceans Reporting; DAFF; DEA – SAWS; DEA - SANBI)

Relevant legislation that the science will help serve
- Same as for the Algoa Bay Sentinel Site

Science collaborations, actual and potential
- University of the Western Cape: Prof AJ Smit
- DEA Oceans and Coasts: Existing UTR network in South Africa and the South-Western Indian Ocean (Prof Mike Roberts, Dr Alan Boyd)
- DAFF: Existing UTR network in the Western Cape (Dr Steve Lamberth)
- South African Weather Services (SAWS): Several real-time coastal temperature sensors linked to hybrid weather stations. Approximately 40 stations where daily thermometer readings of coastal temperature are taken.
- South African Institute for Aquatic Biodiversity (SAIAB): Possible source of temperature data from Acoustic Telemetry Array Platform (ATAP). All ATAP instruments have a UTR attached to them.

- Conservation agencies managing MPA's (SANParks, ECPTA, CapeNature, EKZNW): Agencies issue permits to deploy instruments in conservation areas. SAEON required to produce annual reports, metadata and data from the instruments.
- Research entities (universities, councils, etc.): data exchange, research collaboration
- Government departments (DEA, DAFF): data exchange, integrated platforms, platform hosts

Opportunities for developing research platforms which could attract science collaborators

New deployments of UTRs will provide broader spatial resolution around the coast, especially in data poor areas, e.g. Wild Coast, West Coast and KZN North Coast. A large integrated data set of all coastal temperature data that is easily accessible will vastly increase collaboration on physical drivers and biodiversity studies.

Cross-nodal collaboration

The network of UTRs is located in a very shallow band of the littoral zone. This zone is influenced by oceanic and terrestrial / land-based drivers. Collaboration will be required with Egagasini Node, Grasslands Node (catchments), Arid Node (Orange and Olifants river catchments) and Fynbos Node (Western Cape and Eastern Cape catchments).

Theme 4: Marine Protected Area Unit: Long-term Ecological Research and Monitoring

The ultimate goal of this theme is to provide a significant contribution to the development of effective long-term monitoring (LTM) protocols that enable sustainable management of marine subtidal reef fisheries and conservation of reef biodiversity. The recent and continuing collapse of many reef fisheries have demonstrated that considerable gaps exist in our knowledge on how to optimise sampling design and monitoring protocols, as well as the subsequent interpretation of large datasets. By addressing these knowledge gaps through basic research on sampling methods and experimental design, this theme makes a significant contribution to the development of effective LTM protocols and sustainable resource use.

To ensure that these LTM protocols achieve their management and scientific objectives, many questions first need to be addressed. These include (i) what is the best method to use, (ii) how best to use such a method and, (iii) how to ensure data interpretation is accurate. Over the last seven years, methods research activities led by the MPA Unit of the Elwandle Coastal Node have identified the most suitable methods to monitor reef fish resources on the continental shelf of South Africa.

However, a considerable amount of work is still required to identify the most suitable method to survey subtidal reef invertebrate communities. Along the continuum between fundamental and applied reef ecosystem research, this theme will focus on knowledge gaps on what methods are best to survey subtidal rocky reef ecosystems and how best to use these methods. The research activities will investigate how alternative experimental design choices will influence the reliability of the data products, and identify which experimental design choices are most appropriate for effective applied reef ecosystem research with a particular emphasis on sustainable LTM.

Key questions motivating the theme
- Which method or combination of methods is the most cost-effective to monitor resource trends and biodiversity on subtidal reefs in South Africa?
- Can the signatures of anthropogenic impact, short-term and long-term (e.g. climate change) natural variability be separated through LTER at protected baseline and exploited sites?
- Which approach (in spatial extent and temporal repetition) can realize national monitoring of subtidal reef resources and biodiversity in a sustainable manner while informing management appropriately?

Key beneficiaries of the science
- National and international science community
- Fisheries resource managers
- Biodiversity managers
- Conservation planners
- Status and impact assessors
- Policy makers
- Marine taxonomists
- Education sectors
- Fishing industry
- Tourism industry

Relevant legislation, if any that the science will help serve
- National Environmental Management Act
- Environment Conservation Act
- South African National Biodiversity Assessment
- National Protected Area Expansion Strategy
- Marine Living Resources Act
- National Environmental Management Act
- International Long-Term Ecological Research Network

Science collaborations
Actual collaborators
- Dr Anthony Bernard (South African Institute for Aquatic Biodiversity [SAIAB])
- Dr Lara Atkinson (Egagasini Node)
- Dr Henning Winker (South African National Biodiversity Institute [SANBI])
- Dr Denham Parker (University of Cape Town [UCT]), Prof Colin Attwood (UCT)
- Dr Sven Kerwath (Department of Agriculture, Forestry and Fisheries [DAFF])
- Dr Toufiek Samaai (Department of Environmental Affairs [DEA])
- Prof Euan Harvey (University of Western Australia [UWA])
- Dr Graham Edgar (University of Tasmania [UT])
- Mr Kyle Smith (South African National Parks [SANP]), Dr Ane Oosthuizen (SANP)
- Ms Megan van der Bank (Eastern Cape Parks and Tourism Agency [ECPTA])
- Mr Wayne Meyer (Cape Nature [CN])
- Ms Lauren De Vos (Safe Our Seas Foundation [SOSF])
- Dr Bruce Mann (Oceanographic Research Institute [ORI])
- Prof Marc Gibbons (University of the Western Cape [UWC])

Potential collaborators
- HEIs: Nelson Mandela Metropolitan University / University of Fort Hare / Friedrich-Alexander University / University of KwaZulu-Natal
- Industry: Fishing industry / Marine technology industry

Opportunities for developing research platforms which could attract science collaborators

In the past 4 years SAEON Elwandle and SAIAB have been developing the 'Optical Platform' which is available, in collaboration, to other research entities. Currently, this platform includes stereo- and mono- baited remote underwater video systems (BRUVs) to monitor fishes and jump cameras (JC) to monitor invertebrates. The next steps are to (i) purchase more BRUVs and JC units, (ii) add a horizontal stereo-camera component to the JCs to enable monitoring of erect-growing invertebrates and, (iii) develop units (BRUVs and JC) for deep water applications between 150 and 600m. Twelve of the 14 above listed 'actual collaborators' have used existing units from this Optical Platform in collaboration with SAEON Elwandle. It is expected that this level of interest is going to grow with more collaborators accessing platform units in future due to the increased number and reach of the units.

Opportunities for cross-nodal collaboration

At this stage, SAEON's Egagasini Node is the best target for collaboration. The development of soft-sediment monitoring capabilities within Egagasini is the logical complementary extension of SAEON's marine optical toolbox. However, so far these soft-sediment monitoring tools are targeting the deeper waters and are dependent on larger vessels (i.e. ships). With Elwandle's plans to extend their reef monitoring

capabilities towards deeper reefs and Egagasini's need for shallower soft-sediment monitoring tools, there is an obvious opportunity for inter-nodal collaboration in the form of information exchange and joint development programmes. These opportunities are currently being explored.

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List of acronyms and abbreviations

ADCP	Acoustic Doppler Current Profiler
AENP	Addo Elephant National Park
ATAP	Acoustic Telemetry Array Platform
BRUV	Baited Remote Underwater Video
CN	Cape Nature
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA O&C	Department of Environmental Affairs Oceans and Coasts
DEA	Department of Environmental Affairs
DoT	Department of Transport
DWS	Department of Water and Sanitation
ECPTA	Eastern Cape Parks and Tourism Agency
EKZNW	Ezemvelo KwaZulu Natal Wildlife services
JC	jump cameras
LTER	Long Term Ecological Research Network
LTM	Long-term monitoring
MPA	Marine Protected Area
NCDENC	Northern Cape Department of Nature Conservation

NMMU   Nelson Mandela Metropolitan University
NSRI   National Sea Rescue Institute
RU   Rhodes University
SAIAB   South African Institute for Aquatic Biodiversity
SANCTN   South African National Coastal Temperature Network
SANHO   South African Navy Hydrographic Office
SAWS   South African Weather Service
SOSF   Save Our Seas Foundation
UCT   University of Cape Town
UFH   University of Fort Hare
UKZN   University of KwaZulu-Natal
UT   University of Tasmania
UTR   Underwater Temperature Recorders
UWA   University of Western Australia
UWC   University of the Western Cape [
UZ   University of Zululand
WSU   Walter Sisulu University