SAMSS
PORT ELIZABETH 2017

THE 16TH SOUTHERN AFRICAN
MARINE SCIENCE SYMPOSIUM

PROGRAMME

4 - 7 July 2017 • www.samss2017.co.za

Boardwalk Convention Centre • Port Elizabeth • South Africa

Nelson Mandela Metropolitan University
for tomorrow

SANCOR

CMR Coastal and Marine Research

Theme: Embracing the blue I Unlocking the Ocean's economic potential whilst maintaining social and ecological resilience

SAMSS is hosted by NMMU, CMR and supported by SANCOR

WELCOME

It is our pleasure to welcome all SAMSS 2017 participants on behalf of the Institute for Coastal and Marine Research at Nelson Mandela Metropolitan University and the city of Port Elizabeth. NMMU has a long tradition of marine research and its institutional marine and maritime strategy is coming to fruition, which makes this an ideal time for us to host this triennial meeting. Under the auspices of SANCOR, this is the second time we host SAMSS in PE and the *theme 'Embracing the blue – unlocking the ocean's potential whilst maintaining social and ecological resilience'* is highly topical and appropriate, aligning with *Operation Phakisa,* which is the national approach to developing a blue economy. South Africa is at a cross roads and facing economic challenges. Economic growth and lifting people out of poverty is a priority and those of us in the 'marine' community need to be part of the solution – we can't just hide in our ivory towers! Under this broad theme we will include six separate specialist workshops plus many contributions under three broad subthemes: biodiversity and conservation, global change, and food security.

The conference, like all such gatherings, is primarily an **opportunity** to network, exchange ideas and learn from local and international experts. This will lead to debate and collectively coming up with new ideas. We are heartened to see the high proportion of young scientists attending - more than 200 students - which augurs well for the future. To these emerging scientists we say that a symposium like this serves as a milestone and a recurring benchmark in one's career; a chance to introduce yourself to the marine community and to meet and hear established experts (names that you previously only came across on books or publications). Besides the very important informal networking, the formal vehicles for communication are through posters and presentations – we have 200 posters and 190 presentations, including three top international authorities and local experts giving plenaries on the subthemes.

Any symposium is also a **meeting of colleagues.** Much of our life as scientists and academics is spent interacting with colleagues locally or on opposite ends of the country/world. We go through challenging situations together and become good friends. Here we have the opportunity to renew contacts and celebrate our individual and collective achievements, while contributing to the intellectual advancement of the marine science community and the objectives of the country as a whole. We don't enter science to get rich but because we are passionate about it and want to make a difference. The collegiality we develop along the way is one of the greatest rewards from this approach!

On behalf of the hosts, CMR and NMMU, and the organizing committee, we would like to **thank all** who have contributed to making this a success. In particular we recognize: Tanya Schmidt and her team at Eastern Sun, colleagues who have served and assisted on the LOC, sponsors Aegean, CMR, NMBT, NMMU, Faculty RTI, NRF, SANCOR and scientific committee members who assisted with screening abstracts and compiling the program, and the NMMU management for their support. We are grateful to all those individuals that contributed in any way to make this conference a success. It is a pleasure to host everyone here.

Finally, we wish all participants a stimulating a rewarding meeting that will generate new partnerships, local and international, to address critical issues across disciplines.

Profs Ronel Nel & Anton McLachlan

LOCAL ORGANIZING COMMITTEE

Ronel Nel (Chair) – NMMU
Anton McLachlan – NMMU
Carmen Visser – SANCOR
Nicky James – SAIAB
Shaun Deysel – SAEON
Pieter Swart – NMMU
Linda Harris – NMMU
Malcolm Smale – Bayworld
Patrick Vranken – NMMU

ORGANISERS SPECIAL SESSIONS

Janine Adams – NMMU (Estuaries)
Margaux Noyon – NMMU (Indian Ocean)
Mike Roberts – NMMU & University of Southampton (Indian Ocean)
Pierre Pistorius – NMMU (Top Predators and Spatial Data)
Steve Kirkman – DEA/O&C (Top Predators and Spatial Data)
Steve Holness - NMMU (Department of Zoology)
Judie Mann-Lang – SAAMBR (Science Communication)
Penny Haworth – SAIAB (Smell of Science)
Vanessa Rouhani – SAIAB (Smell of Science)

SCIENTIFIC COMMITTEE

Greg Hofmeyr (Chair) – Bayworld
Judy Mann – SAAMBR
Juliet Hermes – SAEON
Anusha Rajkaran – UWC
Laura Blamey – UCT
Sven Kerwath – DAFF
Tammy Robinson – SUN
Maya Pfaff – DEA/O&C
David Heading – Unisa
Isabelle Ansorge – UCT
Azwianewi Makhado – DEA/O&C
Maelle Conann – NMMU
Kerry Sink – SANBI
Fiona Mackay – ORI
Prideel Majiedt – SANBI
Motebang Nakin – WSU
Lorenz Hauser – U.Washington
Jennifer Olbers – Ezemvelo
Malcolm Smale - Bayworld

PLENARY SPEAKERS

ROBERT COSTANZA - The Australian National University - Australia

COSTANZA has an H-index above 100 and >60 000 citations. His area of specialisation is ecosystem goods and services and ecological economics. Costanza's transdisciplinary research integrates the study of humans and nature to address research, policy, and management issues. His work has focused on the interface between ecological and economic systems, particularly at larger temporal and spatial scales, from small watersheds to the global system. This includes landscape-level spatial simulation modelling; analysis of energy and material flows through economic and ecological systems; valuation of ecosystem services, biodiversity, carrying capacity, and natural capital; and analysis and correction of dysfunctional incentive systems.

OMAR DEFEO - Universidad de la República - Uruguay

DEFEO has an h-index of 47 and >8000 citations. His specialisations are small scale and traditional fisheries and coastal ecology. He has made substantial contributions to sandy beach ecology, understanding human impacts in coastal marine systems, fisheries stock assessment and management, and population dynamics of exploited marine stocks. He is a Titular Professor at the Faculty of Sciences and also a researcher at the National Institute of Fisheries (now National Direction of Aquatic Resources) in Uruguay, where he was responsible for assessment of invertebrate stocks and also served as coordinator of Research Area on Fisheries Development. He has supervised more than 60 postgraduate students. He was awarded a Distinguished Marine Conservation Fellowship and a Pew Fellowship in Marine Conservation from the Pew Environment Group, United States. He has served as leader or coordinator for some 25 research projects as coordinator in Uruguay and Mexico and a key collaborator in international projects carried out in Chile, Ecuador and the USA (Biodiversity Support Program). An international authority in small scale and traditional fisheries and coastal ecology, he is familiar with the South African situation and has a track record of collaboration with South African marine scientists.

CALLUM ROBERTS - University of York, United Kingdom

ROBERTS has an h-index of 63 and >17 000 citations. His specialisations include marine conservation biology, fisheries management, marine protected areas, marine reserves, biodiversity and coral reefs. His work examines the impact of human activity on marine ecosystems, particularly coral reefs. He has studied the effects of marine reserves closed to all fishing, showing both the scale of human impacts on the sea, and the means of protecting marine ecosystems from such effects. He works to gain a wider acceptance for marine reserves and advise fishermen on how to promote the concept within the industry and to politicians. He has also been active with the Coral Reef Fish Specialist Group of the World Conservation Union (IUCN). With colleagues, he has developed global maps of the biodiversity distribution of reef fishes and other faunal groups. He was awarded a Pew fellowship in marine conservation in 2000 to tackle obstacles to implementing marine reserves, and in 2001 he was awarded a Hardy fellowship in conservation biology at Harvard University.

NATIONAL SPEAKERS

COLEEN VOGEL - University of the Witwatersrand

Coleen Vogel has recently re-joined the University of the Witwatersrand, Johannesburg after spending time at the University of Pretoria. Professor Vogel was also a "visiting" Professor with the University of Stellenbosch working on climate change adaptation and trans-disciplinary. She is a climatologist by training but has increasingly worked in the social dimensions of climate change, focusing particularly on climate change adaptation. She has chaired and been the vice-chair of international global environmental change scientific committees (e.g IHDP and LUCC and involved in the Earth System Science Programme), groups that preceded the current Future Earth developments. She has assisted in several government-related development activities in South Africa and was a contributor to the Disaster Management Act process in South Africa. She was one of the chapter lead authors of the Fouthr IPCC (Intergovernmental Panel on Climate Change) Africa Chapter and part of the final synthesis author panel of that report and was a chapter author contributing to the 5th Asessment of the IPCC, working on a chapter dealing with Human Security. A Nobel Peace Prize was awarded to the author team together with Al Gore for the efforts made in compliling the 4th assessment report. She has also received the Burtoni Awards for international excellence in adaptation research and received the University of the Witwatersrand Vice Chancellor's teacher's award for excellence in teaching. Her current research interests include working in the social and physical dimensions of climate change resilience including helping to build and enhance robust responses to environmental change, effective climate change responses and efforts in disaster risk reduction. Allied to such themes are efforts in improved understanding on social learning and transformative education at various levels and with various groups.

CRAIG SMITH - Department of Agriculture, Forestry and Fisheries

Mr Craig Smith obtained his MSc in Zoology in 1999 at the University of Cape Town. He has worked for Department of Environmental Affairs as a fishery scientist from 1999 until 2006. In 2014, Craig was appointed as Director: small-scale fisheries management at DAFF. His current role is to establish economic needs of communities.In his role as scientist his main area of work was on invertebrates and large pelagic fisheries. He has authored and co-authored a number of peer-reviewed scientific papers; the most notable collaboration won the 2013 Department of Fisheries and Oceans (Canada) publication of the year award. As a fisheries manager he was responsible for managing South Africa's industrial and high seas fisheries as well as regulating port access of foreign fishing vessels. As a fishery manager and scientist, he has also represented South Africa at various tuna regional fishery management organisations, including IOTC, ICCAT, and CCSBT and has contributed to the development of international conservation and management measures for tuna fisheries. His achievement to date has been the drafting of the South African National Plan of Action for Sharks (2013) as well as the drafting of the Small-Scale Fishing Regulations, published in March 2016. Craig has also drafted the Small-Scale Fishing Regulations and successfully managed the first ever registration process for small-scale fishers in South Africa in 2016. Craig is also a member of the Abalobi development team that is seeking to revolutionize the way in which data is collected, managed and interrogated between government and fishers using smart phone technology.

MANDY LOMBARD - Nelson Mandela Metropolitan University

Professor Lombard was awarded the Purcell Memorial Prize for the best zoological Ph.D at the University of Cape Town (UCT) in 1989. After post-doctoral work in the USA and Australia, she held academic positions at UCT, NMMU and the University of Pretoria. She specialises in conservation planning, and has also worked as a consultant in this field for 18 years. Her early work advanced conservation planning research in South Africa and was instrumental in establishing it as a necessary step in policies to expand and proclaim both terrestrial and marine protected areas. in 2004 she pioneered South Africa's marine conservation planning research and assessments. She is frequently invited to international workshops to advance conservation planning globally, and has supervised many post-graduate students, published 47 peer-reviewed scientific papers, 1 book chapter and 43 consultancy reports. In 2013, Thomson Reuters listed her as one of the 6 most cited ecologists in South Africa. She has an NRF C1 rating for her research and an H-index of 25. She is and editor of the Journal Conservation letters and a board member of the Marine Section of the Society for Conservation Biology. She has a special interest in animal welfare and ethics and sits on national and international ethics committees.

GENERAL INFORMATION

WIFI
Username: guest@sun Password: None

NAMETAGS
Exhibitors must please wear name tags at all times, including social events

CONFERENCE MANAGEMENT
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REGISTRATION & INFORMATION DESK
The desk will be located in the foyer area of the Boardwalk Convention Centre, and will be open during the following times

4 July: 08h00 - 18h00	6 July 08h00 - 16h00
5 July: 08h00 - 18h00	7 July 08h00 - 16h00

SPEAKER PREP ROOM
The speaker prep room will be situated at Yellowwood 2, and will be open during the following times:

4 July: 07h30 - 17h00	6 July 07h30 - 16h00
5 July: 07h30 - 17h00	7 July 07h30 - 14h00

INFORMATION FOR SPEAKERS
Speakers must please load presentations in the speaker prep room (Yellowwood 2), at least 90 minutes before the start of the session during which you present from 5-7 July. Special Session Presenters on 4 July to load in the venue with the technician, not in the speaker prep room please. The support technician in the speaker prep room will check formats, videos and sound to make sure all presentations are correctly formatted. If you are able to load your presentation on arrival at conference, please do so , the speaker prep room will be open, full day, 4-7 July.

INFORMATION FOR CHAIRPERSONS
Please report to your session room 15 minutes prior to the scheduled starting time. Introduce yourself to the AV technician in your room. They will familiarise you with the light switches, the timer system, microphones and other venue equipment. The timer system will be operated by the AV technician. Introduce yourself to the speakers before the session. Remind the speakers of their time limit and the format of the presentation: Long Presentation: 12 min present, followed by 3 min Q&A, and Speed Presentation: Speed Presentation: 7 min Presentation time, at the end of the sessions 25 min Q&A. Be strict with time keeping. Begin the session on time and please do not allow speakers to go over time as this will impact the whole programme. Reserve a front row for yourself and the speakers.

Introduce yourself and the topic to the audience at the beginning of the session, and then each speaker prior to his or her presentation.

BAYWORLD

Bayworld is a combined museum, oceanarium and snake park. It conducts environmental education and research. This much loved local institution has its origins in 1856. It currently reaches some 100 000 school children annually. In addition to public displays and daily presentations, it houses important natural history collections. The primary research directions are herpetology, marine biology and marine mammals. Delegates to SAMSS 2017 are entitled to free entry to the complex on the 4th and 5th of July upon the presentation of their conference name badges. The complex is open 9:00 - 16:30 with presentations at 11:00 and 15:00. It is located at the corner of Beach Road and Brookes Hill Drive in Humewood.

SOCIAL EVENTS

OFFICIAL OPENING AND WELCOME COCKTAIL FUNCTION:

The opening Plenary will take place on Tuesday 4 July at 17h00 in B2 (Plenary Venue) and will include the Gilcrest Lecture, Presented by Mark Gibbons. After which the welcome cocktail function will take place at 19h00-20h00

A limited bar tab will be made available for wine, beer and soft drinks on arrival, after which a cash bar will be made available
Dress Code: Work attire / Smart-casual

Presentation:
Mark J Gibbons - Department of Biodiversity and Conservation Biology, University of the Western Cape
Jellyfish: a celebration through culture and science
Abstract:
Although the word jellyfish has only been around for the last couple of hundred years, the animals themselves are embedded in our culture and, increasingly, in our science. This presentation does not have a beginning and an end but is rather a rambling combination of Zoology 101 and Classics 101, with a liberal dose of media hype. There is some science c/o PNAS, Nature, the Royal Society and Science (itself) but the aim here is celebrate in all but dance, the kings of the Cambrian.

CONFERENCE DINNER

The dinner will take place on Thursday 6 July at 19h00 at Venue B2, Boardwalk Conference Centre

Wine, appletizer and bottled water will be placed at each table, after which a cash bar will be made available
Dress Code: Semi-formal

SPONSORS

Thank you to our sponsors for their contributions:

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NMBT (Nelson Mandela Bay Tourism)

NMMU (Nelson Mandela Metropolitan University)

NMMU Science Faculty (Nelson Mandela Metropolitan University)

NRF (National Research Foundation)

SANCOR (South African Network for Coastal and Oceanic Research)

EXHIBITORS

The exhibitors include:
Echoview Software
Monitoring and Control Laboratories
Vemco

PROGRAMME

SPECIAL SESSIONS - Day 1: 4 July

08:00	09:00	**Registration**									
		VENUE: B2 PLENARY SCIENCE, POLICY AND MANAGEMENT FOR ESTUARIES		**VENUE: C1 INDIAN OCEAN ECOSYSTEMS AND SERVICES - A CONTRIBUTION TO THE IIOE2**		**VENUE: C2 TRACKING MARINE TOP PREDATORS FOR THE IDENTIFICATION OF ECOLOGICALLY IMPORTANT AREAS**		**VENUE: WOOD ROOMS TELLING OUR STORIES-COMMUNICATION SKILLS FOR SCIENTISTS**			
09:00	09:15	**Janine Adams**	Introduction: Science, policy, management for estuaries			**Steve Kirkman**	The EBSA process, its relevance to marine spatial planning and other place based management tools where top predator spatial data can be useful				
09:15	09:30	**Guy Bate**	Consortium for Estuarine Research & Management	**Mike Roberts**	Oceanic eddies as transport vectors for biological connectivity between southern Madagascar and the African continent	**Stephen Holness**	The EBSA process, its relevance to marine spatial planning and other place based management tools where top predator spatial data can be useful				
09:30	09:45	**Lara Van Niekerk***	National Biodiversity Assessment 2018: Scope, Data requirements & Progress	**Margaux Noyon**	Plankton distribution within a cyclonic eddy off south-western Madagascar	**Pierre Pistorius**	Habitat use in marine top predators at the Prince Edward Islands- A case study				
09:45	10:00	**Lara Van Niekerk***	National Biodiversity Assessment 2018: Scope, Data requirements & Progress	**Angus Macdonald**	Paella connectivity across the Mozambique Channel	**Taryn Morris**	Marine IBA development as precursor to identifying EBSAs				
10:00	10:15	**Ntombivuyo Madlokazi**	The national estuary management programme : reflection and lessons learnt on its implementation	**Sohanna Singh***	Population genetics and phylogeography of Panulirus homarus in the south-west Indian Ocean	**Malcolm Smale**	Movements and hot spots of sharks off southern Africa				Science Communication Welcome and Introduction
10:15	10:30	**Pierre De Villiers**	Progress with estuary management plans	ALL	Discussion	**Theoni Photopoulou**	Movement patterns of white sharks in False Bay from passive acoustic detections				Marine Science Communication - why, what and how of informal science communication
10:30	10:45	**Gerhard Cilliers**	Implementation of the national estuarine monitoring programme in South Africa : case studies on selected estuaries in the Western Cape								
10:45	11:15	**Tea Break**									Practical Session - telling our stories - from messages to presentation
11:15	11:30	**Alan Whitfield**	Micro-estuaries	**Jean-Francois Ternon**	Seamount ecosystems in the South West Indian Ocean : the MAD-Ridge project	**Gwenith Penry**	Spatial and Temporal distribution of individually identified Bryde's whales along the South African coastline				
11:30	11:45	**All**	Discussion			**Els Vermeulen***	Indian Ocean humpback dolphin (Sousa plumbea) movement patterns along the South African coast				Lessons from the Frontline - marine science communicators share their stories
11:45	12:00	**Renzo Perissinotto**	Lake St Lucia: Ecological monitoring and rehabilitation	**Patrick Vianello**	On the circulation over the Madagascar Ridge using Satellite Data	**Mduduzi Seakamela***	Satellite tagging of humpback whales Megaptera novaeangliae off the east coast of South Africa				
12:00	12:15	**Lucienne Human***	Change in the water quality of Knysna Estuary	**Shael Harris**	Influence of eddy dynamics and substrate type on larval fish assemblages around seamounts in the SWIO Region	**Carl van der Lingen**	Abundance, distribution and environmental drivers of sardine and anchovy off South Africa				
12:15	12:30	**Guy Bate**	Blackwater in estuaries	**Patrick Vrancken**	Law of three seamounts in the Indian Ocean	**Linda Harris**	Bridging the gap between biologging and spatial prioritisation for marine top predator conservation in ecosystem-based marine spatial plans				
12:30	12:45	**Ricky Taylor**	What we know about the Mlalazi Estuary and what we would like to know	**ALL**	Discussion	DISCUSSION: General discussion on using tracking data for MSP including EBSA delineation, and inventory of available tracking data					Behaviourally effective communication
12:45	13:00	**Daniel Lemley***	Harmful algal blooms								
13:00	**14:00**	**Lunch Break - No Refreshments Provided on the 4th, delegates to arrange own lunch (various restaurants within the complex)**									Practical Session - planning your communication
								14:00			Wrap up and evaluation
								VENUE: WOOD ROOMS SMELL OF SCIENCE: SMELL, EMBRACE, OBSERVE			
14:00	14:15	**Stephen Lamberth**	Hypersalinity and west coast estuaries	14:00	14:10	**Sean Fennessy**	Indian Ocean Fisheries - some perspectives	14:00	14h15		What is Gyotaku?
14:15	15:00	**Discussion**	New research & future opportunities	14:10	14:20	**Diane Le Gouvello***	Modeling the fate of sea turtle hatchlings oceanic dispersal in South Africa				
				14:20	14:30	**Tommy Bornman***	Phytoplankton of the South-West Indian Ocean	14:15	14:30		**Break**
				14:30	14:40	**Jenny Huggett**	Plankton measurements in the Western Indian Ocean since 1975 – the Nansen voyages	14:30	15:00		Hands on experiential print making
				14:40	14:50	**Margaux Noyon**	How to assess the role of zooplankton at the basin-scale in the South West Indian Ocean ecosystem? Is the ZooScan the way forward?				
				14:50	15:00	**Angus Paterson**	ACEP - Transforming East Coast science to meet the demands of the blue economy				
				15:00	15:10	**Mike Roberts**	A new research program: Sustainable Oceans, Livelihoods and Food Security through Increased Capacity in Ecosystem research in the Western Indian Ocean (SOLSTICE-WIO)	15:00	15:15		How to do Haiku
				15:10	15:20	**Ashley Johnson**	South Africa's Contribution to IIOE-2	15:15	15:40		Haiku writing session - embracing the essence
				15:20	16:00	**All**	Discussion	15:40	16:00		Sharing prints and haikus and wrap up
17:00		Official Opening (Venue: B2)									
18:00		**Gilchrist Lecture: Mark Gibbons - Jellyfish: a celebration through culture and science**									
19:00		**Welcome Function (Cocktail) & Poster Session 1**									

SYMPOSIUM - DAY 2: 5 JULY 2017

		Venue: B2 Plenary **Chairperson: Ronel Nel**			
09:00	10:00	**Prof Robert Costanza - Valuing and Managing Marine and Coastal Ecosystem Services**			
10:00	10:40	**Prof Coleen Vogel - Making 'shared' meaning of environmental change: challenges and opportunities**			
10:40	11:00	**Tea Break**			
		Climate & Global Change **Venue: B2** **Chairperson: Charles von der Meden**	**Estuaries** **Venue: C1** **Chairperson: Dimitri Veldkornet**	**Coast and Nearshore** **Venue: Wood Rooms** **Chairperson: Gavin Rishworth**	**Top Predators** **Venue: C2** **Chairperson: Gwen Penry**
11:00	11:15	The value of foundational biodiversity knowledge in tracking environmental change **Lara Atkinson**	Deteriorating water quality in South Africa's estuaries threatens ecological resilience **Janine Adams**	An unexpected Atlantis: using artificial structures in the conservation of an endangered seahorse species **Louw Claassens***	The foraging behaviour of Cape gannets during the guard and post-guard phase of chick rearing **Jonathan Botha***
11:15	11:30	Science in the service of society: relevant, holistic, reliable and objective **Keverne Cochrane**	Evaluation of temperate mangrove estuaries as food patches using RNA:DNA ratios to assess body condition in larvae of Gilchristella aestuaria **Eugin Bornman***	Variability in stable isotope signatures of South African Laminariales: implications for kelp forest food web studies **David Dyer***	Optimal foraging strategies of African Penguins: relevance to resource competition and group foraging **Alistair Mcinnes**
11:30	11:45	Managing conflicts between economic activities and threatened migratory marine species towards creating a multi-objective blue economy **Linda Harris**	Hippo dung causes declines in benthic productivity in an estuarine lake: implications for ecosystem functioning and management **Jessica Dawson***	Early stage ichthyofauna from shallow water habitats of the Angola-Benguela Frontal Zone **Matthew Farthing***	Movement ranges and time scales in marine predators – acute and seasonal environmental drivers **Taryn Murray**
11:45	12:00	Where have all the cormorants gone? Insight from SANCCOB admission data to understand the decline of the Cape cormorant **Katta Ludynia**	Ecophysiology and nutrients:The prolonged bloom persistence by Cyanothece sp. in Lake St Lucia, South Africa **Schalk du Plooy**	Emergent effects of predator diversity in regulating predator-prey interactions in an shallow water aquatic ecosystem **William Froneman**	Abundance and habitat use of Indian Ocean humpback dolphins (Sousa plumbea) along the south coast of South Africa **Danielle Conry***
12:00	12:15	Feeling the heat: the susceptibility of African Penguins to hot weather events and climate change **Noelle Tubbs***	Effects of flood events on estuarine fish communities **Nicola James**	From resident to migrant: an empirical classification of coastal fish movement **Jade Maggs***	Evidence for a postreproductive phase in female false killer whales **Theoni Photopoulou**
12:15	12:30	Climate Change Adaption in a Blue Carbon Ecosystem formed by the Seagrass, Zostera capensis **Cloverley Lawrence**	Invertebrate and ichthyofaunal communities in selected micro-estuaries and micro-outlets of the Eastern Cape Province **Mandla Magoro***	Influence of sedimentary dynamics on the distribution of the Spartina maritima intertidal salt marsh of the Keurbooms Estuary, Western Cape **Athi Mfikili***	Acoustic occurrence and behaviour of Antarctic blue and fin whales in South Africa and Antarctica **Fannie W. Shabangu**
12:30	12:45	Red tide conditions and spatio-temporal patterns in intertidal invertebrate recruitment: does food particle size matter? **Carlota Muñiz**	Is observational bias impacting fish conservation efforts? Lessons from early life history studies in temperate South Africa **Nadine A. Strydom**	Modelling significant areas for larval fishes in the Algoa Bay region **Paula Pattrick**	Effect of sex and ontogeny on the trophic ecology of Antarctic and Subantarctic fur seals **Liezl Pretorius***
12:45	13:00	A tale as old as time: The flightless moth and Wandering Albatross **Tanya Haupt**	Spatial and temporal variability of metabolic rates in subtropical estuarine communities **Morgana Tagliarolo**	The Chronicles of Larvia: almost 30 years of research on larval ecology in South Africa **Francesca Porri**	Why Swift Terns are winning the race: comparing Benguela-endemic seabirds that compete with fisheries **Davide Gaglio**
13:00	14:00	**Lunch**			
		Climate & Global Change **Venue: B2** **Chairperson: Sean Porter**	**Estuaries 1** **Venue: C1** **Chairperson: Phakama Nodo**	**Coastal & Nearshore 1** **Venue: Wood Rooms** **Chairperson: Linda Harris**	**Top Predators** **Venue: C2** **Chairperson: Lorien Pichegru**
14:00	14:07	Thermal tolerance and the potential effects of climate change on marine organisms in the Kariega Estuary and adjacent intertidal coastline **Kerry-ann Van Der Walt***	A Systems Approach to Understanding Complex Estuarine Functioning During Increased Climatic Variability **Christopher Waspe***	Defining the drivers biomass allocation, phylogeography and phenology of Sarcocornia tegetaria across a geographical gradient **Catherine Brown***	Animal-borne video and accelerometers reveal marked changes in swimming behaviour during high energy requirements of white shark breaching behaviour **Alison Kock**
14:07	14:14	The effects of Climate Change on Cetaceans - mapping dolphin distribution in the south-western Cape,by means of dedicated boat surveys **Monique Laubscher***	A regional scale estuarine resource allocation process using a scenario-based approach: The Mvoti to Mzimkulu WMA case study **Lara Van Niekerk***	Sea turtles: vectors of nutrients from sea to land **Diane Le Gouvello***	Contrasting Movement Behaviour of Two Endemic Catshark Species within Mossel Bay, South Africa **Ralph Watson**
14:14	14:21	Automated weather stations: Assessment of Wind Field in the Southern Benguela Upwelling Region **Mbongeni Tyesi**	Natural eutrophication in pristine micro-estuaries and micro-outlets along a section of the South African coast **Lucienne Human***	Seasonal changes in the salt marsh-terrestrial boundary vegetation **Rebotile Matabane ***	Variability in the distribution patterns and diet of two common catsharks caught in demersal trawls off the coasts of RSA **Grant Van der Heever**
14:21	14:28	The relationship between human activities and mangrove health in South Africa - sustaining mangroves forests into the future **Anusha Rajkaran**	Sediment Grain Size Distribution, Chemical Composition and Hydrodynamics of the channels and the floodplains of the Swartkops Estuary **Sipho Ndibo***	Monitoring nesting loggerhead sea turtle health using epibionts **Christopher Nolte***	The effects of sex and season on the presence of broadnose sevengill sharks (Notorynchus cepedianus) along the South African coast **Tamlyn Engelbrecht***
14:28	14:35	Measuring responses of South African mangroves to sea-level rise: Better late than never **Jacqueline Raw**	Small-scale variation of microalgal assemblages: Effectiveness of artificial substrates as a water quality monitoring tool in the St. Lucia Estuary **Monique Nunes***	Larval fish communities associated with nearshore fronts **Paula Pattrick**	Recreational SCUBA Diving Interaction With The Vulnerable Ragged-Tooth Shark (Carcharias taurus) At The Aliwal Shoal Marine Protected Area, Kwazulu-Natal **Presented by Deborah Robertson-Andersson on behalf of Rigardt Hoffman**
14:35	15:00	Q & PD	Q & PD	Q & PD	Q & PD
		MPAs & Spatial Plan1 **Venue: B2** **Chairperson: Zoleka Filander**	**Estuaries 2** **Venue: C1** **Chairperson: Jackie Raw**	**Coastal & Nearshore 2** **Venue: Wood Rooms** **Chairperson: Paula Pattrick**	**Top Predators** **Venue: C2** **Chairperson: Theoni Photopoulou**
15:00	15:07	Determining an optimal epibenthic photographic sampling intensity for the Prince Edward Islands (Southern Ocean) **Robyn Adams***	Spatio-temporal dynamics of macrozoobenthic communities of the Mdloti Estuary (KwaZulu-Natal, South Africa) **Thembeka Radebe***	Identifying the factors that drive phytoplankton biomass and community composition along the Nahoon – an urban located estuary **Phumlile Cotiyane***	Does it always pay to defend one's nest? A case study in the African penguin **Gwendoline Traisnel***

PROGRAMME

SYMPOSIUM - DAY 2: 5 JULY 2017

		MPAs & Spatial Plan1 Venue: B2 Chairperson: Zoleka Filander	Estuaries 2 Venue: C1 Chairperson: Jackie Raw	Coastal & Nearshore 2 Venue: Wood Rooms Chairperson: Paula Pattrick	Top Predators Venue: C2 Chairperson: Theoni Photopoulou
15:07	15:14	Larval fish biodiversity in relation to biozones off the KwaZulu-Natal Coast: Biodiversity surrogates for marine pelagic conservation planning **Makolobe Mabotja***	The influence of prolonged mouth closure on the zooplankton taxa of a temporarily open/closed estuary (Mdloti Estuary, KwaZulu-Natal) **Kajal Lechman***	Towards the biogeography of marine benthic diatoms along the coast of South Africa **Phumlile Cotiyane***	Food-web structure of the Namibian Islands Marine Protected Area: An update from stable isotopes **Laurie Johnson**
15:14	15:21	Towards the development of indicators for an ecosystem-based condition assessment of subtidal rocky reefs in South Africa **Kaylee Smit***	The Spatial and Temporal Variability of Mesozooplankton in the Permanently Open Mlalazi Estuary of KwaZulu-Natal, South Africa **Dane Garvie***	The use of Casuarina spp. for coastal protection throughout the IOSEA: Effects and distribution in sea turtle nesting habitat **Deidre De Vos***	Movements of individually identified Bryde's whales along the South African coastline **Gwenith Penry**
15:21	15:28	Patterns and potential drivers of benthic epifaunal communities in unconsolidated sediment habitats of the KwaZulu-Natal coast **Mari-lise Franken**	Exploring the unique vegetation of the Kosi Estuarine Lake **Meredith Fernandes**	A review of research along the Northern Cape coastline against past and present development pressures **Louise Geldenhuys**	Satellite tagging of humpback whales Megaptera novaeangliae off the east coast of South Africa **Mduduzi Seakamela**
15:28	15:35	The significance of traditional fish traps on the β diversity of the Kosi Bay system, are they ecologically important? **Amy Shurety***	Triggers of phytoplankton succession patterns in a permanently eutrophic South African estuary **Daniel Alan Lemley***	Top-down vs Bottom-up forcing: algal succession on rocky shores **Jeff Hean***	Discovery of humpback whale Megaptera novaeangliae "Super-Groups": Low latitude feeding in the Benguela Current Ecosystem **Mduduzi Seakamela**
15:35	16:00	Q & PD	Q & PD	Q & PD	Q & PD
16:00	16:20	**Tea Break**			
		MPAs & Spatial Plan2 Venue: B2 Chairperson: Kerry Etsebeth	**Science Comm Venue: C1 Chairperson: Rachel Kramer**	**Pollution Venue: Wood Rooms Chairperson: Tanya Haupt**	**Fisheries & Top Predators Venue: C2 Chairperson: Alistair McInnes**
16:20	16:27	A comparative study of SDMs and GIS in spatial distribution of limpets in the Wild Coast **Lulama Matshamba***	SeaKeys – Lessons from Citizen Scientists Unlocking Foundational Marine Biodiversity Knowledge **Rosanne Palmer**	Impacts of plastic pollution on post-hatchling loggerhead turtles **Ronel Nel**	Cape fur seal teeth as a record of historical changes in the abundance and distribution of small pelagic fish **Maelle Connan**
16:27	16:34	Modelling cetacean distribution to help spatial and temporal management of anthropogenic activities in a South African marine environment **Jean Purdon***	"Journeying towards the Green List" (Tracking 13 years of SASSI assessments) **Monica E Betts**	Bacterial Counting: Quick, easy and accurate? **Travis Kunnen***	Long-term trends in Cape fur seal mortality from stranding data along the Eastern Cape coast **Greg Hofmeyr**
16:34	16:41	Identifying and Mapping Strategic Fisheries Resource Areas to Support Marine Spatial Planning in South Africa **Tsamaelo Malebu***	Digital conservation: Scientists portal to connecting with the public? **Kaveera Singh***	Microplastics Make Fish Anally Retentive **Matthew Coote**	The impact of Cape fur seals on chokka squid fishing operations during the peak spawning season **Presented on behalf of Frikkie van der Vyver by Greg Hofmeyr**
16:41	16:48	Topic Title TBC **Cristina Louro**	Building Scientific Knowledge And Capacity Through Partnership: The Ocean Stewards Initiative **Tamsyn Livingstone**	Microplastic contamination within the tissue of varying size classes of Perna perna along the east coast of South Africa **Michael Skeeles***	Hidden at sea – the numbers and fate of sharks discarded by pelagic longline fisheries for tuna and swordfish **Gareth Jordaan***
16:48	16:55	Good fences make good neighbours? Port, city & environment of Durban, South Africa **Obakeng Molelu**	The role of Academia as South Africa takes over as Chair of the Indian Ocean Rim Association (IORA) **Presented on behalf of Juliet Hermes by Nicole du Plessis**	Counting and sizing microplastic fibres, the accurate and easy way **Travis Kunnen***	Involving fishers in seabirds conservation: bridging the gap between the needs of seabirds and the fishing industry **Tayla Ginsburg**
16:55	17:20	Q & PD	Q & PD	Q & PD	Q & PD
17:20	19:00	Poster Session			

SYMPOSIUM - DAY 3: 6 JULY 2017

		Venue: B2 Plenary Chairperson: Sean Fennessy			
09:00	10:00	**Dr Omar Defeo - Small-scale fisheries: assessment, management and drivers of change**			
10:00	10:40	**Mr Craig Smith - Small-scale Fisheries: A catalyst for radical socio-economic transformation in coastal fishing communities?**			
10:40	11:00	**Tea Break**			
		Oceanography Venue: B2 Chairperson: Xolisa Dlomo	**Fisheries Venue: C1 Chairperson: Lungi Nomxego**	**Genetics & Taxonomy Venue: Wood Rooms Chairperson: Debbie du Preez**	**Intertidal & Benthos Venue: C2 Chairperson: Lauren de Vos**
11:00	11:15	Renewable Ocean Energy around South Africa **Eckart Schumann**	Distribution changes in the demersal fish community of the Agulhas Bank, 1986-2016 **Jock Currie***	A paradigm for sandy beach macroinfaunal connectivity **Karien Bezuidenhout***	Disentangling the influence of spatial and environmental processes in structuring warm-temperate reef fish communities **Alexander Dyer***
11:15	11:30	Quantifying the impact of mesoscale activity on the Benguela upwelling front **Matthew Carr***	Taking stock of our seabream: red steenbras and white stumpnose **Denham Parker**	A genomic appraisal of the stock structure of the South African sardine, Sardinops sagax **Tirupathi Rao Golla***	Dragging up the past off South Africa's east coast **Sean Fennessy**
11:30	11:45	Evaluating the effects of climate change in the southern Benguela system using the Atlantis modelling framework **Kelly Ortega-Cisneros**	The effect of bait on fine-scale habitat associations of reef fish investigated with a remote video technique **Nick Schmidt**	Molecular species identification of two South African endemic shark genera, Haploblepharus and Poroderma **Katie Gledhill***	Habitat associations and distribution of the hyperbenthic shrimp, Nauticaris marionis, around the sub-Antarctic Prince Edward Islands **Charles Von Der Meden**
11:45	12:00	Oceanographic conditions influencing deep-water Cape hake (Merluccius paradoxus) juveniles on the Orange Banks nursery ground **Fisokhule Mbatha***	Understanding the impacts of global change on coastal fishes – from pattern to process **Warren Potts**	"Putting names to faces": Unraveling the taxonomy of Chrysaora and Rhizostoma from around South Africa **Verena Ras***	Hermit crabs in South Africa – biodiversity, distribution patterns and associated fauna **Jannes Landschoff***
12:00	12:15	Wintertime rates of total, new and regenerated production in the southern Benguela Upwelling System **Raquel Flynn***	Management considerations for estuarine fishery species in South Africa, based on a decade of acoustic telemetry research **Rhett Bennett**	Genetic diversity and distribution of Porphyra species along the South African coast **Maggie Reddy***	Factors affecting trophic signatures of deep sea benthic invertebrates at a Sub Antarctic archipelago **Eleonora Puccinelli**

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SYMPOSIUM - DAY 3: 6 JULY 2017

		Oceanography Venue: B2 Chairperson: Xolisa Dlomo	Fisheries Venue: C1 Chairperson: Lungi Nomxego	Genetics & Taxonomy Venue: Wood Rooms Chairperson: Debbie du Preez	Intertidal & Benthos Venue: C2 Chairperson: Lauren de Vos
12:15	12:30	Assessing the impact of assimilating OSTIA SST and along-track AVISO SLA on the performance of HYCOM over the Agulhas Bank **Christo Peter Whittle***	Interspecific, ontogenetic, spatial and temporal variability in nitrogen and carbon stable isotope ratios of small pelagic fish off South Africa **Carl van der Lingen**	A molecular phylogeny of the spiny lobster Panulirus homarus supports a new species from the Southwest Indian Ocean **Sohana Singh***	Defining the potential ecological roles of three sea turtle species (Caretta caretta, Chelonia mydas and Eretmochelys imbricata) along the eastern seaboard of South Africa **Ryan Rambaran***
12:30	12:45	Investigating the relationship between volume transport and sea surface height in the Agulhas Current using the Hybrid Coordinate Ocean Model **Estee Vermeulen***	Modelling effects of spatio-temporal spawning variability on the transport and retention success of sardine (Sardinops sagax) eggs around South Africa **Alice Mcgrath***	Functional and taxonomic structure of marine macrobenthos as a biodiversity surrogate for the KZN marine conservation planning **Sikhumbuzo Maduna***	Using resource utilisation as a tool for predicting regional spread of marine alien species **Tammy Robinson**
12:45	13:00	A multi-disciplinary approach to understanding the oceanography and benthic biodiversity of the submarine Cape Canyon, South Africa **Zoleka Filander**	Progress in implementing the ecosystem approach to fisheries in South Africa in principle and in practice **Elethu Duna**	Developing the field of biodiversity informatics in South Africa through using primary data and informatics tools to address biodiversity challenges **Fatima Parker-Allie***	Impacts of the novel invasive mussel, Semimytilus algosus, on the prey preference of two native subtidal predators **Lisa Skein***
13:00	14:00	**Lunch**			
		Oceanography1 Venue: B2 Chairperson: Manare Sejeng	**Fisheries Venue: C1 Chairperson: Rhett Bennett**	**Taxonomy & Genetics 1 Venue: Wood Rooms Chairperson: Lorenz Hauser**	**Intertidal & Benthos 1 Venue: C2 Chairperson: Eleonora Puccineli**
14:00	14:07	Controls on new production and carbon export in the southern Benguela Upwelling System **Jessica Burger**	Is the ban on harvesting of berried female lobsters in South Africa justified on biological, economic and management grounds? **Andrew Cockcroft**	Evolution dictates gene flow in the Western Indian Ocean: a regional theme **Angus Macdonald**	Shifts in benthic community structure following a sweepstake recruitment event of alien mussels **Maya Pfaff**
14:07	14:14	Spatio-temporal distributions of picophytoplankton in the southern Benguela using a flow cytometer **Zimkhita Gebe***	New age data of Namibian M. capensis using the fast growth hypothesis: consequences for stock assessment **Margit Wilhelm**	Connectivity between populations of Anaulus australis Drebes et Schultz at sandy beaches around the South African coast **Debbie Du Preez***	Is bigger better? How much is enough? Optimisation of quadrat size, point distribution, and point counts, for temperate reef monitoring **Rita Steyn***
14:14	14:21	Ocean dynamics that influence sea temperature structures in the Algoa and St. Francis Bay region **Xolisa Dlomo***	A Fuzzy logic decision-making toolset to assist abalone ranching in Port Elizabeth **Andrew Witte***	Genetic investigation of reproductive philopatry in the raggedtooth shark (Carcharias taurus) along the South African coast **Juliana Klein***	Horizon scanning for intertidal predatory crab invaders: South Africa as a case study **Cheruscha Swart***
14:21	14:28	Mesoscale/submesoscale features of Agulhas current origin in the South Atlantic Ocean **Ngwako Rabodiba Adam Mohale**	Towards standardised monitoring; The effect of bait type on reef fish assemblage structure observed with baited remote underwater stereo-video systems **Sarah Halse**	Application of a multiple method approach for stock identification and discrimination of South African kingklip, Genypterus capensis (Smith 1874) **Ayesha Mobara***	The Relationship between macrobenthos, fish and birds of Durban Bay **Bomikazi Tshingana***
14:28	14:35	Organic carbon export and phytoplankton community composition across the Agulhas System Climate Array **Ruan Parrott***	Changes in recreational angler attitudes towards, and awareness of, linefish management along the KwaZulu-Natal coast, South Africa **Rachel Kramer**	Progress and pitfalls in the regional genetic assessment of elasmobranch species **Aletta Bester-van der Merwe**	Intertidal macrobenthic assemblages of mixed bottom shores: a response to integrated substratum and wave attenuation gradients? **Cornelia Garner**
14:35	15:00	Q & PD	Q & PD	Q & PD	Q & PD
		Oceanography2 Venue: B2 Chairperson: Christo Whittle	**Fisheries Venue: C1 Chairperson: Irfan Nunkoo**	**Taxonomy & Genetics 2 Venue: Wood Rooms Chairperson: Karien Bezuidenhout**	**Intertidal & Benthos 2 Venue: C2 Chairperson: Rita Steyn**
15:00	15:07	Examining the sub-meso and mesoscale variability across the Crossroad Transect for the period between 2013 and 2015 **Manare Caroline Sejeng**	Modelling the occurrence of postflexion stages of a marine estuarine-dependent fish in temperate South African estuaries **Yanasivan Kisten***	Morphological and genetic variation of Gymnothorax undulatus (Anguilliformes: Muraenidae) in the Western Indian Ocean **Yonela Sithole***	Effects of limpet-barnacle interaction on the shell morphology of limpets **Siyasanga Zoko**
15:07	15:14	Changes in copepod communities across the South Subtropical Front in the southwest Indian Ocean **Riaan Cedras***	Whole mounts method associated with maturity scale development of the shallow water hake Merluccius capensis in South Africa **Lunelwa Nomxego**	Unravelling the identities of two apparently cosmopolitan Nereidid polychaetes in South Africa **Jyothi Kara***	A first remote imagery survey to determine patterns of diversity for benthic macrofauna of False Bay, South Africa **Lauren De Vos***
15:14	15:21	Mesozooplankton communities associated with two shallow seamounts on the Madagascar Ridge (South-West Indian Ocean) **Zo Tsihoarana Rasoloarijao**	Observations on the biology and seasonal variation in feeding of the East Coast redeye (Etrumeus wongratanai) (Clupeiformes), off Kwazulu-Natal **Lyle Vorsatz***	Demospongiae taxonomy and diversity of the Amathole region (Eastern Cape, South Africa) **Robyn Payne***	Quantifying the effect of a resource pulse (turtle nesting phenomenon) on predator (ghost crab, Ocypode ryderi) populations **Kylie Harris***
15:21	15:28	The South African atlas of sea surface temperature trends and extreme events **Robert Schlegal***	Investigating trophic interactions between parasites and their hosts **Mark Weston***	DNA barcoding supports morphological evidence for a new genus of Alcyoniidae (Cnidaria: Octocorallia) **Kerry Etsebeth***	Top-down vs bottom-up processes in epifaunal communities associated with intertidal macro-algae **Aldwin Ndhlovu***
15:28	15:35	The effects of extreme weather events on the ocean dynamics of the shelves and bays of the eastern Aghulas bank **Dylan Bailey***	Acoustic telemetry reveals behavioural complexity in the Leerfish, Lichia amia (Teleostei: Carangidae), in southern Angola **Alexander Winkler***	Metabarcoding the hidden biodiversity of sandy beaches **Lorenz Hauser**	Population density and size structure of gastropods on exploited and unexploited sites along the east coast of South Africa **Zinzisa Nokwali***
15:35	16:00	Q & PD	Q & PD	Q & PD	Q & PD
16:00	17:00	**Venue: C2** Presenting a new Marine Research Funding Instrument **Dr Kaniki**			
19:00	23:00	**Conference Dinner (Venue: Boardwalk Convention Centre)**			

SYMPOSIUM - DAY 4: 7 JULY 2017

		Venue: B2 Plenary Chairperson: Kerry Sink
09:00	10:00	**Prof Callum Roberts - 10% by 2020 and beyond: the role of marine protected areas in a changing world**
10:00	10:40	**Prof Mandy Lombard - The Tsitsikamma Marine Protected Area – winners and losers**
10:40	11:00	**Tea Break**

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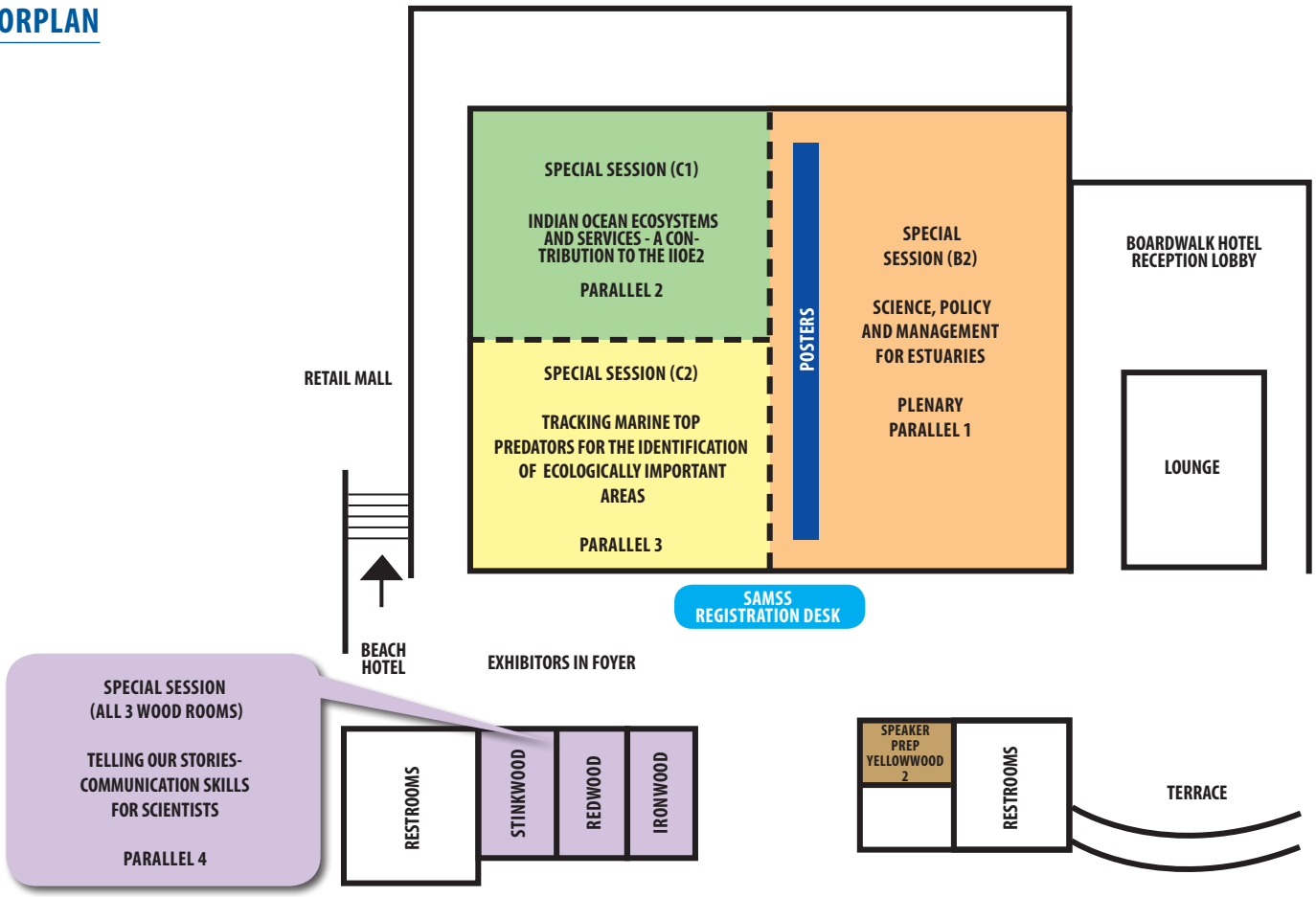
SYMPOSIUM - DAY 4: 7 JULY 2017

		Social & Economics Venue: B2 Chairperson: Thembinkozi Dlaza	Global & Climate change Venue: C1 Chairperson: Tammy Robinson	Marine Geoscience Venue: Wood Rooms Chairperson: Leslee Salzmann	MPAs and Spatial Planning Venue: C2 Chairperson: Kaylee Smit
11:00	11:15	Livelihood support, cherished treasures, Climate Change: Estimating the SCUBA diving use-value of coral reefs in northern KwaZulu-Natal and southern Mozambique **Stuart Laing***	Long-Term Dynamics of a High-Latitude Coral Community at Sodwana Bay, South Africa **Sean Porter**	Reconstructing the palaeo-Agulhas Plain: clues from the continental shelf **Hayley Cawthra**	Habitat characterisation and epibenthic biodiversity in Algoa Bay, South Africa **Hannah Raven***
11:15	11:30	The economics and logistics of a research ship servicing the Operation Phakisa initiatives – the RV Algoa as a pioneer **Mthuthuzeli Gulekana**	The ghost crab as model organisms in marine climate-change ecology: unicorn or red herring? **David Schoeman**	The Eastern Cape shelf: exciting new insights from multibeam bathymetry **Andrew Green**	The role of Dwesa-Cwebe Marine Protected Area in protecting surf-zone line-fish: Wild Coast, Eastern Cape, South Africa **Megan Van Der Bank**
11:30	11:45	Estuarine Ecohydrology and Ecoengineering – Vital Steps in Support of a Blue Economy **Alan Whitfield**	Long-term trends in cetacean occurrence during the annual Sardine Run off the Wild Coast, South Africa **Michelle Caputo***	Geological control on nearshore configuration and morphodynamics at Isipingo beach, KwaZulu-Natal **Carlos Loureiro**	The value of Marine Protected Areas goes much further than support for fisheries management **Jean Harris**
11:45	12:00	The Competency Group: An experiment in co-producing knowledge for coastal zone policies **Dianne Scott**	Predicting the performance of cosmopolitan marine species: mechanistic model skill drops across large spatial scales **Cristián Monaco**	Abrupt coastal drowning of estuaries and associated back-barrier systems: lessons from Protea Banks, KwaZulu-Natal **Lauren Pretorius***	Optimising Marine Protected Area design to increase benefits to conservation and people **Sizakele Sibanda***
12:00	12:15	Extent of blue carbon habitats and ecosystem services in South Africa **Sinegugu Mbense***	Warming effects on high shore soft sediment ecosystems: the interactive role of autogenic engineering and grazing **Martin Phillippe Emanuel***	Large marine storms recorded in the Durban shelf stratigraphy, a foretaste of things to come? **Andrew Green**	Assessment of deep-water benthic fish along the KZN continental shelf using Baited Remote Underwater Videos to support Marine Spatial Planning **Nokuthula Daweti**
12:15	12:30	Increased access, participation and integration in promoting biodiversity and conservation for emerging regional economies: Growing sustainable blue economies in Africa **Nomtha Hadi***	Indications of ocean acidification in the Benguela Upwelling System **Mutshutshu Tsanwani**	Rapid beachrock formation (< 5 years) on a dynamic, reflective, beach, Durban, South Africa **Errol Wiles**	Research and monitoring outcomes of the re-zonation of the Tsitsikamma Marine Protected Area **Kyle Smith**
12:30	12:45	SASDI and SDI as a catalyst to unlocking the oceans economy **Nicolene Fourie**	Will ocean acidification impact on the survival, growth and skeletal development of larval dusky kob (Argyrosomus japonicus)? **Bernard Erasmus***	Precambrian relics along South Africa's coastline: living peritidal stromatolites and the drivers of their persistence **Gavin Rishworth**	Spatial management options for marine fisheries in South Africa: case studies of specific industries **Jodie Reed***
12:45	13:00	Booms, bins and bags: the B3 solution to the BIGA problem! **Deborah Robertson-Andersson**	The metabolic response of larval dusky kob (Argyrosomus japonicus) to pCO2 induced ocean acidification **Carla Edworthy***	Benthic microalgal spatial patterns associated with peritidal stromatolite microhabitats along the South African coast **Ross-lynne Weston***	The application of new offshore research results in the establishment of the Phakisa Proposed Marine Protected Area Network **Kerry Sink**
13:00	14:00	**Lunch**			
14:00	15:35	**Venue: B2** Plenary Debate: How can blue economies be developed and sustained? Chair: Kevern Cochrane, Plenary Speakers and DEA Representative			
15:35	16:00	**Closing Ceremony - Student Prize giving**			

FLOORPLAN



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1

Climate-change and Antarctic Krill

Dr Albrecht Gotz[1]
[1]*Saeon*

Krill shape the structure of the marine Antarctic ecosystem due to their central position within the Southern Ocean food web. The main population centers of krill in the Southern Ocean are characterized by a decline in sea ice cover and krill abundance during the last 20 years. Recent investigations provide evidence that winter represents a bottle-neck for krill's recruitment and spawning success, and suggest importance of understanding the processes during this period. Due to logistical difficulties, investigations during winter are rare and direct observations beneath moving offshore ice floes have only been attempted once before.

2

Renewable Ocean Energy around South Africa

Dr Eckart Schumann[1]
[1]*Nmmu*

Renewable energy in South Africa has concentrated on land sources, in particular wind and solar. However, the ocean also has tremendous sources of energy waiting to be exploited, with tidal, wave, current and temperature of special interest.
Tides have been used for energy generation for decades, but the South African microtidal climate means that this is not an option here.
Ocean wave energy tends to increase with increasing latitude, corresponding to increasing wind strengths. Around South Africa available wave energy can vary from less than 10 kW/m in summer to over 100 kW/m after a winter storm, with the highest averaged values occurring off the west and south coasts. An average of more than 30 kW/m is considered an exploitable wave energy resource.
On the other hand, South Africa probably has more suitable conditions than any other country for the exploitation of ocean currents and temperature. This is due to the presence of the mighty Agulhas Current, flowing southwest-wards along the southeast coast. It brings with it warm tropical and sub-tropical waters and current speeds often in excess of 2 m/s. An additional advantage is that the core of the current lies close to the coast, minimising transmission line distances.
Available data indicate that conditions off northern KwaZulu-Natal are suitable for ocean temperature energy conversion (OTEC), while ocean currents reach optimum conditions in the region of the Mbashe River mouth.

4

Sea turtles: vectors of nutrients from sea to land

Mrs Diane Le Gouvello[1], Ms Ronel Nel[1], Ms Linda Harris[1], Ms Karien Bezuidenhout[1]
[1] *Coastal and Marine Research Institute, Zoology Department, Nelson Mandela Metropolitan University*

Sandy shores are dynamic systems where beach food webs are almost entirely supported by erratic allochthonous subsidies. Sea turtles nest on sandy beaches and deposit large amounts of eggs seasonally in those nutrient-poor ecosystems, but no studies have quantified the amount of energy introduced by sea turtles. This study quantified the turtle-derived nutrient inputs by determining the energy value of eggs and hatchlings of two species of sea turtles nesting on South African sandy beaches. These results were then scaled to a population level for both species. The study demonstrated that loggerhead turtle along shore distribution is not uniform, having a high nest density to the north (105 nests.km-1) and low nest density to the south (7 nests.km-1). However, a total number of ca. 554,025 loggerhead and leatherback sea turtle eggs are deposited on this sandy shore annually. Subtracting the nutrients that leave the beach in the form of successfully incubated hatchlings it is estimated that a total of 37,521,567 kJ of energy remains in the beach ecosystem and potentially available to beach food webs. This equates to ca. 670 kJ.m-1 in a single nesting season or 7.4 kJ.m-1.day-1. These results confirm that the seasonal input of eggs from sea turtles is a pulsed resource subsidy of small temporal scale that makes substantial contributions to the energy budget of sandy beach ecosystems> The study also demonstrate that sea turtle act as vector of nutrients from marine foraging grounds to sandy beach/dune ecosystems.

6

Estuarine Ecohydrology and Ecoengineering – Vital Steps in Support of a Blue Economy

Prof Alan Whitfield[1]
[1]*SAIAB*

Ecological Engineering (or Ecoengineering) is increasingly used in estuaries to re-create and restore ecosystems that have been degraded by human activities. The focus of this presentation is on ecosystem restoration and offset initiatives in which the physical system is modified in order to create and restore natural processes and habitats. This strategy relies on successfully applying Ecohydrological principles, where suitable physical conditions, especially hydrography and sedimentology, are introduced to allow the estuarine ecology to recover. This successional process then allows a range of biota to reoccupy the rehabilitated areas, thus restoring the natural food web and ecology of the system. The presentation specifically examines how changes in the Ecohydrology of St Lucia and Richards Bay necessitated Ecoengineering initiatives to restore or maintain the functionality of these systems. The two examples indicate the trade-offs between sugar cane production and harbour development on the one hand, and the maintenance or restoration of viable nursery habitats for economically valuable estuary-associated fish and invertebrates on the other. These case studies provide important lessons for both the scientific understanding and management of South African estuaries, including the fact that successful estuarine restoration is a complex and often difficult process, but one that has to succeed if we want a viable Blue Economy.

7

Modelling the occurrence of postflexion stages of a marine estuarine-dependent fish in temperate South African estuaries

Mr Yanasivan Kisten[1], Prof Nadine Strydom[2], Prof Renzo Perisinotto[1], Dr Sourav Paul[1]
[1]DST/NRF Research Chair in Shallow Water Ecosystems, Nelson Mandela Metropolitan University, [2]Department of Zoology, Nelson Mandela Metropolitan University

The movement of postflexion larvae of marine estuarine-dependent species into estuaries is critical for the survival of fishes reliant on estuaries as nurseries. However, detailed studies focused on environmental variability experienced by postflexion larvae entering a range of estuary types under varying conditions are rare. This study assessed the in situ conditions (temperature, salinity and water clarity) under which the southern African endemic fish Rhabdosargus holubi (Sparidae) recruits into estuaries. Postflexion larvae were sampled in three biogeographic regions (cold temperate, warm temperate and subtropical boundary), which included three estuary types (permanently open estuaries (POEs), temporarily open/closed estuaries and estuarine lake systems) on a seasonal basis, independent of each other. Rhabdosargus holubi larvae were more abundant in spring and summer, in POEs in the warm temperate region. Models predicted that higher larval occurrence in estuaries is a function of lower salinity (e.g. mesohaline zones of 5-17.9 salinity) and lower water clarity (e.g. 0-0.2 Kd, light extinction coefficient), particularly for warm, temperate POEs. This re-emphasizes the importance of freshwater for optimal nursery functioning, which may be compromised by impoundments, abstraction and climate change in water-short countries like South Africa.

8

Microplastics Make Fish Anally Retentive.

Mr Matthew William Coote[1]
[1]*University Of Kwazulu-natal*

Microplastic particles comprise a large component of marine plastic pollution. Ingested microplastics may affect an organism's physical processes such as digestion, assimilation and gut evacuation. Observational studies of fish within natural systems are unable to accurately correlate microplastic consumption with physiological effects, due to high natural variability. These eco-physiological effects are better examined in aquacultural systems. This study investigates whether microplastic particles are assimilated on a cellular level within the gastrointestinal tract of mullet (M. cephalus L.). Links are investigated between the likelihood of assimilation of certain microplastics in relation to their bio-availability and retention time. Mullet collected from Durban Bay were maintained on a 1 month depuration diet, after which gut retention experiments were conducted using various microplastics. Fish were then isolated and force-fed diets containing known amounts of various UV fluorescent microplastics for 14 days. The fish were dissected and histological samples taken from the gastrointestinal tract. After chemical digestion of the tissue, light microscopy with UV light was used to determine whether microplastics were assimilated on a cellular or histological level in the gastrointestinal tract. Preliminary gut evacuation rate experiments with mullet indicated significantly increased retention times of 39.6 ± 5.8 h and 23.8 ± 10.4 h for microbeads (5 mm) and microfibres (1 mm) respectively, compared to a natural gut retention time of 13.3 ± 1.6 h. Given that microplastics may serve as vectors of contaminants to marine biota, the increased retention times here observed may play an important role in increasing pollutant levels in fish.

9

Wintertime rates of total, new and regenerated production in the southern Benguela Upwelling System

Miss Raquel Flynn[1], Miss Jessica Burger[1], Miss Keshnee Pillay[2], Dr Sarah Fawcett[1]
[1]*Oceanography Department, University Of Cape Town,* [2]*Department of Environmental Affairs*

Primary production is an indicator of the amount of energy available to an ecosystem. The high rates of primary productivity associated with eastern boundary currents are supported by the upwelling of cold, nutrient-rich water from depth. Upwelling regions are thus typically characterized by high rates of nitrate-fuelled phytoplankton growth ("new production"). The southern Benguela region experiences upwelling in summer, with a relaxation of upwelling-favourable winds in winter. Net primary production (NPP) and nitrate- and ammonium uptake (i.e., new and regenerated production) were measured throughout the euphotic zone at six stations (inshore, midshore, offshore) in the southern Benguela Upwelling System (BUS) in May 2015 using isotope tracer addition experiments. Wintertime rates of euphotic zone NPP were highest at the inshore stations and lowest at the offshore stations, coincident with lower temperatures and higher nutrient concentrations in inshore surface waters. However, a greater percentage of NPP was apparently exported from the euphotic zone at the stations furthest from the coast, as indicated by the high specific nitrate uptake rates at these stations. Inshore waters, by contrast, were characterised by high specific ammonium uptake rates. On average, the entire region was predominantly supported by regenerated nitrogen, with mean euphotic zone f-ratios of 0.07-0.41. Comparing the average wintertime daily rates of euphotic zone integrated NPP measured in this study (2010 mgC.m-2.day-1) to previous summertime measurements (3468 mgC.m-2.day-1) confirms the expectation that winter in the southern BUS is less productive than summer, and suggests an annual average rate of NPP of 1000 gC.m-2.y-1.

10

Modelling cetacean distribution to help spatial and temporal management of anthropogenic activities in a South African marine environment.

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Increasingly innovative technologies are being applied to resource identification and use within South Africa's regional oceans economy. This coupled with Operation Phakisa, which is a recent South African Government initiative to unlock the oceans economic potential, could if not managed adequately have the possibility of negatively affecting ocean health. One area of concern is increasing evidence that chronic noise produced by anthropogenic activities results in negative impacts on marine fauna. South Africa has no legislation protecting marine fauna from acoustic pollution and to implement laws or policies accurate and reliable information on species distribution is required. We model species distribution from a number of different presence only data sets using maximum entropy (MaxEnt) which is an algorithm that does not require absence data. The distribution of three of South Africa's more common cetacean species were modelled using this method; the sperm Whale (Physeter macrocephalus), the southern right whale (Eubalaena australis) and the humpback whale (Megaptera novaeangliae). We used MaxEnt to construct predicted species distribution maps in South African waters with the predictor variables consisting of bathymetry, slope, distance to shore, sea surface temperature, chlorophyll a and sea surface height. This is part of a larger project where we will model species exposure to anthropogenic activities; more specifically seismic surveys and commercial shipping. This in turn will enable spatial and temporal management of the ocean, reducing exposure time of harmful anthropogenic activity to marine fauna and may provide useful knowledge to implement legislation to protect marine fauna from acoustic pollution.

11

Controls on new production and carbon export in the southern Benguela Upwelling System

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The southern Benguela upwelling system is characterised by high levels of primary productivity. Coastal upwelling supplies the euphotic zone with cold, nutrient-rich water from depth, thus governing the biological response to nutrient enrichment. On timescales of months, phytoplankton growth supported by newly available nitrate ("new production") is balanced by the export of organic matter from surface waters, ultimately resulting in the sequestration of atmospheric CO_2 "fixed" as organic carbon biomass at depth. The coastline bordering the southern Benguela region is irregular. Topographical features like bays and capes cause a shear in the wind stress field allowing for the formation of discrete upwelling centres, one of which is located at Cape Columbine. In the shadow of upwelling centres, retention zones are formed, for example St Helena Bay to the north of Cape Columbine. They are of major ecological and biogeochemical importance as they act as nursery grounds for young fish and can be prone to harmful algal blooms and hypoxic conditions. In this study, a station in St Helena Bay (station 2 of the St Helena Bay monitoring line) was sampled daily for 10 days during the upwelling season (November/December 2016). Primary production and nitrate and ammonium uptake rates were measured daily through in situ tracer incubation experiments. These results will be discussed in the context of hydrography, nutrient concentrations, chlorophyll concentrations and phytoplankton community composition data, with the goal of better understanding the dynamics of short-lived species and their impact on biogeochemical cycles and climate.

12

Bacterial Counting: Quick, easy and accurate?

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The cycling of nutrients via the microbial loop enables ecosystems to function at a relatively stable rate in the absence of allochthonous nutrient sources, which although essential, are heavily dependent on rain and wind driven modes of transport. Although phytoplankton have received attention as the primary producers in aquatic environments, considerably less attention has focused on the essential link between the primary producers and the primary recyclers within the global food web. Heterotrophic bacteria are the means by which used nutrients are recycled to a usable form and then re-introduced into ecosystems for use by both phytoplankton and other biota, instead of being lost. The need to rapidly and accurately count and size bacteria within an aquatic ecosystem is key to understanding the direct links between the primary recyclers, producers and other biota within the food web and ecosystem carbon linkages. Traditional enumeration of bacteria is tedious and time consuming. We present here the use of a user-assisted counting and sizing macro using Image-Pro-Plus to analyze individual bacterial cells. Validation was accomplished by volunteers manually counting and sizing bacterial cells, and then using the macro. Statistical analysis showed that the macro is significantly better than manual analysis with a 1765% reduction in total time spent assessing the bacterial cells with significantly less variation in data generation. This method resulted in a time saving of 7–11 months. Novel applications and the effect of colour blindness will be discussed.

13

Counting and sizing microplastic fibres, the accurate and easy way

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Marine plastic pollution consists of both macroplastic particles (> 5 mm) and microplastics. Primary microplastics (≤ 5 mm) are generally used for commercial and industrial abrasives while secondary microplastics, result from the disintegration of larger plastic particles. Currently one of the most common sources of secondary microplastics is the shearing of plastic textile fibres from clothing in washing machines, and with the increase in domestic appliance reliance, microfibre pollution is escalating. The need to accurately and reliably count and size microplastic fibres from environmental samples or laboratory experiments is impeded by the slow process of sifting through sand, gut contents and filters, requiring the need for manual evaluation by microscopy. We present here the use of a macro-enabled counting and analysis program coded specifically for IPP (Image-Pro-Plus) for the automated analysis of fluorescent microplastic fibres. To test the efficiency, accuracy and reproducibility, manually collected data was compared to data from the automated counting feature. Accuracy of counts, size measurements and time taken for analysis, were compared. The macro showed no statistical differences between the numbers of fibres counted and size measurements (with the use of an algorithm). A significant statistical difference was found for average time taken with 23.90 ± 6.86 vs 1.2 ± 0.77 mins for manual and automated analysis respectively per filter (12 images), resulting in a massive 2382% decrease in time taken for analysis. We recommend the use of the macro to accurately count and size microplastic fibres.

14

Spatio-temporal distributions of picophytoplankton in the southern Benguela using a flow cytometer

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Picophytoplankton are primary producers ranging in size from 0.2 to 2 µm, and are comprised of prokaryotic cyanobacteria and a diversity of eukaryotic cells. There is very limited information on these groups in the southern Benguela. This study sampled picophytoplankton along four monitoring lines off the west coast of South Africa from 2015, contributing to the Integrated Ecosystem Programme of the Department of Environmental Affairs. Sampling was conducted seasonally (May, September, November and February) to determine the spatial and seasonal variability of these groups and to identify possible environmental factors that influence their distributions. Seawater was collected from the surface and chlorophyll maximum layers using CTD rosette sampling bottles. Samples were pre-filtered through a 200 µm sieve and fixed with glutaraldehyde, snap frozen in liquid nitrogen and stored in -80°C prior to analysis. Flow cytometry was used to enumerate the picophytoplankton and to identify the main types, based on their size and pigment signatures. Results are presented here for Synechococcus and picoeukaryotes. In May 2015 there was high abundance of picoeukaryotes close to shore and low abundance of Synechococcus. The opposite was observed in September, November (2015) and February (2016), both groups were abundant offshore. These results have been related to physicochemical variables and, although there are indications that picophytoplankton abundances are greatest in newly upwelled water, this pattern is not consistent. This study forms a basis for further investigations of the roles these picophytoplankton groups play in biogeochemistry and microbial food webs in the southern Benguela.

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A tale as old as time: The flightless moth and Wandering Albatross

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The Polar Regions experience rapid Global change with implications for both terrestrial and marine systems. For organisms, growing, surviving and reproducing is highly dependent on regional temperature regimes, making their physiological and behavioural response to changing temperatures a significant concern.
On Marion Island, a tale as old as time, is one of the Wandering Albatross and the flightless moth caterpillars inhabiting their nests. Pringleophaga marioni are keystone in ecosystem functioning, and a more complex interaction could not be envisaged. Using this unique opportunity, we examine the response of caterpillars to changing temperature regimes (nest conditions), and discuss the implications thereof given future Global change.
A large mismatch between the thermal optimum (Topt~22°C) and preferred temperature (Tpref~8°C) is in keeping with high latitude temperate species. A high Topt compared to body temperatures suggests an enhanced ability to cope with rising temperatures. However, Tpref may be better matched to temperatures at which survival is maximised (5°C), suggesting that optimum temperatures differ for different physiological traits. The limited acclimation ability and low survival at high temperatures suggests that P.marioni may not easily persist in warmer conditions. Besides the general warming trend, increased variability is also predicted. The significant metabolic depression at fluctuating temperatures suggests an increased sensitivity to rising temperatures without taking environmental variability into account. Any impact on P.marioni may indirectly impact ecosystem functioning: rising temperatures may increase primary productivity and hence resource demand. This sequence of events could change nutrient cycling and because of its' keystone role, functioning of the system.

16

Benthic microalgal spatial patterns associated with peritidal stromatolite microhabitats along the South African coast.

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Eukaryotic microalgae, such as diatoms, have previously been considered to have had a minor contribution towards the formation of stromatolites. In contrast to their ancient counterparts, many modern marine stromatolites have a coarser internal structure and host a diverse eukaryotic community. Known as eualgal-cyanobacteria stromatolites, these Phanerozoic formations are likely a result of the abundance of larger sediment particles from the biomineralisation of skeletal material. However, it is unclear how eukayotic microalgae have contributed towards modern stromatolite formation. Therefore, the aim of this study is to investigate how the microalgal community contributes towards the differences observed amongst mesofabric structures in terms of depth profiles and layering at representative stromatolites forming along the southern South African coastline. This was achieved by comparing the proportional abundances of each of the major microalgal classes (cyanobacteria, diatoms and green microalgae) between the different mesofabric types and depth profiles. Clear variability in terms of proportional abundance was apparent between microhabitats and with depth. Coarser, more bioturbated types had a higher diatom biomass than smoother types. This is likely a consequence of the greater efficiency of diatoms in terms of trapping larger sediment particles. The implications of these results are discussed in terms of eukaryotic microalgae (specifically diatoms) being important ecosystem engineers in these modern ecosystems.

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Feeding preferences of the calanoid copepod Pseudodiaptomus hessei under condition conditions

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In the natural environment, feeding of estuarine copepods generally involves a diel vertical migration. It has been proposed that copepods migrate upwards at night to feed, returning to deeper strata at dawn. However, some research has shown that copepods might also be feeding on benthic food source such as detritus and microalgae during the day. This study aims to improve our understanding of feeding biology of Pseudodiaptomus hessei, particularly whether P. hessei it prefers feeding on suspended phytoplankton or benthic microalgae. Copepods were allowed to fed on two species of microalgae (Isochrysis galbana and Tetraselmis suecica), one presented as benthic and the other as a suspended food source. The choice of algae and presentation state were also swapped. The amount of each algae species in the gut of P. hessei was quantified using real-time PCR. Food source consumption was significantly different ($p<0.026$) between benthic and planktonic food source suggesting that P. hessei prefers to feed on the planktonic food source. After 80 min, P. hessei then shifts from planktonic to a benthic food source. The results of this study confirm the assumption from previous ecology research that P. hessei might be feeding on a benthic food source during the day.
Key works: Diel migration, benthic food source, planktonic food source, real-time PCR

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Seasonal changes in the salt marsh-terrestrial boundary vegetation

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Salt marsh ecosystems are vulnerable to climate change, particularly sea level rise (SLR). However, salt marshes are able to adapt to SLR through biophysical processes, provided that these processes are not altered by anthropogenic activities. Understanding the effects of environmental factors on plant growth and survival is required to predict, manage and adapt to climate change. Seasonal changes in the salt marsh-terrestrial boundary were investigated at the Swartkops Estuary. Long-term monitoring plots were established to track changes in plant cover abundance and sediment characteristics of this ecotone habitat. In addition, laboratory studies were used to assess the morphological response of selected ecotone plant species Disphyma crassifolium to different salinity and inundation states. This was done using a controlled experiment of three inundation levels (tidal, waterlogged and drought) and five salinity levels (0, 8, 18, 35 and 45 ppt). The transect surveys identified three distinct vegetation zones along the boundary i.e. Drosanthemum parvifolium, Sarcorconia pillansii and D. crassifolium dominated zones distributed along an elevation gradient. During winter, the vegetation changed and an Isolepis sp. was dominant in the ecotone habitat growing in response to low electrical conductivity and increased disturbance. Laboratory studies showed that D. crassifolium grew best in the dry treatment at a salinity of 8 ppt. There was a decrease in growth under waterlogged conditions and steady growth in the tidal treatments in high salinity (>18 ppt). These results indicate that D.crassifolium is sensitive to high salinity and waterlogging and wouldn't survive changes in these parameters caused by SLR.

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Morphological and genetic variation of Gymnothorax undulatus (Anguilliformes: Muraenidae) in the Western Indian Ocean

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Gymnothorax undulatus is an Indo-Pacific moray eel species, currently identified by colour pattern. Colour pattern variation and a wide range in morphology have caused taxonomic confusion and several synonyms. This study, therefore, aims to re-evaluate the taxonomic status of G. undulatus in the WIO using morphology and genetics.

A total of 99 specimens from the WIO and extralimital areas were examined. Eight morphological characters were subjected to multivariate principal component and discriminant function analyses in PAST and STATISTICA, to examine morphological differentiation between specimens from various geographic regions. Meristic characters (vertebrae and dentition) were also examined. DNA sequence data from mitochondrial genes (COI and 16S) were analysed using standard phylogenetic procedures in MEGA7 to examine relationships and differentiation among the various regions of the WIO for G. undulatus.

The results revealed considerable morphometric overlap among specimens from different geographic regions, but with little to no overlap for three regions. These groupings accounted for 83.53% of the total variation, with 57.58% overall classification success of individuals to their original geographic regions. Significant ($p<0.05$) morphometric differentiation among clusters was supported. Furthermore, analysis of the total vertebrae count produced similar clusters to the multivariate analyses. Colour patterns distinguished South African samples from those of other regions. The neighbour-joining and maximum likelihood trees from the genetic analyses revealed two distinct clades within G. undulatus, each with bootstrap support >80%. A widely distributed clade should retain the name G. undulatus, while the genetically-and morphometrically-distinct South African clade should be described as a new species.

22

Precambrian relics along South Africa's coastline: living peritidal stromatolites and the drivers of their persistence

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Living stromatolites are rare in modern ecosystems but previously dominated shallow oceans during the Precambrian, from 0.5-3.7 bya. These structures form through the layered trapping of sediment and cellular deposition of calcium carbonate by microalgae, principally cyanobacteria and diatoms. An extensive network of actively accreting stromatolites has been discovered within the past two decades along the South African coastline. These coastal stromatolites form at the interface of groundwater seepage and the ocean high-water mark, constructing rimstone dam-like pools at an accretion rate of ~2-5 mm per year. The aim of the current study was to characterise the biological community from representative stromatolite sites near Port Elizabeth, South Africa, in terms of microalgae and macroinvertebrates, as well as to describe some of the functional drivers of community change. Key physico-chemical attributes of the stromatolite pools are related to the frequent, complete states shifts between freshwater and marine conditions, driven by tidal and ocean swell variability. Salinity, as well as temperature and macronutrient concentrations (dissolved inorganic nitrogen and phosphorus), are the primary drivers of biological community change within the microalgal assemblage. Furthermore, a trophic analysis using stable isotopes to assess dietary composition was used to characterise metazoan dependence on the stromatolite microalgae as a food resource. These results are discussed in light of stromatolite persistence in modern ecosystems, especially in terms of the factors which preclude stromatolite formation in other habitats, such as metazoan bioturbation or grazing.

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Ciliate-zooplankton epibiosis in Africa's largest estuarine lake

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Epibiosis is a symbiotic association of two organisms in which one species (epibiont) uses the surface of another species (host) as an attachment substrate. Although not traditionally regarded as parasitic, recent studies have revealed that epibionts have a mainly deleterious effect on zooplankton hosts. In spite of its widespread occurrence, there are very few studies in Africa that address epibiosis in the aquatic environment, particularly that involving zooplankton as hosts. Epibiotic ciliates are often found in zooplankton samples from the St Lucia Estuary, Africa's largest estuarine lake.

A study was conducted in the St Lucia Estuary between 2014 and 2017 to determine:
a) The identity of the epibiotic ciliates.
b) The association of the epibionts with the St Lucia Estuary zooplankton.
c) The environmental conditions that promote the proliferation of the epibionts.

The results of this study reveal that the epibiotic ciliates are the peritrich Epistylis sp., are specific for the dominant copepod Pseudodiaptomus stuhlmanni, and have a negative association with the fitness of this copepod. Epistylis sp. is favoured by salinities below 20 and turbid conditions, with the latter only holding true if characterized by a high organic matter content.

The ecological implications of ciliate-zooplankton epibiosis in the St Lucia Estuary and similar systems will be discussed.

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Diel patterns and photic preferences that drive Algoa Bay's observed rocky reef fish community structure

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The diel change in ambient light is recognised as an important driver of animal activity patterns, with consequent diel changes in the structure of animal communities. South Africa's nocturnal rocky reef fish communities and those inhabiting deep (55-100m) reefs, however, remain understudied. The importance of natural ambient light in shaping the distribution of Algoa Bay's rocky reef fish communities at shallow (10-30m) and deep (55-100m) sites was demonstrated using baited remote underwater stereo-video systems (stereo-BRUVs). Distinct day and night fish communities were sampled at shallow and deep reef sites, with significant diel differences in species richness ($p < 0.001$), species abundance ($p < 0.001$) and community composition. These shifts appeared to be driven by diel activity patterns associated with species specific photic preferences. Top predatory teleost species and low level consumers, many belonging to the family Sparidae, showed evidence for strict diurnal activity, with their activity being further restricted to shallow reefs. These species were responsible for the most diverse fish community being sampled at shallow reefs at day. It is therefore hypothesised that this habitat was associated with a high risk of negative interspecies interactions, such as competition and predation. It is likely that the biotic conditions associated with shallow reefs at day drives the three movement patterns identified in this study; movement onto shallow reefs at night from adjacent sandy flats, movement onto shallow reefs at night from deep reefs and movement out of sheltered micro-habitats which are occupied by nocturnal species at day.

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Changes in recreational angler attitudes towards, and awareness of, linefish management along the KwaZulu-Natal coast, South Africa

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[1]Ukzn, [2]ORI, [3]SAAMBR

Fisheries management is about managing the people, not the fish. Management of recreational fisheries cannot only be based on biological data, but needs to include the social aspects of the anglers within the fishery and their dynamic attitudes towards changes in fishing pressures and polices. Without regular assessment of the dynamics of both fish and fishermen, management can become compromised.

Two independent snap-shot monitoring surveys were conducted on the KwaZulu-Natal recreational shore fishery between 1994-1996 and 2008-2009. These formed part of an envisioned national programme to evaluate the linefishery and its management along the South African coastline. Whilst the baseline social information collected from these surveys have been used to assess certain aspects of the shoreline fishery in KZN, there has yet to be any detailed evaluations done to understand the relationship between the anglers' knowledge, attitudes, behaviors and legislative changes occurring in South Africa between these two periods. Through the use of psychographic information, along with institutional and legislative changes, the perspectives of anglers through time can be assessed and incorporated into management. Since it has now been seven years since the last survey, and with drastic fisheries management changes currently taking place along the KZN coastline, it is vital that this research continues to be done in order to provide necessary information for the improvement management. A better understanding of the anglers' attitude towards fisheries management and how they perceive and react to regulatory frameworks can contribute to more effective compliance and reduced ignorance of changing management decisions.

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Recreational SCUBA Diving Interaction With The Vulnerable Ragged-Tooth Shark (Carcharias taurus) At The Aliwal Shoal Marine Protected Area, Kwazulu-Natal.

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This research observed interactions between the ragged-tooth shark (Carcharias taurus) and the recreational SCUBA diver at the Aliwal Shoal Marine Protected Area. Ragged-tooth sharks are listed as vulnerable (IUCN red list) and the behaviours of recreational SCUBA divers may alter the behaviour of the shark, ultimately endangering the shark population. A code of conduct has been developed for divers and diving operators regarding diver behaviour that should be obeyed when encountering these animals. The particular study site at Aliwal Shoal is the Cathedral dive site, which is a very popular dome-shaped-cave that the sharks use for refugia in the process of breeding. It is also visited by hundreds of divers each year, and this may alter the sharks behavior.

The study aims to video the behaviours of divers and the reactions of the ragged-tooth shark population to see the effect that the divers have on the sharks. The diver behaviour may possibly alter the mechanics of a population and could impact the sharks behaviour. Examples of this may be chasing them away from preferred refugia, which may be less conducive to mating behaviour and also make them more susceptible to predation by great white sharks (Carcharodon carcharias) and tiger sharks (Galeocerdo cuvier). Preliminary results have shown that divers prefer to be as close to the entrance of the cave as possible and that shark numbers are decreasing when divers are present.

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Assessment of species sensitivity to the impacts of climate change for key marine species in the southern Benguela system

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The aim of this study was to conduct a risk assessment for the key marine species in the southern Benguela system to identify their sensitivity to the impacts of climate change.
For our analysis, priority species were nominated on the basis of economic, ecological and recreational importance. A total of 40 species was selected after consultation with experts. A literature review was conducted for each species to gather information on the life history, habitat usage and stressors and to create species assessment profiles for assessing the risk under different sensitivity attributes. The sensitivity of a species was estimated using indices based on abundance, distribution and phenology. Fourteen indices were used to determine the sensitivity and capacity to respond to climate change of the selected species. A score ranging from low (1) to high (3) sensitivity was given for each index based on the available information. Similarly, a score was assigned to the type and quality of information used to score a particular attribute.
The analysis identified the white Steenbras, abalone, St. Joseph shark, west coast rock lobster and harders, in order of vulnerability, as the most sensitive species to climate change impacts in the southern Benguela system. This study also identified information gaps on fecundity, larval dispersal and on settlement and metamorphosis cues on most of the evaluated species. Our results can be used by resource managers to better prioritize what type of monitoring, intervention or planning may be required given limited resources.

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DEVELOPMENT OF AN EGG DISINFECTION PROTOCOL FOR SOUTH AFRICAN MARINE AQUACULTURE FINFISH SPECIES.

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As the South Africa local mariculture finfish industry is still in its infancy. The transfer of disease via eggs has been demonstrated in various cultured fish species suggesting that it is highly possible that pathogens could be transferred between facilities with potential catastrophic. Aim of study was to develop a safe, simple and effective egg disinfection protocol for Dusky kob (Argyrosomus japonicus). Dusky kob eggs obtained from captive broodstock fish at Pure Ocean (Pty) Ltd, East London conditioned to spawn in a recirculating system. First study was to determine the efficacy of four disinfection agents on their ability to adequately reduce the bacteria microflora community on the surface of dusky kob eggs. Four disinfection agents (Formaldehyde (FO: 2.5g/L for 15 min & 5g/L for 5min), Povo-iodine (PI: 5g/L for 15min & 10g/L for 5min), Chloramine-T (CT: 7.5g/L for 10min & 15g/L for 5min), Hydrogen peroxide (HP: 1.8g/L for 15min & 0.9g/L for 5min) & untreated control were tested at various concentrations and exposure times. The untreated egg control had (mean±SE 786.5±118.5 CFU/mL). Doses with higher concentrations and five minute exposure times showed greater efficacy. All disinfectants with the exception of formaldehyde significantly ($P<0.05$) reduced the bacterial microflora community on the eggs surface (CT15g/L 5min 8±0; CT7.5g/L 10min 9.5±0.5;HP1.8g/L 5min 19.3±7.8; HP0.9g/L 15min 52±3; PI10g/L 5min 21.3±4.8 & PI5g/L 15min 24.5±5.5 CFU/mL). The best two disinfectants (Chloramine-T & Hydrogen peroxide) will be tested to determine the effect of the disinfecting agent on the hatchability, survival and quality of dusky kob larvae.

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Ecophysiology and nutrients:The prolonged bloom persistence by Cyanothece sp. in Lake St Lucia, South Africa.

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The effects of climate change and eutrophication have been associated with persistent cyanobacterial blooms becoming more frequent, with possible negative effects on human health. The occurrence of an 18-month long Cyanothece sp. bloom from June 2009 to December 2010 in Africa's largest estuarine lake, St Lucia, highlighted the susceptibility of ecosystems to anthropogenic alterations. This study investigated the long-term survival and physiological adaptations of Cyanothece sp. to various and dynamic environmental conditions. The main findings are the high salinities at which Cyanothece sp. could perform important physiological processes such as N uptake, N2 fixation and photosynthesis. Nutrient uptake (both nitrogen and phosphorus) was observed over the full experimental salinity range (0-300) while N2 fixation was only observed up to a salinity of 120. Nutrient uptake rates significantly decreased at this threshold salinity of 120. Photosystem II activity was not observed in Cyanothece sp. during this study, but photosystem I activity was robust across all experimental conditions. Zooplankton abundance within the St Lucia system was negatively correlated with salinity, while grazing experiments indicated that the typical estuarine zooplankton species can graze on Cyanothece sp. cells. Therefore, the disappearance of zooplankton at salinities above 60 must have been an important factor in the bloom persistence. Apart from the ecological factors that were at play in St Lucia during the bloom period, the persistence of the Cyanothece sp. bloom can be attributed to the robust nature of their nutrient uptake, nitrogen fixation and photosynthetic systems to maintain activity despite extreme hypersalinity levels.

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Factors affecting trophic signatures of deep sea benthic invertebrates at a Sub Antarctic archipelago

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Food availability is a key factor that regulates the distribution, metabolism and success of benthic populations. In deep sea ecosystems, hydrodynamics and depth play fundamental roles in determining food resources for the benthos. Recent studies suggest that, due to climate change, the Sub-Antarctic Front is shifting southwards, with implications for primary production dynamics and benthic food availability around Sub-Antarctic Islands embedded in the Antarctic Circumpolar Current. We used fatty acid (FA) and stable isotope (SI) analyses to investigate the dietary signatures of benthic invertebrates and suspended organic matter (SPM) at three Depths (shallow-100m, middle-300m and deep-600m) and in three Areas with different flow and productivity regimes around the Prince Edward Islands. The SI values of SPM showed effects of both Area and Depth, while, as expected, feeding guild was the most important overall factor for consumers. Specifically, the ways in which trophic signatures responded to Area and Depth differed among groups. Depth generally affected the δ15N and FA signatures of suspension feeders, deposit feeders and predators, with deeper samples being depleted, reflecting greater remineralization of SPM, while Area only affected the δ13C signature of detritivores and suspension feeders. Critically, the effects of Depth and Area were taxon-specific, indicating that long-term responses to environmental change may be complex, with consequent implications for the higher trophic levels that these populations support and the entire ecosystem functioning.

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Triggers of phytoplankton succession patterns in a permanently eutrophic South African estuary

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Despite the complexity of phytoplankton blooms, the ability to predict their occurrence, persistence and decay, as well as species succession patterns are important from a social and ecological perspective. The Sundays Estuary provides a unique opportunity to investigate these processes as it is permanently eutrophic and has recurrent harmful algal bloom (HAB) events of Heterosigma akashiwo (Raphidophyceae). As such, this study aimed to provide insight regarding the spring/summer bloom dynamics in the estuary. Subsequent to initial HAB formation, monitoring of abiotic and phytoplankton parameters was undertaken twice a week for a month, with surface water salinities ranging from 9 to 12 a prerequisite for site selection. During the study, two exceptional HABs (> 550 µg Chl-a l-1) of H. akashiwo occurred, lasting for approximately a week. Statistical analyses highlighted nutrient depletion (i.e. nitrate and phosphate concentrations) as the key constraint ($p < 0.001$) on bloom duration. During periods in which H. akashiwo densities were low, community composition became more diverse with species belonging to Bacillariophyceae (Pleurosigma angulatum and Cyclotella atomus) and Dinophyceae (Karenia cf. mikimotoi and Heterocapsa rotundata) abundant; albeit to a lesser degree (< 180 µg Chl-a l-1). Further, dissolved oxygen shifted from super-saturated conditions (> 14 mg l-1) during peak bloom conditions, to instances of bottom-water oxygen depletion (> 2 but < 4 mg l-1) during the HAB decay phase. These findings highlight the potential severity of transforming a catchment from natural to highly-regulated via agricultural practices, whilst also emphasising the need for management intervention.

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Small-scale variation of microalgal assemblages: Effectiveness of artificial substrates as a water quality monitoring tool in the St. Lucia Estuary.

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It is important to understand the spatio-temporal variability within estuaries before ecological indicators can be used to inform ecological change. One way of compensating for natural variability is the use of artificial substrates. Here we tested the efficacy of microalgal assemblages in response to changes in the freshwater flow and nutrient input to the St. Lucia Estuary. This is of particular concern due to the recent reconnection with the agriculturally-impacted Mfolozi River. The microalgal assemblages collected from the two principal natural habitats in St. Lucia, (pelagic and benthic), were compared to periphyton grown on artificial substrates in situ. Sampling carried out weekly for 4-weeks showed no significant biomass differences ($p > 0.05$) in either of the natural habitats over the experimental period. In contrast, the periphyton biomass accumulation on artificial substrates was highest following a natural input of nutrients during Week 2. Statistical analyses indicated that the growth of periphyton on the artificial substrate was affected mostly by DIN and salinity. The highest species diversity index ($H' > 2$) for both the natural pelagic and benthic habitats was recorded in Week 3, while the periphyton diversity gradually decreased over time (ca. 1.35 to 0.54). These data indicate that periphyton reflect the nutrient input to the St. Lucia Estuary and that artificial substrates should be incorporated into future monitoring efforts for this highly variable system.

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Possible links between river flow, zooplankton dynamics and dominant zooplanktivorous fish species in a warm-temperate estuary

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River flow, as a primary determinant of nutrient inputs into estuaries, has a strong influence on phytoplankton productivity within these systems. Phytoplankton is an important food resource for zooplankton which is, in turn, consumed by planktivorous fishes. The estuarine round-herring (Gilchristella aestuaria) and Cape silverside (Atherina breviceps) are among the most abundant planktivorous fish species in many South African estuaries and as such, there is potential for inter-specific competition between these two species. This study investigated the links between river flow, plankton and aspects of the ecology of these key zooplanktivorous estuarine fish species. Zooplankton and fish data was collected on seasonal basis along the length of the Kariega Estuary. River flow data was provided by the Department of Water and Sanitation (DWS) and estuarine physico-chemical data was collected by SAEON. Selected fishes 30-70 mm standard length were collected from seine net hauls from multiple sites and were retained for stomach content analyses in the laboratory. Spatio-temporal changes in physico-chemical conditions, zooplankton abundance and biomass, and fish abundance and distribution were recorded. Highest zooplankton abundance and biomass values were recorded in the middle reaches of the estuary while peaks in G. aestuaria and A. breviceps catches were more spatio-temporally variable. Both fish species, however, consumed similar zooplankton taxa as high dietary overlap was documented for most seasons of the year. This study highlights the role of river flow in driving zooplankton distribution and abundance, thereby influencing zooplanktivorous fish distribution, abundance and competition.

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The Acrothoracican barnacles of South Africa

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Abstract
The Acrothoracica are a Superorder of barnacles within the Infraclass Cirripedia, which also contains the Thoracica (conventional attached barnacles) and Rhizocephala (castrating parasites of decapod Crustacea). Acrothoracicans are unusual, shell-less barnacles that burrow into calcareous objects, such as mollusk shells, corals, bryozoans and limestone. Locally and globally this entire superorder remains poorly known. To date there are only four known species from South Africa, and other than their original taxonomic descriptions, nothing is known about their distributions, the ranges of hosts occupied, or any other aspects of their biology. The aims of this project are to review the Acrothoracican fauna of South Africa, re-describing each of the known species, describing any new species or records, documenting the spectrum of hosts each species occurs in, the proportions of each host infected, the number of barnacles per infected host, their geographical distributions around our coastline, etc. Lastly we intend to create an illustrative guide to the Acrothoracican fauna of South Africa. Sampling is taking place on the cool-temperate West Coast, Warm-temperate South Coast and Sub-Tropical East Coast. Preliminary data suggest that Acrothoracicans show little host specificity and occur in more host species than currently documented. More than one species can occur on a single host and they have been found at densities of more than 350 individuals per host. Images and preliminary distributional data are presented, but as Acrothoracicans are difficult to find, we welcome any additional specimens, or observations.

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Invertebrate and ichthyofaunal communities in selected micro-estuaries and micro-outlets of the Eastern Cape Province

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South Africa has more than 200 Temporarily Open/Closed Estuaries (TOCEs) along its 3100 km coastline. In addition, there are more than 100 micro-estuaries and micro-outlets on the subcontinent, many of which share some of the characteristics with TOCEs but differ in that they are supplied by localised coastal stream catchments with a more limited supply of freshwater and less connectivity to the marine environment. The physico-chemistry, species abundance and composition of invertebrates and fish inhabiting four micro-estuaries and four micro-outlets along the warm-temperate section of the Eastern Cape coast was investigated over a one year period. Zooplankton, benthic macroinvertebrates and fish community surveys were conducted during winter, spring, summer and autumn at each of the eight systems. Zooplankton were collected using a hyperbenthic sled fitted with a 200 µm mesh D-net. Macro-zoobenthos were sampled using a van Veen benthic grab, while the fish were sampled with a seine net. Chironomidae and Ephemeroptera dominated benthic macro-invertebrate communities in micro-outlets, while Amphipoda were most dominant in micro-estuaries. Copepoda dominated the zooplankton assemblages in both system types. Fish communities in micro-outlets were dominated by juvenile Myxus capensis, while Gilchristella aestuaria, M. capensis and Monodactylus falciformis were the three most common fish species in the micro-estuaries. Seasonal variations in physico-chemical parameters and community composition of both fish and invertebrates were recorded during this study. The results confirm that there is a distinction between the biota of the two system types, with micro-estuaries having more diverse invertebrate and fish assemblages than micro-outlets.

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Is observational bias impacting fish conservation efforts? Lessons from early life history studies in temperate South Africa

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Fish ecology is compartmentalized within schools of thoughts and existing focus areas, often driven by habitat, funding, applied aspects and short term postgraduate degrees. Using examples from South African shallow water studies on early life history stages, evidence is given for tunnel vision creep and a case is made for breaking down thinking silos. Schools of thought have resulted in overemphasis of value of certain types of habitats while ignoring others impacting the understanding of fish use patterns. Diel and gear sampling bias has rendered some species absent when actually present. Habitat use studies show conflicting results for juvenile fish as too few comparisons were used to fully elucidate patterns. Attaching value to certain habitat types is an essential contribution for conservation planning however belief in winners and losers precludes understanding plasticity in habitat use. Recent work on microhabitat use and residency in small areas in mangrove creeks shows that typical winner habitat is not selected equally within a species. Habitat use plasticity contributes to species success in estuarine nursery areas. Ontogenetic habitat shifts in some species form a nursery continuum and underpins early life history strategies that are often missed in a compartmentalized research approach that will focus on either marine, estuarine or riverine habitats. Habitat continua must be included in seascape conservation and protected area planning worldwide. Climate change, freshwater abstraction, habitat alteration, pollution, migration barriers and alien species introductions are taking place faster than our ability to change our thinking in aid of holistic fish conservation efforts.

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Habitat use by young fishes in select temperate estuaries to assess use patterns in a changing environment

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Estuaries are among the most productive ecosystems worldwide as they provide important refuge and feeding areas for the juveniles of many marine species, many of which have recreational importance. The use of these nursery areas by juvenile fishes remains poorly understood in South Africa and many critical areas such as shallow water creeks and vegetated habitats remain understudied. The aims of this study were to assess the current status of juvenile fishes in select estuaries and compare this with historical catches from the same estuaries. In addition, the links between fishes and plant communities within nursery areas was explored. Many of the important marine recreational species that utilize these estuarine systems during their juvenile phase are still present but their abundance have declined by as much as 40% due to overfishing and is linked to the decline of spawning adults. Juvenile fishes that occur in these estuaries utilize a range of vegetated habitats ranging from saltmarsh creeks, Zostera capensis beds, Spartina maritima and previously unexplored Phragmites australis areas. Evidence of plasticity in use of vegetated areas was observed. Fishes are also showing evidence of feeding and sheltering in these areas. Knowledge of fine-scale habitat use by fishes is essential for conservation planning as exclusion zones can be optimised to limit anthropogenic influence on nursery use patterns in fishes.

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Evaluation of temperate mangrove estuaries as food patches using RNA:DNA ratios to assess body condition in larvae of Gilchristella aestuaria

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Estuaries serve as important nurseries to fishes worldwide. Estuaries are dynamic systems and are thus likely to vary in nursery function, mostly due to habitat quality and food availability. Mangroves are thought to be good nurseries as they enhance food availability and protection, allowing more early stage fishes to be recruited into the adult population. As growth and survival are linked to the nutritional condition of larval fishes, the nutritional condition can be used as a proxy to food patch quality. Recently the RNA:DNA method has increased in accuracy and is commonly used to quantify the nutritional condition of fish larvae. This study aimed to compare the food patch quality of similar mangrove and non-mangrove estuaries by using the RNA:DNA ratios of Gilchristella aestuaria larvae. Results indicated that the G. aestuaria larvae in the Nahoon (mangrove) estuary was in the best body condition (1.62 sRD) while larvae in the Gonubie (non-mangrove) estuary (1.41 sRD) and in the Xhora (mangrove) estuary (1.49 sRD) were in a lower body condition. No relation between body condition and physico-chemical variables such as temperature, salinity nor turbidity were found. Thus, food availability and timing of spawning events may be the biggest factors determining the nutritional condition and survival of larval fish in these estuaries which supports the match-mismatch hypothesis. This study is the first of its kind and much more is needed to fully understand the advantages of mangroves stands in temperate estuaries in providing additional food for resident planktivorous fishes.

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IDENTIFYING SUB-TROPICAL EAST COAST COPEPODS FOR LARVICULTURE OF DUSKY KOB, ARGYROSOMUS JAPONICUS (TEMMINCK & SCHLEGEL, 1843)

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Pseudodiaptomus hessei (Mrázek) is a copepod species commonly found along the sub-tropical east coast of South Africa, and is also a food source for numerous finfish larvae. The use of P. hessei as a food source for sub-tropical finfish larviculture could potentially decrease the cost of feed in aquaculture as it is an easy to obtain, nutritional local food source. P. hessei was found in abundance along the Mlalazi estuary and Mtunzini fish farm and was subjected to a range of temperatures and salinities, where it thrived at 27 °C and 25 psu. In order to produce a substantial and nutritional P. hessei population as feed for larvae, a balanced diet is required. Copepods feed on a variety of microzooplankton and phytoplankton species in the wild emphasizing the need for a mixed diet as single species diets have shown to be of poor nutritional value and fatty acid content. This experiment used the flagellates Isochrysis galbana Parke and Tetraselmis Stein as feed for P. hessei. These two microalgal species are fed to ovigerous P. hessei females in ratios of 25:75, 50:50 and pure cultures over a 21 day period, to determine the optimal microalgal diet based on copepod survival, growth, and fatty acid profiles. Identifying optimum conditions in aquaculture systems is important to increase the nutritional value and survival of copepods, with the potential to enhance growth and development of finfish larvae.

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Diversity and distribution of phytoplankton communities across micro-estuaries and micro-outlets along a section of the Austral temperate South African coast

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There are more than 100 coastal micro-outlets and micro-estuaries along the South African coast and none of these systems have had detailed ecological studies conducted on their biotic and abiotic characteristics. A multivariate study approach on these systems was carried out to assess the diversity and distribution of pelagic phytoplankton communities so as to determine if the communities are unique for each type of system. This study aimed to relate the phytoplankton population community structure to coastal system type using chlorophyll-a concentrations for each system. Eight systems, four probable micro-outlets and four probable micro-estuaries between Gonubie Estuary and Black Rock were sampled seasonally over a one-year period. Over 200 phytoplankton species were recorded within the micro-outlets and micro-estuaries, with the micro-outlets being more diverse in terms of species composition. Diatoms were predominant, accounting for >30 % of the total abundances. The nMDS analysis highlighted no clear separation of phytoplankton according to seasons and system type, with species richness being found to differ significantly amongst seasons and similar among systems. Total chl-a concentration was generally higher in the micro-outlets compared to the micro-estuaries, with significant differences being observed among seasons and systems. The multivariate linear modelling revealed a significant relationship between the phytoplankton composition and seasonal variation as indexed by salinity. Our results demonstrated that phytoplankton composition was strongly related to freshwater input and salinity variation within each system and these had a significant effect in structuring of abundances, composition and biomass.

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The foraging behaviour of Cape gannets during the guard and post-guard phase of chick rearing

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During breeding, seabirds are central place foragers and are particularly sensitive to changes in local prey availability. Throughout the breeding season, the foraging behaviour and distribution of individuals is expected to change in response to the depletion of prey around the colony. Animal-borne tracking devices are typically deployed on adult birds during the early stages of chick rearing, with few studies having focused on tracking seabirds during the later (post-guard) stages. Using GPS tracking and diet analysis, this study investigated the foraging behaviour of Cape gannets (Morus capensis) at Bird Island, Algoa Bay, throughout the chick-rearing period. The results revealed a clear increase in foraging range of adults as the season progressed. However, birds attending chicks older than 50 days showed an unexpected contraction in foraging range, which appeared to coincide with a dietary shift. During the early stages of breeding the diet was comprised almost exclusively of anchovy (Engraulis encrasicolus). As the season progressed the proportion of anchovy decreased in the diet, while the proportion of saury (Scomberesox saurus) increased substantially. This suggests that Cape gannets increase their foraging range in response to local prey depletion as the season progresses. However, if alternative prey becomes available a dietary shift may allow breeding individuals to access prey closer to the colony. Overall, this study provided the first comprehensive assessment of foraging behaviour throughout chick-rearing in gannets and suggests that through a combination of foraging and dietary flexibility, Cape gannets may buffer the effects of prey depletion during the breeding season.

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Rapid beachrock formation (< 5 years) on a dynamic, reflective, beach, Durban, South Africa.

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Beachrocks, and their cements, are often used as proxies for past sea level. The character of the beachrock and cements present indicating the likely zone of cementation under particular conditions. Traditionally changes in palaeo-beachrock cement type and character are associated with changes in sea level whereby transgression, or regression, alter the conditions under which cements are precipitated. Such changes are then used to reconstruct palaeo-environmental conditions. In this contribution we document rapid cementation (<5 years) of beachrock from the wave-dominated, microtidal coastline of Durban, South Africa. The beachrock is developing at mean sea level on a steep (10° – 30°), reflective beach prone to periodic erosion by high-energy wave action. Transmitted light microscopy and scanning electron micrographs show two dominant cement types have precipitated in response to the location of the outcrop relative to the active beachface. During normal conditions the beachrock lies landward of the beachface in undersaturated upper intertidal to supra tidal conditions where meniscus cements are precipitated. Following erosion of the beach, and a landward shift in the beachface, the beachrock is exposed to saturated conditions which promote growth of acicular cements. Apart from rapid, contemporary, beachrock cementation between significant erosional events, we show that beach progradation and retrogradation simulates regressive and transgressive conditions as recorded by the cement textures observed on the present-day beachrock at Glenashley Beach, Durban. Palaeo-beachrock cements and package geometry must be carefully considered in the context of the setting before changes in sea level are inferred.

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Sediment Grain Size Distribution, Chemical Composition and Hydrodynamics of the channels and the floodplains of the Swartkops Estuary.

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[1]*Saiab*

Grain Size Distribution (GSD) and compositional analysis of sediment samples from channels and floodplains is carried out. Sieve analysis method is used of PSD analysis and for mineralogical analysis three methods are used, that is, Petrographic microscope, X-ray powder diffraction, Sediment Electron Microscope (SEM), and Raman Spectroscopy. In addition, the fossil and total organic matter content (TOC) is determined with appropriate methods. Sediment in the estuary consists of three main mineralogical groups. The predominantly sediment type is sand consisting largely of quartz. The subordinate sand fraction consists of skeletal carbonate material (fossil/shells) which is mainly derived from the sea. The coarse-grain fraction of the sand that enters the estuary from the sea through the tidal inlet consists largely of CaCO3. The finer-grained fraction is more quartz-rich. Other common mineral constituent in the estuary are clay minerals. The change in sedimentation in relation to the hydrodynamics in the estuary marine-derived sediment enters the estuary under flood-tidal conditions and land-derived sediment accumulates in the upper estuary and is mostly derived from the river catchment basin. The estuary is predominantly sandy and most of the sand is fine-grained to medium-grained. GSD across the floodplain revealed that there's integration of very fine sand and silt from depths of 0 to 80 cm and shell-rich beds from 80 to 120 cm.

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Evaluating the effects of climate change in the southern Benguela system using the Atlantis modelling framework

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The southern Benguela system has been categorised as one of the global warming hotspots, because it is warming faster than the rest of the ocean and experiencing social tension as a consequence of the environmental changes. Here, an application of the Atlantis modelling framework for the Benguela and Agulhas current (ABACuS v2) together with climate projections derived from the coupled biogeochemical NEMO-MEDUSA 2.0 model were used to forecast the effects of fishing and climate change (acidification and warming) in the southern Benguela system. Time series of horizontal and vertical velocities, salinity, temperature and pH at 1/4° spatial resolution from 2000-2050 under the RCP 8.5 emission scenario were used. Of the drivers examined in this study, warming had the greatest effect on species biomass and the effect was mainly negative. Acidification strongly affected zooplankton biomass, with both positive and negative effects among size classes. On the other hand, fishing mainly had negative effects on demersal and large pelagic fish. The responses of species and species groups to the combined effect of acidification, fishing and warming were mainly synergistic and antagonistic. Small pelagics and mesopelagics mainly exhibited antagonistic responses to the combined effect of multiple stressors, while demersal and large pelagics mostly showed synergistic responses.

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Community composition and phylogenetic distribution of picoeukaryotes in the Southern Benguela upwelling region

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Picoeukaryotes (cells <2-3 µm in diameter) found in the marine environment contribute significantly to primary production and picoplankton biomass in the ocean. The picoplankton (0.2–2 µm in diameter) are the most abundant photosynthetic organisms found in the ocean. To date, little is known of their diversity in the productive Southern Benguela upwelling system. The Southern Benguela, situated on the west coast of South Africa, boasts high primary productivity and is well known as a strong, wind-driven, coastal upwelling system. It is thus important to quantify the dominant picoeukaryotic phylogenetic groups in this natural environment in order to understand their contribution to the microbial food web as well as the biogeochemistry of the region. In order to achieve this, 18S rDNA amplicons were sequenced using Illumina from surface and 10m samples taken during a week-long sampling expedition at Elands Bay. Additionally, samples were analysed for environmental data like nitrogen uptake, nutrient levels, oxygen availability and temperature. The environmental and phylogenetic data were used to gauge whether the identified picoeukaryotes were involved in biogeochemical cycling.

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Quantifying the impact of mesoscale activity on the Benguela upwelling front

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Located off the west coast of southern Africa, the Cape Basin is characterised by a unique combination of strong coastal upwelling and vigorous offshore mesoscale variability. The coastal upwelling is primarily controlled by the prevailing equatorward winds, while mesoscale variability occurs in the form of eddies and filaments originating from the Agulhas retroflection and within the Cape Basin itself. The upwelling front is well defined following the shelf edge. However, mesoscale features are observed to interact with and modify the upwelling front exchanging shelf and open ocean waters. The South Atlantic MOC Basin-wide Array (SAMBA) provides high resolution in situ velocity measurements from four deep-sea moorings at ~34°S on the 1000, 2000, 3000 and 4000 m isobaths respectively. In conjunction with remote sensing products, the in situ data was used to identify a cyclonic/anti-cyclonic eddy pair interacting with the upwelling front inducing significant cross-shelf transport. Strong westward (offshore) flow was observed from 28/09/2014 to 16/11/2014 at each of the moorings. This offshore flow was associated with a large chlorophyll a (chl-a) filament extending from the upwelling front to a distance of 362 km offshore, indicating substantial offshore transport of productive shelf waters. The chl-a filament and offshore transport were centred directly over the mooring array, providing a unique opportunity to quantify the volume of water and amount of chl-a transported offshore. The mechanisms and quantification of the cross shelf transport is presented highlighting the impact of mesoscale features on the Benguela upwelling system.

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Modelling effects of spatio-temporal spawning variability on the transport and retention success of sardine (Sardinops sagax) eggs around South Africa

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The South African sardine population is hypothesised to consist of western, southern and eastern sub-stocks, each of which has distinct spawning grounds, and management of the sardine fishery needs to take account of this structure and likely mixing between stocks. The western sub-stock spawns and recruits off the west coast, and whilst the southern sub-stock spawns and mostly recruits off the south coast, this stock also makes an annually varying contribution to west coast recruitment. A particle-tracking individual-based model (IBM), coupled with either an older 3-D hydrodynamic model or a more recent, higher resolution model, was used to investigate how ocean dynamics affect the transport and retention of sardine eggs around South Africa. Estimating the proportion of eggs spawned off the south coast that recruit off the west coast, and how this may vary, was a focus. The effects of spawning area, and month, year, and depth of particle release, were investigated for each coupled 3D-IBM simulation using linear models. Qualitatively-similar results are obtained when using either 3-D hydrodynamic model but some quantitative differences are observed, with a higher contribution to west coast recruitment from south coast spawning in the higher resolution model. The southern Benguela sardine IBM has further been updated to include two new spawning areas off the south coast, as well as an extended recruitment area on the south coast, both to more accurately represent the hypothesised sardine life history strategy in this area, and preliminary results arising from this extension are also presented.

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Maritime Spatial Planning in South Africa: A nexus between Legal, Economic, Social and Environmental agendas.

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In this study, an exploratory approach into understanding Maritime Spatial Planning and its applicability in South Africa is conducted. Detailed layout on current legal regimes governing marine environment and maritime activities is drawn. Maritime Spatial Planning is viewed as a tool to arbitrate current imbalances between economic, environmental and social agendas whilst arresting future ocean space user and use conflicts.

Notwithstanding the fact that in South Africa, Maritime Spatial Planning development plans were initiated for the purpose of conserving biodiversity and ecosystem; this study is however advocating for economic growth to become the cornerstone of such an innovation. The National Development Plan visions for 2030 evokes South Africa to develop strategic frameworks for sustainable environmental and inclusive economic growth; and Maritime Spatial Planning development is seen as a tool to coordinate and harmonize cooperation amongst different maritime investors. Arguments are made in this study that Maritime Spatial Planning development has the potential to turn South Africa into a maritime economic country. Although there are challenges such as lack of scientific and technical skills pool, case studies conducted for Germany, China and the United States indicate that the cost of not implementing Maritime Spatial Planning will in the future deprive South Africa's realization of the true economic capital that can be generated from maritime resources.

With the current environmental legal regime, this study argues that South Africa can afford to radically and progressively reform its policies towards economic growth related regimes whilst maintaining the balance between environment and social integrity.

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A new, fully-illustrated guide to the echinoid (Echinodermata, Echinoidea) fauna of South Africa

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The 1976 Southern African echinoid guide by Clark & Courtman-Stock, which has been the standard reference text for over 40 years, is now outdated, as well as being poorly illustrated and too technical for most users to work with. Furthermore, it reviewed the echiniod fauna of the broader southern African region, including southern Mozambique and Namibia, rather than that of South Africa specifically. In light of this, we have produced an easy to use, photographically-illustrated identification field guide to all currently known South African echinoids., with species from Namibia and Mozambique now excluded. After incorporating 19 species added to the fauna since 1976, the number of South African species now stands at 71, representing 14 orders and 29 families. In our guide, these taxa are arranged according to phylogenetic and alphabetic sequence. For each species we provide synonyms and literature references to earlier descriptions, a short description and an indication of maximum size. The global and South African distributions and depth range form another paragraph. Each entry is accompanied by one or more photographic illustrations, plus a map showing its known distribution records around South Africa. We present examples from this this guide and hope it will serve to assist both professionals and non-experts in accurately identify South African echinoids. As such, it should improve the knowledge base of this taxonomic group and stimulate users to report new locality records and additional species they might find.

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Preliminary results showing the effect of microplastics on the survival of the amphipod G. lognorum following a 10 day exposure

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Plastic pollutants in the marine environment have been a problem since mass production of plastics began in the 1940's. Microplastics have also recently been recognized as a significant problem in the marine systems. Amphipods are the primary consumers in the marine environment, therefore, may contribute to bioaccumulation and biomagnification of compounds within the marine foodchain. This project aimed to investigate whether the gammarid amphipod, G. lignorum does assimilate microplastics and whether the survival of the amphipod is affected by the presence of microplastics. Amphipods were exposed to microplastics isolated from a commercial facial cleansing soap in a 6 by 5 grid over a period of 10 days. Amphipods were then digested in 10% HN03 at room temperature for a period of 48hours to remove soft tissue and aid in enumerating microplastics under a dissecting microscope. One way univariate ANOVA was used for statistical analysis. Amphipods were found to ingest microplastics, a significant difference ($p<0.05$), was found between the control and exposed juveniles experiments and no significant difference ($p>0.05$) was found among adult amphipods in different treatments. Therefore, survival was found not to be affected by microplastics in adultamphipods, however, they did affect juvenile animals. The significant effect of microplastic ingestion on Acute toxicity of metals Zn, Pb and Cu and the potential of microplastics to act as vectors in G. lignorum will also be discussed. These results emphasize the vulnerability of early life stages of animals to stressors in the marine environment and the importance of understanding these effects.

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Successful invasion of the West Coast by the mussel Semimytilus algosus, examined through genetics, life-history and interaction with Mytilus galloprovincialis

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Worldwide, the spread of marine alien species has increased. In South Africa, three species have been associated with major invasions: the mussel Mytilus galloprovincialis, the barnacle Balanus glandula and, recently, a second mussel, Semimytilus algosus. Invasive success is influenced by genetic diversity, life-history traits and competitive ability. To determine the source and route of introduction of Semimytilus we analysed the population structure of the mitochondrial DNA cytochrome oxidase I gene (COI). Introduction most probably occurred through a natural range expansion from Namibia through larval dispersal, with high propagule pressure and a large effective population. The resulting lack of genetic structuring may have contributed its success. Semimytilus also has a high reproductive output and an exceptional recruitment rate, allowing rapid colonisation. While Semimytilus dominates the low shore, Mytilus occupies the mid shore. We experimentally assessed the interactions between the two by installing the two species in cages at three shore heights. Survival, growth, condition and recruitment were measured, and showed Semimytilus cannot tolerate high-shore conditions; but low on the shore its exceptional recruitment rate offsets its high mortality, explaining its dominance there, Mytilus has a higher tolerance to desiccation, permitting it to occupy the mid shore, where its settlement and survival are highest. Tolerance of physical conditions seems to determine their repective zonation patterns, in a manner parallel to that shown by Mytilus and Perna perna on the south coast of South Africa.

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Modelling significant areas for larval fishes in the Algoa Bay region

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Earlier research within Algoa Bay, predicted that coastal species with pelagic eggs spawn offshore. Given the prevalence of early developmental stages in plankton catches in the Bay, the aim of the present study was to investigate whether fishery and important ecological species are potentially spawning in Algoa Bay. Larval fish data, from a mosaic of coastal habitats in Algoa Bay, were used to model (1) the spatial distribution of larvae and (2) the spawning location of species. A novel approach using a maximum entropy machine-learning algorithm to model distribution was coupled with reverse progressive vector plots (RPVPs) to predict spawning areas. The results demonstrated that larval fishes in the nearshore habitats of Algoa Bay exhibit species-specific spatial variability. Results from RPVPs indicate that larvae occurring at any location within Algoa Bay could be hatched and transported extensively within the bay before reaching a suitable size to swim independently of nearshore currents. The spawning of several important fishery species, namely Engraulis encrasicolus (Engraulidae), Sardinops sagax (Clupeidae) and Argyrosomus inodorus (Sciaenidae), was located in Algoa Bay. Our results indicate that spawning occurs closer to shore than what was previously thought. Larvae typically remained in close proximity to their spawning origin. Larval fish distributions, although variable amongst all study species, correspond to known adult distributions, reef habitats and upwelling zones in the study region. Adult spawning, habitat type and associated physico-chemical variables play a pivotal role in determining larval fish species composition, density and distribution across the various coastal habitats in Algoa Bay.

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Intertidal macrobenthic assemblages of mixed bottom shores: a response to integrated substratum and wave attenuation gradients?

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The South African intertidal environment is heterogeneous, ranging from steep, wave-exposed rocky shores, through portions composed of both sand and rock, to well-developed sandy beaches. Since the shore classification by Bally et al. (1984) in which 'mixed shores' were identified as a distinct intertidal habitat, there have been few studies of their biota in South Africa. Intertidal communities of mixed hard and soft substratum shores may furnish useful information if viewed as systems in a state of flux experiencing regular, low level disturbance. We examined the macrobenthos of 20 mixed bottom shores located within the diverse Agulhas marine province of the South African southeast coast. Environmental variables (shore topography and configuration, wave climate and exposure rating, sediment characteristics and depth, beach characteristics) and biotic data (importance values of macrobenthic species from both substrata) were subjected to ordination analysis and classification. Species data were pooled at site level. The classification identified three broad-based biotic groupings on mixed substrate shores of the region. There are potentially at least two more biotic groupings nested within identified primary groups. These remain to be explored using further replication at a finer resolution. Ordination showed that species distribution was a response to the integration of cross-shore wave attenuation gradients and substratum characteristics such as cross-shore extent, rock topography and sediment grain size. Species richness compared well with that of sandy beaches and sand-free rocky shores. Important intertidal species that were poorly represented or absent included Scutellastra cochlear, Donax serra, Gelidium pristoides and Porphyra capensis.

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Oceanographic conditions influencing deep-water Cape hake (Merluccius paradoxus) juveniles on the Orange Banks nursery ground

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Environmental variables were investigated that could influence abundance and distribution of deep-water Cape hake (Merluccius paradoxus) juveniles on the Orange Banks nursery ground on the west coast of South Africa. Hydrographical observations collected from annual Nansen surveys were analysed in association with the abundance of deep-water Cape hake juveniles (length range 0–15 cm) and recruitment estimates from a stock-recruitment model were correlated with alongshore wind speeds from combined satellite wind data from 1999–2015. Enhanced catches (>10000 fish.trawl-1) occurred in 2003 during a summer survey over the Orange Banks, associated with warm, saline, near-bottom mid-shelf water that was oxygenated. Catches were reduced (<5000 fish.trawl-1) over the Orange Banks in a 2008 summer survey, associated with cool, saline, near-bottom mid-shelf water that was oxygen depleted. Results of a single parameter quotient analysis indicated that deep-water Cape hake juveniles were disproportionately found in near-bottom waters that were oxygen-depleted to oxygenated (~2–4 mL O2.L-1) and were disproportionately scarce when oxygen concentrations were very low (<2 mL O2. L-1) or high (>4 mL O2. L-1). There was a positive correlation between a deep-water Cape hake recruitment index and summer wind speed anomalies in the same year and autumn wind speed anomalies in the previous year. There was no similar correlation for shallow-water Cape hake. Strong northward winds occur during summer and spring on the Orange Banks and weaker winds during autumn and winter. The relationship between winds and near-bottom oxygen concentrations on the Orange Banks is unclear and needs to be investigated.

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Can abalone larvae be used to augment natural populations?

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South African abalone, Haliotis midae, supported the fishery for almost two decades until it started declining in the early 1970s. More decline in the resource were observed with the introduction of poaching activities in the 1980s and is still rife. Therefore, South African government gazetted and issued experimental permits for abalone ranching and stock enhancement for seeding of depleted areas. However, using large seed is expensive, and these seed is being targeted by predators during the seeding events; thus, reducing the number of available seed considerably. This study experimented the usage of abalone larvae for ranching purposes. Four days old abalone larvae were batch-tagged with calcein at two concentrations (0.05 g/L and 0.1 g/L) in sodium bicarbonate buffered sea water and were held for two time periods (24h and 48h), and later settled in settlement bags. More larvae were immersed at 0.05 g/L calcein in sodium bicarbonate buffered sea water for 48h, after which were settled in a secluded rockpool by the sea. Calcein tagged juveniles shells was visible in the spire of the samples from the bags. The tag was most pronounced on juveniles from 0.05g/L for 48 and 0.1 g/L for 24h bags, and was equally visible from other bags. Of the juveniles sampled from the rockpool, 51% were tagged, but the tag was in most cases less pronounced. This study confirmed that abalone larvae can be used for abalone ranching and mortality rate would be minimise. However, there is a need for a new tag.

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A multi-disciplinary approach to understanding the oceanography and benthic biodiversity of the submarine Cape Canyon, South Africa

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Owing to their complex topography, submarine canyons host a range of unique and widely varying habitats that support diverse benthic assemblages. Recent literature shows that canyon ecosystems have a relatively low resilience to environmental change, and are thus internationally recognized as sensitive biodiversity hotspots. Yet, data on canyon ecosystems, especially around South Africa, are scant. Very little knowledge exists on their geographic location, associated processes, benthic biodiversity and ecosystem function. Consequently, submarine canyons are under-represented in both national and international protective frameworks. Through a multidisciplinary approach we are documenting benthic biodiversity, mapping habitats and collecting oceanographic data on the Cape Canyon, off the west coast of South Africa. Preliminary findings from the first detailed survey show that unconsolidated benthic communities, such as echinoderms, molluscs, and crustaceans dominate the canyon head, where waters were cooler, less saline and better oxygenated. Oceanographic profiles of the near-shore revealed anoxic conditions which were dominated by polychaetes and molluscs. Within the canyon, bottom temperatures were much lower than the surrounding waters, indicating recent funnelling of nutrient-rich South Atlantic Central Water up the canyon slope, likely providing good conditions for crustaceans to live below 200 m. These initial findings will inform further research and allow us to assess the uniqueness, and better understand benthic biodiversity of the Cape Canyon and the influence of oceanography on the abundance and distribution of benthic organisms. Furthermore, it will also contribute to management and protection plans for the Cape Canyon as well as other submarine canyons around South Africa.

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Acoustic occurrence and behaviour of Antarctic blue and fin whales in South Africa and Antarctica

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We assessed the seasonal occurrence and calling behaviour of the rarely sighted Antarctic blue and fin whales in South Africa and Antarctica using passive acoustic monitoring. Data were collected using autonomous acoustic recorders deployed in South Africa and Antarctica between 2014 and 2015. Our results show that migratory blue and fin whales were present in South African waters between May and August with fin whales extending their presence to November. Blue whales were present year round in Antarctica suggesting that not all whales migrate to the low latitudes but some animals remain in the Antarctic throughout the austral winter while fin whales were seasonally present in Antarctica. We detected the characteristic Antarctic blue whale Z-call, the feeding related D-calls, and eastern Antarctic fin whale calls in both recording sites. Diel call rate patterns of both whale species varied between seasons of the year, indicating an adaptation to changes in light and prey depth regimes. Random forest model identified wind speed, sea surface height, sea surface temperature, time of the day, log-transformed chlorophyll-a, temperature at AAR depth and months as important predictors of call occurrence and calling behaviour of blue and fin whales. This study presents the first acoustic recordings of Antarctic blue and fin whales in the Southeast Atlantic Ocean, and provides preliminary information on which to concentrate further research effort to investigate abundance, distribution and seasonality of these whales in South Africa and Antarctica. Our work also highlights the importance of acoustically monitoring large baleen whales in different latitudes.

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Variability in growth and survival of anchovy (Engraulis encrasicolus) larvae in relation to environmental variables

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Variability in growth and survival of anchovy (Engraulis encrasicolus) larvae in relation to environmental variables

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Understanding the effect of changing environmental conditions on population dynamics requires the understanding of growth and survival as a function of time, space, the size of an individual and its life-history. Anchovy (Engraulis encrasicolus) growth and survivorship were simulated from first feeding larvae to recruitment in the deterministic, spatially-explicit, bioenergetics-based and size-structured fish population model “Apex Predator ECOSystem Model-Estimation” (APECOSM-E). APECOSM-E was forced with outputs from the hydrodynamic model, Regional Ocean Modelling System (ROMS), which was fully-coupled to the biogeochemical model, Pelagic Interaction Scheme for Carbon and Ecological Studies (PISCES). The coupled ROMS-PISCES tri-dimensional model outputs (temperature, currents, oxygen concentration, two phytoplankton groups and two zooplankton groups) were used as inputs to APECOSM-E. They allow the determination of habitat, calculation of passive drift, and provide constraints on larval physiological rates in both space and time. APECOSM-E calculates anchovy survival to fish lengths at which they recruit to the fishery. Simulated length distributions were compared with literature values, and the sensitivity of the model was examined by comparing simulated length under a range of temperature and prey concentration inputs.

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Taking stock of our seabream: red steenbras and white stumpnose

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The forty two seabream species in South Africa, of which most are southern African endemics, have all been targeted by either recreational or commercial fisheries in the post-colonial era. We compare two of these species that differ biologically, but whose stocks are currently under pressure from overexploitation by the linefishery: red steenbras Petrus rupestris and white stumpnose Rhabdosargus globiceps. The world's largest seabream, the red steenbras, has been subject to substantial decline during the 20th century. Commercial linefishing catch data over the last three decades indicate an observed reduction of 65% in the east region and 96% in the south-west region of South Africa. The once widespread stock is now largely limited to a single area of core abundance off the coast of East London. In contrast, the white stumpnose has recently experienced localised depletion in Saldanha Bay on the West Coast. This fishery was exceptionally productive during a survey from 2006 - 2008, with an estimated annual catch of 141.2 tons. However, analysis of post-survey CPUE data provides strong evidence that these levels of exploitation lead to the substantial depletion of the local white stumpnose stock. Commercial CPUE (2000 - 2015) declined by approximately 40% and a concomitant severe decline (>95%) in juvenile white stumpnose survey CPUE was observed from 2007 - 2016. For both seabream, the catch and effort restrictions appear largely ineffective as they were unable to control fishing mortality.

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Top-down vs bottom-up processes in epifaunal communities associated with intertidal macro-algae

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Understanding the processes that regulate community composition is a central goal in ecology. We assessed the relative importance of top-down (algal-grazing, predation) vs bottom-up (nutrient availability due to upwelling) effects on a conspicuous intertidal ecosystem engineer, the macroalgae Gelidium pristoides, and its associated epifaunal communities. We achieved this through a manipulative field experiment on the mid shore region at four sites along the southeast coast of South Africa. Four treatments (predator exclusion, grazer exclusion, control, procedural control) set out in a block design (n = 5) were monitored monthly for algal cover. Epifaunal abundance, species composition and algal substratum plant surface area were assessed at the end of the 12 month experiment. The experiment was run at two upwelling sites interspersed with two non-upwelling sites. Grazing significantly decreased algal cover, but the composition of epifaunal communities was not significantly affected by the presence of herbivores or predators. Epifaunal community composition did differ amongst sites independently of upwelling; sites were more similar to adjacent sites than those farther away. Total epifaunal abundance (normalized to algal surface-area, but not algal cover) was significantly affected by grazing. This suggests that grazers reduce the amount of 3-dimensional habitat provided by G. pristoides for associated epifaunal communities, demonstrating that indirect rather than direct top-down processes are important in structuring epifaunal communities.

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Can morphological charaterization be used to distibguish two non-territorial patellids along the wild coast?

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Abstract
Scutellastra granularis is found throughout South Africa while S. natalensis is predominantly in the Wild Coast. Genetically, these two non-territorial limpets are very closely related than other patellids. A detailed description of the morphological characteristics of these two limpets was thus performed across four sites. Results showed that S. granularis was longer (28.70±21.53 mm) than S. natalensis (22.29±19.17 mm) in all sites. Scutellastra granularis (2.68±1.37 g) was also heavier than S. granularis (1.34±0.62 g). In contrast, S. natalensis (0.37±0.02%) was more conical than S. granularis (0.39±0.01). There were no differences in the roundness of both species across three sites: Dwesa-Cwebe (t=1.6856, df=58, p=0.0973), Hluleka (t=0.0030, df=58, p=0.9976), Silaka (t=1.001, df=58, p=0.3211). Scutellastra natalensis was more conical than S. granularis in Silaka (t=18.21, df=58, p<0.0001) but similar in Dwesa-Cwebe (t=0.3936, df=58, p=0.6953), Hluleka (t=1.997, df=58, p=0.0528) and Mkhambathi (t=0.86, df=58, p=0.3911). Regression analysis detected that shell length influenced the width more than the height of both species. These limpet species differed mostly in body size and habitat preference than morphological features.

Key words: Aperture, coneicity, ellipticity, nodules, radula, size variation.

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Embracing the blue through biodiversity surrogacy for marine biodiversity assessment and planning

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Ecosystem classification and mapping is foundational for effective ecosystem based marine spatial planning and to support integrated ocean management. This study advances classification and mapping of outer shelf habitats for improved biodiversity assessment and management in KwaZulu-Natal on the east coast of South Africa. A total of 17 sites, including rocky, mixed substrate, sand and gravel habitats, in the 48 to 85m depth range were examined using epifauna data quantified from seabed imagery collected by Remotely Operated Vehicle. Multivariate analyses revealed that epifauna at unconsolidated sites were significantly different to that occurring on either mixed or reef substrates and epifauna occurring on mixed substrates were also significantly different to those occurring on reef. Epifauna at mixed sites were more similar to epifaunal assemblages at reef sites than unconsolidated sediment sites. The significantly different epifaunal communities detected did not align with the existing national or provincial habitat classifications. To further investigate the species distribution patterns of KwaZulu-Natal deep reefs, we analysed data from 17 reef stations between Tongaat and Scottburgh. Multivariate analyses revealed a clear biogeographic break off Durban with reef assemblages north and south of this break differing by approximately 65%. Reefs located north of Durban had higher abundances of octocorals and porifera morpho-species while southern reefs hosted more porifera morpho-species. Potential environmental drivers of these patterns, including depth, latitude, bottom temperature and turbidity, are under investigation. The knowledge acquired from this study can be incorporated in marine spatial planning and used to identify priority areas for MPA design.

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Using captive birds to assess assumptions of a diet analysis technique: stable isotope analysis

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Seabirds are marine top predators often used as indicator species for determining the status of marine ecosystems and prioritizing conservation hotspots. In the past, destructive or lethal methods were used to collect dietary data but less intrusive methods have been developed to reduce the negative effects on birds. These include stomach content flushing, the fatty acid signature and stable isotope analyses (SIA) of various tissues, and more recently DNA analysis of guano, with each method having different benefits and limitations. In order to use SIA to infer diet, the way the bird assimilates nutrients from its prey to the study tissue needs to be known, as does the influence of its physiological state. We will determine how seabird physiology affects the carbon and nitrogen stable isotope ratios of blood components – plasma, red blood cells and whole blood – using captive African penguins (Spheniscus demersus) by comparing birds of different ages and at different breeding stages. Diet-blood discrimination factors for African penguins will be determined and compared to published values as well as values calculated concurrently in other seabird species: Hartlaub's gulls, kelp gulls, Cape cormorants and swift terns. The results will be presented in the context of the assumptions underpinning the use of stable isotopes and the effects of physiological state on the isotopic values. A comprehensive understanding of diet-tissue discrimination factors and the impact of physiology on SI ratios are essential for accurate studies conducted in the wild.

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Where have all the cormorants gone? Insight from SANCCOB admission data to understand the decline of the Cape cormorant

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The Cape cormorant (Phalacrocorax capensis), once an abundant seabird species in the Benguela Current, underwent a dramatic population decline in recent years and has been classified as Endangered in 2013. The main reason for the decline is likely to be food shortage but disease outbreaks and seal predation also play important roles. SANCCOB sees large numbers of Cape cormorants admitted annually with increasing numbers in the last few years. In the last 4 years, juveniles made up on average 79% of all Cape cormorants being admitted to the centre and most birds were in weak condition (65%) compared to lower numbers of injured birds (22%). Disease surveillance is of high priority in this species, seeing the high prevalence of blood parasites (mostly Babesia, 57%) and previous avian cholera outbreaks. Most birds were found in the greater Table Bay and False Bay area. The only breeding colony with over 1000 breeding pairs in these areas is Robben Island but high admission rates indicate the movement of birds along the coast as well as the role of human presence. Weak birds from more remote locations might die unnoticed and would not be brought to SANCCOB for rehabilitation. We use SANCCOB data on reasons for admission and cause of death to assess the current situation of this endangered species and how this relates to numbers of breeding pairs in the wild as well as food availability around different colonies. We will discuss potential conservation measures to ensure the survival of the species.

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Measuring responses of South African mangroves to sea-level rise: Better late than never.

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Climate change, and in particular rapid sea-level rise, is expected to substantially impact coastal regions. Mangroves and salt marshes can offer some protection from rising sea levels. However, the resilience of these ecosystems in response to accelerated sea-level rise depends on two main attributes: surface elevation change and inland migration. These are determined by regional and local aspects, including geomorphologic characteristics and tidal range, but can also be influenced by land use practices that change sediment dynamics and hydrology. Recent global assessments have therefore indicated that the persistence of mangroves under contemporary sea-level rise will be regionally variable. The aim of this project is to establish the first monitoring programme for sea-level rise responses of mangroves along the South African coastline. Sites for monitoring will be selected based on accessibility and proximity to tidal gauges. The globally standardized methods for measuring surface elevation change relative to sea-level rise will be used, with modifications where necessary. As with many areas of climate change research, the African continent represents one of the largest geographical knowledge gaps on these aspects. Mangroves make a significant contribution to the livelihoods of many coastal populations in the region and the threat of sea-level rise therefore needs to be quantitatively assessed. This research is therefore a crucial starting point for collecting the data on which these subsequent assessments can be based.

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A genomic appraisal of the stock structure of the South African sardine, Sardinops sagax

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The southern hemisphere sardine Sardinops sagax is common in two of South Africa's temperature-defined marine provinces (cool-temperate west coast and warm-temperate south coast), and during the KwaZulu-Natal sardine run is also represented on the subtropical east coast. Non-genetic data suggest that the species may comprise at least two regional stocks that need to be managed separately, and it is possible that different environmental conditions among the provinces may have influenced population structure and driven adaptive divergence. However, genetic evidence for such spatial heterogeneity is lacking, and results from previous studies using traditional molecular methods remain inconclusive. As a result, a single-stock management strategy is presently being applied, which can potentially result in stock collapses as regional stocks become overexploited. To address this question, we generated genomic (DNA) and transcriptomic (RNA) data, and compared samples from different marine bioregions. The majority of genomic markers were selectively neutral, and a pattern of isolation by geographic distance was found. Moreover, outlier loci under thermal selection identified three genomic clusters that displayed a west-to-east cline, but with a large amount of admixture. This population subdivision was confirmed by the transcriptome data, which recovered different gene expression patterns between individuals from the western and southern regions. These results reject the idea that the South African sardine stock is genetically homogeneous, and challenge present management practices.

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Histological studies on the reproduction of Scutellastra longicosta

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Histological studies on the reproduction of Scutellastra longicosta

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Abstract
Microscopic anatomy of reproductive cells was undertaken to describe gonadal development and sex differentiation in Scutellastra longicosta. The results showed that 45% of the smaller (<20 mm) individuals were males, while 55% of the larger (20–60 mm) individuals were females. Maximum sex differentiation detected a sex ratio of 1:1.2 in all size groups. The gonad somatic index of females was significantly greater ($H=33.80$, $p>0.001$) than that of males and neuters. Histology also showed that the female developmental process of germ cells were divided into oogonia, early stage I oocytes (22.29–50.89 µm), late stage I oocytes (48.01–76.23 µm), stage II oocytes (85.01–97.68 µm) and stage III oocytes (84.04–100.01 µm). The developmental process in males was spermatozoa (20 µm), spermatocytes (50 µm), spermatogonia (20 µm) and spermatids (50 µm). Overall, histological studies showed that S. longicosta males are smaller than females thus suggesting a protandrous reproductive pattern in this species.
Keywords: Histology, dioecious, protandrous, oogonia, oocytes, spermatogonia, spermatids.

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Movement ranges and time scales in marine predators – acute and seasonal environmental drivers

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This study made use of multi-year acoustic transmitters to track the movement patterns of two teleost (Argyrosomus japonicus, Lichia amia) and two elasmobranch (Carcharias taurus, Carcharodon carcharias) predatory species within Algoa Bay, Eastern Cape, South Africa. We hypothesised that season and the associated changes in sea temperature would influence the spatial distribution of tagged individuals within Algoa Bay and that tagged fish would make use of warm sheltered habitats during cold upwelling events. Localised movements by A. japonicus, L. amia and C. taurus were strongly associated with distinct seasonal temperature regimes, with animals favouring the western side of the bay during austral spring and summer, and moving to the eastern side during the winter months. However, due to their ability to control their core body temperature, C. carcharias did not display seasonal differences, being recorded around Bird Island (a seal colony) throughout the year. The teleosts were affected by summer-dominated upwelling events and used the sheltered habitats of the Sundays and Swartkops estuaries and the Port of Ngqura as thermal refugia. The characteristic seasonal inshore movements of C. taurus altered during an anomalous red tide during the summer of 2013-2014 as tagged individuals were recorded on offshore receivers in Algoa Bay during this event. These findings provide insights into the movements of these threatened predatory species, and hence can inform spatial-based management planning. Furthermore, given the observed increase in average sea temperature within Algoa Bay over the past eight years, this information provides cautioning evidence of potential climate change impacts.

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SAMREF: A platform for academic and ocean industry collaboration

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The South African Marine Research and Exploration Forum (SAMREF) was launched in January 2016 as part of the South African Government's Operation Phakisa Oceans Economy initiative. Initially formed to facilitate partnerships between the Oil and Gas industry and the scientific community the forum was expanded to include other ocean industries. SAMREF is a multi-sector forum, inclusive of public and private sectors with the objective to:

- Identify and take advantage of opportunities provided by various commercial marine industry activities and platforms, to gather important marine ecosystem data which would otherwise be difficult and expensive to obtain;
- Facilitate new collaborative offshore studies that would increase South Africa's state of knowledge of the offshore marine environment, related to renewable energy potential, marine biodiversity and ecology, climate change and ecosystem functioning.

Through this platform it is hoped that a metadatabase can be built which will maximise the use of the industry collected data instead of the data being collected for single use. This will also require there to be standards for collection and storage to build a reliable database.
As the oceans economy grows, SAMREF will look towards new opportunities in new industries being explored.

SAMREF aims to build on South Africa's commitment towards creating a sustainable blue oceans economy by building collaborations and understanding between the academic community and ocean industries.

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Untangling larval mysteries: the use of morphometrics and DNA-barcoding to positively identify fish and invertebrate larvae

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The early life history of most marine fish and invertebrates begins with a pelagic larval stage, which differs from adults not only in behaviour, but also in appearance. Linking the larval stages of a species to the adult is therefore problematic as larval specimens are often morphologically misidentified. To untangle this issue, morphological appearance, coupled with DNA barcoding, can be used to precisely link larval stages to adults. Positive identification of larval specimens is key for a better understanding of larval ecology, which underpins the success of an adult population. Past, recent and ongoing plankton collections from the shallow coastal nearshore region (400 – 2500m from shore, 10 – 50m deep) within the Eastern Cape (Cape St Francis in the West to Kenton-on-Sea in the East) are used to investigate the phylogeny of larval fishes and invertebrates. Fish and invertebrate larvae were sampled using a bongo net and a submersible plankton pump respectively. Larval specimens were photographed and their morphology described. DNA extraction, polymerase chain reaction (PCR), purification and sequencing has been completed and barcoding using the 5' terminus of the mitochondrial cytochrome c oxidase subunit 1 (CO1) gene is underway. Sequences are being edited manually using ChromasPro version 2.0 software and compared in the Barcode of Life Data (BOLD) system for a positive species identification. Preliminary work on 25 fish larvae and egg specimens, which have previously been undescribed in the literature, and are important from an ecological and/or commercial point of view, will be reviewed and presented.

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Indian Ocean humpback dolphin (Sousa plumbea) movement patterns along the South African coast

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The Indian Ocean humpback dolphin was recently recognized as 'Endangered' in South African waters during a 2014 National Red List Assessment. Nonetheless, data on the species' national abundance, movement patterns and population structure are extremely limited. In view of this, a national research collaboration was established, the SouSA project. Subsequently, 20 identification catalogues collected between 2000 and 2016 in 13 different locations along the South African coast were analysed to assess humpback dolphin movement patterns. Out of a total of 517 identified dolphins across 13 study sites, 328 (between 47 - 100% in each study site) remained after exclusion of poor quality images and poorly marked animals. Of these, 90 matches were found representing 61 individuals over multiple sites, resulting in 238 uniquely marked humpback dolphins identified in South Africa. Long range movement patterns of humpback dolphins, up to 500km, were evident despite long-term site fidelity to certain areas. Dolphins ranging along the south coast of South Africa apparently form one single population at the western end of the species' global range, largely isolated from another population ranging along the coast of KwaZulu-Natal. The presented data suggested the presence of <500 individual humpback dolphins along the entire South African coast. Bearing in mind the poor conservation status of the species in the country, increased research efforts are essential, particularly to allow for an in-depth assessment of population numbers and drivers of changes therein. The present study clearly indicates the importance of scientific collaboration when investigating highly mobile and endangered species.

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Cryptic diversity within the Spongites yendoi complex:

A new name for southern and east coast specimens

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Non-geniculate (encrusting) coralline red algae are widespread in all the world's oceans where they are often the dominant cover on shallow, hard-bottomed marine environments. The South African rocky intertidal and subtidal habitats in particular are rich in diversity of these algae. The ecologically important, Spongites yendoi is reported to occur around the entire South African coastline and forms a characteristic band on the mid- to low shore, particularly in association with the territorial, gardening limpet Scutellastra cochlear. Molecular-assisted alpha taxonomy, that combines molecular and classic morpho-anatomical data to identify and describe organisms, has revealed a number of cryptic species posing under this name in South Africa. New research is currently proposing a new genus to accommodate South African specimens ascribed to Spongites. The aim of the current study was to provide a new name and description for those specimens found, through molecular analyses, to conform to the ecological concept of South African 'S. yendoi' occurring along the southern and east coasts. The new species can be characterised by a suite of morpho-anatomical characters largely associated with the tetrasporangial conceptacle roof anatomy, and by unique psbA sequences. Additionally we provide a key to the South African species currently ascribed to Spongites and the new genus taking congnisance of the field and histological characters useful in delimiting them. This study has highlighted the need to reassess all South African names, for non-geniculate corallines based on type localities of species from other continents and ocean basins, using DNA sequence data.

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Natural eutrophication in pristine micro-estuaries and micro-outlets along a section of the South African coast

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There are more than 100 small coastal outlets around the South African coast arising from streams flowing from catchments within the coastal zone. Eight of these small systems were sampled seasonally over the period of a year to acquire baseline information on their water quality and chlorophyll a status. All the catchments were relatively pristine, with little or no human impacts. Standard methods for the analysis of inorganic nutrients and chlorophyll a were used. Biological data showed a seasonal trend, with blooms of both micro- and macroalgae in the summer and dieback in autumn. During summer, only one system, had a phytoplankton peak in chlorophyll a above 20 μgL^{-1}, while the microphytobenthos concentrations in three of the systems was above 100 mg m^{-2}. Summer blooms of green filamentous macroalgae occurred in all four micro-outlets and in one micro-estuary. Six of the systems sampled had significant drivers for algal growth related to temperature, DO and NH_4 which, in combination with available light and sufficient water residence time, are known to stimulate primary production. The results show that eutrophication occurs naturally without any undesirable ecosystem responses. The findings are also indicative of a balanced state that would have existed in larger disturbed estuaries that now respond to nutrient enrichment from anthropogenic sources and therefore exhibit signs of artificial eutrophication.

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LONG-TERM DYNAMICS OF A HIGH-LATITUDE CORAL COMMUNITY AT SODWANA BAY, SOUTH AFRICA

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Dynamics in percentage cover, mortality and recruitment success of a high-latitude coral assemblage in South Africa were studied over 20 years with the rationale of detecting the effects of climate change. Coral communities at this locality are the southernmost on the African continent, non-accretive, attain high biodiversity and are dominated by soft corals. Long-term monitoring within fixed transects on representative reef was initiated in 1993, and has entailed annual photo-quadrat surveys and hourly temperature logging. Although sea temperatures rose by 0.15°C p.a. at the site up to 2000, they have subsequently been decreasing, and the overall trend based on monthly means since monitoring commenced has been a significant decrease of 0.03°C p.a. Minor bleaching was encountered during the 1998 El Niño Southern Oscillation event. A significant decreasing trend in soft coral cover has been evident throughout the monitoring period, attributable to decreases in Sinularia and Lobophytum spp. cover. Contrastingly, hard coral cover gradually and significantly increased up to 2005, this being largely attributable to increases in cover by Acropora spp. Recruitment success and mortality for both soft and hard corals has displayed high inter-annual variability with increasing but non-significant trends in the last five years. The reduction in soft coral cover has been more consistent and greater than that of hard corals but it is difficult at this stage to attribute this to changes in acidification-linked accretion or temperature. These factors as well as other possible causes for the decline will be discussed.

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Abrupt coastal drowning of estuaries and associated back-barrier systems: lessons from Protea Banks, KwaZulu-Natal.

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Holocene-age incised valley systems and their associated barrier and back-barrier environments provide opportunities to examine how the continental shelf behaved whilst it was submerged during the last deglaciation. In this study multibeam bathymetry, seismic and core data are used to examine the sedimentary architecture of an under-filled incised valley and associated barrier system from the Protea Banks region of southern KwaZulu-Natal. The data reveal a gently dipping continental shelf that is almost completely devoid of sediment. Notable depocentres take the form of partially filled incised valleys which are exposed between depths of 80 and 100 m. These valleys meander across the shelf, and in some instances merge with submarine canyons that impinge the shelf break. Their seismic stratigraphy reflects two distinct packages; a lower set of moderate amplitude reflectors that drape the incised valley walls, and an upper series of flat-lying reflectors. The upper valley fill package comprises mainly marine sands with several pebble horizons that are associated with the flat-lying, high-amplitude seismic reflectors. The upper fill assemblage is derived from shelf sediment that cascaded into the depression of the valley. Transgressive infilling appears to have been interrupted by a significant step in sea level that left the accommodation drowned and which relocated the palaeo-estuary ~ 8 km landwards. In the context of rapid contemporary climate change, such periods of abrupt coastal drowning may recur, having significant consequences for the low-lying, low gradient estuarine systems of the South African coastline.

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Habitat associations and distribution of the hyperbenthic shrimp, Nauticaris marionis, around the sub-Antarctic Prince Edward Islands

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The association of organisms with particular habitat types or characteristics can strongly influence species distributions and wider ecological interactions. Given its trophic importance, particularly to penguin populations, we investigated the habitat associations of the caridean shrimp Nauticaris marionis at the sub-Antarctic Prince Edward Islands. Twenty-five stations varying in depth and location on the shelf and slope around the islands were sampled photographically with a towed benthic camera sled. Point-count estimates of the percentage cover of habitat-forming sessile epibenthic organisms, and absolute counts of the shrimp, were made within 'digital quadrats'. At the broadest level, the distribution of the shrimp was influenced by depth, substratum type and overall biogenic cover. Shrimp were found within a depth range of between 50 – 150 m, and were limited to mud and gravel habitats with > 50 % biogenic cover. Multivariate tests on the composition of biogenic cover showed that the presence/absence of the shrimp was related to significantly different epibenthic assemblages, and was contingent on depth. Likewise, densities of the shrimp were significantly affected by epibenthic assemblage composition (biogenic habitat type). The shrimp were associated with two biogenic habitat groups, one dominated by red-algae, the other by structurally complex bryozoan species. It is suggested that these habitat associations relate to the structural complexity shared by both of these biogenic habitat groups, rather than the specific taxa involved. Our study highlights the dependence of the shrimp on biogenic habitats and, therefore, the importance of this relationship for higher organisms preying on the shrimp.

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The relationship between human activities and mangrove health in South Africa - sustaining mangroves forests into the future

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In South Africa, mangrove forests cover less than 1% of the area and are classified as the rarest and smallest forest type in the country. Limited to the eastern portion of the 3 000 km coastline, the distribution stretches from Kosi Bay to Nahoon Estuary, which itself is an anomaly as mangroves were planted in the latter in 1969. Climate and global change linked to rural, urban and industrial developments are major determinants for the health of mangrove forests. The aim of this study was to determine changes in mangrove population dynamics and health and to relate these to activities occurring at the estuary. Mangroves were sampled for population structure, presence and absence of crab and snails in 2014 and 2015 while the occurrence of mangrove pathogens and diseases were sampled prior to this. Results showed that Kosi Bay is still the only forest with all six true mangrove species, many of which show positive demographic growth. The distribution of Avicennia marina is expanding due to human interventions and climate change in estuaries south of Nahoon. Avicennia marina trees in estuaries such as St Lucia, Mapelane, Mtunzini, Mgeni, Durban Bay, Isipingo and Mngazana showed signs of branch and stem cankers, die-back, wood-boring insects and leaf galls. South African mangrove studies often focuses on the health of the population in terms of growth, this study will combine individual and ecosystem health and aims to link it to human activities to provide a better understanding of the conservation requirements of this ecosystem.

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Hermit crabs in South Africa – biodiversity, distribution patterns and associated fauna

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Hermit crabs (Decapoda: Anomura: Paguroidea) are a diverse group of decapod Crustacea characterised by their habit of colonising hollow objects, especially discarded gastropod shells. The last monograph on South African hermit crabs was by Barnard (1950), although Emmerson (2016) published an updated species list with identification notes, but little other validated taxonomic information. Over the past 2.5 years, we collected >2500 specimens of hermit crabs from around South Africa. These revealed >20 taxa which represented either notable range extensions, new records for South Africa, or species new to science. Discovery rates and species richness were both highest on the East Coast. Currently, our catalogue comprises >65 South African hermit crabs, 50% more than listed in Barnard. Particular attention was focussed on members of the deep-water family Parapaguridae, which are unusual in that they inhabit 'pseudoshells' constructed by zooanthids. Over 2000 parapagurid specimens derived from DAFF demersal survey cruises, were examined. This greatly increases the knowledge of the distribution patterns of these species, but also resulted in the discovery of a new parapagurid species, as well as three new species of parasitic castrating barnacles that infect these species.

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Emergent effects of predator diversity in regulating predator-prey interactions in an shallow water aquatic ecosystem.

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Predation plays an important organisational role in structuring plankton communities. Predator diversity can, however, lead to emergent effects where the outcomes of predator/prey interactions are modified. The importance of predator diversity in regulating predator-prey interactions was investigated during a 9-day mesocosm study conducted in the middle reach of a temporarily open/closed temperate southern African estuary. The zooplankton community comprising almost exclusively of calanoid/cyclopoid copepods of the genera Pseudodiaptomus, Acartia and Oithona, were subject to three different early life history fish predator treatments 1: predation by Gilchristella aestuaria, (Gilchrist, 1913; SL 15.3±2.4mm); predation by Myxus capensis ((Valenciennes, 1836; SL 12.8±3.7mm); 3; combination of the two predators. Results of the investigation indicate that the presence of the predator contributed to a significant decline in the zooplankton abundances (ANCOVA; $P< 0.05$ in all cases) with a concurrent increase in total chl-a concentrations, consistent with the expectations of trophic cascade. The extent/magnitude of the interaction was, however, strongly treatment dependent with the mixed treatment demonstrating the weakest trophic cascade. Results of the mesocosm experiment indicate the diversity of early life-history fish can through emergent effects, play an important role in mediating predator/prey interactions and the strength of trophic cascades within the estuary.

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Long-term trends in cetacean occurrence during the annual Sardine Run off the Wild Coast, South Africa

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During austral winter, cetaceans and other apex predators follow the annual north-eastern movement of shoaling sardines along the south-east coast of South Africa, including a 400km stretch called the Wild Coast. In total, 131 opportunistic aerial surveys were conducted between May-July from 1996-2014 to monitor sardine movement. The aerial surveys provided a unique opportunity to focus on the long-term trends in frequency of occurrence of cetaceans. In total, 630 sightings of five cetacean species were recorded: 268 (approximately 32,400 animals) of Indo-Pacific bottlenose dolphins (Tursiops aduncus), 108 (approximately 79,400 animals) of long-beaked common dolphins (Delphinus capensis), 242 (approximately 670 animals) of humpback whales (Megaptera novaeangliae), 1 (2 animals total) of southern right whales (Eubalaena australis), and 11 (16 animals total) of Bryde's whales (Balaenoptera edeni). Common dolphins, typically associated with sardines, decreased significantly in average group size over the study period (P=0.0343). Bottlenose dolphins, considered generalist feeders, demonstrated no such trend (P=0.916). Humpback whales were most frequently sighted between 2010-2014, with significantly larger groups towards the end of the study (P=0.0121). For all species, the majority of the sightings were made inside one of the four MPAs located along the Wild Coast (>70% for dolphin species and >65% for humpback whales) both pre and post-2005. Results indicate that common dolphin movement may be employed as a proxy for sardine occurrence. Long-term trends also demonstrate the importance of this area to bottlenose dolphins and its use by humpback whales as a migratory corridor.

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Connectivity between populations of Anaulus australis Drebes et Schultz at sandy beaches around the South African coast

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The majority of large, high-energy sandy beaches of the south coast of South African are dominated by populations of the surf diatom, Anaulus australis Drebes et Schulz. The ITS1-5.8S-ITS2 region was used to measure genetic distance between several of these populations to investigate the extent of connectivity between them. The biology of Anaulus australis in its specialised habitat suggests that each population should be relatively isolated from others. The populations from seven beaches (Muizenburg and Macassar in False Bay, De Hoop, Wilderness, Sedgefield, Sundays River Beach and Cintsa) were measured. Variation in the ITS region was found at all of the beaches with the exception of Muizenburg and Macassar indicating that the ITS region is suitable for this level of population study. The ITS-variants found indicated connectivity between De Hoop, Wilderness, Sedgefield, Sundays and Cintsa as common ITS-variants were found at all of these beaches. Wilderness, Sedgefield and Sundays (three variable sites) had greater variation than the other beaches (Cintsa and De Hoop – one variable site). No variation was found at Muizenberg and Macassar.

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A novel approach to fluorescence quantum yield determination in the Southern Ocean

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The fluorescence quantum yield (FQY) of marine phytoplankton refers to the ratio of photons emitted as fluorescence to those absorbed by the individual cells and serves as a first order estimate of photosynthetic efficiency. Chlorophyll concentration, pigment packaging and various photoprotective mechanisms influence FQY. The Southern Ocean is a complex high-nutrient low-chlorophyll region characterised by strong seasonal cycle dynamics. This important regulator of global carbon export is often under sampled due to weather-restricted access and the high cost of research cruises. Initial in situ studies will lead to improved understanding of the factors that influence FQY variability and will ultimately allow for enhanced remote sensing capabilities of this important region, furthering investigations into species composition, light environment and nutrient availability from space. A JFE Advantech Multi-Exciter Fluorometer (MFL), originally designed to discriminate phytoplankton species in a population, was selected as a low-cost option to derive FQY. An optical characterisation of the instrument was performed, allowing for a relative determination of FQY. Initial results indicate that the repurposing of the MFL may serve as an accessible, cost-effective tool to study variability in FQY. This will in turn aid in the development of superior Southern Ocean-specific FQY algorithms and allow for further regional characterisation of phytoplankton dynamics.

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Large marine storms recorded in the Durban shelf stratigraphy, a foretaste of things to come?

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The changing frequency and intensity of coastal storms and their associated risk to coastal infrastructure is a major concern within the context of changing climate. Using a combined ultra-high resolution seismic, multibeam bathymetric, geochemical and modelling approach, we examine a series of high-energy sedimentary deposits preserved in cores from the lower shoreface offshore Durban. The high-energy events form hummocky seismic units, which have clear marine geochemical signatures. These comprise discrete fining upward cycles, which we interpret as periodic high-energy storm-wave deposits or tempestites. Tempestites date from 6480 ± 40 cal yr BP to 4595 ± 35 cal yr BP, a period when sea level was between current levels and + 3 m above mean sea level. Modelling of the wave orbital velocities and the threshold bed stresses required to entrain gravel sized material on the shoreface, based on the 1:100 and the largest storm waves recorded (Hs = 8.5 m), reveals a completely mobile lower shoreface seabed. The tempestite deposits in the cores remained un-reworked by these storm-waves and thus indicate deposition by palaeo-storm waves much larger than those experienced in recorded history offshore Durban. This period matches with a strongly positive Indian Ocean Dipole (IOD) anomaly, linked to warmer sea surface temperatures. As global warming continues, stronger positive anomalies in the IOD are expected. We thus consider that storms of increasingly larger magnitude are likely to impact the coastline of KwaZulu-Natal. This will require a major re-evaluation of coastal development and planning practice for our coasts.

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Physical properties of nearshore fronts off Cape Recife, Algoa Bay, South Africa

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Nearshore fronts are zones where convergence or divergence occurs. They are often sites of enhanced biological activity and can accumulate and deliver larvae to shore. On the surface, they are visible as narrow bands of rippled or smooth water, or as slick (foam) lines. Off Cape Recife, the western promontory of Algoa Bay, fronts are shore-parallel, about 1-3 km offshore, 1-20 meters wide and visible for 100s of meters. To investigate these fronts, four cruises took place during December 2014 and May 2015 off Sardinia Bay. Each cruise consisted of three onshore-to-offshore coupled stations: one inshore of the front, one in the front and one offshore of the front. Measurements were made by a CTD and a boom-mounted ADCP lowered over the side of the boat.

Currents were predominantly westward, but eastward and onshore near the bottom during the first three cruises. Current speeds were highest in bottom and surface layers and lowest shoreward of the fronts. Vertical currents were mostly downward through the water column but upward near the bottom. Fronts clearly separated water masses of different quality, being demarcated by the surface and subsurface structures of temperature, salinity, turbidity, pH, oxygen and fluorescence. At the front, the isotherms and isohalines bulged upward during the first cruise and downward during the last cruise; other cruises showed a warm, high saline surface layer seaward of the front. Turbidity was highest on the surface at the front. Oxygen, pH and fluorescence showed separation between offshore and onshore throughout the water column.

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Mesoscale Alongshore Transport of Larvae

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Marine organisms have a pelagic larval stage which is important in maintaining coastal populations of adults. The survival and transport of larvae to settlement sites can be key determinants of the adult population. The aquatic habitat is dynamic, offering several means of dispersal for larvae with limited swimming abilities. The mechanisms that influence larval transport and delivery to the adult/settlement sites remain poorly understood. The aim of this study is to investigate the alongshore transport of larvae at four sites on the south east coast of Eastern Cape. Mussels (Perna perna, Mytilus galloprovincialis, Choromytilus meridionalis) and barnacles (Chthamalus dentatus, Octomeris angulosa, Tetraclita serrata) are the targeted species for this project. Larval distribution is determined at nearshore line transects (perpendicular to the shore) of up to 2.4km, and 3 depths (surface, middle and bottom layer). Depths range from 15m (inshore) to about 50m (offshore). Larval settlement/recruitment on the rocky shores is measured by deploying 20 (10 each for barnacle and mussel settlement) artificial larval collectors at each site (collected and replaced monthly), which are preserved in ethanol or frozen for further processing. Preliminary results for barnacle recruitment show greater abundance of juvenile barnacle than cyprids, suggesting that settlers arrive and quickly metamorphose into juveniles within the four weeks of deployment. Mussel recruitment indicates a greater abundance of recruits than settlers suggesting that settlement had peaked prior to the start of sampling. Differences in abundance of mussel settlers amongst the sites also indicates site variability within the targeted 180km stretch of coast.

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Management considerations for estuarine fishery species in South Africa, based on a decade of acoustic telemetry research

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In the quest to improve the management of over-exploited estuarine fishery species in South Africa, acoustic telemetry studies were conducted in multiple estuaries on four species heavily targeted in estuarine fisheries (Argyrosomus japonicus, Lichia amia, Lithognathus lithognathus and Pomadasys commersonnii). Empirical data on movement patterns, residency periods, mortality rates, and levels of connectivity between estuarine and marine environments were evaluated, to assess the species' vulnerability and the potential effectiveness of no-take zones for their protection. Juveniles of all four species exhibited high levels of residency, spending most (up to 100%) of their time in their respective tagging estuaries, during studies of approximately one year. While most L. amia ranged extensively within their tagging estuaries, L. lithognathus, P. commersonnii and, to a lesser extent, A. japonicus exhibited fidelity to certain areas within the estuary. Low levels of connectivity with the adjacent marine environment highlighted their dependence on estuarine nursery areas. The results suggest that area closure (no-take zones) within estuaries may afford protection to these species. Recapture rates of tagged fish were extremely high (up to 56% for A. japonicus and 24% for L. amia), providing new information on estuarine fishery mortality. Corrective management actions are therefore essential for these overexploited species. Accordingly, findings from this research were incorporated into the planning process for a proposed marine protected area and associated estuarine protected area. To complement these findings, large-scale movements and migrations of the adults of these four species are now being tracked along the South African coastline.

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Growth and habitat preference of Siphonaria concinna along the Wild Coast of South Africa.

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Not only does habitat heterogeneity influence species distribution, it also determines the growth rates of species and community structure in rocky intertidal shores. This study thus tested seasonal effects on the growth and diversity of habitats occupied by Siphonaria concinna. Results showed that S. concinna lives as either singles, pairs or clusters. Shells of singles (2.09±0.03 cm), pairs (1.94±0.13 cm) and clusters (2.04±0.03 cm) were longest in winter. Shell width of pairs (1.4±0.09 cm) was higher in autumn while singles (1.44±0.05 cm) and clusters (1.43±0.04 cm) were broadest in winter. Shell height was greater in winter for singles (0.3±0.01 cm), pairs (0.26±0.034 cm) and clusters (0.29±0.01 cm). Singles (1.07±0.03 g), pairs (0.91±0.16g) and clusters (1.05±0.03g) were heaviest in winter and lighter in summer (singles = 0.89±0.18 g, pairs = 0.73±0.09g and clusters = 1.86±0.13 g). Habitat preference was highest for emergent rock (singles = 86%, pairs=95% and clusters = 95%) than rock pools and crevices. Overall, S. concinna grows isometrically and occupies a variety of habitats.

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Assessing the composition and structure of neuston communities in the southern Indian Ocean gyre

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Neuston occupies the sea-air interface of a water column in freshwater and marine environments. As a consequence of neuston drifting on the surface of the ocean, they experience a range of environmental stresses. The aim of this study was to investigate the neuston community within the southern Indian Ocean gyre. The objectives were to investigate neuston community diversity and abundance in the gyre, compare samples from different stations, and to graphically represent the relationships. Samples were collected from the center of the gyre using a manta trawl net, where a total of three samples were collected per station. The results showed that the neuston community within the gyre is similar in composition and structure to communities in other parts of the ocean. It was also evident from the conductivity, temperature and depth (CTD) results, that depth (sound) and integrated fluorescence contributed 79% to the variability within the community. Although a full comprehensive analysis was not done on all samples collected due to time constraints, the study assists in providing further information on neuston in the southern Indian Ocean gyre. These results will help add to the limited knowledge of neuston.

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The application of new offshore research results in the establishment of the Phakisa Proposed Marine Protected Area Network

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Operation Phakisa: Oceans economy includes an initiative to protect 5% of South Africa's ocean through 22 new Marine Protected Areas (MPAs). This Presidential initiative spurred offshore research cruises that collected new evidence to support MPA establishment, boundary adjustment, habitat classification and mapping and ecosystem assessment. Key results from the ACEP (African Coelacanth Ecosystems Programme) Deep Secrets and Spatial Solutions cruises, a survey of Protea Canyons and three opportunistic surveys linked to the Benthic Trawl Experiment are presented. Three deep water camera systems, sleds and grabs were used to collect seabed data for 12 proposed MPAs. Highlights include the first images of five different cold water coral habitats at Childs and Browns Banks, Protea Canyons and on the Agulhas shelf edge; verification of distinctive mud habitats in the proposed uThukela Bank, Benguela and Agulhas Mud MPAs, evidence of differences in canyon biodiversity between eco-regions and the discovery of a rocky ridge off Port Elizabeth. Twelve single-beam transects and 14 camera surveys revealed that this feature is longer than 40 km, exceeds 100 m in height and constitutes coral habitat, but with possible trawl impacts. The feature may play a key role in kingklip ecology and recommendations include revision of the Port Elizabeth Coral MPA boundary. Analysis of benthic macrofauna and epifauna indicate that the proposed uThukela MPA covers regionally rare habitats, highly specialised species and potentially globally unique ecosystems. Further mapping of gravel habitats, phosphate deposits and potential coral anchoring substrates on the outer shelf of South Africa is needed.

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Feeling the heat: the susceptibility of African Penguins to hot weather events and climate change

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The African Penguin was classified as endangered by the IUCN in 2010. Among the threats facing this species is breeding failure due to heat stress. Historically, most African Penguins bred in guano burrows, providing buffered microclimates and shelter from predators. Guano scraping led to habitat loss, an issue that exacerbates heat stress. Without a burrow's protection, adults may leave their nests to cool down in the sea. This is often fatal for broods in surface nests due to predation and exposure. Climate change is increasing extreme weather, worsening the situation. Previous studies indicate that artificial nests can reduce impacts, but it was not understood if they could fully replace natural burrows. This study sought to determine the temperature when heat stress begins in African Penguins, understand behavioral responses to temperature, evaluate artificial nests' effectiveness, and investigate how climate change affects penguins. Laboratory studies showed that penguins could not cope with ambient temperatures above 28.5°C, almost 2°C lower than similar species, suggesting that African Penguins are particularly sensitive to climate change. Field studies using penguin models showed that heat stress may occur more often and at lower temperatures than anticipated. Artificial nests experienced high summer temperatures, above penguins' heat stress point. Sun exposure increased temperature in all artificial nest types, but did not significantly affect natural burrows, indicating that artificial burrows do not adequately protect penguins from heat stress. Our results provide tools to predict how African Penguins may be affected by future climate change, limiting impacts by informing management actions.

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Observations on the biology and seasonal variation in feeding of the East Coast redeye (Etrumeus wongratanai) (Clupeiformes), off Kwazulu-Natal

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The basic biology and ecology of Etrumeus wongratanai was investigated from samples of fish collected by jigging off the east coast of South Africa throughout 2014 and 2015. Counts of annuli deposited on sagittal otoliths indicate that E. wongratanai is a short lived species reaching a maximum of up to 3 yrs. of age with rapid growth in its first year of life. Etrumeus wongratanai showed high gonadosomatic index values from June to December indicating that the breeding season lasts for 6 and 8 months for males and females, respectively, and that spawning takes place from the onset of winter to early summer. Condition factor was lowest in May through to August and increased from September, and which could reflect the physiological strain before and during the spawning season. Fish larvae were the most important food item in samples collected in summer, whereas eucalanids were the most important prey item in autumn and winter. Overall, large copepods were the dominant prey items in terms of frequency and importance. Stable isotope data suggests that there are gradual changes in the trophic level and diet of E. wongratanai as it increases with size, and whilst δ15N values differed between seasons δ13C did not.

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Population density and size structure of gastropods on exploited and unexploited sites along the east coast of South Africa

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Marine invertebrates, especially gastropods, are subjected to severe exploitation by humans and predation by other species. We compared the density over four seasons, at two unexploited sites (Dwesa-Cwebe and Hluleka Nature Reserves) and two exploited sites (Nqabara and Presley's Bay) on the intertidal rock pools of the east coast of South Africa. The results of the multivariate analysis revealed significantly greater densities of five gastropod species (Cellana capensis, Oxystele tabularis, Siphonaria capensis, Siphonaria serrata and Helcion concholor) on the low and middle shores of unexploited sites than on high shores while the low shore of exploited sites had highest densities of these gastropods. Additionally, density of gastropods was significantly greater inside one non-exploited and exploited sites adjacent to each other than the other two exploited and unexploited sites. Densities were highest during the Autumn and Summer sampling. Most gastropods (C. capensis, S. serrata, O. tabularis, H. concolor, S. capensis and Siphonaria concinna) were largest in was largest at one exploited. The degree of variability of results from this study between unexploited and exploited sites suggests (e.g. increased exploitation at one exploited site than the other and at one unexploited experienced more poaching than the other) suggests that the efficiency in management of reserves differs even within the same region and is possibly driven by accessibility of certain sites, regardless of the protection state.

Keywords: non-reserve sites, marine protected areas, rocky intertidal, poaching, subsistence harvesting.

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Thermal tolerance and the potential effects of climate change on marine organisms in the Kariega Estuary and adjacent intertidal coastline.

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Temperature is responsible for controlling physiological and life history functions in marine organisms and as such climate change effects on marine organisms are often interpreted relative to temperature changes. Studying the thermal tolerance of animals is the first step to understanding species vulnerability to climate change. The aim of this study is to determine thermal tolerance of various temperate and tropical fish and invertebrate species from the warm-temperate Kariega Estuary and adjacent rock pools using the dynamic method. Various fish species were sampled in summer and results show that the temperate Sarpa salpa reached its CTMax (Critical Thermal Maximum) at 33.8°C and its CTMin (Critical Thermal Minimum) at 7.6°C. The temperate Diplodus capensis reached its CTMax at 34.9°C and it's CTMin at 8°C. The tropical species, Kuhlia mugil reached its CTMax at 37.8°C and it's CTMin at 8.7°C. Bottom water temperatures in the rock pools sampled range between 13.6°C and 23.4°C. These results suggest that the three rock pool fish species sampled are able to tolerate temperatures well above and below their habitat temperatures and may be fairly resilient to climate change. Interestingly, Kuhlia mugil, being a tropical species, was able to tolerate low temperatures similar to that of the two temperate species. These experiments are also being conducted on invertebrates in rock pools and fish and invertebrates in the estuary to determine which species may be vulnerable to climate change. Experiments will also be repeated in winter.

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The metabolic response of larval dusky kob (Argyrosomus japonicus) to pCO2 induced ocean acidification

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Ocean acidification is a climate change associated phenomenon that is altering the chemistry of seawater. These changes result in elevated pCO_2 and reduced pH in seawater and this is impacting marine organisms. Current research on the impacts of ocean acidification on fishes is mostly limited to adults and juveniles of marine species with little information on the larval stages, particularly of estuarine associated species. In order to determine larval vulnerability to ocean acidification, small volume, static respirometry was used to determine the metabolic rates of larvae raised in three pCO_2 treatments including a control (pCO_2 = 327.50 ± 80.07 µatm at pH 8.15), moderate (pCO_2 477.40 ± 59.46 µatm at pH 8.03) and high treatment (pCO_2 910.20 ± 136.45 µatm at pH 7.78). Pre-flexion larvae showed no metabolic response to ocean acidification treatments, however, post-flexion stage larvae showed metabolic depression of standard metabolic rate and a reduced metabolic scope when exposed to the high pCO_2 treatment. Larvae raised in the high pCO_2 treatment also showed high levels of mortality with no individuals surviving past the post-flexion stage. Larvae raised in the moderate pCO_2 treatment were unaffected. This suggests that ocean acidification conditions expected for the end of the century may have significant impacts on the metabolism of early stage dusky kob, which may ultimately translate to reduced growth, retardation of skeletal development and ultimately poor survival. This study highlighted the need to consider the combined effect of ontogeny and life-history strategy when assessing the vulnerability of species to ocean acidification.

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Investigating trophic interactions between parasites and their hosts

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Stable isotope analysis has been widely used to investigate the trophic interactions in ecological communities in a variety of ecosystems, both terrestrial and aquatic. This has proved fundamental in improving understanding of ecosystem functioning and for the synthesis of food-webs. More recently there has been a drive to include parasitic species into food-web studies as they have been largely ignored as essential components of ecosystems. A few recently published studies on the isotopic signatures of parasite species have shown contrasting results with some parasite taxa showing enriched and others showing depleted isotopic signatures. Here the isotopic signatures and trophic interactions between gill parasites and their marine fish hosts are investigated for the first time in South African waters. Fish hosts were collected during the 2015 and 2016 years via surveys conducted by the Department of Agriculture, Forestry and Fisheries and examined for head and gill parasites. Seventeen species of fish were examined, these from lower (sardine, lanternfish, horse mackerel) to upper (tuna, swordfish) trophic levels documenting fourteen species of parasitic monogeneans and nineteen species of parasitic copepods. Isotopic signatures of copepod and monogenean parasites were then compared to those of their hosts. Results indicated a general pattern of enrichment in nitrogen stable isotope ratios of the parasites compared to ratios of their associated host gill tissue, indicating that these parasites are feeding directly off of the host gill tissue.

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Acute toxicity of ammonia and mercury to the estuarine amphipod, Melita zeylanica.

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Toxic pollutants are constantly discharged in the aquatic environment. Elevated mercury levels in the Richards Bay Harbour are a cause for concern. In order to test the toxicity of mercury, the amphipod Melita zeylanica was used. Amphipods are considered good test organisms due to their general sensitivity to contaminants. A 10 day sediment test was done to evaluate the toxicity of mercury. A 96 hour water only ammonia test was also done. The sensitivity of an animal to ammonia must be known before comparing the toxicities of other contaminants. It was evident that ammonia posed a problem after only 24 hours as a 0% survival was observed in the last 2 concentrations. The LC50 for ammonia after 96hours at a salinity of 20 was 67mg/l. The Tukey-Kramer test showed that were survival differences between all concentrations except between the control and 20mg/l. The LC50 for mercury was 0.13mg/l which further reiterated how potent mercury is to most organisms. ANOVA showed that both mercury and ammonia affected the survival of amphipods as there was a significant difference between the survivals at different concentrations ($P < 0.05$). The study showed that both mercury and ammonia are toxic to M. zeylanica. This proves that the discharge of domestic and industrial waste is destroying the aquatic ecosystem. Industries need to discharge their waste in a more responsible manner which will not contaminate the Richards Bay Harbour and all its inhabitants.

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Impacts of the novel invasive mussel, Semimytilus algosus, on the prey preference of two native subtidal predators

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Strong predation pressure from native predators can invoke biotic resistance towards invasive prey species that can limit the abundance and distribution of invasive prey. Alternatively, native predators may fail to recognise novel invasive prey organisms as an additional food source, a concept referred to as predator naivety. The South African coastline has experienced invasions from two dominant alien prey species, the mussels Mytilus galloprovincialis, present on shores for over 30 years, and the recently introduced Semimytilus algosus. Both mussels co-occur with the native species Aulacomya atra and Choromytilus meridionalis. Together these mussels are considered to represent an important food source for various native marine predators, including the rock lobster Jasus lalandii and the starfish Marthasterias glacialis. This study aimed to determine whether these generalist subtidal predators exhibit predator naivety or preference toward abundant invasive mussel prey. Prey preference experiments were conducted in a laboratory setting, where both predators were offered varying proportions of the four mussel species. A selectivity index based on the number of consumed mussels per species was used to assess the prey preference of each predator. Both native predators were found to exhibit strong preference toward the native C. meridionalis, while both invasive species were avoided, suggesting naivety towards the invasive prey. These results are concerning, especially in light of the recent range expansion of S. algosus. The strong preference for native prey by these predators may lead to a depletion of native prey, which in turn could facilitate further invasion of S. algosus.

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Spatial management options for marine fisheries in South Africa: case studies of specific industries

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Marine Spatial Planning (MSP) provides an operational framework to promote sustainable use of the economic potential of the ocean while maintaining the value of marine biodiversity and the integrity of the ecosystem to provide services. Current and potential conflicts of multiple-use objectives, as well as cumulative impacts on ecosystems are identified and managed. In order to balance ecological and socio-economic objectives, tradeoffs among conflicting uses are inevitable. In South Africa, the MSP process has been catalysed by Operation Phakisa, aimed at unlocking the economic potential of our oceans. However, the ability to meet challenges and exploit opportunities may be compromised by a paucity of science to support spatial management of the ocean. The South African fisheries sector is well established and various spatial conflicts are known and remain unresolved under current management approaches, including user-user conflicts and user-environment conflicts. This leads to the fisheries sector as a natural choice for the development of case studies to develop the science to support spatial management. In three case studies, conflicts will be identified and measured and decision-support software (e.g. MarZone, Zonation, InVEST) will be used to optimise management solutions to meet spatial objectives for both environmental and user targets, while minimising conflicts and user costs. Scenario-planning analyses will be performed to determine trade-offs under various management options. Results will provide management recommendations that coordinate the needs of the fishing industry with legislation, while providing the necessary level of environmental protection in a manner that will support effective implementation.

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Variability in stable isotope signatures of South African Laminariales: implications for kelp forest food web studies

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Stable Isotope Analysis has become an indispensable tool for investigating food webs, with particular focus on trophic structure and functioning. However, variability of basal resources is poorly understood and often neglected, despite being a key assumption of food web models. Kelp forests provide an excellent ecosystem to evaluate the scale and implications of this variability as they exhibit "bottom-up" control. This study highlights the natural variability of stable isotope signatures (δ13C and δ15N), at different scales, within two kelp species. Tissue was collected from different parts within a single plant (holdfast, stipe, primary blade and frond) and at different positions along the length of a single frond (from primary blade to frond tip). Representative samples were also collected at nine geographical localities between Port Nolloth and Betty's Bay. SIA revealed a range of 1.65‰ and 3.75‰ within an E. maxima plant, for δ13C and δ15N respectively. There were consistent variability patterns along the length of a single frond in both species, for both isotopes. Across localities, E. maxima and L. pallida were highly variable in δ13C (9.37‰ and 11.22‰ respectively) and δ15N (3.44‰ and 4.51‰ respectively). Within-site variability was a major contributor to the overall spatial variability for both species. Although the cause of the variability is not entirely understood, it can lead to erroneous conclusions if not considered when modeling food webs. Therefore, the nature and scale of stable isotope variability within kelps is imperative for gaining an accurate understanding of South African kelp forest food web functioning.

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Physiological response of Jasus lalandii to chronic hypercapnia

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The West Coast rock lobster, Jasus lalandii, is a commercially important crustacean in South Africa and Namibia and inhabits a habitat that is characterised by strong upwelling events in summer, which can lead to acute hypercapnia. Such hypercapnic events could become more frequent and severe in the future due to ongoing climate change. In addition, global ocean acidification will cause chronic hypercapnia. Few studies exist reporting on such long-term exposure of crustaceans to hypercapnia. We therefore investigated juvenile J. lalandii that were exposed to hypercapnic conditions (i.e. pH lowered to 7.3) for 28 weeks. Subsequently, changes in the extracellular fluid (haemolymph) were analysed. Results revealed: 1) acid-base balance was adjusted and sustained by increased bicarbonate and 2) quantity and oxygen binding properties of haemocyanin changed. Compared with lobsters kept under normocapnic conditions (pH 8.0), during prolonged hypercapnia, juvenile lobsters increased bicarbonate buffering of haemolymph. This is necessary to provide optimum pH conditions for oxygen binding of haemocyanin and functioning of respiration in the presence of a strong Bohr Effect. Furthermore, modification of the intrinsic structure of the haemocyanin molecule, and not the presence of molecular modulators, seems to elevate oxygen affinity under conditions of elevated pCO2. Our results show the capability of juvenile J. lalandii to fully compensate the experienced extracellular acidosis, protecting oxygen carrying capacity of haemocyanin and ensuring an outward gradient of CO2. The West Coast rock lobster is therefore well equipped for its habitat where these hypercapnic events are known to occur frequently.

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Evidence for a postreproductive phase in female false killer whales

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A substantial period of life after reproduction ends, known as postreproductive lifespan (PRLS), is at odds with classical life history theory and its causes and mechanisms have puzzled evolutionary biologists for decades. Prolonged PRLS has been confirmed in 2 non-human mammals, both odontocete cetaceans in the family Delphinidae. We investigate the evidence for PRLS in a 3rd species, the false killer whale, Pseudorca crassidens, using a quantitative measure of PRLS and morphological evidence from reproductive tissues. We examined specimens from strandings (South Africa, 1981) and harvest (Japan 1979-80) and found morphological evidence of age-related changes in the activity of the ovaries. Ovulation had ceased in 50% of whales over 45years, and all whales over 55years had ovaries classified as postreproductive. We also calculated a measure of PRLS, known as postreproductive representation (PrR) as an indication of inter-population demographic variability. PrR for the combined sample was 0.14, whereas the mean of the simulated distribution for PrR under the null hypothesis of no PRLS, was 0.02. The 99th percentile of the simulated distribution was 0.08 and no simulated value exceeded 0.13. These results suggest that PrR was convincingly different from the measures simulated under the null hypothesis. Our results present morphological and statistical evidence for PRLS in South African and Japanese pods of false killer whales, suggesting that this species is the third non-human mammal in which this phenomenon has been demonstrated in wild populations.

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Defining the drivers biomass allocation, phylogeography and phenology of Sarcocornia tegetaria across a geographical gradient.

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Phylogeographic patterns of the salt marsh species Sarcocornia tegetaria showed divergence between the biogeographical regions along the coast of South Africa during screening of nuclear and chloroplast DNA regions. The objective of this study is to provide more details on the genetic divergence of S. tegetaria and whether there are differences in biomass allocation and phenology between populations in the two biogeographical zones. The above- and belowground biomass of S. tegetaria was harvested, and morphological features, physico-chemical parameters and sediment characteristics measured. Phenology and morphology were determined at the cool temperate Langebaan estuarine bay and compared to the warm temperate Kowie estuary. The aboveground biomass of cold temperate estuaries had a mean of 130.16 ± 10.34 g.m2 and warm temperate estuaries had a mean aboveground biomass of 81.92 ± 5.48 g.m2. Peak flowering period occurred during November – January in the cool temperate Langebaan estuary compared to January – March in the warm temperate Kowie estuary. Intertidal salt marsh habitats are a rare type of plant community found in a narrow portion of the intertidal zone that provide important ecosystem services. The information provided by this study could be used to infer the historical evolutionary processes that gave rise to the diversity within Sarcocornia species in South Africa and how these species will respond, in future, to the pressures of climate change and development in estuarine habitats.

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Entanglement of large migratory whales in fisheries related gear in South Africa

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Large migratory whales such as humpback whales (HBW) Megaptera novaeangliae and southern right whales (SRW) Eubalaena australis are impacted by anthropogenic activities. Ship strikes, oils spills, and noise pollution are a few of the impacts that they incur. In South Africa, entanglement of large whales in fisheries gear is a significant threat. In 2006, DEA and other stakeholders established the South African Whale Disentanglement Network (SAWDN), which has subsequently been engaged in monitoring of, and responding to, whale entanglements; where possible SAWDN have attempted to disentangle individuals. For the period 2006 to 2015, the average entanglement rate was ±10 reports per annum with a total 109 incidents reported. This soared to 24 incidents reported in 2016. Humpback whales accounted for half of the recorded entanglement events between 2006 and 2015 (51%) but for two thirds (67%) of the events in 2016. The humpback whale population has been recovering at > 10% per annum following years of overexploitation and the increase in numbers on the west coast is in evidence from the recent discovery of feeding “super-groups’’ with numbers exceeding 120 animals per group in this area. The recovery of whale populations is likely to lead to increased rates of encounters between whales and human activities such as fishing, and concurrent growth of fisheries that use entangling materials such as ropes or long-lines will exacerbate this. This highlights the need for appropriate mitigation measures and consideration of important whale areas in the context of Marine Spatial Planning.

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Animal-borne video and accelerometers reveal marked changes in swimming behaviour during high energy requirements of white shark breaching behaviour

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Large predators expend large amounts of energy foraging for prey based on expected high return. Documenting how they manage costs and benefits of feeding is difficult, particularly for marine predators. Here we combined animal-borne video, accelerometry, depth sensors, and biomechanical relationships to examine behaviour and estimate metabolic rate, as a measure of energetic cost, during white shark (Carcharodon carcharias) breaching – a behaviour where sharks launch from the water while attacking Cape fur seals (Arctocephalus pusillus pusillus). Our biologging approach revealed the marked change in swimming behaviour underlying this remarkable foraging tactic. We show that breaching begins at depths up to 20 m, is characterised by a brief (~ 7-16 s) ascent to the surface during which pitch angle increases by ~ 30 °, and tail-beat frequency is ~2-4 times higher (0.83-1.67 Hz) than non-predatory ascents (0.4 Hz). Sharks also demonstrated the ability to rapidly adjust their approach to the seal during ascent. Biomechanical considerations suggest that breaching attacks require 1.8-3.3 times more energy than non-predatory ascents. Energy requirements increased during a breach by a maximum of ~7-fold. This highly energetic tactic leads to high rates of predation success, exemplifying the high cost/high return foraging strategy of top predators.

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20 Years of whale strandings along the South Western Cape Coast of South Africa

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The adoption of non-lethal research by cetacean researchers has reduced opportunities for biological data collection. Cetacean strandings therefore offer biologist the opportunity to collect information that is otherwise impossible to obtain. In South Africa, strandings are a known phenomenon that spans centuries. Hunter gatherers of the Cape relied on stranded cetaceans as a source of protein. Since 1988, DEA and their stakeholders have been responding to live and dead stranded cetaceans. Crucial biological information such as genetic and morphometric data are collected and in some cases, autopsies are conducted. DEA's effort is mainly focused in the southwestern Cape area. During the first decade (1997-2006), 64 dead strandings were responded to. The number increased to 162 from 2007 to 2016. Large migratory whales namely the southern right whale (Eubalaena australis) and the humpback whale (Megaptera novaeangliae) accounted for 47% of strandings. Pygmy sperm whales (Kogia breviceps), a rarely encountered species, also featured prominently (22%) over the 20 years. The majority (72.6%) of the strandings of large migratory whales coincided with the winter/spring months when they overwinter in tropical waters of Southern Africa. A notable increase in the numbers of strandings has occurred during 2009 – 2016. Although not always possible to establish causation, symptoms have included entanglements in fisheries gear (7), injuries consistent with ship strikes (21), parasite overloads (3) and plastic ingestion (2). The increasing rate of urbanization, introduction of non-whale friendly fisheries gear and increasing maritime activity along the South African coast will increase cases of human induced strandings.

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Is the ban on harvesting of berried female lobsters in South Africa justified on biological, economic and management grounds?

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Biological benefits from a ban on retention of females in berry occur when (a) females in berry aggregate and constitute an incentive for commercial targeting and/or when (b) fishing disturbs the reproductive behaviour of individuals that are not captured, either directly or via habitat disturbance or damage.

South Africa has two important trap-fisheries targeting rock lobster species. A fishery for Jasus lalandii occurs in shallow water (< 100 m) along the west coast while the harvesting of Palinurus gilchristi occurs in deep water (100 - 200m) along the south coast. The appropriateness of a ban on the retention of berried females in these fisheries is evaluated in terms of biological, economic and management criteria. The biological factors include the synchronicity of the annual berry cycle both in time and space, the aggregation of berried females, the growth rate of female and harvest discard mortality. Economic factors include the percentage of females in the catch, the catch rate per trap and the relative capital investments in the fisheries. The management criteria include the status of the resource (harvestable biomass as a percentage of pristine levels), the success achieved in meeting management biomass rebuilding targets, the presence or absence of boat limitation and/or effort control measures and the success of compliance measures in containing illegal harvesting. The results clearly highlight the appropriateness of the restriction in the retention of berried females in the one lobster fishery whereas limited biological benefits at considerable economic cost make it inappropriate for the other.

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The effects of extreme weather events on the ocean dynamics of the shelves and bays of the eastern Aghulas bank

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A complex relationship between the Aghulas current and coastal winds off the south-eastern coast of South Africa creates a region of highly variable circulation and upwelling patterns. In a numerically oriented approach to further the understanding of these processes, the Regional Ocean Modelling System (ROMS) was used to simulate the ocean response to local wind fields and the Aghulas current. Various nested model domains ranging from ¼ degree to 1/36 degree in resolution were implemented to this effect, with the final model configured to output data every 3 model hours to capture the detailed effect of extreme weather events. Model outputs were in good agreement with previous studies in terms of general upwelling and circulation mechanisms. Analysis of the data suggest that large storm systems have significant effect on large oceanographic processes along the Aghulas shelf. Sudden changes in currents and sea surface temperatures can occur over large areas in a short amount of time. Wind driven coastal trapped waves can elevate sea surface heights that may result in coastal flooding if coincided with large spring tides. Strong winds and coastal trapped waves created by these large weather systems may also be responsible for the spawning of certain large meanders in the Aghulas current over the shelf.

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Does it go ‘pap’?

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Myoliquefaction, the post-mortem breakdown of fish muscle tissue, is a phenomenon which negatively affects both marine capture fisheries and aquaculture ventures worldwide. In South Africa, the term ‘pap’ is used to describe fish affected by myoliquefaction, especially snoek (Thyrsites atun). This condition has been linked to a variety of factors including incorrect handling, poor fish health and even specific months but is actually caused by muscle-dwelling myxosporean parasites of the genus Kudoa.
Members of the genus Kudoa typically infect the skeletal muscle fibers and employ proteolytic enzymes to digest surrounding host tissue for nutrition. Upon the host’s death, these enzymes accumulate in the muscle as a result of blood flow cessation and may induce detectable myoliquefaction. Myoliquefaction severely compromises the aesthetic appeal of fish fillets and causes customer rejection leading to economic losses. Two kudoid species, namely K. thyrsites and K. paniformis, have so far been recorded in South African waters infecting at least 6 fish species. Here, we review the infection dynamics and effects of Kudoa spp. in commercially harvested marine fishes off South Africa with respect to host habitat and ecology and provide new information on the morphological description of K. thyrsites originally described from snoek off Cape Town by John Gilchrist in 1924.

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First investigation of parasites of oilfish Ruvettus pretiosus Cocco, 1829 (Perciformes: Gempylidae) in South Africa

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The oilfish (Ruvettus pretiosus) is a widely distributed mesopelagic, predatory gempylid. One particularity of oilfish is the high content of indigestible wax ester of its flesh, which if consumed in large quantities can lead to keriorrhea episodes. These characteristics make it useful inin traditional fishing communities as a natural laxatives, an anti-malaria agent and as a mosquito repellentOilfish are targeted by small-scale fisheries but are regularly caught in long-line fisheries around the globe, including South Africa. Knowledge of local oilfish biology and their parasites is limited and have never been investigated in South African waters.

Here we report the findings of a preliminary survey of the metazoan parasite assemblage of Ruvettus pretiosus caught off South Africa in 2016/2017. Although only eight specimens were examined a total of seven parasite taxa, representing five new host records (Bolbosoma capitatum, Rhadinorhynchus sp., Hepatoxylon trichiuri, Digenea sp. 1, Anisakis sp.) and one new locality record (Bolbosoma capitatum) were recorded. This study has increased the number of parasites known to infect oilfish globally from six to 11, indicating a need for further investigation of the parasite fauna of this unusual species.

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From resident to migrant: an empirical classification of coastal fish movement

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Understanding movement patterns of fishery species is essential for the identification and implementation of corrective management strategies. Mark-recapture data, collected over the past 30 years by the Oceanographic Research Institute's Cooperative Fish Tagging Project (ORICFTP), were used to investigate broad-scale movement patterns of 30 prominent coastal fishery species. Fishes were tagged with plastic dart tags along the coastline of southern Africa from Angola to Mozambique. This exercise yielded more than 10000 recaptures. The 30 chosen species represented 14 families, although 12 species belonged to a single family (Sparidae). Overall, 67% of recaptures were reported from the original tagging locality and 73% were recorded within 5 km of the tagging locality. The remaining observations extended from 6-3000 km. Movements were assigned to four categories (0-5, 6-50, 51-500, >500 km) and modelled with an ordinal logistic regression. Species, life-stage (juvenile/adult) and time at liberty were included as predictor variables. Model coefficients were then included in a cluster analysis, which produced two primary groupings of species (Type I and II), with two sub-groupings (Type IIa and IIb). Type I species were characterised by wide-ranging movements, greatest median recapture lengths and highest trophic levels. Type II species were characterised by residency, smaller body sizes and lower trophic levels. These findings have implications for fisheries management. Exploitation of resident species may lead to localised depletion, but their diffuse spatial distribution may offer some resilience. In contrast, even localised targeting of migratory species may pose a population level risk if individuals are known to aggregate.

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Role of the Amathole Marine Protected Areas in conserving adult populations of threatened reef fish species

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As South Africa moves towards extending the current Marine Protected Area (MPA) network, it is vital that data are provided to substantiate the effectiveness of existing MPAs and to optimise their design and distribution.

The Amathole MPAs are three nearshore no-take zones close to East London, set aside to conserve local biodiversity and in particular populations of reef fish that have been heavily impacted by boat-based line-fishing. The region is central in the distribution of some severely depleted species such as seventyfour (Polysteganus undulosus), red steenbras (Petrus rupestris) and dageraad (Chrysoblephus cristiceps), but little data are available to provide evidence of the protection afforded to these and other species by the MPAs.

We used baited remote underwater stereo-video systems (stereo-BRUVs) to assess the fish communities occurring from 10 to 100m depth inside and adjacent to the MPAs. The stereo-BRUVs method permits measurements of individual fish lengths as well as estimates of species abundances and diversity. These indices are compared between sampling sites.

Our results indicate that the existing MPAs provide an effective refuge for a number of species. Fish sizes, species abundances and diversity are generally greater within the protected areas in comparison to the exploited areas. However, some important species were only observed at depths greater than those covered by the existing MPAs, and larger individuals of several others are also more abundant at greater depth. This suggests that an offshore expansion of the MPAs would better enable them to protect some particularly vulnerable species and life history stages.

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Genetic diversity and distribution of Porphyra species along the South African coast

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The genus Porphyra was formerly known for its economic value in the multibillion dollar nori industry, however a major taxonomic revision of the group transferred many commercially important species into the genus Pyropia. Only eight species from an initial ca. 130 species remained in the genus Porphyra. In South Africa a single species, Porphyra capensis Kützing was recognized until recently. Using both molecular and morphological data Porphyra capensis was shown to comprise of a cryptic species complex and a new, endemic species was identified. South Africa is now home to the highest number of Porphyra species in the world. In the present study we explore the diversity and distribution of these species along the South African coast. Specimens were collected from 35 sites across the Agulhas and Benguela marine provinces in South Africa. Phylogenetic trees, haplotype networks and diversity indices were inferred from two unlinked loci the mitochondrial, cox1 (n=187) and the plastid, rbcL (n=78). The Porphyra capensis complex occurs largely on the west coast of South Africa and is characterised by high genetic diversity. Several major lineages were identified but were not geographically structured. The new Porphyra species strictly occurred along the south coast of South Africa and presented low levels of genetic variation with ca. 70% of individuals belonging to a single haplotype group. Historic and contemporary processes that may have shaped present-day genetic patterns in South African Porphyra are discussed.

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Ocean dynamics that influence sea temperature structures in the Algoa and St. Francis Bay region.

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Bay-scale currents, thermohaline circulation, upwelling, fronts and mixing in Algoa and St Francis Bay occur over short and long time periods. They play a major role in the primary and secondary production of the region by driving nutrients to the surface or concentrating them in certain areas. These thermal and salinity gradients are driven by the wind and open ocean influences, such as the Agulhas Current, daily and seasonal variations in solar radiation, long and short period waves, air-sea fluxes and freshwater inflow from the land. The phenomena are poorly understood in the Algoa and St. Francis Bay region, but now with the implementation of SAEON's continuous monitoring platform (CMP), an opportunity has arisen to study them in detail. The project focuses on the physical ocean dynamics that drive the temporal and spatial distribution of nutrients in the bays and adjacent coastal regions, in order to gain a deeper understanding of the physical functioning of the systems and at the same time supplement the work of the biologists.

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A Fuzzy logic decision-making toolset to assist abalone ranching in Port Elizabeth.

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Abalone ranching and stock enhancement to rebuild stocks depleted by poaching has undertaken on an experimental basis at Cape Recife, Port Elizabeth since 2014 in response to operation Phakisa. Habitat suitability is critical to the success of the abalone seeding. As dive surveys are very labour intensive, the present project thus attempted to identify suitable habitat types using unsupervised classification of satellite imagery. The output classes were then reclassified and ranked according to abalones' preference for different substrate types ,as observed in dive surveys. The reclassified rasters were then fuzzified using "fuzzy membership response curves". Outputs were ground-truthed using correlations preformed between visual assessments, fuzzy outputs, and emergent abalone counts for ground-truthing sites (n = 47). Maximum depth was collected for each ground-truthing site. The results indicate weak but significant correlations between the fuzzy predictors and abalone densities, abalone densities and visual assessment, and fuzzy predictors and visual assessment. There was also significantly negative correlation between depth and abalone densities. The use of GIS and remote sensing can assist stakeholders in the spatial planning and multi-criteria decision-making for such initiatives. This approach has assisted abalone ranching in effectively selecting suitable area while decreasing the need for intensive diving and long search times.

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Preliminary assessment of the influence of eutrophication on acidification in KZN estuaries

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Coastal systems, at the land sea interface, have and continue to be influenced by land-based anthropogenic activity. These activities affect biogeochemical process in estuaries both, spatially and temporally which in turn influence the valuable ecological services provided by these systems. Nutrient enrichment resulting in eutrophication of estuaries is apparent in many of South Africa's estuaries. Eutrophication has been identified as a serious problem that also contributes to acidification in some coastal regions. In fact, recent international research claims that the effect of eutrophication on water pH is a more serious threat in coastal waters (including estuaries), as opposed to acidification caused air-water CO_2 exchange (commonly referred to as ocean acidification). In this study, we conduct a preliminary investigation to assess potential eutrophication-linked acidification in two estuaries, Mdloti and Tongati, along the KwaZulu-Natal Coast, that are subject to land-based anthropogenic effects. Further, we consider co-existing effects on dissolved oxygen patterns. The nexus between eutrophication, pH and dissolved oxygen has been shown to be complex. This will require more research to deepen scientific understanding and, specifically to contextualise conditions for the South African situation, including potential ripple effect on sensitive estuarine biota.

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The role of Dwesa-Cwebe Marine Protected Area in protecting surf-zone line-fish: Wild Coast, Eastern Cape, South Africa

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The Dwesa-Cwebe MPA is located along the Wild Coast, which is a key area for subsistence fishing in South Africa. Community conflict and increasing pressure for access to marine resources recently resulted in policy changes to allow shore-based fishing within this historically no-take MPA. The aim of the present study was to use shore-based research fishing to determine the effectiveness of the MPA prior to the rezonation, by comparing it to an adjacent fished area, Mazeppa Bay. In addition the study aimed to set a baseline for future monitoring. Dwesa and Cwebe were able to support higher fish abundance, taxonomic distinctness and Shannon-Wiener diversity and support stable fish communities compared to Mazeppa Bay. Dwesa supported higher Diplodus capensis and Argyrosomus japonicus abundance and biomass compared to Mazeppa Bay. Cwebe showed lower fish abundance and biomass compared to Dwesa but was still higher or equal to that at Mazeppa Bay. Multivariate analyses indicated that fishing had no effect on the shape of the relative length frequency distributions, but had a significant effect on fish abundance within each length class. This suggests that the local fisheries impacts have been indiscriminate, targeting all size fish within the assemblage sampled. The study highlights the value of this MPA in providing refuge for nearshore fish assemblages but raises concern about Cwebe as it may be failing to offer sanctuary to exploited fish species. Further monitoring of the MPA is advocated to determine the effects of policy changes on fish assemblages and the socio-economic benefits thereof.

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Larval fish communities associated with nearshore fronts

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Nearshore fronts are common coastal oceanographic features and have major implications for larval fish survival, distribution and settlement. The effect of fronts on larval fish assemblages was investigated in the coastal nearshore of Sardinia Bay, on the east coast of South Africa. Accumulation of fish larvae was observed in association with the fronts. Densities of larvae were higher within and inshore of the front, with lower abundances towards the offshore, suggesting onshore retention of fish larvae. Within the front, larval abundance was dominated by the larvae of demersal species in the families Blenniidae, Mugillidae and Sparidae. Inshore of the front, a mix of pelagic (Clupeidae) and demersal species (Gobiesocidae, Gobiidae and Soleidae) dominated. The transport and distribution of both coastal and oceanic species therefore appears to be influenced by the retentive effects of the front on larvae. Larvae of clupeids, gobiesocids, mugillids and soleids showed shallower distributions which coincided with significantly higher temperatures, salinity and oxygen. Cynoglossidae (demersal) and Engraulidae (pelagic) larvae dominated catches offshore, but were generally restricted to the deeper layers, where current velocities were faster, but predominantly eastward and onshore. These nearshore fronts could therefore play an important role in transportation of these larvae to the inshore. Retention of larvae within the inshore has important implications for larval growth and survival due to high productivity and low predation rates. Therefore, nearshore fronts could play an important role in contributing substantially to the variability in the survival of fish larvae.

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Red tide conditions and spatio-temporal patterns in intertidal invertebrate recruitment: does food particle size matter?

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In summer 2014 the dinoflagellate Lingulodinium polyedrum was responsible of an unusually intense, extensive and persistent red tide along 100s km of the south coast of South Africa. Comparison of remote sensing data among the red tide year and the preceding and following years, showed increased wind stress and lower sea surface temperatures (SST) in the Agulhas Bank during the winter preceding the red tide. Winter pre-conditioning, might have caused higher SST and lower chlorophyll presence during the spring preceding the red tide, resulting in a late summer bloom in the form of a red tide lasting until autumn. Dominance of the phytoplankton community by the dinoflagellate can dramatically modify food availability during the period when planktonic larvae of benthic organisms undergo development. Considering the importance of successful recruitment to population dynamics, recruitment of mussels and barnacles was compared within and outside the area affected by the red tide during two settlement seasons: (1) the autumn influenced by the red tide and (2) the following autumn with no influence. Growth and mortality rates of juvenile barnacles were also studied for six months after settlement. The results indicate a strong influence of the red tide with higher mussel recruitment in its absence and the opposite for barnacles. Slower growth was recorded during the red tide for barnacles one month old and faster for individuals after five months. No differences in mortality were shown under presence of the red tide. Effects of other environmental factors known to influence recruitment will be discussed.

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Effect of mouth closure and hypersalinity on the fish community of the St Lucia Estuarine System after Cyclone Gamede.

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St Lucia, the largest estuarine lake system in Africa, has been closed since 2002 except for a five month period in 2007 when the mouth was breached by Cyclone Gamede. Mouth opening in 2007 was preceded by five years of low lake levels and hypersaline conditions, which changed the fish species composition and greatly reduced marine fish species diversity. Mouth opening in March 2007 caused the system to partially fill and marine salinities were restored, allowing recruitment of marine species. This study assessed changes in the fish community during the period 2008-2011 following mouth closure after the Cyclone Gamede breaching event. A total of 19,726 fish representing 61 species were collected with seine nets at six sites across the system during biannual sampling between 2008 and 2011. After mouth closure in August 2007, salinities increased and North Lake became hypersaline during 2009-2010. Marine species dominated in terms of species number, but freshwater and estuarine species became progressively more abundant, notably Oreochromis mossambicus and Ambassis ambassis. The number of species decreased from 51 in 2008 to 37 in 2011, with 22 marine and two estuarine species being lost from the system. The abundance of marine species decreased by >75% as the system became progressively more saline and the closed mouth limited recruitment to infrequent overtopping events. Changes in the fish community were largely driven by salinity changes across the three main regions of the system.

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Cape fur seal teeth as a record of historical changes in the abundance and distribution of small pelagic fish

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The combined effects of climate change and industrial-scale fishing have had an unprecedented impact on marine ecosystems. For example, stocks of small pelagic fish inhabiting the southern African coast, such as sardines and anchovies, collapsed fifty years ago before showing differing trends in recovery. The Cape fur seal Arctocephalus pusillus (CFS) is an important predator of small pelagics. We used carbon and nitrogen stable isotope values from CFS tooth dentine to determine whether collapses and geographical shifts of small pelagics were reflected in their diet. Historic and modern samples (from skulls housed in South African Museums since 1946, and from recently stranded animals in southern South Africa and Namibia) were combined. Potential sexual and ontogenic variation in the diet was controlled by only selecting canines from males and exclusively analysing tooth material deposited during the fourth year of each animal by fine scale drilling. The results of the two bioregions differed. While $\delta^{13}C$ stayed relatively constant in southern South Africa, a peak of $\delta^{13}C$ values was observed in the 1990s in Namibian samples. Contrastingly, $\delta^{15}N$ values highlighted important changes in both bioregions, with Namibian samples exhibiting highest values in recent years while CFS from South Africa exhibited lower $\delta^{15}N$ values on average. Combined $\delta^{13}C$ and $\delta^{15}N$ values therefore suggest different responses in the trophic ecology of CFS from the two bioregions. This study ultimately shows the value of historical samples and data in predicting future ecosystem modifications in the context of global change.

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The impact of Cape fur seals on chokka squid fishing operations during the peak spawning season

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Operational interactions between Cape fur seals (Arctocephalus pusillus pusillus) and chokka squid (Loligo reynaudii) fishermen may include the disruption of squid aggregations, depredation of catches, entanglement of gear, and retaliation by fishermen, contributing to the perception among fishermen that seals significantly impact their catches. Our preliminary study attempts to describe interactions between seals and squid jigging operations and provides the first evaluation of the effect of seals on CPUE (Catch Per Unit Effort). We conducted independent onboard observations over a 10 day fishing trip in the peak spawning season. Seals were present at 70% of spawning locations upon arrival and during 85% of all dedicated jigging sessions. An average of 2.7 seals were present per session. Although squid were depredated from lines, no entanglements by seals were observed. On 45% of all jigging sessions, seals were observed causing minor temporary disturbances to spawning squid masses. No significant correlations were found between the number of seals present, operational interaction events, and variations in CPUE per session. No negative impacts on seals from squid jigging operations were observed. Although the current impact of Cape fur seals on jigging operations during the peak spawning season appears minor, the potential for conflict is high. It remains unclear whether seals are attracted to jigging vessels, either to depredate catches, or as an indication of squid aggregations. Further data on interaction events and the perceptions of fishermen are needed to fully understand the economic impact of seals on the squid jigging industry.

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The effect of varying microplastic bead concentrations and mussel size on the filtration and ingestion of microplastics in Perna perna

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Human activities have exacerbated the presence of plastic debris in the world's seas and oceans. Microplastics are plastic particles, filaments, beads and spheres < 5mm in size. The longivity and ubiquitous nature of plastics pose severe threats to marine animals. Microplastic beads used in cosmetics and industrial applications contribute significantly to the negative health impacts of marine organisms, having repercussions for growth, reproduction, recruitment, survival and feeding processes. P.perna is harvested along the Natal Coast and is considered an important food source for subsistence collectors and a luxury item for others. The biomagnification of toxicants associated with microplastic beads are also predicted to directly induce health hazards for humans as mussels are a food source. Mussels are receptive to microplastic ingestion due to their filter feeding food procurement strategy and sedentary lifestyle. This study investigated the filtration and ingestion rates in different size classes of P.perna [small: 0 – 29mm], [medium: 30 - 59mm] and [large: 60 – 89mm] exposed to microplastic bead concentrations of [0.5 mg/L], [2 mg/L] and [5 mg/L). 80% of Microplastic pollution into Durban's rivers comprise of 71% microfibers and 9% microbeads. Despite this very few studies acknowledge the effects of microbeads on marine organisms. The intensified use of plastic materials may soon have far-reaching effects for human food consumption and the economy of mussel fisheries. Therefore, the results of this study aims to contribute to the growing body of knowledge on the impacts and need for prevention and management of microplastic pollution in aquatic environments.

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Factors influencing infection indices of West Coast round herring Etrumeus whiteheadii by a digenean tetracotyle type parasite in South Africa

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Parasites are presently being used in South Africa as biological tags to elucidate the population structure and distinguish between different stocks of exploited fish species such as sardine, Cape hakes, and others, but this approach has not yet been applied to West Coast round herring Etrumeus whiteheadii. Here we investigate the factors influencing infection indices (i.e. prevalence of infection, mean parasite abundance and mean infection intensity) of a digenean "tetracotyle" type parasite of the genus Cardiocephaloides in round herring and investigate whether the data provide insight into its population structure. Fish were collected during the 2014 recruit and 2016 spawner biomass pelagic surveys along the coast of South Africa and the numbers of this parasite in each fish was recorded. Analysis of variance was used to test for significant differences in parasite infection indices between the west and south coasts. And a generalised boosted regression trees model was used to identify the most important environmental (latitude, longitude, remotely sensed sea surface temperature, chlorophyll-a, wind speed and direction) and biological (fish weight, length, sex, fat and gonad maturity stages) predictors of infection indices of round herring. Round herring infection indices were substantially lower than those for the same parasite in sardine. We found no evidence of spatial variation in infection indices that might be indicative of multiple round herring stocks off South Africa.

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Investigating the relationship between volume transport and sea surface height in the Agulhas Current using the Hybrid Coordinate Ocean Model.

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The relationship between the volume transport of the Agulhas Current at 34˚S (the position of the Agulhas Current Time-series array) and the gradient of sea surface height across the current is investigated using a regional Hybrid Coordinate Ocean Model. Previous studies have suggested a high correlation between SSH slope and Agulhas Current transport and, based on 3 years of in-situ measurements, a transport proxy between along-track satellite data and in situ data was developed. The aim of the proxy was to measure the multi-decadal variability of the Agulhas Current, which has been shown to play an important role in moderating the Earth's climate system. Using the model we are able to create a virtual environment in which we can test the sensitivity of the transport proxy to changes in the vertical structure of the current, as well as the sensitivity to the length of the time period of observations used to create the proxy. Analysis of the vertical profile of the modelled current showed that a meandering current due to offshore variability reduced the correlation of the proxy. Correlating the transport proxy to 34 years of modelled transport data gave a correlation coefficient of 0.72, indicating that the proxy is unable to represent all of the variability in the Agulhas Current transport. This work complements previous studies to further understand and motivate the need for a coherent, in situ and satellite based observing system supporting operational ocean monitoring as well as ocean and climate research.

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Pseudodiaptomus spp. distribution in the Mlalazi Estuary

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The distribution of two copepod species of the genus Pseudodiaptomidae¬ – Pseudodiaptomus hessei and Pseudodiaptomus stuhlmanni, and their relationship to physico-chemical factors in the Mlalazi Estuary were investigated. Zooplankton samples used were from 2013 and 2016. The samples were collected using a double-plankton net of 2 m length each net, mouth diameter of 300 mm and 200µm mesh size, fitted with a calibrated flowmeter. Selected environmental variables were recorded at each sampling station. For the 2013 session salinity followed the typical estuarine salinity gradient, with lower salinities at the upper reaches and higher salinities at lower reaches. March 2016 had high salinities making their way to the upper reaches. On the other hand the August 2016 session had much lower salinities. Temperature was highest during the March 2016 session and lowest during the August 2016 session. The highest pH and Turbidity levels were recorded for the March 2013 session. Salinity could not be significantly correlated with the densities of the two species, however P. hessei showed distinct patterns of salinity preference. A negative relationship with temperature was established for P. hessei whereas a positive relationship was established between temperature and P. stuhlmanni densities. A detailed study on the subject is recommended.

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Geological control on nearshore configuration and morphodynamics at Isipingo beach, KwaZulu-Natal

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Nearshore morphological configuration and large-scale behaviour are often approached considering an invariant concave-upward profile geometry, representing conditions of dynamic equilibrium determined by sediment size. Equilibrium profiles develop along the active section of the nearshore, assumed to extend seawards to a depth of closure exclusively dependent on parametric wave conditions. The influence of the underlying geology is completely disregarded under such assumptions; nearshore profiles are considered as unlimited piles of similarly-sized unconsolidated sediment, free to morphodynamically adjust to variations in wave forcing and sea-level.

In this work, we demonstrate the role of geological control on the nearshore configuration and morphodynamics of Isipingo beach, KwaZulu-Natal. Profiles obtained from multibeam bathymetry were compared to dynamic equilibrium profile models based on: a) uniform wave-energy dissipation; b) balance of sediment transport relationships. Equilibrium profile models were applied considering the range of sediment sizes observed in the nearshore area of Isipingo and computed using the morphodynamic important wave conditions for nearshore sediment transport, determined by a magnitude-frequency analysis. Results reveal a disagreement between observed and modelled nearshore profiles, suggesting that the active nearshore zone extends seaward, deeper than indicated by parametric depth of closure calculations. Shallow sub-bottom seismic profiles from the Isipingo nearshore further demonstrate that the underlying geological framework exerts a fundamental control, which influences nearshore morphodynamics and large-scale coastal behaviour. Our work expands the reasoning that coastal systems, more often than not, deviate significantly from simplified dynamic equilibrium concepts and this must be considered in coastal defence and engineering schemes under future global change.

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Distributional overlap between two squaloid sharks, Squalus acutipinnis and Squalus mitsukurii, caught as bycatch off the coast of South Africa

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Bycatch is a major problem for the world's fishing industries as it involves the accidental capture and in some cases death, of non-target species. Southern African waters are reported to home roughly 25 species of Squaliformes sharks, which are referred to as dogfish. Dogfish represents a significant proportion of the demersal fish fauna and thus play vital roles in ecosystem functioning. Squalus acutipinnis and S. mitsukurii are the most abundant and co-occurring species of dogfish and are important, common bycatch for the demersal fishing industry. Despite this, these sharks show similar geographic and bathymetric distributions yet, species-specific studies are very lacking within the region. This study aims to follow the trawl footprint of these species and understand co-existence by assessing their geographic and bathymetric distributions, in order to determine if they partition their physical habitat or environment on a spatial or temporal scale. Distributional data provided by DAFF dating from 1984 to 2015 indicate that these dogfish segregate by depth, size and sex both within and between species. Squalus acutipinnis is more abundant on the south coast than the west coast while S. mitsukurii is more abundant on the west coast. When they co-occur and are the same size, there is a significant difference in abundance of each species. Furthermore, the deeper the water the larger the dogfish, with only large-female dogfish occurring within shallower waters. It has been shown that when similar sharks co-exist, they need to partition their environment to reduce the intensity of competition to facilitate co-existence.

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Macrobenthic community response to Fish Farm impact in Richards Bay Harbour.

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Worldwide, aquaculture seems to be a viable solution in boosting economic activities and attaining food security. South Africa is also assessing the feasibility of expanding and establishing fish-farms across the country. However, there are contrasting views about whether finfish farming on a large scale should be pursued. Objections are usually based on environmental issues such as eutrophication. Macrobenthos are the most sensitive living components of aquatic systems and are therefore suitable for evaluating ecosystem integrity against eutrophication. Six sites were selected for sampling, with Site 1 being in close proximity to the fish-farm. Water quality and sediment characteristics were analysed. The results indicated salinity as the environmental factor that best defined the estuarine environment which was dominated by the Bivalve, Dosinia hepatica. Moreover, high ammonia levels and hypoxic conditions were recorded in Site 1. In summer, Site 1 recorded the lowest number of species, densities, as well as, species richness and evenness. Site 1 was significantly different compared to all the other sites and was most affected by the fish-farm. A temporal and spatial scale of different sites was mapped out using Canoco. The summer sampled sites were dispersed, whilst, the winter samples clustered together. The best combination responsible for structuring the macrobenthic community was conductivity and dissolved oxygen. The results indicated that the fish-farm contributed to the eutrophication in Site 1. Monitoring the changes in the macrobenthic community proved to be an efficient way of indicating the impact of the fish-farm at The Richards Bay Harbour.

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Harbour Associated Impacts On Nematode Communities In Inter-tidal Subtropical Mangroves

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The use of nematodes in ecological studies has tremendously increased worldwide due to the characteristics they possess which makes them good bio-indicators. A comparative study was conducted between nematodes communities at Mhlathuze estuary and Richards Bay harbour. These two systems were once a large shallow and highly productive basin called Mhlathuze estuary. The nematodes samples (two sites at the estuary and two sites at the harbour) were taken during the summer season in month of April and winter season in August 2016. From the analysis findings, only winter samples were identified to a family level. The findings indicated that nematode density and family richness are higher in Mhlathuze estuary sites and lower in Richard's Bay harbour sites. From the five identified functional feeding groups namely bacterivores, herbivores, fungivores, omnivores and predators; bacterivores showed dominance in both systems while herbivores were almost equal in all sites. The mean Plant Parasitic Index differ significantly ($F_{3,16}= 66.92$; $p < 0.01$) between the four treatments. From the comparative study, results obtained indicated that Richards Bay harbour is subjected to more disturbance environment when compared to Mhlathuze estuary due to factors such as nutrients inputs, sediments texture, sediments sorting, and grain size.

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Acoustic telemetry reveals behavioural complexity in the Leerfish, Lichia amia (Teleostei: Carangidae), in southern Angola

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Lichia amia (Linnaeus, 1758), supports important recreational and subsistence inshore fisheries throughout its global distribution. This species is underexploited off the southern Angolan coastline, where it attracts large numbers of foreign recreational anglers, and raises in excess of US$ 243 per harvested kg. The aim of this study was to investigate the movement behaviour of sub-adult, and adult L. amia, using a multi-method approach encompassing both fishery dependent (tag recapture, CPUE and angler interview data) and fishery independent (population genetics and acoustic telemetry) data to understand their habitat utilization and circannual movement patterns in relation to environmental cues. Thirty-nine acoustic listening stations were deployed in September 2013 along a 150 km stretch of coastline in southern Angola covering exposed coastline (Flamingo Fishing Area (FFA)) and two embayments (Baia dos Tigres (BT)) and (Tombwa bay (TO)). Both fisheries dependent/independent data suggested partial migration, where a portion of the population migrated to BT and the rest remained resident in FFA. Acoustic telemetry revealed behavioural complexity where migrating fish exhibited differing levels of affinity to BT during the summer months, yet all arrive back to the FFA in June each year, where they overwinter and are thought to spawn. The acoustic telemetry results support the contingent hypothesis, suggesting that individuals in a population remain distinct by maintaining divergent migration pathways that intersect at a common spawning ground. This behavioural complexity has relevance for our predictions of the impacts of climate change and the consequences of exploitation on behavioural dynamics.

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Modelling the nearshore wave field and its role on sediment mobilisation of the Isipingo embayment, KwaZulu-Natal.

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The nearshore zone extends from the shoreline to the offshore zone where the interaction between waves and seabed sediment becomes significant. The nearshore is poorly understood with regards to its response to storm waves and sediment motions and, unlike the adjacent and better studied beach environment, less is known regarding the agents responsible for changing seabed morphology and sediment mobility in these areas. This study examines the nearshore of an embayed coastal compartment, Isipingo, from a bathymetric and modelling perspective. Multibeam and single-beam bathymetric data were collected for input into a third-generation spectral wave model, SWAN (Simulating WAves Nearshore). The primary aim was to model the characteristics of the wave field in the nearshore region, by focussing on the propagation of offshore wave conditions to the nearshore. Input wave parameters were obtained over a range of statistically calculated wave conditions, including the mean, 90%, 95% and 99% exceedance levels. The modelling results revealed marked variability in the wave field, orbital motions and bed shear stresses under these varying settings, ranging from mean conditions to the strongest recorded storms. By combining wave modelling results with information of the seabed sediments, this research provides further insights on the potential for sediment mobilisation in the nearshore under each different wave conditions. Key to this research is the determination of areas of increased mobility during storm conditions, critical knowledge needed to effectively plan and maintain offshore and coastal engineering schemes such as the proposed Durban Dugout Port, for the area.

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Spatial and temporal variability of metabolic rates in subtropical estuarine communities

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Estuaries carbon fluxes constitute a significant component of coastal CO_2 emissions and nutrient recycling, but uncertainty is still present due to the high spatial and temporal heterogeneity of these areas. Although South Africa has nearly 300 estuaries, very little is known about their contribution to carbon emissions or sequestration. This study aims to provide a first estimation of the carbon emissions and nutrient fluxes of South African sub-tropical estuaries through a direct quantification of respiration, primary production and nutrient regeneration of benthic and planktonic communities from subtropical estuaries. In order to account for the extreme variability in subtropical estuarine areas, due to seasonality in rainfall, two estuaries with opposite characteristics were studied; the temporarily open/closed Mdloti Estuary subjected to strong anthropic pressure, and the permanently open Mlalazi Estuary located in a natural reserve.
Field deployment of benthic chambers and clear/dark bottle assessed oxygen, ammonia and phosphate fluxes of both benthic and planktonic communities. The incubations were performed seasonally at two sites for each system accounting for the heterogeneity of communities occurring along the axial salinity gradient. An inverse pattern between benthic and pelagic primary production was found in both estuaries. The annual average carbon emission indicates that the two systems are heterotrophic over the year releasing important CO_2 emissions into the atmosphere.
This study is the first estimation of carbon emissions in South African sub-tropical estuaries through direct in situ quantification of respiration and photosynthesis.

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Predicting the performance of cosmopolitan marine species: mechanistic model skill drops across large spatial scales

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Climate change requires us to anticipate species responses and this is increasingly attempted by using individual-based models with a mechanistic basis. Dynamic Energy Budget (DEB) models allow the simulation of physiological processes (maintenance, growth, reproduction) in response to variability in environmental drivers. High levels of computational capacity and remote sensing technologies provide an opportunity to apply existing DEB models across global spatial scales. To do so, however, we must first test the assumption of stationarity, i.e. that parameter values estimated for populations in one location/time are valid for populations elsewhere. Using a validated DEB model parameterized for the cosmopolitan intertidal mussel Mytilus galloprovincialis, we ran growth simulations for native, Mediterranean Sea, populations and non-native, South African populations. The model performed well for native populations, but overestimated growth for non-native ones. Overestimations suggest that (1) unaccounted variables may keep the physiological performance of non-native M. galloprovincialis in check, and/or (2) phenotypic plasticity or local adaptation could modulate responses under different environmental conditions. The study shows that stationary mechanistic models that aim to describe dynamics in complex physiological processes should be treated carefully when implemented across large spatial scales. Instead, we suggest placing the necessary effort into identifying the nuances that result in non-stationarity and explicitly accounting for them in geographic-scale mechanistic models.

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Icthyoplankton composition and distribution in two adjacent bays on the south coast of South Africa.

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The structure of assemblages of coastal icthyoplankton is complex and may be driven by physical mechanisms and/or behaviour. Very few studies have assessed icthyoplankton composition and distribution in South Africa. Larval fish assemblages in the nearshore waters of Algoa Bay and St Francis Bay, South Africa were investigated in March, April 2013, and September, October 2013. Larvae were collected by means of a boat based bongo net (57cm diameter; mesh aperture 500µm). An onshore (2km) and an offshore (3km) station were sampled twice during the daytime (06:00 – 18:00) with two horizontal tows; near the surface (0.5m), and close to the bottom (12m) Tows were repeated at night (18:00 – 06:00) for onshore sites. Larval catches were represented by 16 fish families and 40 species. A multivariate analysis indicated that the species composition was significantly different ($p<0.05$) between Algoa Bay and St Francis Bay with Engraulis encrasicolus, Caffrogobius nudiceps and Solea turbynei making important contributions to the catch in Algoa Bay, while Engraulis encrasicolus, a species in the Tripterigiidae family and a species of the Blenniidae contributed significantly towards catches in St Francis Bay. Onshore catches also differed significantly ($p< 0.05$) between day and night, with a higher abundance of larvae occurring at night. Differences in assemblage composition were also noted between the Spring (Sep–Oct) and Autumn months (Mar-Apr). These results highlight, that despite the close vicinity of Algoa Bay and St Francis Bay, species composition and their distribution may vary significantly.

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The use of Casuarina spp. for coastal protection throughout the IOSEA: Effects and distribution in sea turtle nesting habitat.

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The use of Casuarina spp. for coastal protection was raised as a red flag during the 7th convention of the Signatory States of the IOSEA marine turtle memorandum. The aim of this study was to quantify the effects of Casuarina spp. on sea turtle nesting habitat. Field data were collected within loggerhead (Caretta caretta) nesting habitat in iSimangaliso, South Africa. Vegetation type along the dune line was categorized as; Casuarina spp. present, natural vegetation present and no vegetation present to allow for multiple comparison between beach variables. Variables included beach shape, sand temperature, sand pH, shade density, sand moisture content and sand penetrability.

By using a Kruskal Wallis test, preliminary results indicate a significant difference ($p < 0.05$) in sand temperature, shade density, pH and penetrability between the different vegetation types. Sand temperature measured with temperature loggers (iButtons) underneath Casuarina spp. was approximately 0.6 °C lower than that of natural vegetation. For Casuarina spp. shade readings were, on average, 220 µmol m-2 s-1 less than underneath natural vegetation. pH was, on average, 0.85 units more acidic underneath Casuarina spp. than natural vegetation. To measure penetrability, a steel rod was dropped from a fixed height (50 cm) and it was found that the rod would penetrate approximately 5 cm deeper into sand underneath Casuarina spp. stands vs. natural vegetation. Sand moisture and beach shape is still being analysed.

Even these preliminary results suggest that the planting of Casuarina spp. could have possible negative impacts on sea turtle nesting habitat.

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Uptake of microplastic fibres and the resulting effects on feeding and filtration, by the Natal Rock oyster (Saccostrea cucullata).

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[1]*Ukzn*

Microplastic pollution within the marine environment has increased substantially. Particular concern has arisen for marine bivalves. This is attributed to their ability to filter particles and other contaminants from within the water column. The potential for microplastic ingestion by these organisms is therefore exacerbated. In this study, the Natal Rock Oyster (Saccostrea cucullata) was investigated. S. cucullata is a popular source of food for Kwa-Zulu Natal subsistence harvesters. The consumption of oysters possibly containing microplastics may therefore introduce concerning health risks to consumers. Past studies have depicted the presence of microplastics in commercially harvested shellfish such as mussels and oysters. Mussels have been used as the model specimen to depict presence of microplastics within the tissues, the digestive glands, gills and circulatory system. Oysters, which are also important ecosystem engineers, have been studied less extensively, in particular laboratory studies which involve microplastic fibres. These fibres have the potential to reduce feeding ability, filtration and alter energy allocations as seen in mussels. Therefore, this study aims to assess the uptake of microplastic fibres within oysters and to analyse the effects on feeding and filtration rates. A pilot study involving microplastic uptake was concluded. The oysters were then exposed to low(2mg/L), medium(5mg/L) and high(10mg/L) concentrations of fluorescent microplastic fibres. Feeding and filtration rates were assessed under microplastic exposure. Oysters should successfully ingest the fibres due to the similarity in size ranges of their natural foods. Filtration and feeding rates are hypothesized to decrease.

Keywords: Bivalves, Saccostrea cucullata, feeding, filtration, microplastics

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Spatial Database Development within the Marine Geoscience Unit

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The Marine Geoscience Unit (MGU) has been undergoing a long-term process of cataloguing and archiving spatial information obtained during former commercial and statutory projects. This process has been taken up by several individuals within the past decade, but recent technological advances have necessitated a change in practice and that a updated standard operating procedure be put in place and firmly adhered to when dealing with newly acquired or historical datasets and the manner in which they are stored and catalogued. This is done in an attempt to preserve their precious survey data and to allow seamless integration of past surveys with future survey endeavours.

Obstacles encountered when dealing with historical survey data include facets such as the loss, obsoletion, redundancy and duplication of datasets with time. Technological advancements in equipment and positioning systems have resulted in much higher quality data in the last few decades which makes integrating different data sets a challenge and may render previously collected datasets (e.g. singlebeam bathymetry) inadequate. Changes in software packages over time have led to certain data to becoming difficult to access and the separation of survey datasets from their project metadata has been cause for data integrity loss.

The Marine Unit of the Council for Geoscience is undertaking a manipulation of the existing database and the establishment of an improved method of database management going forward as a part of their South African Nearshore Mapping Programme (SANMAP) – an initiative to systematically map South Africa's coastline.

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The impact of changes in freshwater flow on the demersal fish assemblages of the freshwater-dominated Great Fish Estuary

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Freshwater inflow has a strong impact on the biological, chemical and physical characteristics of estuaries, which in turn affects the distribution and abundance of estuarine organisms. Increased climatic variability associated with climate change is predicated to modify precipitation patterns and this will intensify floods in estuaries. The demersal fish assemblages of the freshwater-dominated Great Fish Estuary were studied using a beam trawl net on a monthly basis from December 2013 to November 2014. This study coincided with six months of very high flow, with estuarine conditions only found in the mouth region, followed by six months of below average flow, with estuarine conditions recorded up to 10 km from the mouth. The greatest richness and abundance of both marine and estuarine species was recorded during low flow conditions. River flooding and subsequent reduced salinity resulted in a decrease in diversity and abundance in the estuary, with only three species; two estuarine residents (Glossogobius callidus and Psammogobius knysnaensis) and the marine migrant Solea turbynei, recorded during peak flooding (i.e. when flow rates exceeded 200 m^3s^{-1}). It was concluded that, although freshwater inflow into estuaries is important for the nursery functioning of these systems, flooding, especially in freshwater-dominated estuaries, may cause a temporarily decline in the abundance of most marine and estuarine fish species. Understanding the effect of river inflow, either from flood events or increased rainfall, on estuarine fish assemblages is essential to improve our understanding of the role of estuaries to fishes.

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Identifying the factors that drive phytoplankton biomass and community composition along the Nahoon – an urban located estuary.

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Estuaries are under intense pressure due to anthropogenic activities such as urban developments and water abstraction. This study examined the water column characteristics of the Nahoon Estuary by identifying the factors that influenced phytoplankton dynamics during 2014 and 2015. The estuary was found to be saline (~33 ppt) and remained well oxygenated (~6 mg l^{-1}) throughout the study. During this period, freshwater inflow into the estuary was low and consequently chlorophyll a biomass was also low (3.6 ± 0.3 µg l-1). However, elevated nutrients from the catchment were delivered into the system and induced the presence of cyanophytes (9 687 cells.m l^{-1}), which were in high cell density, along the upper reaches. The phytoplankton dynamics of this estuary were found to be particularly influenced by the fluctuations in nutrient levels. The results of this study are important for the future management of the Nahoon Estuary and specifically the management of pollution along the Nahoon River catchment which will mostly likely lead to eutrophication along the upper reaches of the estuary.

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Effects of flood events on estuarine fish communities

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Rivers in southern Africa and Australia are already subject to more extreme flood behaviour than those elsewhere in the world. Downscaled regional climate models indicate the likelihood of increased heavy/extreme precipitation events along the South African East Coast. This will have implications for the fauna inhabiting estuaries. The effect of flooding on the fish communities in four permanently open estuaries (Kariega, Mbashe, Thukela and Breede) were examined and were found to be dependent on the type of estuary and the intensity and duration of the flood. In the freshwater dominated Thukela Estuary flooding was found to decrease both the abundance and diversity of species. In the Mbashe Estuary although flooding also resulted in a temporary decrease in species richness and abundance, it played an important role in scouring sediment from this system, which receives enormous quantities of fluvial sediment during the summer months. In contrast, a large episodic flood into the normally marine-dominated and at times hypersaline Kariega Estuary allowed for the development of a normal horizontal salinity gradient and an increase in both species richness and abundance. In the large Breede Estuary, which is located in the transition zone between the warm and cool temperate biogeographic regions, only successive flooding negatively influenced species abundance. The results of this study demonstrate the effects of floods on the fish communities of four different permanently open estuaries.

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A biodiversity assessment of Chaka's rock and surrounding rocky areas; Should special management be implemented?

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Chaka's Rock is found on the KwaZulu-Natal coastline on the east coast of South Africa and is known for its high biodiversity, however, conservation in this region is minimal. This paper aims to determine whether Chaka's rock has biodiversity significantly high enough to be declared a 'special management area' under the National Environmental Management Act: Integrated Coastal Management Bill 2006. To do this, a biodiversity survey using transects, BRUVS and critical observation to quantify the biodiversity of three sites in Chaka's rock, was completed and compared to a control site with similar geological morphology. The Chaka's rock region was divided into three sub-regions: a southern, northern and a tide pool site. Within the northern and southern site, five permanent transects span across 20 m intervals at each site. Quadrats (50 cm x 50 cm) were laid down perpendicular to the shore at two meter intervals. Data from the transects were preserved using image capturing. In the tide pool, three transects were laid and underwater imaging of the quadrats served to capture data. All images were then analysed using Coral Point Count with Excel extension (CPCe) to determine the diversity indices. The relative abundance of fish in the tidal pool was determined using Baited Remote Underwater Video (BRUV). Recordings of mobile species were taken using observational studies for each transect at each site. In addition, usage of the sites was monitored for 8-12 hour periods via video analysis. Management options for Chaka's rock will be discussed.

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The significance of traditional fish traps on the β diversity of the Kosi Bay system, are they ecologically important?

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The Kosi Bay lake system, found on the East Coast of South Africa, provides economic, social and ecological benefits. One such service is the provision of protein and revenue to the surrounding, rural community by the means of traditional fish traps. Despite these benefits and partly due to the increases, iSimangaliso management are considering removing them. The traps have been in the system for over 400 years and it is likely that they play an ecological role, similar to the vis-vywers in Arniston. The aim of this study is to determine their impact on the β diversity of the Kosi Bay system. This was measured by estimating the total area available for colonization by the fish traps. Wet samples and photo quadrants were processed to determine the total vegetative cover and diversity found on the fish traps. The results were then compared to the natural vegetative cover and diversity, using PRIMER. A total of seven fish traps were sampled in different sections of the system. As this is a socio-political issue, it was challenging to obtain the cooperation of the locals to collect more replicates. This research is significant, as it will help understand the ecological consequences of removing the traps. These could include changing the community structure and stability of the system, as it is predicted that the fish traps increase the amount of deposition, vegetative cover and diversity present. Alternative management options will be proposed, to maintain the ecological functioning of the system while keeping the traps sustainable.

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“Putting names to faces”: Unraveling the taxonomy of Chrysaora and Rhizostoma from around South Africa.

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Chrysaora and Rhizostoma comprise two of the most and least speciose genera within the Scyphozoa, respectively and, with a dearth of morphological characters used to separate them, their taxonomies have suffered much confusion. Around South Africa, three species (two Chrysaora and one Rhizostoma) are known, namely: C. fulgida (Reynaud 1830), C. africana (Vanhöffen 1902) and Rhizostoma pulmo (Macri 1778). Now, a third morphotype of Chrysaora is seen, which bears a resemblance to both C. fulgida and C. africana, while two distinct morphotypes of Rhizostoma have also been seen. A complete qualitative and quantitative analysis of the morphology and meristics of these species was conducted, along with an in depth study into the cnidome (where possible). These findings are supplemented by a genetic analysis using cytochrome c oxidase subunit I and internal transcribed spacer 1 gene markers. The results unambiguously identify the third species of Chrysaora to be new; C. agulhensis sp. nov. and it can be separated in the field on the basis of tentacle number and shape, colouration and shape of the oral arm, shape of the gastrovascular pouches and the number and shape of the marginal lappets. Two species of Rhizostoma are also now recognized, R. luteum and R. pulmo, although genetic analyses suggest a complete revision of this genus is required.

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Phylogeographic study of Lepidonotothen squamifrons distributed across the Southern Ocean

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The Southern Ocean is formed from the collective southern parts of the Pacific, Indian and Atlantic oceans. Fish belonging to the Nototheniidae family dominate and are the most diverse fish population within the frigid Southern Ocean waters. Since little is known concerning the distribution and speciation of Nototheniidae fish, this study aimed to investigate the bio-geographic and population structure of an abundant Southern Ocean fish species, Lepidonotothen squamifrons. The mitochondrial cytochrome oxidase I (COI) gene was used to produce several DNA sequences from L. squamifrons populations across the three ocean sectors of the Southern Ocean. Analyses of these sequences showed 10 haplotypes, 6 of which were private haplotypes, and had an overall high genetic diversity (Hd= 0.8125). Furthermore, analyses with AMOVA provided further evidence that the populations of L. squamifrons in the three Southern Ocean sectors are diverse and genetically different (variation among the three oceans = 40.90%; P = 0.4). Moreover, higher genetic variation was detected within groups (Variation= 49.28%; P = 0.5). Additionally, high levels of differentiation were inferred by the Fst value greater than 0.15 (Fst=0.50721). Thus, these results suggested that that there is a significant genetic differentiation among the L. squamifrons populations in the Indian, Pacific and Atlantic oceans. The research is funded (partially or fully) by the National Research Foundation (NRF).

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A Systems Approach to Understanding Complex Estuarine Functioning During Increased Climatic Variability

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Estuarine response to changing climatic variability is a growing management issue. Estuaries are among the most productive aquatic ecosystems, providing valuable ecosystem services. Estuaries are highly dynamic systems and experience regular environmental variations in food web components. Food webs are central to understanding many ecosystem questions. Ecological Network Analysis (ENA) is a systems-orientated methodology used to analyse within system interactions and to identify holistic properties. The aims of this study were to develop and apply an ENA framework to understand complex estuarine food web functioning along the KwaZulu-Natal (KZN) coast. Analysis will assess seasonal changes in multiple KZN estuaries. The estimated biomasses and trophic exchanges of various biotic and abiotic components were used to establish ecological networks using Linear Inverse Modelling. ENA was used to calculate several ecosystem indices indicating energy flow, system resilience and viability. Initial results indicate a strong seasonal influence on the food web structure in the permanently open estuary, Mlalazi. At a system level, Total System Throughput and flow organisation is highest in summer. At the level of functional groups, the average compartment activity, flow diversity (H), functional flows and compartments is highest in summer. The system structure changes from a summer system highly pelagically dependent (phytoplankton and suspended organic content) to a highly benthically (microphytobenthos) dependent winter system. These preliminary indicators clearly show a system strongly influenced by seasonal changes. While specific influencing factors (temperature, rainfall etc.) may be unknown, it is vital to understand these seasonal patterns with the prospect of increasing climatic variability.

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Potential avoidance of seismic survey activities by penguins

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With increasing human populations and development, the demands on energy push for constantly exploring grounds in search of petroleum, natural gas and mineral deposits. Seismic surveys investigate subterranean structure at sea using airguns emitting sound towards the sea floor with sound pressure levels up to 255 dB. Whales, fish, and sea turtles are known to all exhibit "avoidance" behaviour when encountering sounds above ~155dB, with movements on the scale of 1-30 km. However, no evidence to date has been brought about impact of such seismic surveys on penguins. This study investigated the behavioural response of African Penguins Spheniscus demersus to seismic surveys in South Africa. Breeding adults were equipped with GPSs before and concomitantly to activities of seismic surveys within 50 km of their colony. African penguins showed a strong avoidance of their preferred foraging area when surveys were active in its vicinity, which may have been either because of displacement of their prey or of direct disturbance from noises. In addition, monthly coastal surveys of beached carcasses showed a peak of mortality in African penguins the month following the seismic survey. Although this peak might be coincidental and was concomitant to the largest red tide recorded in Algoa Bay, it raises grave concerns about the potential lethal impact of seismic activities on this Endangered species. African penguin numbers have decreased by 70% in the last 10 years, and its dire situation urges for precautionary management decisions, including the exclusion of seismic exploratory activities within 50-100 km of their colonies.

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Towards the biogeography of marine benthic diatoms along the coast of South Africa

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Marine botanical biogeography has been extensively documented in South Africa with a specific focus on macroalgae (seaweed). The knowledge of patterns in the geographic distribution of diatom flora is limited and the diversity of marine benthic diatoms along the coast of South Africa remains unknown. Due to changing ocean temperatures and increased anthropogenic impacts, there is a degree of change with respect to species distribution in the marine ecosystem. Despite temperature being identified as the main determinant of biogeographical patterns and ecosystem processes, the aim of the research is to determine the biogeography of marine littoral diatoms along the coast of South Africa by determining the main environmental drivers responsible for such geographic patterns. Diatoms are excellent bioindicators of their environment, and once the diversity, biogeography and environmental drivers are known, species can be used to detect change in the marine environment. Preliminary results will indicate the diversity of species present and the extent of their distribution.

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Patterns and potential drivers of benthic epifaunal communities in unconsolidated sediment habitats of the KwaZulu-Natal coast

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Patterns of benthic soft sediment epifauna distribution and the potential drivers thereof were examined relative to existing habitat classifications. The study area extended along more than 150 km on the outer shelf of the South African East coast. This was achieved using epifauna abundance data quantified from seabed imagery collected with a Remotely Operated Vehicle (ROV) from 15 sites within the 50-110m depth range. Three epifaunal biotopes were identified along with their respective characteristic taxa. More than 55 taxa representing 2800 individuals were included in the data set. Key fauna included foraminiferans, octocorals, sponges and hermit crabs. The distribution of epifaunal biotopes did not align with the existing national habitat classification (ANOSIM R = -0.195, p > 0.05) nor the provincial biozone classification (ANOSIM R = -0.104, p > 0.05). Using 10 abiotic variables, five emerged as potential drivers, explaining only 36% of the observed community structure. These were gravel (%), surface chlorophyll-a (mg m^-3), mean annual bottom temperature (degrees Celcius), distance from shore (km) and sediment organic carbon (%). All three biotopes identified are represented within the National Operation Phakisa proposed MPA network. Results from this study are informing broader-scale studies of marine biodiversity surrogacy and are being used to improve marine ecosystem classification and mapping. These improvements are foundational to marine biodiversity assessment, marine spatial planning and current Marine Protected Area (MPA) expansion efforts.

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Influence of sedimentary dynamics on the distribution of the Spartina maritima intertidal salt marsh of the Keurbooms Estuary, Western Cape

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Salt marshes are some of the most productive ecosystems in the world and in South Africa play an important role in coastal protection and mitigation against sea level rise. Sediment substrate is one of the important environmental drivers influencing the growth of salt marshes. The permanently open Keurbooms Estuary along the south-east coast of South Africa is subject to occasional fluvial flooding and its intertidal area lacks well developed salt marshes with Spartina maritima restricted to the lower reaches of the Bitou and few sections of the Keurbooms tributary. Therefore, the importance of sediment and hydrodynamics on the distribution of the S. maritima salt marsh within the Keurbooms Estuary was examined. The GIS mapping showed that S. maritima distribution is negatively influenced by riverine floods over the last three decades. Despite showing an overall decline, S. maritima area coverage remained more consistent in the muddy substrate of the lower reaches of the Bitou tributary than in the sandy Keurbooms tributary. However, the roots of S. maritima in both tributaries were mostly restricted to the sub-surface substrate layer, although the Bitou populations showed more vegetative propagation than the Keurbooms populations. However, despite showing a decline in area cover, the production of viable seed and observed vegetative propagation suggest that the S. maritima is likely to colonize open stable intertidal mudflats/sandflats, thus maintaining its distribution as an intertidal species in the salt marshes of the Keurbooms Estuary. Therefore, continuous monitoring is necessary to assess distribution of the S. maritima in the system.

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Good fences make good neighbours? Port, city & environment of Durban, South Africa

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Ports do not grow in isolation, but in response to changing opportunities and demands involving different temporal and geographical scales and intensities. The globalizing market and sustainability agendas continue to challenge port authorities to use port assets more efficiently and productively, socially responsible and environmentally sustainable. The footprint of port operations extend far beyond the port and into the ocean, the city adjacent to the port and the hinterland. Ports are a focal point for their contribution to the Blue Economy. The inevitable port-city connectivity requires innovative strategies that support mutual success. In this project we explore the changing relationship between the port and the city, as well as impacts of institutional and external forces on the port-city relationship in Durban. The results show that there are three distinct development phases, the transition from one to the next has been largely influenced by institutional changes as well as significant societal changes. The port-city relationship has shifted, from conflict to cooperation and back to conflict, during these phases especially regarding environmental and economic interests of actor groups at the interface. Further exploration of the ecosystem-based Blue Economy will add more complexity to the system that is worth examining.

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Habitat occupancy of seaweeds on the rocky shores of Hluleka Marine Protected Area

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Rocky shores comprise a variety of habitats and seaweeds occupy a wide range of habitats. This study quantified the effects of habitat heterogeneity on seaweed distribution and diversity. QGIS revealed three distinct habitats, with emergent rocks being the dominant habitat. Rhodophyta occupied 24% of the outcrops, 3% of rock pools and 17% of the mixed habitats. The highest diversity (H'=1.02) was recorded for outcrop Rhodophytes in the high shore. Chlorophyta were restricted to 2.22% of the rock pools in the high shore. In the mid shore, Ochrophyta occupied 11%, Chlorophyta 13% and Rhodophyta 16% of the outcrops. The lowest diversity (H'=0.3) was recorded for Chlorophyta in the mid shore. Chlorophytes were the most diverse (H'=1.65) on the low shore outcrops. ANOSIM found high variations (R = -0.098, p = 0.998) between habitats. SIMPER revealed that outcrops were 81% different to mixed habitats, 87% different to rock pools while rock pools were 85% different to mixed habitats. Only 11 % similarity was detected between high and low shore species composition, while 18% similarity was found between low and mid shores. Overall, habitat types play a crucial role in structuring the zonation pattern of seaweeds.

Key words: abundance, percentage cover, distribution, diversity, GIS, rocky shores, similarities.

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Using turbulence schemes to model the mixing and surface dynamics in a 1-D water column located in the Southern Ocean

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Turbulent waters are important for many physical and biogeochemical processes in the oceans. It is important to choose the best turbulence scheme to accurately model these processes. This study focusses on finding the best turbulence scheme to use for the sub-Antarctic Southern Ocean (SO) at a location between South Africa and Antarctica.

The ocean physical model used was the Nucleus for the European Modelling of the Ocean (NEMO) model. The one dimensional model created by Reffrey et. al. (2015) using NEMO focussed on a location in the Northern Pacific Ocean. However, this model was not implemented for the SO. This study implemented the one dimensional model that was adapted for the SO.

Due to the lack of physical observational data, different reanalysis products (ECMWF ERA-INTERIM, JRA55, NCEP, NASA) were used to force the SO simulations. Six different vertical turbulence closure schemes (that accompany NEMO) were used for simulating the vertical mixing and the water column structure. The number of vertical levels were also varied to test for grid dependence.

This study gives preliminary results (temperature, salinity, biases, mixed layer depth, turbocline, diffusivity and Brunt Vaisala frequency) for how the choice of different reanalysis products, turbulence schemes and number of vertical levels influenced the vertical mixing in the water column. A comparison of the results between different levels and between different turbulence schemes are presented.

Reference:
Reffray, G., R. Bourdalle-Badie, and C. Calone (2015). "Modelling turbulent vertical mixing sensitivity using a 1-D version of NEMO." DOI : 10.5194/gmd-8-69-2015.

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Response of Spartina maritima intertidal salt marsh to inundation and salinity stress related to predicted sea level rise

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Salt marshes are some of the most productive ecosystems in the world, however, are particularly sensitive to changes in sea levels. Sea level has been rising for centuries and due to global warming the rate of sea level-rise has been anticipated to increase. Considering the present predictions of sea level rise, it is very likely that the frequency and magnitude of high tide level will increase which will expose intertidal salt marsh vegetation to prolonged submergence. The S. maritima in the Keurbooms Estuary is limited only to the lower Bitou, the confluence and few patches in the Keurbooms tributary. The S. maritima population in the confluence and Bitou often grow on muddy waterlogged substrate while the Keurbooms tributary population grow on a sandier substrate. The S. maritima plants on waterlogged muddy substrate were shorter and showing more evidence of below-ground vegetative reproduction than those on sandy substrate. The mean chlorophyll fluorescence PSII (FV/FM) for S. maritima in the Keurbooms Estuary ranged from 0.694 ± 0.023 to 0.773 ± 0.006. Plants in the waterlogged conditions of the Bitou marsh had significantly lower PSII values than other plants indicating signs of photo-inhibition. Tidal inundation experiment showed reduced PSII values when the sediment surface of the plants was completely submerged during high tide but increased to normal values during the outgoing tide indicating highly adaptability of the S. maritima species to short-term submergence conditions. These results suggest that tidal inundation themselves do not prohibit plant growth of this species but prolonged submergence will.

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Phylogeography and population genetics of Pteromylaeus bovinus on the KwaZulu Natal coastline

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Pteromylaeus bovinus is a chondrichthyan that belongs to the family Myliobatidae. The life history traits of chondrichthyans make them particularly vulnerable to fishing which causes low population growth rates. These traits include long gestation periods, long lifespans, low productivity, late sexual maturity and high amounts of maternal investment. Their populations have been overfished and habitats destroyed. The Information on the health status of P. bovinus worldwide is especially limited. The International Union for the Conservation of Nature (IUCN) has globally assessed the bull ray as 'data deficient' as it has clearly been poorly monitored. The proposed study aims at determining the phylogeography and population genetics of P. bovinus along the KwaZulu Natal coast line, Richards Bay to Port Edward (+- 350 km), by using molecular techniques. The molecular markers used for this study were cytochrome c oxidase subunit I (COI) and exon-primed intron-crossing (EPIC) markers. The COI results showed P.bovinus in KZN was diverse and that the majority of the five populations sampled on the KZN coastline were genetically homogeneous. The exception to this was the Durban central and the outside Durban bay populations which showed significant genetic differentiation. The COI results therefore suggest a panmictic population but with slight structure in the Durban area. The EPIC data indicated two population clusters with significant structure present in the populations near Durban. The results provide further insight into the breeding and migration patterns of P. bovinus along the KZN coastline.

Key Words: Pteromylaeus bovinus, chondrichthyans, phylogeography, COI, EPICs

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Habitat characterisation and epibenthic biodiversity in Algoa Bay, South Africa

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The marine environment of the continental shelf supports essential ecosystem services which in turn sustains extensive commercial activities, however, patterns of species richness and ecological functioning of many of South Africa's subtidal marine ecosystems are poorly known. Spatially explicit foundational data of benthic marine ecosystems are thus required for effective marine spatial planning and management. Using underwater camera sampling we characterise patterns of benthic epifaunal biodiversity in unconsolidated marine sediment habitats in Algoa Bay between 30 – 100m depth. Specifically, this research aims to understand patterns of species distribution and abundance, and how these relate to the distribution of habitat types and other potential abiotic drivers, such as depth and sediment type. Photo quadrats and sediment samples were collected from 9 sites across two depth bins 30-50 m and 51-100 m. Epifauna larger than 1cm were identified and quantified. Sediment was analysed for organic content and particle size distribution. Characterising the epibenthic assemblages, a multivariate cluster analysis with SIMPROF identified three significantly different groups of stations. A PERMANOVA analysis with depth and sediment type as factors, showed significant effects on assemblages. A SIMPER analysis identified a polychaete, Diopatra cuprea punctifera, a sponge, Isodictya spp., and a cup coral as driving the separation among groups. These data provide baseline information of species diversity and distribution for unconsolidated habitat types in Algoa Bay, both inside and outside the proposed Phakisa marine protected area and will support the fine scale validation of the National Biodiversity Assessment benthic habitat map.

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Using resource utilisation as a tool for predicting regional spread of marine alien species

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In light of the serious threats marine invasive species pose to the ecology, socio-economic well-being and human health of invaded regions, there is a need to develop approaches for predicting species spread. While modelling strength and geographic extent of invasion vectors or applying climatic matching techniques are useful at a global scale, predicting regional spread to account for species-specific traits and local environmental variability is lacking. We addressed this need using the alien mussels (Mytilus galloprovincialis and Semimytilus algosus) and the barnacle Balanus glandula as model groups. For each we (1) contrasted per capita food resource use between the alien species and native comparators; (2) considered if relative resource uptake accurately reflected field abundances; (3) measured resource uptake under environmental conditions of surrounding but uninvaded areas and used this to predict spread into those areas; (4) assessed the validity of the predictions through annual field surveys. Both alien groups displayed higher resource utilisation than natives under cool nutrient rich conditions, reflecting abundances on invaded west coast shores. Under warmer conditions with lower algal concentrations (typical of the south coast), resource use suggested that S. algosus would spread to the region but M. galloprovincialis would maintain dominance. Unexpectedly, B. galndula was predicted to spread and become dominant. Field surveys confirmed the continued dominance of M. galloprovincialis as well as the spread of S. algosus and B. glandula onto the south coast. While these invasions are in their early stages, this approach has shown promise as a tool for predicting regional spread.

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Unravelling the identities of two apparently cosmopolitan Nereidid polychaetes in South Africa

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The polychaete group includes many species with apparent cosmopolitan or widespread distributions. Studies demonstrated that such distributions are usually unnatural and may be reported due to incorrect identifications and synonymizations or transport outside of their native ranges by human-mediated means. These issues led to an overestimation of polychaete distribution ranges and underestimation of global polychaete diversity. Platynereis dumerilii and Platynereis australis are classified as cosmopolitan or widespread species. Both have type localities outside of South Africa, several synonymies and South African specimens are morphologically similar to each other. This study aimed to determine whether these species have been misidentified in South Africa or whether they represent one or two local cryptic species. Random patches of algal beds were sampled from rocky intertidal zones at eleven sites from the west coast of the Western Cape to the south coast of the Eastern Cape. Worms were preserved in ethanol for molecular analysis and formalin for taxonomic assessment. Diagnostic characters were used to identify species according to Day (1967). The mitochondrial COI gene was amplified by Polymerase Chain Reaction. Bayesian Inference results indicated that South African Platynereis dumerilii is genetically different to P. dumerilii from France (type locality) and P. australis. Principal component and discriminant analyses reveal two distinct morphological groups for the South African species, but with a large degree of overlap in characters. Thus, what Day (1967) has identified as P. dumerilii in South Africa is an indigenous cryptic species and not cosmopolitan, and is a distinct species from P. australis.

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Upwelling cells on the South-East coast of South Africa

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The Transkei shelf, located on the east coast of South Africa and is one of the few shelf systems globally, that is flanked by a major western boundary current. This region, dominated by the warm and fast-flowing Agulhas Current, is described as having a moderately productive ecosystem. It has been theorised that perturbations along the inshore edge of the Current, as well as the interaction of the Current with the underlying topography, influence the occurrence of localised upwelling cells along the shelf. During upwelling events, pockets of relatively fresh and cold nutrient rich water are upwelled, dispersing the overlying warm sea surface water. During January 2017, a research cruise was undertaken between Cape St Francis and Port Shepstone to identify and characterise these upwelling centres and determine the influence of the Agulhas Current on the Transkei shelf ecosystem. In situ data indicated the occurrence of cold (<12 °C) surface water off Cape Recife and 14-15°C water in the vicinity of Port Alfred. The upwelling off Cape Recife appeared to be wind-driven whereas the Port Alfred upwelling was due to the divergence of the Agulhas Current from the coast. The Cape Recife upwelling cell was associated with near-zero chlorophyll a indicating very low phytoplankton biomass in the newly upwelled water. In contrast, the cool water off Port Alfred had slightly higher chlorophyll a biomass (< 0.6 mg m-3). These upwelling cells may be important for stimulating phytoplankton growth and supporting ecosystem functioning on the moderately productive shelf along the South-East coast.

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A comparative study of SDMs and GIS in spatial distribution of limpets in the Wild Coast

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Traditionally, species distribution models (SDMs) have been used to quantify the spatial distribution of species while geographic distribution models such as GIS have received little attention on rocky shores. This study thus compared Morista dispersion SDM with QGIS to quantify limpet diversity, density, dispersion and habitat preference in Dwesa MPA. GIS showed that Cellana capensis (41%), Scutellastra longicosta (50%) and Siphonaria capensis (60%) preferred rock pools. The outcrops were preferred by Siphonaria concinna (63%), Scutellastra granularis (66%) and Fissularia natalensis (73%) preferred. GIS also showed that species density differed per habitat for each limpet species. Morisita index reflected that Cellana capensis was clustered in rock pools (I^{δ}=1.67562) and mixed (I^{δ} =1.67), but uniformly in crevices (I^{δ} =0.82). Cymbula oculus was uniformly dispersed on outcrops (I^{δ}=0.58), random in mixed habitats (I^{δ}=0.00) and clustered in rock pools (I^{δ} =1.65). Helcion concolor reflected uniformity of I^{δ} =0.95 and I^{δ} =0.88 for crevices and mixed respectively, while it was aggregated on emergent outcrops (I^{δ} =1.29) and rock pools (I^{δ} =1.41). Siphonaria serrata uniform in crevices (I^{δ} =0.91), mixed habitats (I^{δ} =0.90) and rock pools (I^{δ} =0.94). GIS and SDMs were found to be valuable methods that complement each other as both had some shortfalls in depicting limpet distribution patterns.

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Keywords: Habitat preference, mapping, species density, species richness, rocky shores, zonation pattern.

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Does it always pay to defend one's nest? A case study in the African penguin

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Food availability has a major influence on the breeding success of African penguins Spheniscus demersus. However, under similar environmental conditions, inter-individual variations in breeding success can be observed but mechanisms leading to such differences are unknown for this species. The notion of personality in animals developed quickly in the 21st century and can be a powerful tool to partly explain individual differences in breeding success. Here, we related breeding success to individual personality in African penguins over two breeding seasons of contrasting food availability. Using penguins' response to a human approach, we determined individual boldness degree in nest defence when rearing chicks on Bird Island, Algoa Bay. Based on their behaviour (i.e. backward and attack events), birds were categorised as shy or bold. We also investigated pair assortment in boldness degree and assessed breeding success through chick growth and survival over 4 weeks in 2015 and 2016. Birds did not pair with their mate according to their own personality. Overall, pairs of two shy partners had the highest breeding success (higher chick growth), relation especially apparent during food shortage, possibly reflecting a higher energy investment when foraging. In contrast, in pairs of two bold partners, chicks grew significantly slower under limited food conditions. In conclusion, food availability did influence the relation between pair assortment by personalities and breeding success in African penguins. In the context of climate change, food shortage events may become more frequent, thereby possibly selecting for shy individuals and leading to reduced genetic diversity in African penguins.

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Kelp forest mapping and assessment of Ecosystem Conditions in South Africa

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Kelp forests constitute some of the most productive habitats on earth. They support fisheries, aquaculture and human health, are exploited for economic benefits and constitute coastal ecological infrastructure, delivering key ecosystem services. The mapping of kelp forest ecosystems is foundational to assessment of their ecosystem condition and important for their spatial management. In South Africa four kelp species occur at varying geographical and vertical distributions with Ecklonia maxima and Laminaria pallida constituting the dominant forest forming taxa. Mapping efforts to date have focused on aerial photography and satellite imagery with existing maps covering 900km of kelp from the Namibian border to Cape Agulhas excluding two key gap areas. Advancing technology and remote sensing imagery are now being employed, and limitations encountered in the 2000s are being overcome. This study advances earlier work to map kelps using novel approaches including Synthetic Aperture Radar, a hyperspectral sensor, and GIS, focusing on Macrocystis, Laminaria and Ecklonia species. The study area extends between the Orange and Mtamvuna Rivers. Aerial imagery offers high spatial resolution (improved with use of infrared wavelength), although flight time and geo-referencing constitute constraints. We show that Landsat 5 and 7 multispectral bands enable detection of kelp beds, but are very poor in the de-lineation of species and total kelp bed area. Therefore, it is practical to advance these mapping methods with a sensor that collects several hundreds and more narrow spectral bands, allowing for kelp forest classification and mapping at the species level.

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Passive Acoustic Monitoring of coastal dolphins (Sousa plumbea and Tursiops aduncus).

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Two inshore dolphin species inhabit the coastal waters of the south and east coast of South Africa, Sousa plumbea and Tursiops aduncus. Given decline in conservation status of both species and the myriad threats they are faced with in their coastal environments, there is a need for further research and monitoring on these species, including the need to set up monitoring programmes. Traditional visual survey work for monitoring dolphins can be time-consuming and expensive, alternative approaches have been developed such as Passive Acoustic Monitoring. This study assesses the efficacy of passive acoustic monitoring (PAM) for monitoring the two species of coastal dolphin, in the Plettenberg Bay area. In order to distinguish the two species, automated detection algorithms based on tonal sounds and clicks are being developed for PAM data with observations from a nearby land-based lookout used to verify identifications. The usefulness of PAM for determining the sizes of pods of dolphins of each species shall then be determined through comparison of group sizes from land-based observations with concurrent acoustic call rates of the two species. The round-the-clock PAM recordings obtained shall be used to describe the temporal patterns of each species, including effects of time of day, season and other natural cycles.

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What parents will do for their chicks – a novel foraging strategy by breeding gentoo penguins

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To help meet the high energy demands of raising the young, some seabirds alternate between short, frequent foraging trips to maximize food delivery to the young, and infrequent, long foraging trips that serve towards self-maintenance. For the first time, this study investigated the foraging behaviour of breeding gentoo penguins Pygoscelis papua at sub-Antarctic Marion Island through the combined use of GPS loggers and time-depth recorders. The shallow inter-island shelf between Marion and Prince Edward Island proved to be an important foraging area. Penguins undertook alternating trips of relatively short and long durations. Short trips, performed in the afternoon, were likely associated with self-maintenance as they were followed by roosting on the beach overnight and not returning to the colony. These trips were followed by longer, more distant foraging trips, after which the penguins returned to their colony and provisioned chicks. To our knowledge, this is the first study to associate short trips with self-maintenance for a seabird. We suggest that due to the close proximity of a predictable foraging area for these penguins at Marion Island, there is minimal energetic cost to return to land after self-provisioning. Hence, unlike other seabirds, gentoo penguins at Marion Island are uniquely afforded the opportunity for short self-maintenance trips. Finally, we argue that these birds may be using this novel strategy due to sub-optimal feeding conditions resulting from environmental change

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Increased access, participation and integration in promoting biodiversity and conservation for emerging regional economies: Growing sustainable blue economies in Africa

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The ocean is becoming a new focal point in the discourse on growth and sustainable development, especially for emerging and developing economies around the world. Inadequate access to biodiversity inventory and monitoring systems, knowledge on and ability to handle biodiversity information and integrated ocean governance will impede on sustainable regional economic growth. This paper reviews four key areas (biodiversity and conservation, participation within the ocean environment, emerging regional economies and integration that promotes sustainability and economic growth) that are important in unlocking the ocean's economic potential as captured in a number of growth and development strategies in Africa and globally. The analysis highlights frameworks and practices key for biodiversity and conservation, the integration strengths and weaknesses associated within emerging regional economies along Africa's coastal line and what key global lessons may be beneficial for growing the ocean's economic potential whilst maintaining social and ecological resilience in Africa. It also analyses the importance of natural resources and the emerging regions' potential in promoting sustainable ocean economic growth while maintaining participation, integration and sustainability. The paper concludes by reflecting upon policy frameworks essential for biodiversity and conservation issues in Africa, reflecting upon the value of integration framework proposed for regional economic growth using ocean resources.

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Microplastic contamination within the tissue of varying size classes of Perna perna along the east coast of South Africa.

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Pollution of the marine environment by microplastics, plastic particles no larger than 5 mm, has become a global phenomenon. A primary risk of these microplastics is their ability to become incorporated into food-webs, especially by indiscriminate filter-feeders. The brown mussel, Perna perna, is a numerically dominant mussel along the east coast of South Africa. This study analysed the in situ microplastic load within three different size classes of P. perna across four sites along the coast employing the nitric acid digestion methods. Results were expressed as the number of microplastics within a gram of tissue (wet weight). Overall microplastic load in the mussel tissue of the three cohorts did not differ significantly and varied from 0 to 2.20 microplastics g-1 (ww). Moreover, there was no significant relationship between microplastic load and mussel size ($P > 0.05$), and no spatial differences recorded ($P > 0.05$).

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Perna perna mortality in relation to complexity of artificial biodiversity enhancers deployed within the Port of East London, South Africa

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Abstract
Marine ecosystems are impacted by anthropogenic activities such as development of artificial structures in harbours and the increasing maritime traffic, with consequences to loss of biodiversity. This study, as part of the broader World Harbour Project, aims at improving biodiversity through the use of eco-friendly material and indigenous ecosystem engineers in the port of East London, South Africa. Perna perna (Linnaeus, 1758) (Mollusca: Bivalvia) mussels were collected from wild populations adjacent to the East London harbour. Mussels were cleaned, seeded onto eco-concrete tiles of different complexity (flat, 2.5cm and 5cm) and monthly monitored for 12 months. Control and seeded tiles were deployed at two sites within the harbour (East and West banks). At each site, the dry weight loss of clod cards deployed for 24 hours monthly was used to assess wave action; thermal loggers were also deployed to monitor in situ temperatures. Results show that early mortality of mussels on seeded tiles was highest on the flat tiles on the East bank, while on the West bank most animals died on the 2.5cm complex tiles. In-situ observations of drilled holes on shell remains provide some evidence of predation on flat tiles. Possible physical, biological, structural drivers of mortality will be discussed.

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Kelp forest mapping and assessment of Ecosystem Conditions in South Africa

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Kelp forests constitute some of the most productive habitats on earth. They support fisheries, aquaculture and human health, are exploited for economic benefits and constitute coastal ecological infrastructure, delivering key ecosystem services. The mapping of kelp forest ecosystems is foundational to assessment of their ecosystem condition and important for their spatial management. In South Africa four kelp species occur at varying geographical and vertical distributions with Ecklonia maxima and Laminaria pallida constituting the dominant forest forming taxa. Mapping efforts to date have focused on aerial photography and satellite imagery with existing maps covering 900km of kelp from the Namibian border to Cape Agulhas with gaps: near Cape Point and Northern Cape. Advancing technology and remote sensing imagery are now being employed, and limitations encountered in the 2000s are being overcome. This study advances earlier work to map kelps using novel approaches including Synthetic Aperture Radar, a hyperspectral sensor, and GIS, focusing on Macrocystis, Laminaria and Ecklonia species. The study area extends between the Orange and Mtamvuna Rivers. Aerial imagery offers high spatial resolution (improved with use of infrared wavelength), although flight time and geo-referencing constitute constraints. We show that Landsat 5 and 7 multispectral bands enable detection of kelp beds, but are very poor in the de-lineation of species and total kelp bed area. Therefore, it is practical to advance these mapping methods with a sensor that collects several hundreds and more narrow spectral bands, allowing for kelp forest classification and mapping at the species level with limited coarse classification.

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Abundance and habitat use of Indian Ocean humpback dolphins (Sousa plumbea) along the south coast of South Africa

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The recent uplisting of Indian Ocean humpback dolphins (Sousa plumbea) to 'Endangered' on the South African red data list highlights an urgent need for a greater understanding of the species' abundance and spatial distribution along the South African coastline. Using small vessels as survey platforms, this study assessed the abundance, spatial distribution and habitat preferences of Indian Ocean humpback dolphins along 150 km of South Africa's south coast. A further aim was to assess the utilisation of the current Marine Protected Area (MPA) network by humpback dolphins along this coastline relative to areas outside of formal protection. Mark-recapture methods applied to photo-identification data produced abundance estimates of approximately 84 individuals (95% CI: 72-115) within the study area. An average group size of 3.94 individuals (range 1-12; SE = ± 0.28) was observed, indicating a decrease in average group sizes since 2002/03. Spatial analysis of humpback dolphin geographic positions indicates that the species is distributed unequally over the coastal zone within the area. Areas of high humpback dolphin densities appear to be associated predominantly with Dissipative-Intermediate Sandy Coast habitat, while low density areas consist predominately of Exposed Rocky Shore habitat. The utilisation of the Robberg and Tsitsikamma MPAs by humpback dolphins was low, while Goukamma MPA was highly utilised, possibly due to the high availability of favoured habitat type within this area. The low population numbers and declines in average group size of Indian Ocean humpback dolphins within the study area warrant concern and call for effective conservation and management measures.

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Research and monitoring outcomes of the re-zonation of the Tsitsikamma Marine Protected Area

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In December 2016 the Minister of Environmental Affairs gazetted new regulations for the Tsitsikamma Marine Protected Area (MPA), allowing local communities recreational fishing access to 20% of the MPA coastline. The decision was not without contention and concerns have been raised by interested and affected parties around the sustainability of fishing and potential impacts on both fish and bait stocks, which could undermine broader conservation and fishery management objectives. South African National Parks, as the designated implementing agent, is tasked with not only implementing the new regulations, but also with the monitoring of potential impacts of these regulations. Accepting MPAs as social-ecological systems a multifaceted approach to undertaking this monitoring has been adopted, covering intertidal invertebrate communities, inshore fish populations and local community perceptions resulting from the new regulations. Here, we provide an overview of the gazetted regulations, describe the monitoring currently undertaken and outline activities that we foresee should be implemented in the future.

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Will ocean acidification impact on the survival, growth and skeletal development of larval dusky kob (Argyrosomus japonicus)?

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Anthropogenic CO2 accumulation and consequent ocean acidification poses a critical threat to marine organisms. While adult fish are considered tolerant to ocean acidification, literature suggests that the early stages may be vulnerable to the changing pCO2 levels. This has largely been attributed to underdeveloped acid-base regulation and high surface-to-volume ratios. Despite their importance in coastal fisheries, few studies have investigated the impacts of elevated pCO2 on the early marine life stages of estuarine-dependent species. Dusky kob (Argyrosomus japonicus) were reared in a control (pCO2 = 327.50 µatm at pH 8.15), moderate (pCO2 477.40 µatm at pH 8.03) and high treatment (pCO2 910.20 µatm at pH 7.78) from egg to 29 days post-hatch (dph). Sixty individuals from each treatment were sacrificed at the egg stage and 2, 6, 13, 18, 21 and 26 dph, measured and stained using an acid-free double staining solution to prevent the deterioration of calcified matrices in fragile larval skeletons. Bone and cartilage development was quantified using a novel pixel counting method. The growth and skeletal development were identical until the post flexion (21 dph) stage. However, from 21 dph growth and skeletal development rate was significantly faster in the moderate treatment and significantly slower in the high treatment when compared with the control. In addition, none of the fish in the high treatment survived after 26 dph. These results suggest that ocean acidification may have major impacts on the early marine phase of estuarine-dependent species when exposed to end of the century conditions.

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Involving fishers in seabirds conservation: bridging the gap between the needs of seabirds and the fishing industry

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This project aims to present spatial conservation options in Algoa Bay for the at-sea habitat of half of the global population of the Endangered African penguin (Spheniscus demersus), by engaging with the purse-seine fishing industries reliant on the same resources, small pelagic fish (sardine Sardinops sagax and anchovy Engraulis encrasicolus). Penguins foraging areas at St Croix and Bird islands are identified from tracking data obtained from 2008-2018. Accompanying data on penguin population parameters and diet will be used to quantify how foraging strategies may differ among years of changing food availability, and differing reproductive success. In parallel, the location of the purse-seine fishing industry's catches will be used to delineate important fishing areas. Penguin and fishing spatial requirements will be overlaid with spatial data on pelagic fish abundance and distribution from monthly acoustic fish surveys, together with knowledge on small pelagic fish biology provided by local fishers. Areas of importance for penguins and the fishing industry will be identified as areas to be managed for both conservation and fishing. Using this information, a strategy to protect areas around both islands will be developed, taking into account the needs of seabirds and industry. We anticipate that this strategy will delineate fishing closures which can be re-adjusted on a bi-monthly schedule, based on fish abundance surveys, fishery needs, and seabird needs. These data will facilitate adaptive management of Marine Protected Areas in the Bay, by providing for the protection of an endangered species, while simultaneously promoting sustainable use of the Bay's resources.

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Climate Change Adaption in a Blue Carbon Ecosystem formed by the Seagrass, Zostera capensis

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Seagrasses form a key habitat along many coastlines and estuaries. They provide a nursery and shelter for several species, and store carbon in their roots/rhizomes. Threats from human and natural influences have caused their global decline. In South Africa, the temperate seagrass, Zostera capensis supports a diversity of fauna and algae that contribute to coastal foodwebs. Zostera populations are declining and completely lost from many estuaries, implying loss in productivity and biodiversity. This study determined key environmental drivers of spatial and temporal variation of Zostera and associated macrofauna, and investigated the effects of temperature on seagrass and epiphytic algae in Langebaan Lagoon. Significant differences between seagrass beds close to the mouth and at the end of the lagoon were observed. High summer temperatures led to considerable decline in seagrass density and biomass. Beds exposed to air for longer periods during low tide had a small-leaved morphology (SLM) (+/- 8.6cm), while deeper intertidal beds had a large-leaved morphology (LLM) (+/- 20.7cm). Macrofaunal community structure was regulated by seagrass biomass and density and dominated by grazing invertebrates. Diversity and richness were higher in LLM beds, while SLM beds had greater abundances. In a mesocosm experiment, leaf length, shoot density and biomass were highest at 22 and 26oC in both morphologies, and declined at 30oC. Warming of coastal waters, could incite a shift in morphology as seagrasses adapt to climate change. Understanding seagrass resilience and adaptation will inform management and restoration efforts and maximize protection of less resilient populations in Langebaan.

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A seasonal comparison of nitrogen uptake and nitrification in the South Atlantic Southern Ocean

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Primary production fueled by nitrate is often equated with carbon (C) export from the euphotic zone. This "new production paradigm" assumes that nitrification (oxidation of ammonium to nitrite and nitrate) does not occur in surface waters. While euphotic zone nitrification has been measured in numerous regions, there are few data from the Southern Ocean. On two cruises across the Southern Ocean, nitrogen (N) uptake and oxidation were measured throughout the mixed layer. In winter, mixed layer nitrate uptake was low (average of 0.29 mmol N m-2 d-1) while ammonium uptake was surprisingly high (average of 7.64 mmol N m-2 d-1). Primary productivity was also low, indicating a decoupling of C and N uptake, likely due to ammonium consumption by heterotrophic bacteria. Summertime nitrate uptake rates averaged 3.25 mmol N m-2 d-1, and 75% of the stations were characterised by ammonium uptake rates <2 mmol N m-2 d-1. The average summer f-ratio of 0.60 is consistent with high nitrate dependence and the potential for significant C export, provided euphotic zone nitrification was minimal. Measured rates of ammonia and nitrite oxidation (vNH4+ and vNO2-) were very low in the summer euphotic zone, with nitrification accounting for ~4% of the nitrate consumed. This suggests that equating nitrate uptake with export production is reasonable in summer. In winter however, vNH4+ and vNO2- averaged 3.5 and 7.76 mmol N m-2 d-1, respectively; these rates are 50-100% of the N uptake rates, confirming that the new production paradigm does not apply to the wintertime Southern Ocean.

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Habitat preference of intertidal organisms on the rocky shores of the Wild coast, South Africa.

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Habitat heterogeneity increases the surface area of rocky shores and results in higher diversity along the rocky shore. Hence substrate for attachment is limited along the rocky shores. This study investigated the effetcs of habitat heterogneity on species distribution and diversity. The habitats and biota from Dwesa and Silaka reserves were therefore quantified. Various habitats were identified and grouped into six catergories which are: the rock pools, grooves, emegernt rock outcrops, boulders, mixed habitats and secondary habitats. Biota was grouped into invertebrates, limpets and seaweeds. The results showed that mixed habitat was the most dominant, while fissures were least common. Species such as Afrolittorina africana and Tetraclita serrata were the most abundant invertebrate species on the emegernt rock outcrops. Cellana capensis was the dominant limpet on the outcrops and mixed habitats. Rock pools were characterized by the Encrusting coralline algae such as Ralfsia verrucosa and Phymatholithon foveatum seaweeds. Oxystele tabularies and Perna perna were abundant in grooves while Gelidium pristoides was dominant species on secondary habitats. Overall, the habitat type was found to be important in determining the diversity and distribution of organisms along the rocky shores of the reserves.

Key words: diversity, dominance, habitat heterogneity, rocky shore

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Carcharhinus humani, in northern South Africa

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Sharks from the genus Carcharhinus constitute one of the most speciose groups of sharks, yet are characterized by remarkable levels of morphological and ecological conservatism. They can be challenging to identify, making monitoring programs problematic. Owing to their slow growth and low fecundity, sharks from this genus are vulnerable to exploitation. The aim of this study was to confirm the presence of a recently described species, Carcharhinus humani, in northern South Africa through the use of genetic tools, and to make the sequence of the COI gene available on GenBank database to facilitate future identification of this species. An unidentified shark carcass (minus head, and internal organs) was washed ashore at Rocky Bay, South Africa. The absence of key morphological characters hampered the use of conventional identification methods. Despite this, the coloration of the fins and genetic analyses of the COI gene (bayesian, maximum likelihood and minimum spanning networks), suggested that the specimen belongs to C. humani, while confirming the presence of this recently described species in northern South Africa. In addition, the COI sequence fragment of 658bp was registered in the GenBank database to facilitate future identification of C. humani through genetic tools. Future molecular studies should also include various markers to infer more robust results on C. humani gene flow. Genetic diversity, biology, habitat and population status of C. humani, are important aspects that need to be studied in order to evaluate C. humani's resilience to anthropogenic impacts and its vulnerability in South African waters.

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Seasonal variation and habitat characteristics of rock pool species on the south coast of South Africa

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Rock pools are a common habitat in the intertidal environment. These pools offer easy access for in situ studies of habitat characteristics and possible ecological limitations on intertidal species. In this study, twelve pools from the shore near of the Great Fish River were sampled to determine how physico-chemical (depth, surface area, substratum, temperature) and biological (habitat preference, predation) parameters influence species composition. From visual and photographic observations, pool substratum significantly changed from bare rock in winter to dense macro-algal beds in summer. Pelagic phytoplankton biomass (estimated as chl-a) was significantly higher in summer (0.69 mg m-3) than winter (0.10 mg m-3). Seasonal variation also influenced species richness especially of macro-algal communities. Simple linear regression analysis indicated that pool surface area was significantly correlated with species richness of macro-algae with relatively higher species composition in bigger pools as predicted by island biogeography theory. Some invertebrates, such as the gastropods Oxystele tigrina and Burnupena lagenaria and echinoderms, for example the dwarf cushion star were ubiquitous. However, hermit crabs, some fishes and chitons exhibited habitat specificity, with strong preferences for deeper pools with high availability of cryptic habitats as compared to bare sandy substrata. Species composition in pools without fish was different from those with fish, thus we postulate that clinids promote a trait-mediated top-down cascading effect on lower level species such as sand shrimps because the crustaceans exhibited an affinity to smaller pools with potentially fewer predators.

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The uptake of microplastics via ingestion, in the caridean shrimp Palaemon peringueyi (Stebbing, 1915).

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Plastic pollution is a conservation issue that has received global attention for a number of years. More recently, the focus has shifted towards microplastic pollutants (those <5mm). This study utilises microplastic fibres, the most commonly found microplastic pollutant in KZN estuaries. A common scavanger in KZN waters, the Glass Shrimp (Palaemon peringueyi (Stebbing, 1915)) maybe exposed to microfibres. Palaemon peringueyi serves as a prey item for a number of species; therefore, if the shrimp are taking up microfibres it is possible that bioaccumulation of fibre associated pollutants may occur. Little research has been conducted on decapod microplastic ingestion. It has been documented that shrimp can be sustained on artificially produced food; this experiment utilised a flake food readily taken up by P.peringueyi. Routes of microfibre ingestion were investigated. To eliminate confounding factors, the microfibres were produced manually and validation experiments were performed. A 48-hour depuration experiment was conducted to determine if the species could survive without food after gut evacuation. Following the depuration, the percentage of feed ingested versus feed wasted was calculated. Different microfibre concentrations were examined to ascertain which best maintained the stability of the flake. Microfibres were suspended in the water column to eliminate filtration as a form of uptake. The final experiment examined presence or absence of microfibres in the gut and gut retention of fibers. The uptake of fibres by these shrimp is concerning as they can be used as live feed in aquaculture which is for human consumption.

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The effect of turbidity on the oxygen consumption rate of different life stages of the mysid Mesopodopsis africana

The Effect Of Turbidity On The Oxygen Consumption Rate Of Different Life Stages Of The Mysid Mesopodopsis Africana Natleen Govender[1], Dr Nicola Carrasco[1], Dr Andre Vosloo[1]
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Many coastal regions are affected by anthropogenic activities for developmental purposes resulting in surrounding systems being affected by turbidity. Turbidity in estuarine environments affects secondary producers such as zooplankton. Zooplankton form an important link between primary producers and higher trophic levels, and their high turnover rates make them important indicators of change in aquatic systems. Mysids are widely distributed in estuarine environments, where they often contribute the bulk of the zooplankton biomass. This study aimed to determine the effects of turbidity on the oxygen consumption rates of different life stages of Mesopodopsis africana, by exposing different life stages to a series of turbidities. The partial pressure of oxygen in the water before and after an incubation period was then measured using two different types of respirometers (Strathkelvin and Pre-Sense). The results indicated that at higher turbidity treatments the juveniles and adults had a higher oxygen consumption rate. This may be due to gut loading, an under-developed homeostatic system and/or damages to respiratory and filtering apparatus. High turbidities may therefore have a structuring effect on zooplankton communities. These findings expand our knowledge on turbidity effects on zooplankton and are important for the management of systems facing similar stressors, both locally and globally.

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Rocky shore community dynamics: zoanthid community assemblages.

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The coastal zone is subjected to acute anthropogenic-related impacts because it is the most accessible part of the ocean to humans. Rocky shore systems, especially, are subject to intense harvesting, pollution, coastal development and other nearshore activities. For scientists and managers to effectively manage these areas, they need to have a good understanding of the processes that affect their health and natural functioning. To collect this information, long term monitoring programs are implemented to observe changes in community composition and species diversity. This research was conducted with the aim of measuring the abundance and distribution of zoanthids along the KwaZulu-Natal Coast by counting zoanthids present in 0.5 x 0.5m quadrats, along 50m transects that start from the littoral to the balanoid zone. This was conducted at four sites, sampled biannually, and served as the initial survey of the KZN shoreline long term monitoring program. It was found that the four sampling sites were not significantly different to each other. During the dry season the highest diversity was observed at Ballito and the lowest at Umdloti, and during the wet season the highest diversity was found at Isipingo and the lowest at Ballito. Zoanthids were found at all four sites in varying densities. Ballito and Isipingo had lower zoanthid cover in relation to Umdloti and Scottburgh. When comparing Perna perna densities, Ballito and Isipingo had higher P. perna cover than Umdloti and Scottburgh. Since all four sites were found in one bioregion it is expected that they do not differ significantly.

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The value of foundational biodiversity knowledge in tracking environmental change.

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Appropriate baseline information is needed against which long-term change can be measured. In 2010 South Africa's deepsea biodiversity was considered poorly studied with 83% of samples collected shallower than 100m. Limited deepsea benthic invertebrate taxonomy and biodiversity information was available, with no long-term offshore benthic invertebrate surveys having taken place. Deepsea cameras are increasingly popular for surveying seabed habitats, however, specimens are still required for taxonomic validation. Over the past decade ongoing efforts have been implemented to collaborate with fisheries trawl surveys in building South Africa's foundational offshore invertebrate knowledge. To date, nearly 17 000 occurrence and biomass records have been captured and 400 taxa identified to either genus or species level. This information has been compiled into a field guide and database through collaborations with taxonomists and researchers from 14 institutions. Through this initiative, thus far, 14 new species distributions have been recorded in South Africa and 20 species new to science have been discovered that are now being described. Data and specimens collected through this research have already supported several student research and long-term impact assessment projects. Aside from contributing to foundational deepsea taxonomy and biodiversity knowledge, information from this long-term monitoring initiative is being used to identify and map potential vulnerable marine ecosystems, define and characterise offshore ecosystems, assess potential impacts of trawling and has the capacity to enable quantification of future species or habitat changes that may occur as a result of a changing environment.

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Interspecific, ontogenetic, spatial and temporal variability in nitrogen and carbon stable isotope ratios of small pelagic fish off South Africa

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Over 1 000 measurements of the nitrogen and carbon stable isotope (SI) ratios of sardine Sardinops sagax, anchovy Engraulis encrasicolus and west coast round herring Etrumeus whiteheadi have been collected from around the South African coast between 2008 and 2016. These were analysed to test hypotheses regarding the relative trophic position and to investigate ontogenetic, spatial and temporal variability in SI ratios of each species. Significant differences in $\delta^{15}N$ and hence relative trophic level were observed between all three species, with sardine having the lowest and west coast round herring the highest values. The difference between sardine and anchovy confirms previous studies, but the bigger difference in $\delta^{15}N$ values between anchovy and round herring suggests that the latter feeds more on pelagic fish larvae and juveniles than was previously considered. Carbon SI ratios corroborate these different trophic niches, being highest for sardine and lowest for round herring. Ontogenetic effects on both $\delta^{15}N$ and $\delta^{13}C$ were absent or weak in all three species. A strong longitudinal gradient in $\delta^{15}N$ was seen in all species with values being highest off the west and lowest off the east coast and differing by 1.5-2.0‰ between 16°E and 30°E. In contrast, $\delta^{13}C$ showed little or no spatial variation. Weak seasonal variability in the ratios of both isotopes was observed. The implications of these results for ecosystem models and when using SI analysis to estimate dietary composition of predators that feed on small pelagic fish are discussed.

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EBSAs in the BCLME: Linking scientific information with marine planning and management

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Ecologically or Biologically Significant Marine Areas (EBSAs) are areas of the oceans that have special ecological or biological importance. For the Benguela Current Large Marine Ecosystem (BCLME), twelve areas meeting EBSA criteria have been described and endorsed by the Convention on Biological Diversity. These include one Angolan, two Namibian and five South African EBSAs - with an additional four transboundary EBSAs. In the framework of the Benguela Current Convention (BCC), the three member states determine gaps for the EBSA network and refine boundaries, undertake status assessments of the EBSAs, and formulate management options. The overall approach is around improving the sustainable management of marine biodiversity and resources of the BCLME through a “move from maps to action” by translating the scientific EBSA information into management protocols for those EBSAs within the national jurisdictions of the three BCC member states. Ultimately, the aims are to: (1) fully embed EBSAs as part of a robust, spatially explicit, Marine Spatial Planning (MSP) process; (2) strengthen the capacities of the BCC and its member states in relation to EBSAs and MSP; and (3) secure tangible and improved management outputs for these key biodiversity assets. A regional working group and national task teams have been established to pursue these processes, with technical assistance provided through the “Marine Spatial Management and Governance” (MARISMA) project, jointly implemented by BCC and German Development Cooperation (GIZ). Initial workshops have identified potential new EBSAs in the region as well as possible refinement of previously defined EBSA borders.

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The South African atlas of sea surface temperature trends and extreme events

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A changing global climate places coastal ecosystems at more risk than those in the open ocean as their temperatures may change more rapidly and dramatically. In addition to the detection of trends in sea surface temperature (SST) and variability, it is necessary to identify the occurrence of marine heatwaves (MHWs) in coastal waters as they can have lasting ecological effects. A framework for defining these events was applied to SST time series from multiple remotely sensed datasets as well as one collected in situ. We show that MHWs occur at least once a year on average within all time series for all datasets; however, significant differences in the timing, count, duration and intensity of MHWs for corresponding time series between some datasets were found. The trends in SST and variability between these time series also tended towards significant differences. The decadal trends for the MHWs generally show that they are increasing in count, duration and intensity. Our analysis also shows that the west, south and east coasts vary in their susceptibility to MHWs, with the south coast most at risk, and the east coast least.

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"Genetic connectivity and hybridisation between temperate and subtropical rocky shore ascidians, Pyura spp."

Miss Alessia Dinoi[1], Prof Peter Teske[1]
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Population connectivity is an important issue to understand the factors regulating the abundance and distribution of marine species, to establish conservation strategies and to manage the impact of climate change.
The present study utilizes as model organisms of the genus Pyura (P.stolonifera and two genetic forms of P.herdmani), of which occur in the temperate marine bioregion and in the subtropical and tropical bioregions along the eastern coast of South Africa.
The hypothesis is that subtropical and temperate evolutionary lineages of Pyura hybridize in the transition zone between the region's major coastal biogeographic provinces and that hybrids will also be found primarily south of this region, as large-scale dispersal is most likely facilitated by the southward-flowing Agulhas current.
A piece of the mantle tissue from 630 animals was collected by hand during the low tide in intertidal and subtidal zones in thirteen different sites (from Port Edward to Port Elizabeth).
Polymorphic microsatellites were used as a genetic method in order to evaluate gene flow between different populations and species and to investigate their levels of hybridization between closely related evolutionary lineages.
The obtained genetic information on this group of ascidians indicates that the different species have overlapping ranges and them often also occur in sympatry on the same rocks. This suggests that interbreeding between neighbors belonging to different evolutionary lineages is possible and the microsatellites are a useful tool for monitoring the effects of climate change and the rate of adaptation to a rapidly changing thermal environment.

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Catostylus azania sp. nov. (Cnidaria, Scyphozoa): description of a new jellyfish from around South Africa

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The appearance of an unknown rhizostome jellyfish species has been noted periodically in estuaries along the east and south coast of South Africa over the last decade. From material collected between 2013 and July 2016, it is clear that this species differs from others, morphologically, and we describe it as a new species: Catostylus azania sp nov. The new species can be identified morphologically by the number of lappets per octant, shape of velar lappets, absence of radiating furrows stemming from the bell margin and size of the distal end on the oral arm. Molecular analyses of mitochondrial cytochrome c oxidase subunit I (COI) and nuclear internal transcribed spacer 1 (ITS1) DNA genes support its identity as a new species: pairwise sequence differences observed here were sufficient to designate Catostylus. azania sp. nov as being a new species.

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Distribution of the benthic invertebrate community and ichthyofaunal associated with Walters Shoal seamount

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Seamounts are unique topographical features found within ocean basins. These features are considered to be biodiversity hotspots, supporting diverse benthic communities and ichthyofaunal aggregations. Despite their significance, relatively few seamounts have been rigorously studied. Thus, little is known regarding seamounts and their associated ecosystems. Walters Shoal is a shallow seamount, with its peak reaching 18m below sea level, located within the western Indian Ocean. This study aims to describe the benthic invertebrate and ichthyofaunal communities associated with this seamount. In 2014 the R/V Algoa conducted a scientific cruise to explore the benthic invertebrate and ichthyofaunal communities, located between the photic zone to 500m depth, associated with the seamount. The benthic invertebrate community was studied using a remote jump camera system and physical samples were collected by SCUBA diving and a benthic rough sled. The ichthyofaunal community was studied using stereo and mono baited remote underwater video systems (BRUVs) and physical samples were collected to support identification of species. Preliminary results show that Walters Shoal is dominated by red coralline algae, within a depth range of 20 – 100m, and is characterised by a slow growth profile. This differs from previously studied seamounts which have been shown to be characterised by a high biomass of filter feeders/suspension feeders. Ichthyofaunal community results suggests that the community is comprised of a greater number of widespread tropical species than previously reported.

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The ghost crab as model organisms in marine climate-change ecology: unicorn or red herring?

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Satellite data have supplemented direct measurements to provided clear evidence that the world is warming. But to demonstrate ecological responses to such changing climates, not only do we need field observations, but we need dedicated time series designed specifically for this purpose. Unfortunately, few such datasets exist, particularly in the ocean, where sampling is difficult and expensive. So, science has relied on making the most of the data that are out there. These resources have revealed strong and consistent patterns of ecological response in the global ocean, but significant uncertainty remains about key mechanisms. Resolving this uncertainty requires the identification of model species for which distributional limits can be efficiently determined with reasonable certainty, that are amenable to laboratory experimentation, and that provide opportunities to distinguish responses to changes in climate variables from responses to other putative drivers of change. Ghost crabs seem to fit the bill. But nothing is that simple. Here, I describe movements in the poleward range edge of a common ghost crab, Ocypode cordimanus, and relate these to multiple metrics of air, sea and sediment temperatures. Although the range edge of this species falls within a marine warming hotspot, air, sea and sediment temperatures exhibit contrasting temporal patterns, and sediment temperatures are also dependent on depth, facilitating opportunities for crabs to select thermal refugia. Thus temperature control of the range edge is shown to be complex, even for this near ideal species, confounding simple predictions of poleward range extension.

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Passive acoustic monitoring of southern Africa's oceans - soundscapes, cetaceans and so much more

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Passive acoustic monitoring (PAM) is commonly used to generate information on the distribution, abundance and behavior of cetacean species and increasingly for fish and other marine life. In African waters, the utilization of PAM lags behind most other continents. Our research group has been using a number of autonomous recorders (click detectors and recording hydrophones) to investigate the long-term presence and acoustic behaviour of cetaceans (mostly coastal dolphins) in Namibia and South Africa. Recording hydrophones (such as SoundTraps) also provide information on non-cetacean sounds in the environment including fish sounds, reef noise, weather associated sounds (rough seas) and anthropogenic sounds including noise associated with boats, construction, naval activities etc. We will provide an overview of the programmes we have conducted to date, including current projects. These include: long term monitoring of 3 coastal dolphin species in Namibia and South Africa using click-detectors (CPODs), monitoring of construction noise, dolphin presence and marine soundscapes during major port construction in Namibia, ongoing monitoring of dolphin and whale presence around the Cape Peninsula/False Bay and automated detection and classification of cetaceans sounds. Anthropogenic noise in the ocean, notably from boats and active sonar, is a growing concern globally, especially for acoustically sensitive species such as cetaceans and soniferous fish species. With the goals of Operation Phakisa being to massively increase human activities in the southern African oceans, it is imperative that a good understanding of baseline acoustic conditions and real and potential impacts in this poorly studied area, is developed as soon as possible.

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The uptake of Cadmium and Zinc and their effects on the osmoregulation of the mangrove crab, Chiromantes eulimene

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The discharge of industrial effluent into Bhizolo canal is of great concern. It poses a threat to biotic components of the system. C. eulimene has a high biomass at Bhizolo canal. This study aims to investigate the uptake and accumulation of Cd and Zn by the mangrove crab, C. eulimene; whether there is a difference between the individual metals and their mixture; whether there are gender differences; and whether the exposure to the metals (Cd & Zn) affects the osmoregulation. Adult male and female crabs were collected from Bhizolo canal. They were acclimatized and exposed to Cd and Zn for 0, 48, 96 & 168 hours intervals. Osmolarity of the haemolymph was recorded. Tissues (gills and digestive gland) were analysed by means of a Varian AA-50 Spectrophotometer. One-way ANOVA was used for data analysis, significant difference considered at $p<0.05$. There was a significant increase in Cd concentration after 48 hours and there was a significant decrease after 168 hours (in the individual exposure) and for the mixture, the increase was only after 96 hours. There was no significant change in Zn concentration with the extension of time (both in the individual & mixture exposures). Cd concentration was significantly high in the male gills than in the female gills after 168 hours of exposure. Exposure to the Cd-Zn mixture for long term (168 hours) resulted into an increase in the haemolymph osmolarity (in females). Differences could have resulted from metal interactions (synergistic effects); species-specific characteristics and gender-based differences (e.g. body size).

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Dragging up the past off South Africa's east coast

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Demersal trawling has a reputation for impacting on sea floor ecology, although hard data to support this contention are often lacking. Frequently, there is no information available for the period before regular trawling commences, or from the initial years of the fishery; this is particularly the case for sub/tropical fisheries. On the east coast of South Africa, research trawl surveys commenced at the turn of the 20th century, in order to investigate fisheries potential of the region. Subsequent surveys occurred in the 1920s, 1940s and 1970s, whereafter regular commercial trawling for crustaceans commenced, with onboard observer data being collected in the early 1990s and the mid-2000s. The fish catch composition data from these periods were validated, standardized and compared using diversity indices and multivariate methods. Difficulties were experienced with comparing data between periods, owing to disparities in the gear types being used, and because of species' identification issues in the early surveys. Many species which were commonly recorded before fishing commenced have persisted, although there have been changes in relative abundance. Ascribing these changes to the effects of trawling on the east coast of South Africa is not straightforward. The implications are discussed in the light of declining effort in the South African east coast trawl fishery, and recent Marine Protected Area initiatives in the region, under Operation Phakisa.

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Has pH in river inflow into estuaries shifted over the past 15 years? – A South African perspective

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pH is a vital variable in the natural environment because acidity controls many mineral and ion exchange equilibriums (Neal et al., 1998). In aquatic ecosystems, pH is an important determinant of chemical species, including the availability and potential toxicity of heavy metals and other substances (Davies and Day, 1998). Biologically, pH regulates the ionic balance of aquatic organisms. Organisms outside their optimal pH range could experience physiological stress (Davies and Day, 1998). pH can vary naturally , for example as result of interactions or reactions with the surrounding geology and soils, or biotic processes within the ecosystem, such as photosynthesis and respiration (Weber and Strumm, 1963; Davies and Day, 1998). Anthropogenic effects on pH include effluent from industries, mining and agriculture (Davies and Day, 1998; Cerco et al., 2013).

One of the key influencing factors of pH in estuaries is river inflow. In this context our study explores whether pH in river inflow into South African estuaries has changed over the past 15 years, using long-term environmental chemical data series collected by South Africa's Department of Water and Sanitation (https://www.dwa.gov.za/iwqs/wms/data/WMS_pri_txt.asp). We selected 43 river systems for which sufficient data series were available, and that were in relatively close proximity to downstream estuaries so as to be most representative of inflow. Time series plots were analysed in order to identify any long-term trends as well as to compare pH distribution patterns across river systems, for example to explore potential influence of catchment geology and vegetation.

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Spatio-temporal distribution of redeye roundherring (Etrumeus whiteheadi) catches by the small pelagic fishery off South Africa's Coast

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Redeye round herring (Etrumeus whiteheadi) is endemic to southern African waters and occurs over the continental shelf between Namibia and the east coast of South Africa. This species is targeted by the South African fishery for small pelagics and was first caught in 1958. Annual landings since then have ranged between <1 000 tonnes and 97 000 tonnes, with an average of around 35 000 tonnes. Redeye are processed into fishmeal and oil, and the fishery is managed via a precautionary upper catch limit (PUCL) of 100 000 tonnes, but this species is presently considered underexploited because its estimated biomass has ranged between 1 and 2 million tonnes over the past decade. We describe the spatio-temporal distribution of commercial catches of redeye using data recorded over the period 1987-2016. The majority of purse-seine catches of this species are made between March and May over the continental shelf between Cape Columbine and Cape Point, with almost no redeye being caught during the rest of the year or elsewhere along South Africa's coastline. Vessels cease fishing on redeye and preferentially target anchovy recruits when they become available off the West Coast, usually from April to September. The centre of gravity of commercial redeye catches has shown a slight southward shift off the West Coast over this period. Little is known about the life history of E. whiteheadi, and information gleaned from commercial catches will be useful for the assessment and management of this stock.

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The role of De Hoop Marine Protected Area in the conservation and management of reef fisheries investigated with remote video

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Marine protected areas (MPAs) are widely used as conservation and fisheries management tools in South Africa and elsewhere. South Africa's MPA network consists of 23 MPAs, one of the larger ones is the De Hoop 'no-take' MPA. Besides the previous shore-angling studies conducted within the MPA, the state of the reef fish populations in the subtidal areas is relatively unknown. To assess the effectiveness of the MPA for protection and replenishment of reef fish populations, baited remote underwater stereo video systems (stereo-BRUVs) surveys were conducted. A total of 102 samples were collected from areas open to fisheries exploitation and areas within the MPA. Videos were analysed to extract species composition, abundance (MaxN) and size structure. PERMANOVA and CAP were applied to investigate the effect of protection status (exploited or protected) on the reef fish community. Results indicated that protection status and habitat type had a significant effect on fish abundance and biomass, i.e. fish communities differed between exploited and protected areas. However, this pattern appeared to be driven by the differences in habitat quality between the two areas. Although every effort was made to sample similar habitat types in both areas, very little subtidal reef could be located inside the MPA, while expansive reef complexes were found in the adjacent areas open to fisheries exploitation. As such the fish community inside the MPA was dominated by sand associated species, including numerous species of sharks, while the community outside the MPA was comprised by typical reef fishes such as sea breams.

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The effect of bait on fine-scale habitat associations of reef fish investigated with a remote video technique.

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Establishing fish-habitat associations can aid in the monitoring of fish stocks and the formation and effectiveness of marine protected areas (MPAs). Information obtained by baited remote underwater stereo video systems (stereo-BRUVs) are able to link the observed fish fauna to their habitat. However, the application of bait can attract fish from surrounding habitats, with the potential to bias our understanding of the relationship between the observed fish fauna and their habitat. To test this, a field study was conducted in the Tsitsikamma National Park MPA to determine the effect of bait on fine scale fish-habitat associations when sampling with remote photographic and video methods. Within the sampling area, photo-quadrates of the macrobenthos were collected using a drop camera, from which five habitat types, based on substrate and macrobenthos, were defined. Baited (stereo-BRUVs) and unbaited (stereo-RUVs) surveys of the fish community were carried. The results show that in general, higher abundances of fish were observed on reef compared to sand habitats and that bait had a positive effect on species richness and fish abundance. Roman (Chrysoblephus laticeps) were common in reef habitats and significantly increased in abundance when bait was present. Stereo-RUVs were unable to detect species associated with sand habitats and were highly variable. The patterns seen by the effect of bait are however consistent between methods across habitat types. The results suggest that stereo-BRUVs are a suitable sampling method to detect fish habitat associations even at fine spatial scales.

Key words: marine ecology; fish-habitat associations; monitoring; stereo-BRUVs

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Air sac helminthiasis in a grey-headed albatross at Marion island

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A higher-than-usual mortality of grey-headed albatross chicks (Thalassarche chrysostoma) was recorded in March-April 2016 at Grey-Headed Ridge (46°57'S 37°42'E), Marion Island. Affected chicks appeared weak, prostrated, apathetic, with drooping wings, and eventually died while sitting on the nest. Increased predation by giant petrels and skuas was noted during this period, and at the time the colony was also heavily impacted by mouse nibbling/scalping and tick infestation. Three grey-headed albatross chick carcasses were collected and necropsied in late April 2016; two died due to starvation, along with significant tick infestation and signs of ante-mortem harassment by predators. The third chick, however, was found to have died as a result of respiratory failure due to air sacculitis caused by helminthic infection. This bird presented a large quantity (>150) of small nematodes (white, length 12-15 mm, width <1 mm) in the thoracic and abdominal air sacs, in association with substantial haemorrhage in the air sacs and moderate-severe multifocal piogranulomatous airsacculitis. These parasites were preliminarily identified as belonging to family Anisakidae. No parasites were found in the trachea or lungs, but there were extensive areas of haemorrhage on the surface of the anterior third of trachea as well as diffuse mild granulocytic pneumonia. To our knowledge, this is the first record of air sac helminth infection in albatrosses (Diomedeidae). The role played by these parasites in the early 2016 increased mortality of grey-headed albatrosses at Grey-Headed Ridge remains unclear.

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When things go wrong: breeding failures and unusual mortalities of African penguins

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The population of African penguins (Spheniscus demersus) has collapsed from 147,000 pairs in the late 1950s to 25,000 pairs in 2015, i.e. an 83% decrease. While this decline appears to be primarily related to the decrease in the availability of suitable prey, unusual mortality events may also have played a role. We reviewed the literature, governmental reports and unpublished data and compiled information on 43 mortality incidents involving this species in the past century, excluding oil spills and predation. Extreme weather events were the most common cause of unusual mortality (51%), especially in Namibia, comprising heat stress, storms, high tide/swells, and windstorms. Starvation and/or malnutrition were identified as the cause of several incidents (19%); however, it is likely that an even greater number of mass mortalities of chicks would have been recorded in recent years if penguin chicks abandoned by their parents had not been systematically removed and hand-reared. Diseases such as pasteurellosis (avian cholera), helminthiases, poisoning due to harmful algal blooms, etc., were seldom identified as the cause of large-scale mortality of African penguins; however, it is unclear whether this is faithfully portrays the role played by disease or if it instead reflects the need for in-depth laboratory investigation to establish such diagnoses. Unfortunately the cause of many incidents (21%) remains unknown due to lack of detailed investigation, and further efforts are recommended to investigate the aetiology of future mortality events and their demographic consequences to the conservation of African penguins.

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Identifying the culprits of predation of African penguins

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Predation by Cape fur seals (Arctocephalus pusillus), caracals (Caracal caracal), leopards (Panthera pardus) and domestic dogs (Canis familiaris) may be a significant pressure to the conservation of African penguins (Spheniscus demersus) in South Africa, especially when problem individuals do surplus killing, i.e. hunting sprees where they kill many penguins whilst only feeding on a few. The Southern African Foundation for the Conservation of Coastal Birds (SANCCOB) regularly receives carcasses of African penguins thought to have been attacked by predators at the Western Cape coast, South Africa. Identifying the species of the predator based solely on post-mortem examination can be challenging, but in 2015-2016 there were several cases of surplus killing where the involvement of dogs, leopards and caracals could be conclusively determined based on camera traps, footprints and sightings. We describe the post-mortem lesions present in these cases, and discuss how they can be used to identify the predator species involved.

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Microplastic extraction from juvenile fish with nitric acid (HNO3): Speeding up the process and the plastics that endure.

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A standard method for the detection and isolation of microplastics is required to adequately investigate plastic ingestion by juvenile fish. Since juveniles are generally more abundant than adults the method needs to be rapid to process larger sample numbers. To investigate the efficacy of nitric acid (HNO_3) in aiding the isolation of microplastics, we digested juvenile glassfish, Ambassis dussumieri (Cuvier, 1828) at room temperature and at 80°C. For a complete digestion, overnight incubation in 10 mL of 55% AR HNO_3 was sufficient for a whole fish of 1 g at room temperature. When coupled with elevated temperature the digestion time is shortened to a few minutes and larger fish of 3 g can be digested in 30 minutes. With the exception of polyhexamethylene nonanediamide (nylon), four other plastic types survived the process. This is a shortfall to the method; however, until a better method replaces it, we still value the use of HNO_3 for its simple, inexpensive, swift and complete digestions of whole fish.

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A molecular phylogeny of the spiny lobster Panulirus homarus supports a new species from the Southwest Indian Ocean.

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Accurate species description in the marine environment is critical for estimating biodiversity and identifying genetically distinct stocks. Analysis of molecular data can potentially improve species delimitations, because they are easily generated and independent, and yield consistent results with high statistical power. We used classical phylogenetic (maximum likelihood and Bayesian inference) and coalescent-based methods (divergence dating with fossil calibrations and coalescent-based species delimitation) to resolve the phylogeny of the spiny lobster Panulirus homarus subspecies complex in the Indo-West Pacific. Analyses of mitochondrial data and combined nuclear and mitochondrial data recovered P. h. homarus and P. h. rubellus as separately evolving lineages, while the nuclear data trees were unresolved. Divergence dating analysis also identified P. h. homarus and P. h. rubellus as two distinct clades which diverged from a common ancestor during the Oligocene, approximately 26 million years ago. Species delimitation using coalescent-based methods corroborated these findings. A long pelagic larval life stage and the influence of ocean currents on post-larval settlement patterns suggest that a parapatric mode of speciation drives evolution in this subspecies complex. In combination, the results indicate that P. h. rubellus from the Southwest Indian Ocean should be acknowledged as a separate species. Consequently, conservation and management efforts should focus on P. h. rubellus as being endemic to south east Africa and Madagascar.

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Interactive effects of nutrients and sandprawn ecosystem engineering on intertidal soft-sediments

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Burrowing sandprawns are dominant members of soft-sediment ecosystems across the globe. Locally, the sandprawn Callichirus (= Callianassa) kraussi dominates the South African coastline, occurring across the oligotrophic east coast and cool upwelling west coast. Sandprawns are regarded as key allogenic ecosystem engineers, with multiple ramifications for food web components and biogeochemical processes. However, little is known about the effects of nutrients in altering pathways by which sandprawns structure sedimentary assemblages. The latter is important given that sandprawns occur at a range of background nutrient levels. This study uses a 6 month field factorial experiment to test the interactive effects of nutrients in altering the strength of ecosystem engineering by sandprawns on intertidal soft-sediment communities. Preliminary results indicate little impact of nutrients in altering sandprawn effects on community metrics. However, results suggest important effects on functional groups, with nutrients being able to reverse sandprawn effects, most likely by enhancing availability of trophic resources. Results also indicate that interactive effects are contextually dependent, with sites dominated by higher wave action and greater sediment particle sizes displaying weaker responses to both sandprawn ecosystem engineering and nutrients, potentially due to background disturbance shifting assemblages to r-selection. Our findings contribute to enhancing understanding of the factors responsible for altering the strength of sandprawn ecosystem engineering on assemblages.

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An unexpected Atlantis: using artificial structures in the conservation of an endangered seahorse species

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Anthropogenic development, especially the transformation of natural habitats into artificial, is of growing concern within estuaries and coastal areas worldwide. Many species are negatively affected as their natural habitats are destroyed or altered. Marine conservation actions usually focus on the protection of natural habitats e.g. Marine Protected Areas, but potential exists in the use of artificial habitats for species conservation. During the development of a residential marina estate in the Knysna Estuary, South Africa, Reno mattresses (horizontal wire cages filled with rocks) were used as a canal lining. Seasonal and monthly population assessments of the endangered Knysna seahorse, Hippocampus capensis, were conducted within the marina and the estuary over a two-year period. Consistently higher seahorse densities were found on the Reno mattresses compared to vegetation habitats and to historical data for the estuary. This result begged the question of whether the artificial habitat was chosen by the seahorse in preference to natural vegetation. An in situ experiment in which adult H. capensis were given the choice between natural vegetation (Zostera capensis) and artificial (Reno mattress) habitat found that seahorses were significantly more likely to move away from Z. capensis onto the Reno mattresses or remain on the Reno mattresses. Adult H. capensis were found to prefer an artificial habitat to Z. capensis and we conclude that Reno mattresses provide an excellent habitat for this species. The results of this study suggest that similar artificial habitats should be examined when considering conservation models for other seahorse species.

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SeaKeys – Lessons from Citizen Scientists Unlocking Foundational Marine Biodiversity Knowledge

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The SeaKeys project aimed to use citizen science to support the mapping of marine species in South Africa. Participants were encouraged to contribute data in the form of photographs with GPS coordinates to an online platform, iSpot and experts were requested to verify submissions. Over three years more than 200 citizen scientists contributed 21564 new distribution records covering over 1150 species. The Coral, Crustacean and Sea Slug Atlas initiatives delivered 3645 coral, 753 crustacean, and 3144 sea slug observations. Fish dominated observations with 8057 records from 732 species being uploaded. The success of the Sea Fish Atlas was attributed to a dedicated coordinator who was paid to validate online submissions, support data upload, give feedback and interact with contributors. Seventy percent of the data came from only ten citizen scientists. Some key limitations of this data set include “effort hotspots” in Sodwana Bay and False Bay and a bias towards charismatic or interesting species. Although successful, this SeaKeys work highlighted several considerations for future citizen science work in South Africa including the need for a simple data entry platform in line with our limited and varying internet connectivity. There are advantages to an independent and custom built platform that need to be weighted up against the benefits of using existing infrastructure. The success of a citizen science initiative is both dependent on and contributes to effective science communication. This data is feeding into habitat mapping and marine biodiversity assessments with potential future contributions for monitoring.

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DNA barcoding supports morphological evidence for a new genus of Alcyoniidae (Cnidaria: Octocorallia)

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Alcyonacea are conspicuous members of reef communities yet the study of their ecology is confounded by inconclusive taxonomic knowledge. The addition of phylogenetic analyses and DNA barcoding to traditional taxonomic approaches has progressed our understanding of genus and species boundaries, however, few markers are suitable for studies of Alcyonacea as they are predominantly mitochondrial and evolve significantly slower in Octocorals than their nuclear counterparts. We investigated the taxonomic resolution of DNA barcoding in a number of shallow-water genera from the Indo-Pacific, and assessed the utility of a nuclear ribosomal gene (28SrDNA) in addition to known mitochondrial markers. As a result, we found that a mitochondrial and nuclear multi-locus barcode (2300bp), consisting of COI+igr1+MutS+28SrDNA, revealed clades with strong resolve to the species-level. We especially targeted one genus, where morphological evidence indicates that a number of species should probably be reassigned to a new genus, and found it was substantiated by a highly supported monophyletic clade distinct from other alcyoniid genera. In addition, 28SrDNA exhibited more parsimony informative sites, higher haplotype diversity, and delineated between species, making it a powerful addition to the existing mitochondrial barcode. Here we present phylogenetic evidence for a proposed new genus. This supports the reassignment of those species found to exhibit morphological discrepancies with their designated genus and incorporates incipient morphospecies. The biogeographical distribution of this proposed new genus currently includes reefs of South Africa, Mozambique, Mauritius, Seychelles, the Nicobars, Fiji, Australia and American Samoa.

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Fine-scale mapping of flora and fauna along Silaka rocky shores

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Fine scale mapping is geographically portrayed from centimeters to meters and covers a small area, but revealing detailed information about the area. This study thus recorded and mapped habitats, limpets and seaweeds at 1 m intervals along 10 m parallel line transects. Five habitats, 31 seaweed species and eight limpet species were found. Rock pools and mixed habitats were the most dominant habitats. Cellana capensis was found in all habitats with densities ranging from 1 to 21 per quadrat. Scutellastra seldom occupied crevices (9%) but preferred mixed habitats (36%) in the low shore. Siphonaria density ranged from 1 to 31, with S. oculus restricted to furrows and crevices. Helcion concolor habitat preference was mixed habitats (48%), furrows (19%), then pools (10%) and outcrops (10%). Habitat preference for Ochrophyta was crevices (2%), pools (24%), mixed (55%) and outcrops (11%). Chlorphyta habitat preference was mixed (37%), furrows (36%) pools (15%) and outcrops (13%). Ralfsia verrucosa and Phymatolithon foveatum contributed 86% toward seaweed habitat differences. Fine-scale mapping revealed that distribution of seaweeds and limpets were influenced mostly by habitat turnover.

Keywords: Abundance, distribution, GIS, habitat, tidal zones, zonation

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Suitability of the endemic South African Pyropia saldanhae for abalone nutrition

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The South African abalone consumes a variety of red seaweeds in combination with kelp, and red seaweeds species within the Bangales family have been recommended as supplementary diet. Pyropia saldanhae was measured for growth rates and analysed for mineral composition and protein content. The results showed that thallus length 50–260 mm) and width (30–150 mm) varied seasonally with bigger individuals in summer and autumn. The order of microelement concentration was Fe>Zn>Mn>B>Cu in this species. The mercury content was far below the detection level, while the order was always consistently As>Cd>Pb for the other heavy metals. Cu was always below 20µg g-1 rendering this species suitable for abalone feed. Cu+Zn (5±0.9 mg 100g-1) was lower than the maximum limits for human consumption. Inorganic arsenic contents (1.80±1.20 mg kg-1) were above the maximum allowed levels set for Australia and New Zealand, but less than those set for France and Japan. Crude protein (30±0.58 %) was less than the formulated K34 Abfeed® but higher than the recently formulated K26 Abfeed® suggesting that this species could be used to substitute this formulated feed in juvenile abalone. Pyropia saldanhae is available year round, rich in mineral and protein content, while possessing relatively low contents of heavy metals at the same time.

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Ocean dynamics in the upwelling zone of Cape Recife, Algoa Bay

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Sardinia Bay is a small beach-headland bay located along the southern shore of Cape Recife, the western promontory of Algoa Bay in the Eastern Province of South Africa. The coastline is zonally oriented, with winds blowing mainly in an east-west direction and the Agulhas Current flowing along the shelf break. To investigate the ocean dynamics in this area, an acoustic Doppler current profiler (ADCP, with waves) was deployed off Sardina Bay in 30m water depth for over a year (2015-current). Recently a thermistor string has been deployed at the site. The South African Environmental Observation Network (SAEON) also has instruments deployed around Cape Recife as part of a long-term ecological research program (LTER). Data from the ADCP , the thermistor string and gully temperature probes (2m depth, long the shore) at Sardina Bay are analysed to give a description of currents, waves and sea temperature over the period of a year. Daily, monthly and seasonal variability in these parameters are quantified. Forcing by wind, tides, internal waves, coastal trapped waves, the Agulhas Current and topography, as well as links with flow around Cape Recife, are investigated. It was found that currents are mainly wind driven and upwelling is a prominent feature during summer easterly winds. Nevertheless, currents and temperature fluctuations occasionally occur which are not wind driven. Strong swells hit this coast from the southwest, which are measured and allows for statistics on various wave parameters to be calculated.

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Determining an optimal epibenthic photographic sampling intensity for the Prince Edward Islands (Southern Ocean)

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In light of South Africa's increasing commercial use of offshore areas and the mandate to sustainably manage these areas, there is a pressing need for rigorous deep-sea sampling methods. Underwater photography has increasingly been applied to non-destructively sample sensitive seabed areas, but while there are benefits to visualising in-situ species relationships and habitat contextualisation, photographic sampling may underrepresent species richness. To ensure meaningful data collection, photographic sampling methods need to be optimized so that appropriate levels of sampling intensity (total area sampled) are applied for a given habitat type. As substrate type is one of several factors that affect epibenthic species richness and the species area relationship (SPAR), the optimal sampling intensity for benthic habitats around the Prince Edward islands (PEI) was determined by comparing 13 incidence based species accumulation curves across four substrate types. The points of deceleration and total estimated asymptotic richness (Chao 2 richness estimator) for each accumulation curve were compared among substrate types. An optimal sampling intensity of 25 replicate photographs (± 20m²) per station was identified as an appropriate protocol for the study region irrespective of substrate type. Sites with fewer individuals did however require more replicates than species rich sites, as these stations needed more replicates to reach the points of deceleration in the SPAR curves. Results from this study enable appropriate levels of species representation in ongoing research at the PEI, and provide a framework for benthic survey methods and monitoring work elsewhere within South Africa's exclusive economic zone.

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Examining the sub-meso and mesoscale variability across the Crossroad Transect for the period between 2013 and 2015.

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Flowing southwest of the continental shelf of Africa is a strong western boundary current comprising of three interdependent components known as the Agulhas Current, Agulhas Retroflection and Agulhas Return Current. Altogether these predominant features strongly influence the oceanic conditions south of Africa. The Agulhas Current, along with its return flow, intersects the Crossroad Transect; a monitoring line established in 2013 to sample both the Agulhas and Return Currents and determine inter-ocean fluxes, as well as the influence of the Agulhas Current on the Agulhas Bank shelf. The key objective of this study was to examine both sub-meso and mesoscale features that attribute to the dynamic and variant nature of the Agulhas system.
Methods employed in this study make use of oceanographic instruments such as the Ship board Acoustic Doppler Current Profiler (SADCP), Conductivity Temperature and Depth (CTD), Thermosalinograph (TSG) and satellite Sea Surface Height data. The presentation shows that surface waters on the shelf are relatively cooler (18-21°C) and less saline (34.7-35.38 psu) compared to both the Agulhas and return currents (22-23°C; 34.73-35.58 psu), and (15-19°C; 35.5-35.72 psu) respectively. In addition, the interannual variability was defined on both spatial and temporal scales. A key finding of this study is the abundance of both the sub-meso and mesoscale features in the Thermo-Salino graph dataset, which are present in the CTD data but are often overlooked. A noticeable trend in current speed variability was observed, where velocity measurements ranging from (2-2.5 m/s) represented the Agulhas Current and (1.4-1.7 m/s) Agulhas Return Current.

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Is bigger better? How much is enough? Optimisation of quadrat size, point distribution, and point counts, for temperate reef monitoring.

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Marine invertebrates in South Africa have not been as widely studied as vertebrates. This is particularly true for the subtidal rocky reef communities within the warm-temperate Agulhas ecoregion where trawls, grabs, and SCUBA assisted surveys have been heavily relied upon for data collection. Drop-cameras provide multiple photos, at greater depths, in a shorter amount of time than diver based quadrats and can cover a larger area. These photo quadrats provide large amounts of data, but little consensus exists concerning optimal quadrat size, random vs. fixed distribution, and total point count necessary to analyse images. Here we examine the optimal quadrat size and point distribution that captures 95% of macrobenthic species richness. Five quadrat sizes (20X20 cm; 25X25 cm; 36X51 cm; 42X60 cm; and 48X64 cm.), random vs. fixed point distribution, and ten point count values, ranging from 6 to 100, were tested comparatively by repeated analysis of 40 images. Initial results indicate that in a random distribution across all five quadrat sizes the point count needed to capture 95% of species richness ranges from 55-74 points, with the lowest number required for 25X25 cm, and the highest for 48X64 cm. However, when comparing quadrat sizes, a significant relationship between quadrat size and richness emerges, as well as a significant difference between the two smaller sizes and the three larger sizes. Simply calculating point count needed to capture 95% richness is not sufficient if one does not also include the effect of quadrat size on richness itself, and bigger is better.

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The Relationship between macrobenthos, fish and birds of Durban Bay

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To understand the biological and ecological status of Durban Bay, macrobenthic invertebrates were examined and co-related to physicochemical parameters as well as fish and birds. Samples were collected between spring 2014 and winter 2015 on both intertidal and subtidal sandbanks. A total of 138 macrobenthic invertebrates species was identified with 86 intertidal and 113 subtidal species. Paratylodiplax blephriskios dominated the subtidal sandbanks and Challichirus kraussi were more dominant on intertidal sandbank. Fifty four fish species were sampled, measured and weighed whereas 50 bird species were counted. Analysis of similarities between the intertidal and subtidal sandbanks showed that these sandbanks differed significantly in faunal composition. Overall, depth, Total Organic Content sediment particle size were found to be the major contributors to the structure of fauna in Durban Bay. The abundance of Callichirus kraussi was positively correlated with number of sacred ibis, cattle egret and the lesser blacked gull, while the rest of invertebrate feeding birds were negatively correlated with the abundance of sand prawn. C. kraussi had a positive correlation with fish that use estuaries for breeding. Both C.kraussi and Paratylodiplax blephariskios had positive correlation with total organic content and sediment particle size. P. blephariskios showed a positive correlation with mostly marine fish occurring in small numbers in estuaries. In addition, intertidal sandbanks were found to support the nursery function of the estuary while subtidal sandbanks supported adult marine fish. This study has managed to show the importance of Durban harbour intertidal sandbanks as breeding ground for both fish and birds.

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Contrasting Movement Behaviour of Two Endemic Catshark Species within Mossel Bay, South Africa.

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Exploring the movement behaviour of shark species provides valuable information on their ecology and conservation needs. Tag-recapture studies have shown that Poroderma africanum (pyjama catshark) and Poroderma pantherinum (leopard catshark) are highly resident. This study aims to better understand their movement behaviour and examine coexistence within a reef complex and within Mossel Bay. Nineteen catshark individuals (ten P. africanum, nine P. pantherinum) were surgically equipped with V16-4H acoustic transmitters (VEMCO, nominal delay: 120 s) and have been tracked since October 2015, using an array of 18 VR2W acoustic receivers (VEMCO) across the bay. Patterns of residency (Residency Index (RI)) were calculated by dividing the number of days detected by the number of days monitored per receiver. Initial results confirm that P. pantherinum is a more resident species than P. africanum, with detections highly concentrated at the reef where they were tagged and released (RI range: 0.12-0.76). There were limited detection at other sites on the same reef complex (RI Range: 0-0.02), and no detections elsewhere in the bay. Poroderma africanum displayed larger movements (>15km) across the bay, but with high individual variability. The RI values provided evidence of this roaming behaviour and ranged from 0 to 0.43 at the reef where they were tagged and released, 0 to 0.12 at other sites on the same reef complex, and 0 to 0.29 at sites further across the bay. The contrasting movement patterns exhibited by these congeneric species suggest that different management strategies may be required for the conservation of each species.

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Managing conflicts between economic activities and threatened migratory marine species towards creating a multi-objective blue economy

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Harnessing the economic potential of the oceans is key to combating poverty, enhancing food security, and strengthening economies. But the concomitant risk of intensified resource extraction to migratory species is worrying given that these species contribute to important ecological processes, often underpin alternatively livelihoods, and many are already threatened. We thus quantify the potential conflict between key economic activities (five fisheries and hydrocarbon exploitation) and turtle migration corridors in southern Africa. From 34 tracks, we used movement-based kernel density estimation to identify three migration corridors for both loggerheads and leatherbacks. We overlaid these corridors on maps of the distribution and intensity of economic activities, quantified the extent of overlap and threat posed by each activity on each species, and compared the effects. These results were compared to annual bycatch rates in the respective fisheries. Both species' corridors overlap most with longlining, but the effect is worse for leatherbacks: bycatch rates are substantial (1500 per annum) relative to the regional population size (<100 females nesting per annum), likely slowing population growth. Artisanal fisheries are of greater concern for loggerheads, but the population appears to be withstanding the high bycatch rates. The hydrocarbon industry currently has a moderately low impact, but exploitation in key areas (e.g., southern Mozambique) could potentially undermine >50 years of conservation. We support establishing blue economies, but oceans need to be carefully zoned and responsibly managed in space and time to achieve economic (resource extraction), ecological (conservation, maintain processes) and social (maintain alternative livelihood opportunities, combat poverty) objectives.

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A review of research along the Northern Cape coastline against past and present development pressures

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Ecosystem based management is dependent on adequate scientific information on the functioning of ecosystems on multiple scales. The Benguela Current Large Marine Ecosystem has been extensively researched, but scientific information on the more localised ecosystems within the bigger system is also needed. In this study the published results of research that took place along the Northern Cape coastline specifically have been analysed against past, present and future development pressures. Studies have been grouped under common themes, and analysed against the different development pressures over time to identify gaps. It was found that the most common themes of research along this coastline are rocky shore ecosystems, the Orange River mouth estuary, and terrestrial rehabilitation after mining. Development pressures have changed from primarily diamond mining and fishing, to diamond and heavy mineral mining, oil and gas exploration, fishing, aquaculture development, renewable energy development, and tourism. In the future industrial harbour development and coastal town development may cause additional pressures. As diamond mining continue to be a pressure there is a serious need for evaluating the site-specific impacts on the coastal and marine environment of the Northern Cape Province, and comparing the results to similar studies done in Namibia. There is also a need for the identification and mapping of ecosystem services of smaller systems such as closed estuaries. If we want to implement the goals of ecosystem based management, we need a better understanding of fine-scale, site specific ecosystem processes and services.

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Monitoring nesting loggerhead sea turtle health using epibionts

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Sea turtles are long-lived migratory species that are sensitive to anthropogenic impacts. Their health condition reflects that of marine ecosystems, and can serve as an indicator for environmental monitoring. This study examined the potential of using epibionts, the organisms living on sea turtles, to infer a turtle's health. To achieve this, nesting loggerheads (Caretta caretta) were sampled during the 2015/16 nesting season and categorised into five body conditions ranging from very poor to very good. Injuries, skin deformities, neck circumference to length ratio and plastron shape were used for this classification. Epibionts from 55 turtles were collected and identified and community composition, species richness and barnacle loading were compared among body conditions. We found that epibiont community composition was related to body condition, with an increase in abundance and species richness as the turtles body condition decreased. Barnacle epibionts showed the greatest variation among the body conditions with significantly higher numbers on turtles in poorer body condition. These results suggest that epibiont loading can be used as indicators of body condition for South African nesting loggerhead turtles and in turn the health of the individual. The fact that all parameters investigated in this study showed distinctive relationships with the body condition of loggerhead turtles, emphasised the value of epibionts as effective and reliable indicators for population health. Epibionts are therefore a cost-effective conservation tool with the potential to be applied to other species and ecosystems.

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Towards standardised monitoring; The effect of bait type on reef fish assemblage structure observed with baited remote underwater stereo-video systems

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Baited remote underwater stereo-video systems (stereo-BRUVs) are relatively novel to South Africa and require standardised application protocols. The technique applies bait as a standard to attract fish into the field of view. Globally, pilchard is the most commonly used bait type, however, its suitability for South African conditions has never been tested comparatively against other bait types. This study aimed to address the effect of different bait types, namely pilchard (Sardinops sagax), squid (Loligo reynaudi) and bivalves (oyster Crassostrea gigas and mussel Perna perna) on the observed reef fish communities of the Agulhas ecoregion. Significant differences in fish abundances and assemblage structures were recorded between stereo-BRUVs deployments when applying the different bait types. The bivalve baits, oyster and mussel, performed poorly as an attractant when sampling the reef fish assemblages of the Agulhas ecoregion. Pilchard and squid sampled similar communities and were able to attract the majority of the reef fish, suggesting they are suitable bait types for stereo-BRUVs in the region. However, a power analysis indicated that roughly twice the amount of samples are required to effectively sample Chrysoblephus laticeps and Cheilodactylidae species when sampling with squid as opposed to pilchard. Both bait types can be locally sourced, however, squid is considerably more expensive than pilchard. Considering the difference in cost and that twice as many squid-baited samples are required, squid is not a cost-effective option. This study recommends pilchard as the most appropriate bait for the Agulhas ecoregion of South Africa.

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Towards the development of indicators for an ecosystem-based condition assessment of subtidal rocky reefs in South Africa

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Multiple anthropogenic disturbances are resulting in the deterioration of marine ecosystems. These stressors are increasing globally and it is largely unknown what effects the cumulative impacts are having on the ecological condition of marine ecosystems. With the shift towards an ecosystem-based approach to management, there is a need to quantify and predict the impacts of disturbance on ecosystems to inform marine spatial planning. To date the marine component of the South African National Biodiversity Assessment (NBA) has used cumulative impact scores to infer ecosystem condition, however, this inference has not been validated or calibrated through field-based assessments. Furthermore, there is a need to better understand the direct response of ecosystems to multiple drivers of change using field based surveys and ecological experiments. This will help establish condition thresholds and tipping points to inform the NBA and management priorities and ensure healthy marine ecosystems. While this is yet to be adequately addressed in South Africa, a vast amount of international research has developed a plethora of approaches, indices and metrics to measure ecosystem condition. Incorporating a review of the global literature, this presentation will address the following questions: What is the best approach to assess the ecosystem condition of rocky reefs? How can we apply these approaches to validate current ecosystem condition maps? Can we use condition data to develop and test predictive models to better infer condition of rocky reefs? This review establishes the groundwork to applying an ecological data-derived approach to assess marine ecosystem condition in South Africa.

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Changes in copepod communities across the South Subtropical Front in the southwest Indian Ocean

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Epipelagic copepod communities were investigated at seven stations across the South West Indian Ocean Ridge during November/December 2009, using vertically stratified nets in the upper 200 m. Forty-nine genera and 135 copepod species were recorded: 40 of the genera were from the Order Calanoida. Generic and species richness was highest in the Agulhas Return Current (ARC) and lowest diversity was associated with the South Subtropical Front (SSTF). The total number of copepods was highly variable between stations, however, the highest abundances were observed near the SSTF, demonstrating the location of a biogeographic boundary coupled with high phytoplankton concentrations between the major oceanic zones. Three distinctive copepod assemblages were identified by multivariate analysis, and communities were associated with the SSTF, ARC and Subantarctic Front (SAF). Clausocalanus laticeps, Metridia lucens and Calanus simillimus were only recorded in the southern part of the survey area. The presence of deep living copepods of the family Metridinidae occurred in the upper surface waters at night suggesting some species, at least, displayed vertical migration over seamounts. Given the sampling depth of the present investigation and the lack of seamount sampling stations, it was not possible to detect seamount advective processes.

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Hidden at sea – the numbers and fate of sharks discarded by pelagic longline fisheries for tuna and swordfish

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Pelagic longline fisheries targeting tuna and swordfish also catch large quantities of sharks as a bycatch. These sharks are either retained or discarded overboard, depending on factors such as species, size and their perceived market value. Whereas the numbers of retained sharks can be quantified when a fishing vessel lands its catch in port, very little information exists on the shark species or quantities that are discarded overboard at sea, or what their fate may have been (alive, injured, or dead). Several of the affected shark species are listed on the IUCN red list of threatened species. The aim of this study was to determine the total mortality of sharks, including retained and discarded, as a result of pelagic longline fisheries along the South African coast. Landings data were provided by DAFF for the 2000 – 2015 period (29 000 records), and shark discard data were collected by an observer during eight local pelagic longline fishing trips at sea. Spatio-temporal trends in catch composition and quantities of the main shark species caught were investigated, and standardised catch trends were constructed using Generalised Linear Mixed Models (GLMMs). Trends in discard practices were investigated. Catch trends were combined with the discard information in a design-based model to estimate total shark mortalities caused by the fishery between 2010 and 2015. This study is the first to investigate shark discard practices, and the impact thereof on overall shark mortalities, of a pelagic longline fishing fleet in South African waters.

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Application of a multiple method approach for stock identification and discrimination of South African kingklip, Genypterus capensis (Smith 1874)

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Stock identification is necessary for the determination of boundaries of sub-populations of a species and can assist in understanding what regulates sub-population abundance, reproduction, growth and survival, and how fishing pressure may impact different stocks in different ways. Kingklip, Genypterus capensis, is a marine demersal fish geographically distributed along the coast of southern Africa from Walvis Bay, Namibia to Algoa Bay, South Africa. This commercially important species is caught by demersal trawling and demersal longlines. Recent genetic analyses of kingklip from South Africa suggest the presence of population sub-structuring with at least two genetic units, one off the west and another off the south coast. To test this result and assess whether these stocks are phenotypically differentiated, a holistic and integrated approach that analysed morphological, meristic and parasitological data of kingklip from the west and south coast was applied. To date 147 fish have been analysed, and results indicate significant differences between fish from the putative stocks in terms of morphometric characteristics (two otolith shape indices: circularity [$p = 0.00007$] and form factor [$p = 0.00662$]) and meristic characteristics (vertebral counts [$p < 0.05$] and gill raker counts [$p = 0.00013$]). Parasitological data proved inconclusive. Results support the hypothesised two-stock nature of the South African kingklip population and identify which phenotypic characteristics may be used to differentiate between them.

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Horizon scanning for intertidal predatory crab invaders: South Africa as a case study

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Biological invasions are rapidly on the rise and pose a threat to biodiversity, the economy and human health. The South African coastline, being depauperate of intertidal benthic predators, is predicted to be vulnerable to the invasion by predatory crabs, globally considered a very invasive group. Horizon scanning was used to create an ordered watch-list of alien crabs that could invade our coastline. A literature review revealed a list of 56 crabs with an invasion history. The presence of vectors to South Africa was used to refine the list to 29 species. Four potential vectors were noted i.e. shipping, yacht fouling, aquaculture imports and the aquarium trade. Similarity between the temperature ranges of the crabs' known regions of occurrence and that of the Benguela, Agulhas, Natal and Delagoa ecoregions were used to determine which regions may be susceptible to invasions under current and future climatic conditions. Finally, potential invaders were ranked based on their EICAT impact rating. The notorious invaders Hemigrapsus sanguineus, Hemigrapsus takanoi and Eriocheir sinensis were placed on top of the list due to their negative impacts elsewhere. Although the vectors present differed among ecoregions, it is notable that at least 26 alien crabs have the potential to reach each region, with incompatible temperature ranges excluding no more than one species from each ecoregion. These patterns remain very similar despite predicted temperature increases over the next half-century. This watch-list of crabs can help support their early detection, and thus minimise the chance of their successful establishment along our coast.

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Automated weather stations: Assessment of Wind Field in the Southern Benguela Upwelling Region

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Sea Surface wind field is measured to estimate the magnitude and timing of occurrence coastal upwelling phenomena around the coast of South Africa, compute air-sea fluxes, wave forecasts, biophysical interactions and climate variability studies.
Even though operational satellite data is easily accessible for research purposes, spatial and temporal resolution for specific areas closer to the land mass along the coast is still a challenge. The highest resolution data available is 25km daily data set.
Daily data obtained from automated weather stations installed at Port Nolloth, Elands Bay and Cape Columbine has be used to characterise the nature of prevailing winds in the Southern Benguela Upwelling region. To quantify seasonal variability in magnitude of the wind field, monthly averages were computed from daily data set. Windrose climatology show dominant frequencies and direction during the upwelling and non-upwelling seasons. Throughout the year upwelling favourable winds (south easterly wind field >4m/s) are dominant in Cape Columbine (60% of the time) and Elands Bay (>60% of the time), South Easterly winds and are strongest and most dominant during the summer season. Port Nolloth station show that dominant winds are from the South Easterly direction in summer and from south westerly direction in winter.

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Hippo dung causes declines in benthic productivity in an estuarine lake: implications for ecosystem functioning and management

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The functioning of aquatic ecosystems depends crucially on cross-system connectivity. In Africa, hippos affect connectivity at scales, frequencies and intensities that cannot be reproduced by other natural processes. Defaecation of terrestrial grasses into aquatic ecosystems is a particularly important pathway by which hippos facilitate system connectivity, but ramifications for assemblages and ecological functioning are poorly understood. Here, we quantify the consequences of hippo dung inputs on benthic assemblages in an estuarine lake in South Africa. The system supports over a thousand hippos, and during recent drought periods (persisting over a decade), hippo dung has been observed to form mats over benthic habitats. Enrichment of plots using exclusion/inclusion cages with dung at current drought concentrations showed a decline in benthic chl-a by roughly 50% and macrofaunal abundance, biomass and richness by up to 76, 56 and 27% respectively. Our findings suggest that continuous inputs of hippo dung can act as an important stressor of benthic systems, leading ultimately to a decrease in macrofaunal metrics. These depressions raise concerns that ecological functions provided by this group are at risk of weakening, leading to ecosystem performance being diminished. Given the prodigious rates of dung inputs (approaching 36tons/day) and the exponential growth in hippo populations in some protected areas, our findings highlight a need for predictive models identifying thresholds at which dung inputs switch from producing positive to negative effects in aquatic systems. Our results also promote awareness of the need to manage dung inputs in order to conserve ecological functioning in vulnerable systems.

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Genetic structure between distant Gobionotothen marionensis (Pisces: Nototheniidae) populations in the Southern Ocean.

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Previous morphological studies split Gobionotothen marionensis into two species, G. marionensis in Prince Edward Islands of the Indian Ocean and G. angustifrons in South Georgia and South Sandwich Islands of the Atlantic Ocean. However, a recent phylogenetic study found that the specimens from these oceans represent same species (G. marionensis) with geographic variation. The present study assessed genetic structure between the G. marionensis populations from Indian and Atlantic Oceans using a mitochondrial DNA (mtDNA) cytochrome subunit 1 (COI) and nuclear DNA recombination activating (RAG) genes. The results obtained from both genes indicated that there is no genetic differentiation between populations from these two oceans, with sequence variance of 6.85% and 0%, respectively, between these oceans. The presence of gene flow in G. marionensis distant populations might be due to their long pelagic larval stage. The Antarctic polar front that flows between localities of the two populations may be acting as transport for pelagic larva to both sides of it. Analyses of the demographic history of G. marionensis populations indicated increasing population sizes in both oceans.

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Bait Identification in the Western Cape

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Polycheates are used widely as bait in the Western Cape, South Africa, but confusion around their identities and common names among fishermen and scientists abound. A single name might refer to several similar or even unrelated species, and it is therefore not clear to what extent polychaetes are being utilised. The aims of the study are therefore to determine which worms are used, and whether there is agreement over their identities. Fishermen at nine sites were asked to contribute bait worms collected, with their common names. Each specimen was photographed and identified to species level using an identification key. Worms going by eleven common names were collected; bloodworm (5 sites), moonshine worms (4 sites), wonder worm (4 sites), coral worm (3 sites), musselworm (2 sites), puddingworm (2 sites), polwurm (1 site), haarwurm (1 site), ribbonworm (1 site), sandworm (1 site), and bloukoppie (1 site). Six species have been identified so far, namely: Pseudonereis variegata (musselworm), Gunnarea capensis (coral worm, polwurm), Diopatra sp. (Moonshine worm), Onuphis quinquedens (moonshine worm), Arenicola loveni (bloodworm) and Abarenicola gilchristi (bloodworm). These identifications suggest that individual common names usually refer to individual (e.g. P. variegata) or several related (e.g., moonshine worms are Onuphinae and bloodworms are Arenicolidae) species. Data from four more sites and remaining species will be discussed fully.

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Expanding an estuarine framework: biota and ecosystem functioning within and beyond system limits.

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Temporarily open-closed estuaries (TOCEs) are especially variable over spatio-temporal scales, exhibiting different states across seasons. High levels of production are achieved by biota able to proliferate in each system state. Global and local anthropogenic stressors such as climate change and river abstraction can result in the exacerbation of variability across states. The respective states have been defined by Taljaard et al. (2009) for physico-chemical variables and chlorophyll-a, however there has not been a complementary quantitative food-web framework describing the states. Due to natural biotic variability and estuarine resilience, the extent to which anthropogenic processes push systems across their different state limits is uncertain. This study will consider Taljaard's framework as it relates to the system states in TOCEs by creating theoretical and building empirical food-web networks onto the existing framework, and examining change in indicator behaviour as the relative importance of components changes across system states. The expectation is a unique range of indices for each state which are utilisable as a tool for obtaining information on the viability of TOCEs relative to incurred stressors. This study will be presented as a conceptual framework, resulting from Ecological Network Analysis (ENA) coupled with a Linear Inverse Modeling approach (LIM). LIM provides ranges of solutions for unknown flow values from which key indicators can be investigated using ENA. Using indicators such as the trophic flow diversity, fitness and robustness, the viable range of states will be identified.

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DNA Barcoding of Sinularia morphotypes from the iSimangaliso Park, South Africa

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Species of the genus Sinularia are one of the most widespread and commonly encountered soft corals in the Indo-Pacific coral reef. Most of the taxonomic work on Sinularia is based on the protocol of Verseveldt, who considered sclerites and overall colony growth as the two most important taxonomic characters. There are presently many uncertainties and difficulties in distinguishing species in the field. In this aspect, phylogenetics can play an important role in revising the current classification of Sinularia and work in conjunction with sclerite analysis to create a better understanding of the evolution of these soft corals. An experiment was designed to evaluate the utility of DNA barcoding for estimates of species boundaries and richness, and to assess their relationship to morphology in the genus Sinularia. It was hypothesized that phylogenetics, using mitochondrial markers, will support the current taxonomy of the genus Sinularia. It was found that not all groupings via sclerite analysis match the groupings in the phylogenetic analysis. There is support of polyphyly within the genus Sinularia. Overall, concatenating the COI+igr and MutS markers appeared to have provided more accurate results, rather than analysis of individual sequence sets.

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Abundance and diversity of ciliates in a permanently open subtropical estuary of good ecological status.

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In estuarine and coastal systems, ciliates play an important role in overall grazing rate, nutrient regeneration and secondary production. Depending on the degree of influence anthropogenic factors have on the ecological functioning of an estuary, South African estuaries were classified as excellent, good, fair, bad or poor. The ciliate community structure (species, abundance and biomass) of the subtropical permanently open Mlalazi estuary, of good status was investigated. 28 ciliate species belonging to 16 genera and six sub-classes were recorded from July 2014 to June 2015, 13 species of which were choreotrichs and seven oligotrichs. Ciliate abundance and biomass ranged from 0 to 4.05 x 104 Cell/L and 0 to 8.22 x 106 C µg/L respectively, differed between the three estuary regions ($p = <0.0001$, $x2 = 20.15$; $p=<0.0001$, $x2 = 20.21$ respectively) but not between the four seasons ($p = 0.09$, $x2 = 6.58$; $p = 0.14$, $x2 = 5.49$ respectively) and was highest in the brackish middle reaches. Overall, choreotrichs and oligotrichs accounted for 80% of the abundance and biomass in the estuary with the genera Strombidium, Strobilidium, Tintinnidium, Tintinnopsis and Codonella dominating at all sites and seasons. Canonical Correspondence Analysis showed that salinity, dissolved inorganic nitrogen (DIN) and temperature influenced the ciliate community structure. The dominance of planktonic oligotrichs and agglutinate tintinnids typical to coastal systems supports the good state of the estuary. Change in ciliate communities is expected if influencing factors change in future as expected under global change, water abstraction and land use (mining and farming) scenarios.

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Parasites infecting Scomber japonicus (Chub Mackerel) in South Africa

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Chub mackerel (Scomber japonicus) is a cosmopolitan species with major populations occurring in most warm and temperate systems in the Mediterranean Sea, Atlantic and Indo-Pacific Oceans. They are of great ecological importance as an intermediate species, providing a food source for many larger fish species, cetaceans, pinnipeds and seabirds while predating on a range of smaller organisms, from mysids to other small pelagic fish. S. japonicus is an economically important species with global catches in the order of two million tonnes, and whilst chub mackerel were historically a major component of South Africa's marine fisheries during the late 1900's, declines in population numbers has decreased their economic importance. The parasite assemblage of S. japonicus has been studied extensively elsewhere with over 40 parasite taxa having been recorded; however, knowledge of this species in South African waters is limited and its parasite assemblage is yet to be documented. This study investigates the parasite assemblage of S. japonicus off the coast of South Africa, comparing it to other scombrids occurring in South African waters, as well as other populations of S. japonicus elsewhere in the world. To date our study has found ten parasite taxa infecting S. japonicus. Three species of monogeneans (Kuhnia scombri, Pseudokuhnia minor and Grubea cochlear) and one copepod (Clavella scombri) on the gills, three digeneans (Nematobothrium scombri, Digenea sp1 and sp2 'tetracotyle'type metacercariae) in the intestines and viscera, one acanthocephalan (Rhadinorhynchus pristis) in the intestines, and one nematode (Anisakis sp.) and one cestode (Tentacularia sp.) in the viscera.

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Preliminary investigation into the parasites infecting two species of gurnards off South Africa

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The Cape gurnard (Chelidonichthys capensis) and the lesser gurnard (Chelidonichthys queketti) are two members of the Triglidae family found off Southern Africa. Chelidonichthys capensis is distributed from depths of 10 m to 390 m in subtropical waters between Namibia and Mozambique, while C. queketti is distributed from 0 m to 150 m in subtropical waters from Table Bay, South Africa, to southern Mozambique. Very little is known about the biology and life cycles of these two species. The parasitic community of these two species has not yet been surveyed, although there are records of a number copepod species documented to infect both species that were recorded for taxonomic purposes. This project aims to examine the parasites of each species from the south coast of South Africa. Preliminary results have yielded two new host records for C. queketti, which include an Anisakis species and an unidentified cestode species - both present in the viscera. Currently, the parasites of many South African marine species (including these two gurnard species) are undocumented, therefore, these results contribute to our knowledge of marine biodiversity, and permit inter-specific and intra-specific comparisons of gurnard parasite assemblages.

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Metabarcoding the hidden biodiversity of sandy beaches

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Interstitial meiofauna in marine sediments inhabit one of the most widespread habitats and may represent one of the most diverse communities on earth, yet little is known about the forces shaping community structure, species distribution and abundance. Species identification is problematic in these tiny organisms, and so biodiversity is poorly known. The overall objective of this project was to elucidate factors shaping global, regional and local patterns of sandy beach meiofauna biodiversity. We sampled meiofauna from three levels of beaches with different morphodynamic characteristics, on the US Pacific Northwest coast and the South African south and west coast. Next generation sequencing approaches were used to analyse two regions of the genome (16S, 18S), resulting in almost 16 million sequences total. Initial data showed high diversity on all beaches. Communities were clearly clustered according to bioregion and habitat in most phyla. Differences in community structure were related to grain size in some regions, but not in others. However, relationships between grain size and diversity was only found in some phyla. Our results clearly showed the high biodiversity of sandy beach meiofauna and demonstrated the power of metabarcoding for studying a taxonomically difficult group of organisms.

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The Spatial and Temporal Variability of Mesozooplankton in the Permanently Open Mlalazi Estuary of KwaZulu-Natal, South Africa

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Mesozooplankton communities form an important ecological link within food webs and can be a key tool in determining changes within the environment they inhabit. The Mlalazi Estuary is considered to be in good condition despite only a few studies being carried out on the ecosystem. By analysing the spatial and temporal variations in the mesozooplankton community, a baseline can be established as to how the community responds to changes in their environment. Monthly zoooplankton samples were collected for two years (July 2014 to June 2016) from four sites within the estuary; the upper, mid (constituting 2 sites) and lower reaches. Prelimary results indicate that the calanoid copepods, Acartiella natalensis and Pseudodiaptomus spp., dominated throughout the estuary in both density and biomass. Both P. hessei and P. stuhlmanni were detected in the samples, an uncommon feature in South African estuaries, with P. stuhlmanni being present throughout the estuary and P. hessei inhabiting the upper reaches of the estuary. Significant differences in density and biomass of zooplankton were detected with maxima being reached during the wet season and minima during the dry season. The community itself was divided into two components comprising of stenohaline marine and mesohaline groups with several freshwater taxa being present as outliers of these groups. No significant correlations between the community and the measured environmental variables were detected due to the homogenous nature of the environment. Prolonged drought in recent years has influenced the freshwater inflow into the system resulting in the estuary becoming more saline and homogenous.

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Phylogenetic identification of bottlenose and common dolphins (genera Tursiops and Delphinus) off South Africa as revealed by mitochondrial DNA

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Although two species are accepted for each genus, the taxonomy of both bottlenose dolphins Tursiops spp. and common dolphins Delphinus spp. remains contentious with suggestions that animals from Southern Africa may represent separate clades for each genus. We therefore used "ancient DNA" molecular analysis of museum specimens to assess the validity of these hypotheses. We analysed teeth from 109 and 113 specimens of bottlenose and common dolphins, respectively, obtained from the Port Elizabeth Museum. These were selected to be representative of different regions along the South African coast. We successfully extracted mitochondrial DNA from 41 and 92 bottlenose and common dolphin specimens, respectively. To add a global perspective, additional sequences were included from GENBANK. The programme MEGA was used to construct maximum likelihood trees. For bottlenose dolphins, two main groups were evident. Four individuals from this study clustered with T. truncatus, while the remainder of sequences from this study clustered with T. aduncus. The Delphinus spp. tree did not reveal a simple pattern. Specimens from South Africa and globally were split into several groups. Therefore, the pattern evident for Tursiops species, agrees with the most accepted taxonomy. This suggests that animals from South Africa belong to the two globally recognised species. In contrast, the pattern displayed by Delphinus spp. indicates a single, highly variable species, Delphinus delphis rather than two distinct species as previously purported.

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The influence of prolonged mouth closure on the zooplankton taxa of a temporarily open/closed estuary (Mdloti Estuary, KwaZulu-Natal)

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Estuaries are important coastal ecosystems which are highly productive and serve many functions to coastal regions. Temporarily open/closed estuaries comprise 70% of the estuaries present along the South African coastline. One such estuary is the Mdloti Estuary situated on the east coast of South Africa. The Mdloti is subject to numerous human impacts which include pollution and freshwater abstraction. Recent years have seen a reduction in mouth breaching events of the estuary, which is a result of reduced freshwater inflow through human abstraction and decreased rainfall. A consequence of prolonged mouth closure is the change in salinity profile and therefore it is important to understand the influence of the salinity change on zooplankton dynamics. Sampling occurred on a monthly basis along three sites of the estuary from July 2014 to June 2016. Preliminary results indicated that the estuary is fresh with salinities ranging from 0.04 – 3.95 ppt. Peaks in salinity were recorded during two occasions of breaching in 2014 and 2015 but these peaks were short-lived. The peaks occurred in August 2014 and 2015 post-breach, and thereafter returned to fresh salinities the following month. The mesozooplankton community prior to the breach had recovered their densities in the subsequent sampling months. A consequence of the oligohaline state is the dominance by freshwater mesozooplankton taxa. These groups include cladocera (Ceriodaphnia spp, Moina micrura, etc), rotifera and copepoda (Mesocyclops sp. and Thermcyclops sp.). The less frequent occurrence and shorter duration of open mouth status has sustained the dominance of freshwater taxa.

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Warming effects on high shore soft sediment ecosystems: the interactive role of autogenic engineering and grazing

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Temperature is a key determinant of assemblage structure at various organisational levels. Ocean warming can generate important population and community level consequences by altering the strength of biological interactions occurring within marine ecosystems. High shore soft sediment marine ecosystems occur at the upper range of physico-chemical conditions; organisms occupying these habitats are therefore potentially more vulnerable to increasing temperature associated with climate change. High shore soft sediment environments are often dominated by autogenic ecosystem engineering marsh grasses and key consumers such as grazers and predators, which together, are the major regulators of ecological processes occurring in these systems. Understanding how warming impacts high shore sedimentary systems thus requires an understanding of how temperature impacts key engineers and consumers as well as resulting shifts in interaction networks. This study therefore tested the single and interactive effects of warming on ecosystem engineering by cordgrass (Spartina maritima) and grazing by the gastropod Assiminea globulus on ecosystem functioning, using a seven week mesocosm experiment. Preliminary results suggest contrasting effects of warming on ecosystem engineering and grazing, likely due to unique biological traits each express. Warming induced changes to engineers and grazers had significant effects on basal trophic resources, resulting in complex and idiosyncratic changes to the trophic environment on which other consumers depend. Our data indicate that under projected climate change scenarios ecosystem engineering and grazing can differentially impact trophic interactions; either additively, antagonistically or synergistically, leading to potentially important shifts in ecosystem functioning.

Keywords: Warming, ecosystem engineering, grazing, ecosystem function.

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The Eastern Cape shelf: exciting new insights from multibeam bathymetry

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The Eastern Cape continental shelf has received research attention from biologists and geoscientists, yet detailed bathymetry and seafloor geology maps from the area have typically been of very low resolution. This has hindered decision making surrounding proposed Marine Protected Areas (MPAs) for this area. Using a high-resolution multibeam echosounder, and other geophysical methods, we reveal an unprecedented series of images of the seafloor from this area. These data span from East London (the capture site of the first scientific record of a living coelacanth) to the Kei River shelf and comprise over 500 km2 of seafloor coverage. Seafloor features observed for the first time from the area include palaeo-drainage systems that extend over the inner shelf, merge with drowned lagoon systems and terminate in palaeo-cliff-bound embayments. Other notable features are the presence of compound rhodolith banks which overlie the palaeo-river courses and a prominent palaeo-shoreline at 100 m water depth that is intersected by the heads of large submarine canyon systems. The new bathymetry indicates that the previously reported and mapped location of the Gxulu Canyon was incorrect and many of the mapped deep reef features were not covered in the National Ecosystem Map. The new bathymetric data have been used to provide science based advice on boundaries and zonation of the proposed new Offshore Amathole MPA and are supporting improvement in national habitat maps. Several features may provide suitable habitat structure for coelacanths, similar to that identified from the northern KwaZulu-Natal continental shelf.

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Disentangling the influence of spatial and environmental processes in structuring warm-temperate reef fish communities

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The composition of local ecological communities is thought to be determined by a combination of niche- and dispersal-driven processes. Data collected from reefs across two localities within the Agulhas Bioregion with baited remote underwater stereo-video systems (stereo-BRUVs) was used to investigate the structure of resident sparid (Sparidae) reef fish communities. First, we related spatial turnover in community structure (β-diversity) to variations in spatial connectivity and the abiotic environment. Second, we integrated body length variation at both, the intraspecific and interspecific level, to test alternative theories of species coexistence. Observed compositional variation of sparid reef fish communities was governed by niche-mediated species sorting along the depth gradient (29 %), and by dispersal processes operating within areas of contiguous reef (9 %). At small spatial scales, enhanced compositional turnover between local sites corresponded to higher than expected degrees of conspecific aggregation which are likely to diminish the strength of interspecific competition. Patterns of local species richness conformed to niche-based expectations, in which species coexistence is promoted via lower community-wide intraspecific variation in species' body lengths. Comparisons between fished and unfished communities, however, revealed that niche packing along the body size axis is disrupted by exploitation, leading to patterns of species richness that conform to trait-neutral expectations.

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Microplastics in mussels: what should the consumer know?

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Microplastic pollution is ubiquitous throughout the marine environment and as a result, has become the subject of large body of research. Due to the small size, microplastics (< 5 mm) become available for ingestion to various marine invertebrates, which may pose numerous physiological consequences. Additionally, the surfaces of microplastics readily adsorb toxicants which may then be absorbed by the organism, bioaccumulated in the tissues and subsequently transferred throughout the food web. There are currently limited studies on the physiological effects of microplastic ingestion by marine invertebrates and the potential harm microplastics pose to local communities relying on marine invertebrates as primary food sources. This study aimed to determine (1) uptake rates of microfibres in the mussel (Perna perna L.) and (2) the sizes and quantities of microplastics in the gut of the mussels after acute exposure. Although higher microfibre concentrations resulted in an initial depression in filtration rates, P. perna adapt within 24 hours and were able to cope with the highest concentration tested. This suggests that mussels are able to filter greater loads of microplastics in natural systems, resulting in the potential for increased toxicant uptake. As mussels are an important subsistence food source for a large social sector, these findings highlight the potential impacts of microplastic pollution on human food sources and emphasizes the need for further research on toxicant transfer mechanisms. The results of this study are currently being used to develop a coastal microplastic bio-monitoring program using brown mussels, for the KwaZulu-Natal coastline.

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An unprecedented view of the Western Cape seafloor: Multibeam bathymetry reveals a series of new and unusual submarine canyons

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Submarine canyons are diverse geomorphological systems that are characterised by a wide variety of geomorphic and sedimentary processes. These are known to influence the biological functioning within and adjacent to these systems. Canyons and seeps frequently constitute Vulnerable Marine Ecosystems that are sensitive to fisheries and mining impacts. As such, better scientific knowledge on their location, formation and ecology is a national research priority. Using multibeam bathymetry, it is possible to examine in unprecedented detail, the geomorphology of submarine canyons and associated sedimentary features. These include seafloor bedforms, slope failure structures, degassing features and general information regarding canyon relief, width and sinuosity. In understanding the geomorphology and sedimentology of these systems, conclusions as to the evolutionary pathways and dominant processes that shape the canyon environment can be made. An innovative industry partnership facilitated new data for multi-disciplinary research on these habitats through the Deep Secrets Project. We present ~ 46 000 km2 of high resolution multibeam bathymetry offshore the Western Cape which reveal 15 canyon systems and numerous slope-hosted erosional gullies. Detailed morphometric analyses of the canyon/gully features reveal a mixture of downslope and upslope eroding paradigms. Of interest are a series of prominent pockmark fields which appear to control the development of arcuate, hook-shaped canyon heads. These are previously undocumented in the literature and may indicate methane-seep dominated ecosystems. Ultra-high resolution seismic profiles reveal several phases of canyon incision and infilling, which relate to periods of increased incision (possible sea level lowstands or increasing fluvial influence), followed by quiescence.

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Influence of the Agulhas current on Crown Crab Dispersal

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The coastline of South Africa is divided into four marine biogeographic provinces: the cool temperate, warm temperate, subtropical and tropical. The Agulhas Current flows southwards along the south-east coast of South Africa and is believed to facilitate dispersal of various marine and estuarine species, including three species of the crown crab genus Hymenosoma, each of which was previously believed to be associated with a specific marine region, namely H. projectum (tropical and subtropical), H. orbiculare (cool-temperate and warm-temperate) and H. longicrure (transition zone between the subtropical and warm-temperate provinces). Using DNA sequences of the COI gene and the intron of the ANT gene, dispersal of the three Hymenosoma species was studied. In addition, particle simulations were performed, which showed that Hymenosoma larvae released in northern regions have the potential to settle anywhere in a southward direction. Genetic data available from H. longicrure show that genetic structure in this species has no relation to geographic distance. However, the actual amount of mixing is lower than expected, as each estuary sampled was populated by a single species. This is most likely due to competitive exclusion, as new migrants of another species are expected to be considerably outnumbered by established residents that occupy the same ecological niche. This study has also shown that H. longicrure, originally thought to be a transition zone endemic, also occurs in the subtropical marine province. This could indicate that H. projectum is actually a tropical species that has established itself in the range originally occupied by H. longicrure

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The effects of Climate Change on Cetaceans - mapping dolphin distribution in the south-western Cape,by means of dedicated boat surveys

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The South African coastline is home to over 30 known cetacean species. Five dolphin species have their global or local distribution ranges end around the Cape Peninsula, a known biogeographical break point between the cold waters of the Benguela Ecosystem and the warmer Agulhas Current. Global climate change has been predicted to have a direct effect on the ranges of most cetacean species, especially those associated with isolated upwelling current areas such as the Benguela Ecosystem (McLeod 2009). The high diversity and short area of change between different habitats and species makes the Cape Peninsula a unique area in which to study several delphinid species at their range limits. We conducted dedicated small boat surveys over two years to map the current distribution ranges of the dolphins and compare this to historical data on species distributions. We are using both presence-absence (GAMs) and presence-only models (MaxEnt), to investigate which environmental factors best predict the distribution ranges of each of the five species. The performance of the models is critically compared based on their ability to accurately predict suitable areas. To date we have run over 55 dedicated surveys and had 60 dolphin encounters. Preliminary results show all animals to be within their current expected ranges. Sea surface temperature and chlorophyll a concentration are two preluding environmental parameters considered as possible factors limiting dolphin distribution, as there are notable differences in temperature and salinity between the waters off the south and west coast which are each occupied by different species.

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Spatio-temporal dynamics of macrozoobenthic communities of the Mdloti Estuary (KwaZulu-Natal, South Africa)

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Estuaries are some of the most productive systems. The Mdloti Estuary (a TOCE) is faced with prolonged mouth-closure as a result of anthropogenic-driven freshwater deprivation, further exacerbated by the recent drought. This has resulted in the system becoming fresh (0.04 – 3.95 ppt). Macrofauna play an important role in ecosystem functioning as primary and secondary consumers. With climate change being predicted to increase the intensity and frequency of droughts and rainfall, understanding macrofauna dynamics under changing conditions can be useful for the implementation of good management practices in the Mdloti Estuary. This study investigated the spatio-temporal dynamics of the macrozoobenthos community structure in the Mdloti Estuary. Monthly samples (June 2015 – June 2016) were collected along the estuary gradient and preliminary results indicate that freshwater species dominate the system. In the current fresh state of the estuary, oligochaetes and chironomid larvae are the most abundant throughout the estuary, whereas previously they were only dominant in the fresher upper reaches. Oligochaete and chironomid densities have doubled since 2007/2008 across all reaches and this can be attributed to the constant low salinity. Under more saline conditions (20-30ppt, 1984), polychaetes were the most abundant (47 233 ind/m² in 2002/2003; 37 963 ind/m² in 2007/2008) and diverse group, however with a shift to more oligohaline conditions abundance (currently at 168 ind/m²) and diversity decreased. Currently, polychaete diversity stands at two species, with previously dominant Desdemona ornata occurring after a breaching event in 2015. Prolonged mouth closure has shifted the community composition of macrozoobenthos.

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"Journeying towards the Green List" - (Tracking 13 years of SASSI assessments)

Miss Monica Betts[1]
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From Red to Orange and ultimately Green, sustainable changes in some of our local fisheries are slowly happening. Since its establishment in 2004, WWFs- Southern African Sustainable Seafood Initiative (SASSI) has begun to make progress as it encourages fisheries and consumers to move towards sustainability. With over 13 years of species assessments and increasing examples of positive changes across the seafood supply chain, it is interesting to examine how fisheries have changed over time and why. The first SASSI list was published in 2005 and covered 92 species; fast forward to 2017 and the SASSI list now contains 209 assessments. Over the years, WWF-SASSI has seen around 37 species change colours with 20 moving down the list to either Orange or Red and 17 moving up the list to either Orange or Green. Through the SASSI assessment process; came Fishery Conservation Project's (FCP) which are aimed at improving the SASSI listing of a number of key species. WWF-SASSI's first every FCP in 2013 for the demersal longline fishery saw kingklip, deep-water and shallow-water hake move from the Orange to Green list in 2015. WWF-SASSI is currently involved in 2 FCP's namely the "Experimental Thresholds Inshore Trawl Project" project and the" Offshore Trawl Bycatch Fishery Conservation Project" both of which aimed to better manage bycatch in the fishery. The WWF–SASSI list is the foundation of all the work WWF-SASSI does; through the assessments WWF-SASSI has seen an increase in engagement from industry, government, NGOs, retailers and consumers.

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Parasites of the South African angelfish, Brama brama (Bonnaterre, 1788)

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Angelfish (Brama brama, also known as Atlantic pomfret) is a mesopelagic species distributed from depths of 0 to 1000 m in temperate waters across the globe. Off southern Africa they primarily occur in continental shelf edge and upper slope waters of the Benguela Current ecosystem, off Namibia and the South African West Coast. Whilst not targeted, angelfish are caught as by-catch in the demersal trawl industry in both countries. Little is known about the biology and ecology of angelfish in the Benguela, and only two parasite species have been documented to infect Southern Benguela B. brama: the copepod Hatschekia conifera and a monogenean thought to be a member of the Diclobothriidae family. This study describes the parasites of angelfish collected during research surveys conducted on the Western Agulhas Bank (November 2015) and off the West Coast (February/March 2016). 35 angelfish ranging in size from 435 - 589 mm TL were examined and a total of six parasitic taxa were documented, the most prevalent of the Western Agulhas Bank samples being Anisakis sp. (100%) whilst H. conifera (100%) was most prevalent in West Coast samples. Other parasites recorded include the unidentified monogenean found in the gills, a Hepatoxylin sp. found in the viscera, and an unidentified digenean species found in the pyloric caeca. These results increase our knowledge about angelfish biology and marine biodiversity, and can also contribute towards understanding the population structure of this species within the entire Benguela upwelling ecosystem via application of the parasite biotag approach.

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Pathways of larval transport: the roles of alongshore and cross-shore transport

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Population connectivity in marine organisms with sedentary or sessile adult stages depends almost entirely on larval dispersal. Patterns of larval transport and population connectivity are still poorly understood. It is well known that the south-east coast of South Africa is characterised by the strong Agulhas Current, mesoscale episodic events and wind-driven currents. Here, we report seascape genetic research on the brown mussel, Perna perna, which has a pelagic larval stage and whose population structure is strongly influenced by coastal topography. We investigated alongshore and cross-shore transport by generating genetic data from 8 microsatellite loci data for the full ontogeny. A strong correlation between the genetic data and simulated dispersal scenarios were observed. The results of this study resolved the mechanisms that determine the pathways of pelagic larvae, with important implications for the management of marine resources.

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Flamingo Channel Foraging Plasticity: Effects and consequences for the Benthic heterogeneity

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Ecological research has shown that ecosystems functioning, structure and resilience is strongly dependent on predation. However, few studies have quantified the different foraging behaviours displayed by predators and its repercussions for communities, particularly in marine sediments. Many predators employ plastic foraging strategies in order to improve reproductive fitness, particularly when the abundance and distribution of trophic resources become spatially and temporally unpredictable. The Greater Flamingo is a shorebird species that displays such plasticity by creating different foraging structures of different sizes. The main goal of this study was to enhance understanding of the ecological consequences of foraging plasticity employed by the Greater Flamingo with a particular focus on successional change in intertidal sedimentary systems. A two-week field survey was conducted at 2 sites within Langebaan Lagoon, involving newly formed large and small foraging structures created by P. roseus being marked and sampled over a period of 8 days to quantify effects on succession. Preliminary results indicate differential effects of different sized structures on benthic community succession. Smaller feeding structures accumulated more trophic resources and generated a greater positive impact on the dominant adult amphipod Urothoe grimaldii over time. Our preliminary data highlights the importance of foraging plasticity in determining levels of trophic resources available to consumers in intertidal sandflats and in enhancing spatio-temporal heterogeneity in these systems.

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Depth regulation of invertebrate larvae across nearshore fronts

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The distribution of the planktonic larval phases of intertidal invertebrates in the coastal ocean is known to affect recruitment to adult populations of these organisms. These distributions are in turn influenced by physical conditions through the water column but also by active larval behaviour. In 2014 we conducted very nearshore sampling of larvae, physical variables and currents at different depths across very nearshore fronts off Sardinia Bay, Eastern Cape. We found that a wide range of decapod zoeae, bivalve and gastropod veligers, polychaete segmented larvae and balanid barnacle cyprids were located at depths at which currents were directed onshore, which suggests active depth regulation. These taxa were more abundant at deep, offshore waters, which suggests that fronts act as barriers for their onshore advection. In contrast, pinnotherid zoeae, bryozoan cyphonauts and chthamalid barnacle nauplii were more abundant at surface inshore and frontal waters and their vertical distributions were not associated with onshore flows. We hypothesise that larval depth regulation in pursuit of water layers moving onshore may be a behavioural mechanism to avoid offshore transport for those larvae developing offshore of the fronts.

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Recognizing the gap in marine bio-invasions research in South Africa

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The overall aim of the National Biodiversity Assessment (NBA) is to assess the status of biodiversity in South Africa and to identify key knowledge gaps and research priorities. This includes alien and invasive species. Recently we re-defined marine alien species as species whose presence in a region is attributed to human actions that enable them to over-come geographical barriers and invasive species as alien species that have self-replacing populations over several generations that have spread from their point of introduction. In preparation for the NBA 2018, new information has been collated and the total number of alien species is 93 of which 53 are classified as invasive. Key vectors include shipping and mariculture with recent research emphasizing yachting. Numerous new reports of invasive species have been from harbours. The impact of marine bio-invasions has only been assessed for 13 of the 93 marine alien and invasive species. Only 21 marine invasive invertebrates and plants; and nine prohibited species are listed in the National Environmental Management: Biodiversity Act (NEM:BA). This poster highlights further research needs in order to support policy and decision making regarding marine bio-invasions in South Africa. These include strengthened baseline research including national species lists and barcodes; research to support early detection, impact assessment and prediction and species- and vector-specific risk assessment to inform regulations. Key differences between the regulatory and newly published species lists will be reported on. Additionally, new maps of invaded areas and heightened risk and areas of high risks have been produced.

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To lump or to split that is the question; the Pocilloporidae of South Africa.

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Hard coral taxonomy has recently undergone a great deal of revision in light of systematic revisions, including molecular evidence. The stony corals of the Isimangaliso Wetland Park in South Africa have not yet been considered in this light. Thus, with a regional perspective on identification and diversity, a new list of stony corals was recently compiled. An additional 84 species have been identified including two new genera of hard coral, comprising a total of 43 genera and 133 species. Previous checklists report between 20 and 40 fewer species. Using the well-studied Pocilloporidae, our aim was to test these new reported species boundaries with previous more conservative species estimates, using these recently collected and identified Pocilloporids. The data generated by this systematic study using molecular evidence, reveals the legitimacy of previous more conservative taxonomic approaches, and challenges more contemporary species boundaries with respect to not only the Pocilloporidae, but all stony corals in RSA.

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Taxonomy of the South African Scleractinia

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Sodwana Bay reef complexes represent the southern range extent of Scleractinia in the Western Indian Ocean, and are some of the highest latitude reefs globally. Scleractinian species checklists have been developed for the region(6, 2) however, none using genetics(1). Globally, recent studies (1, 2, 3, 4, 5) have used genetics to understand phylogeny and evolution, especially in polyphyletic taxa within robust corals. New species designations, within robust and complex clades (1, 3, 4, 5) are under consideration, and are important for future taxonomic and evolutionary study(1). This has implications for scleractinian taxonomy in South Africa, where these data are deficient (1) and designations are in need of revision and global comparison. This presentation represents the first part of information generated in the study. Thus, this project aims to identify South African scleractinian diversity using genetic and morphological data. These data will be used for a comparisons based taxonomic study of regional and global congeners, and will allow for accurate estimation of species diversity, evolutionary history, reticulation, and hybridisation (with special interest in robust corals and two prominent species families, the Acroporidae and Pocilloporidae). This presentation will present the most recent phylogenetic information of this on-going project and results of a brief Scleractinian species checklist of the Sodwana bay reef complex.

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Extent of blue carbon habitats and ecosystem services in South Africa

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In South Africa; mangroves, salt marshes and seagrasses are found in sheltered estuarine environments and are recognized as coastal blue carbon ecosystems. Carbon sequestration is one of many estuarine ecosystem services and is important for biodiversity and sustainability. We quantified the carbon storage in South Africa's estuarine habitats using a Tier 1 assessment, which includes using available area cover data from the updated national estuary botanical database to provide estimates of carbon stocks. Preliminary carbon estimates indicated that Mhlathuze and St Lucia estuaries had the highest carbon content for mangroves (251710.6 Mg and 80867 Mg respectively). In contrast, estuaries such as Bulungula, Mzimvubu and Mzamba ranged from 5.404 to 115.8 Mg. In saltmarsh ecosystems, the Olifants, Langebaan and Groot Berg estuaries had the highest carbon storage (239965.2 Mg, 335427 Mg and 1074060 Mg respectively). Estuaries with low salt marsh areas such as Klein Palmiet, Happy Wanderers and Mzimayi estuaries had lower carbon estimates ranging from 0.255 to 17.85 Mg. Seagrass carbon storage was highest at Knysna (25704 Mg), St Lucia (46602 Mg) and Kosi (70416 Mg) and lowest at Mlalazi (0.108 Mg), Klein Palmiet (2.16 Mg) and Rooiels (3.24 Mg) estuaries. In conclusion, these results showed that larger estuaries dominated by mangroves store more carbon compared to smaller salt marsh and seagrass dominated estuaries, however a more detailed analysis of biomass and sediment is still required. This has implications for conservation as the size of areas required to supply carbon storage services will depend on the natural vegetation type.

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Assessing the impact of assimilating OSTIA SST and along-track AVISO SLA on the performance of HYCOM over the Agulhas Bank

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South of Africa the Agulhas Bank hosts a complex marine region that is influenced by coastal upwelling processes, typical of the Benguela Upwelling System, and also dynamic upwelling resulting from the variable presence of the Agulhas Current. The Agulhas System is one of the most energetic ocean current systems on the globe, exerting a powerful influence on resources and ecosystems in the region, as well as the regional weather on a broad range of temporal and spatial scales. Hydrodynamic modelling and data assimilation techniques play a major role in both furthering the quantitative understanding of the ocean dynamics, as well as providing better forecasts of complicated interactions between this western boundary current system and the adjacent shelf region. This investigation compares daily high resolution blended MODIS sea surface temperature (SST) over the Agulhas Bank and southern Agulhas Current for 2008 and 2009 to SST derived from two Hybrid Coordinate Ocean Model (HYCOM) data assimilation experiments. In the first experiment only along-track satellite sea level anomaly (SLA) data were assimilated, whereas both SLA and OSTIA SST data were assimilated in the second experiment. Both experiments utilized the Ensemble Optimal Interpolation (EnOI) data assimilation scheme. Cost Function values ranging from 0.8 to 1.0 indicated a good fit between SST's derived from the second experiment and MODIS SST's. The additional assimilation of OSTIA data constrains the model SSTs more closely to the blended MODIS SSTs. The results of this investigation are a significant contribution towards the development of a regional ocean prediction system.

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Microbial indicators of water quality for human and ecosystem health at selected sites along Eastern Cape coast of South Africa

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Coastal areas are uniquely biologically productive, economically valuable, and generally desirable for recreation and dwelling. They are fragile and exposed to anthropogenic activities posing a challenge of balancing economic development and healthy coastal ecosystems. Anthropogenic activities such as effluent discharges may introduce microbial pollutants into coastal waters that threaten public and ecosystem health. To estimate the health risks for bather safety, indicator microorganisms such feacal coliforms e.g. Escherichia coli are used as surrogates for microbial pathogens as they are much easier and less costly to detect. Typically, such indicators focus on the health of humans to the exclusion of ecosystem health implications. Therefore when selecting indicator microorganisms for water quality monitoring standards, ecosystem health and human health both need to be considered. Using results from Port Elizabeth and East London beaches, this presentation will demonstrate the value of considering both ecosystem and human health when selecting indicator micro-organisms.

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Progress and pitfalls in the regional genetic assessment of elasmobranch species

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Although there is a growing concern for sharks, rays and chimeras worldwide (class Chondrichthyes), is has been shown that sustainable fishing can be a feasible solution. In order for this to happen, fisheries-based management should ideally be combined with science-based management especially for species with relatively low productivity and elevated risk of extinction. Southern Africa is a shark biodiversity hotspot hosting high endemism while sharing a high number of species with other parts of the world. Similar to other countries, anthropogenic and environmental pressures are increasing and there is a need to ensure sustainable utilisation of this fisheries resource and conservation of regional biodiversity.
In this presentation, an overview of the progress made with regional molecular assessment of several species will be given with a focus on species identification, population genetic structure and reproductive biology. More specifically, application and results of molecular techniques are demonstrated for several species affected by fisheries including Mustelus mustelus, M. palumbes, Galeorhinus galeus, Carcharhinus brachyurus and Rhinobatus annulatus. A brief overview of on-going projects involving high throughput sequencing and genotyping technologies will also be presented. Finally, pitfalls such as sampling bias, species misidentification and realistic implications for fisheries management are discussed. Based on the latter we recommend acquiring baseline barcode and genotype data for all elasmobranchs as a research priority but also highlight the need for multidisciplinary approaches and coordinated efforts towards biodiversity conservation of elasmobranchs in southern Africa.

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DNA barcoding of sponges in South Africa

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Sponges are a very diverse group of animals that mostly occur in marine water. Taxonomic identification of sponges is based on their physical morphology (color, size and shape) as well as the types of spicules they possess. These characters are believed to be insufficient to resolve sponge biodiversity, and in recent years, DNA barcoding has become a popular method to unambiguously identify the different species. Here we report the results of a DNA barcoding study from the east and the west coast of South Africa. Genetic differentiation among samples of what are supposedly the same species but that were collected at different locations indicates that levels of cryptic speciation are high, contributing to the growing evidence that South Africa's marine biodiversity has been underestimated.

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Assessment of deep-water benthic fish along the KZN continental shelf using Baited Remote Underwater Videos to support Marine Spatial Planning

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In light of South Africa's advancements to growing the country's ocean economy, a network of well-managed Marine Protected Areas (MPA) and an ecosystem-based Marine Spatial Plan (MSP) for the country are essential. Both MPA establishment and effective ecosystem-based MSP require the development of habitat and ecosystem classifications and mapping, as this forms the basis of ecosystem assessments which inform planning and ocean zoning. Biogeographic classifications are a useful tool for planning purposes where sampling is not possible. In South Africa, a biozone classification based only on physical data was developed for the KwaZulu-Natal (KZN) region. In an attempt to ground-truth this classification, this study uses baited remote underwater video (BRUVs) data collected within three of the SeaPLAN biozones as part of the two ACEP projects: (Biodiversity Surrogacy and Spatial Solutions). Data are used to verify the KZN biozones by assessing the effects of depth, substratum type, and latitudinal gradient on fish assemblages. Data were collected from sand, reef and mixed substrata. Preliminary viewing of a total of 148 videos reveals Pagellus natalensis as the dominant species in sandy substrata, while reef fish communities are more diverse and dominated by Chrysoblephus puniceus and Cheimerius nufar. This will be the first study of its kind to evaluate fish assemblages in the 40-100m depth zone in KZN. Findings will assist in future MSP initiatives and strengthen existing classifications used to provide representative protection within South Africa's proposed expansion of its MPA network.

Keywords: Benthic Fish Communities, Marine Spatial Planning, BRUVs, Ecosystem Classification

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The twin effects of alien species and harvesting on intertidal rocky-shore communities based on historical and spatial comparisons

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Intertidal rocky shores are the most accessible marine habitats and therefore heavily impacted by harvesting pressures. In recent years, these ecosystems have also been invaded by alien species, which further confounds the effects of harvesting on rocky shore community structure and functioning. Recent survey data combined with historical data from 1974 were used to assess modern-day changes on a rocky shore community at a site where harvesting has increased over the last two decades due to a nearby coastal development (at Kommetjie). Three kinds of changes emerged: (1) the appearance of alien species; (2) the effects of increased harvesting pressure; and (3) the direct and indirect effects of these changes on other species. To disentangle the effects of harvesting from those of alien invasions, comparisons were made with a current unharvested no-take zone (at Scarborough). One striking result is transformation of mid-shore zones on exposed shores by the appearance of the invasive mediterranean mussel Mytilus galloprovincialis, and the indirect effects on the demography of the granular limpet Scutellastra granularis. Adult limpets have been excluded by the mussel, whereas juveniles find a secondary home on the shells of the mussel. In addition, harvesting has decimated granite limpets Cymbula granatina and Argenville's limpet Scutellastra argenvillei. This has led to the proliferation of opportunistic seaweeds, such as Ulva spp. The dual affects of alien invasive species and over-harvesting have major ecosystem effects but do not necessarily diminish biodiversity because alternative habitats develop that provide opportunities for colonisation by additional species.

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The Economic potential of a directed fishery for redeye round herring

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Redeye round herring (Etrumeus Whitehead) is found in abundance on the South African continental shelf. The distribution of this small pelagic fish species stretches from northern Namibia as far as Port St Johns on the East Coast of South Africa, with highest densities often occurring close to the shelf edge. In contrast to other small pelagic fish such as anchovy and sardine, the role of round herring as a forage fish species is not as profound – particularly for predators that feed during the day in the pelagic zone. This resource is currently under-exploited with catches falling way below precautionary upper catch levels and biomass levels in excess of 1 000 0000 having been observed during acoustic biomass surveys in recent years. Given increased demand for fish-meal to feed the aquaculture industry and rising fish-meal prices there is huge potential for a directed fishery on redeye round herring provided that innovative fishing methods can be developed to improve the catchability of redeye round herring. Development of a sustainable round herring fishery is likely to contribute significantly to the economy and has potential for increasing food security and job creation without negatively impacting the ecosystem.

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Movements of individually identified Bryde's whales along the South African coastline.

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The South African inshore Bryde's whale is resident in continental shelf waters and the population is estimated to number fewer than 1000 individuals. Previous studies have shown low levels of genetic diversity within the population, with 93% of individuals (n = 92) having an identical mtDNA control region haplotype. Based on samples taken throughout the known range of this population, no evidence of population structure on a molecular level was found. However, photographic data indicates there is some degree of spatial partitioning among individuals. Here we use data collected over a 12-year period, both opportunistically and from dedicated research projects, to determine the degree of movement by individuals along the coast. Identified Bryde's whales from False Bay (n= 54), Plettenberg Bay (n = 94) and Algoa Bay (n= 26) were available for comparison. No matches were found between False Bay and either of the two more easterly situated bays. Of the 26 individuals identified from Algoa Bay, 11 were also seen in Plettenberg Bay on multiple years, suggesting frequent movements between the two areas. Additional data from areas between Plettenberg Bay and False Bay is needed to determine the movement limitations of individuals and the environmental factors determining these.

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Mercury in commercially available fish: Are we at risk?

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Mercury (Hg) in its organic form methylmercury (MeHg) is a potent neurotoxin. Hg has a high biomagnification potential, meaning it increases in concentration through successive trophic levels in food webs. Certain species of marine fish, particularly large, long lived species, are known to accumulate relatively high Hg concentrations in their muscle tissue. Exposure to Hg through the consumption of fish may pose a risk to the health of human consumers. It is for this reason that health authorities in many parts of the world issue consumption advice, particularly for females of childbearing age and pregnant females. There is no consumption advice for the South African population. The purpose of this study was to develop safe consumption advice for fish purchased in retail stores in South Africa. The muscle tissue of fish purchased from retail stores in Durban and Cape Town were analysed for total Hg. Hg concentrations in the fish are discussed and compared to concentrations in fish from other parts of the world. The number of meals that can be safely consumed per month were defined following guidance from the US Environmental Protection Agency. These limits, and their implications, are also discussed.

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Why Swift Terns are winning the race: comparing Benguela-endemic seabirds that compete with fisheries

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High energetic demands in seabirds make them sensitive to changes in prey availability and this is often reflected in their diet. In the Benguela system the populations of endemic seabirds which rely on small pelagic commercial fish, have all decreased over the last few decades and are listed as threatened. In contrast the population of Swift Terns Thalasseus bergii has increased over the same period. To better understand these conflicting trends, we have investigated the diet of Swift Terns in the Western Cape, South Africa for three consecutive breeding seasons. Diet was assessed using a novel non-invasive methodology that uses digital photography. More than 24,000 prey items were recorded and standard lengths of fish were estimated. Results show that the main prey is Anchovy (65%) which averaged 84 mm long. However, a wide range of other prey was also captured. Prey composition differed significantly between breeding stages, with anchovy especially dominant at the onset of the breeding period and the diet becoming more variable as the season progressed. Understanding species-specific behavioural responses to ecosystem variations in the Benguela upwelling system is vital for assessing the impact of commercial fisheries on seabird populations and fish stocks. Finally, the implementation of the method developed in this study, in long-term monitoring programmes, may provide crucial knowledge for conservation plans and key input to realising an ecosystem approach to fisheries management.

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Impact of harvesting macroinvertebrates in the Langebaan Lagoon MPA, West Coast National Park

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Macrobenthic invertebrates are exploited as bait by anglers who fish within the South African estuaries. Bait digging at the Langebaan lagoon may be destructive causing a decline in the numbers, biomass and species richness of preferred species. This might be detrimental to macroinvertebrates communities. As legislated by the National Environmental Management: Protected Areas Act (Act 57 of 2003), SANParks is required to monitor the use of natural resources in the national parks including Marine Protected Areas. The study aimed to determine population densities of the macroinvertebrates in the intertidal areas of Langebaan lagoon. Five sampling sites were surveyed monthly, including Sandbaai a heavily impacted site; Kraalbaai a trampled area; Maart se plaat a moderately impacted site; Oestewaal a least impacted area; and Kliphoek a sanctuary. At each site, 0.25 m2 quadrant was placed along transect, which was at 5 m intervals. Macroinvertebrates were collected using prawn pump and sieving out specimens, stored in formalin for analysis in the laboratory. Results suggested that Maart se plaat had the highest densities, while Kraalbaai and Sandbaai had the lowest densities. There were no significant differences between all treatments in mean density and species richness. However, other diversity indices and species evenness showed the heavily impacted site to be significantly higher than the sanctuary. Disturbance due pumping have been shown not affect macroinvertebrate densities, instead it promotes diversity. Factors such as predation by birds in the sanctuary, sites characteristics and environmental parameters might have played a role, and this needs to be investigated further

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Livelihood support, cherished treasures, Climate Change: Estimating the SCUBA diving use-value of coral reefs in northern KwaZulu-Natal and southern Mozambique

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Economics and natural resource use are becoming increasingly intertwined. Monetary values are gaining importance in illustrating the value of nature, particularly when the resource in question is vulnerable to change, be it through exploitative and consumptive uses or natural phenomena. The coral reefs of northern KwaZulu-Natal and southern Mozambique are located in marine protected areas (MPAs) with their use being subject to regulation. They are common-pool resources used perennially by SCUBA divers that bring much-needed livelihood support to areas with high (47%) unemployment. Consequently, a survey was conducted (n=801) to establish the recreational use value of the coral reefs by SCUBA divers. Results revealed that respondents made, on average, two visits per year to the area and spent an average of R9200 per trip, R2700 of this on diving. Almost 45% of respondents spent R850 of their total budget on curios. Of concern was the fact that 74% of respondents would dive less if the reefs were badly bleached, with 56% reducing their diving by three or more dives per trip. Respondents' willingness to pay (WTP) to mitigate climate change effects on the coral reefs of the study area was investigated, revealing that 80% would support such a programme at an average WTP of R118 per trip. The projected SCUBA diver spend, based on preliminary population estimates, was ~R184M on visiting and using the coral reefs in the area with ~R4.5M being on curios. The projected WTP by SCUBA divers in support of climate change mitigation would generate ~R1.9M annually.

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SMELL of Science: Smell, embrace, observe

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Smell, embrace, observe
Swim through a bowl of colour
Dead fish came to life

The smell, the thought was
Vivid and bright

Nature is an art
Gyotaku is the language
Through which it speaks

These are extracts from poems written in response to encounters with fish specimens preserved in formalin and alcohol. This unique science communication exercise combines art, writing and science and has a proven track record with audiences of varying ages, backgrounds and creative ability.

The workshop combines two Japanese art forms: Gyotaku is a traditional Japanese art form developed in the 1800s to record the size and shape of a fish specimen. Haiku is an intensely controlled mode of Japanese poetry dating back to the 1400s. The strict formula of the haiku captures sensory responses in expressions of disgust, wonder and philosophical musings.

Participating delegates will be actively engaged in the creative processes of Gyotaku print making and Haiku construction. Then, in conversation, we will explore how the creative experience and a direct appeal to the senses can contribute to improved science communication.

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A socio-ecological assessment of small-scale fisheries in estuaries of the Western Indian Ocean – essential links for improved governance

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A new regional project, ESTUARIZE, was designed to provide a deeper understanding of the social and ecological factors that influence small-scale fisheries during a period of change on many fronts. An explicit two-way feedback relationship between 'human' and 'natural' systems was assumed; these two systems have co-existed for centuries, relying on the resilience of fish stocks, and adaptive capacity of fishing communities. Local customs are now being confronted by rapidly growing human populations, dwindling resources, and top-down governance initiatives. ESTUARIZE compares small-scale fisheries in the Bons Sinais estuary in Mozambique, Rufiji Delta in Tanzania and Tana Delta in Kenya. These are geographically far apart, harbour substantial fisheries in rural and semi-urban settings, and are fairly typical of the region. ESTUARIZE relies on existing data and limited field sampling to describe: (1) estuarine biophysical environment, ecological function and natural capital; (2) human user-groups, socio-economic and cultural setting; and (3) fisheries and effects on trophic dynamics. A participatory approach is used to identify local decision-making processes, and discover linkages and feed-back loops in socio-ecological systems. Semi-quantitative models are constructed to simulate the effects of different exploitation patterns, natural perturbations and governance strategies on livelihoods, ecological functioning and fisheries. Results from the first year describe estuarine hydrodynamics, including GIS mapping of habitats and land-use patterns; define user-groups based on field surveys; and quantify fishers, gear-types and seasonal trends in species and size composition of landings. These data form the basis of socio-ecological simulation models, which will follow in year-2 of ESTUARIZE.

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WHALETIME – a citizen science approach to conservation of humpback whales

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The Wildlands Whale Time Project's goal is to bring science, conservation, tourism and community together around the key phenomenon of the annual migration of humpback whales (Megaptera novaeangliae) along the east coast of South Africa. The Whale Time project has four main elements. The first is to conduct and support research, with student collaboration, to update current knowledge about the population status of the east coast C1-stock humpback whales;to gain an understanding of population trends and any threats to the population. To this end, the project has populated a photographic catalogue of over 400 individual tail flukes from the Mozambique breeding grounds. The second element is the promotion of a citizen science approach to allow the public to become informed participants in knowledge generation, by contributing images to the catalogue, and advocates for marine conservation. The project has established an online platform that will allow "citizen scientists" to upload their photos of whales, which will be identified by experts. The third element of the project aims to build awareness about whales in general, the opportunities they present and the threats they face, using social media platforms, a dedicated website, conventional media or press techniques and the active participation of a wide range of stakeholders. The final element promotes ethical and sustainable community-based tourism. In the pilot phase, five guides have been trained and currently offer tours at the Maritime Museum in Durban, they contribute to the larger Whale Route,and additional activities held or planned by the South Durban Tourism Association.

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Food-web structure of the Namibian Islands Marine Protected Area: An update from stable isotopes

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The Namibian Islands Marine Protected Area (NIMPA) supports important breeding populations of several marine top predators, including threatened seabirds such as bank cormorants Phalacrocorax neglectus, African penguins Spheniscus demersus, Cape gannets Morus capensis, and greater crested terns Thalasseus bergii, as well as one species of pinnipeds, the Cape fur seal Arctocephalus pusillus. The ecosystem in this region has been substantially altered in the last 50 years due to overfishing, with small pelagic fish replaced with jellyfish, salps, and other less nutrient rich species. The new food-web structure is not clearly understood. Studies to date have described trophic structures based on traditional diet analyses (stomach contents, faeces). To complement these short-term diet data, we used stable isotopes to infer trophic ecology over longer time periods. Carbon and nitrogen stable isotope ratios were measured from various tissues of the five top predator species, together with potential prey species. As expected, the predators had higher δ15N values than prey species due to concentration of 15N up the food chain. Cape gannets fed at the lowest trophic level and the furthest offshore, based on low nitrogen and carbon isotopic values in whole blood (breeding season) and feathers (moulting period). Bank cormorants fed more benthically than other predators, while cape fur seals fed at the highest trophic level. African penguins had isotopic values from both whole blood and feather samples, intermediate to that of cape gannets and Cape fur seals. This work provides new insights into the functioning of the NIMPA ecosystem.

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IMPLEMENTATION OF THE NATIONAL ESTUARINE MONITORING PROGRAMME IN SOUTH AFRICA: CASE STUDIES ON SELECTED ESTUARIES IN THE WESTERN CAPE.

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The National Estuarine Monitoring Programme was initiated by the Department of Water and Sanitation in 2008 and is being pilot tested on 28 estuaries across South Africa. Data collected between 2012 and 2016 on the Berg, Bot, Klein and Breede Estuaries was analysed to determine the success of implementation of this programme on a regional and national scale. Data were compared with the Threshold of Potential Concern (TPC) for selected system variables and nutrient levels as determined in the relevant estuary freshwater requirement studies. In the absence of documented TPC's, TPC were calculated making use of the 10th and 90th percentile values of the constituents. The results were expressed as percentage exceedance of the TPC's. This study showed that nutrient loading and turbidity were the main water quality related issues in the systems that needed management intervention. This programme can successfully be used to expand on existing data and identify water quality deterioration that requires management interventions.

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The need for multiple lines of evidence for dredged material disposal: A case study from the Port of Cape Town

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Ports provide a safe environment for the transfer of cargo to and from ocean-going vessels. However, this calm environment facilitates the deposition and accumulation of sediment. Accumulated sediment reduces the depth of navigation channels, turning basins and berthing areas to the extent that safe vessel movement is not possible. Therefore, port authority's routinely maintenance dredge navigation channels and other port facilities to their design dimensions. Sediment is a significant sink for contaminants. The risks posed by contaminants in sediment that requires dredging need to be identified before options for its disposal can be identified. In South Africa, few lines of evidence are used for such decision-making. This study used various lines of evidence to identify risks posed by the dredging and disposal of sediment in Victoria and Alfred Basins (V&A Waterfront) in the Port of Cape Town. This included the analysis of sediment and sediment elutriates for a wide range of chemicals and the toxicity testing of whole sediment and sediment elutriates using amphipods and mysids. Sediment in parts of Victoria and Alfred Basins is highly contaminated by various chemicals (it is in fact the most contaminated sediment in the coastal environment in South Africa), and is highly toxic to amphipods. However, sediment elutriates were not toxic to mysids. The implications of these findings are discussed, focusing on the need to use multiple lines of evidence for decision-making.

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Water quality assessment and nutrient loading in the Ntafufu Estuary

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Ntafufu estuary falls under one of the estuaries for pilot the National Estuaries Monitoring Programme (NESMP) under the Department of Water and Sanitation. Apart from Ntafufu Estuary being located within the Mkhambathi Nature Reserve, which is covered by large amounts of grasslands and forestry, supporting numerous flora, little is known about it water quality. This projects aims at disseminating unknown and current information on the Ntafufu estuarine system. Assessment was conducted using system variables probe, and samples collected for nutrients and chlorophyll a analyses. Temperatures get low as 15 degrees in winter and high as 28 during summer months, with observed stratification in deeper parts of the estuary. Oxygen concentrations have been relatively low in deeper parts of the estuary, equivalent to anoxic conditions. There is evidence of freshwater influence, with marked salinity gradient in the upper parts of the estuary. Of interests, are the nutrients and chlorophyll a concentrations which clearly depicts how degraded the water quality of the system is. Data collection and analysed will assist in determining thresholds of potential concerns, for better management of the estuary.

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Assessing the effects of sediment type and depth on infaunal biodiversity and community composition off southern Namibia

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The BCLME supports one of the largest and most productive commercial fisheries in the world. The benthic regions of these upwelling cells are defined by widespread hypoxic or anoxic conditions which give rise to hydrogen sulphide events. Historically, the ocean depths were considered “species depauperate”. Contemporary research suggests that species richness in the deep sea is comparable to that of tropical rainforests and coral reefs. However, technological and financial constraints make detailed studies of benthic communities challenging. As such, ecological forces driving benthic community structure are still somewhat poorly understood. The benthos is a more complex and dynamic environment than previously hypothesised. The fluctuations in the availability of resources propagate generalist species with pronounced temporal and spatial changes in community composition. Analysis of benthic communities may provide useful data for assessing the condition of marine ecosystems when looking at long-term responses or site-specific impacts. Over 890 samples were collected across nine regions along the inner shelf of the Southern Namibian and South African coastlines from south of the Orange River (29°S) to Luderitz (26°S). Sampled depths ranged from 14m (shallower northern locations) to 141m (southern extent). Sediment texture became finer as bottom depth increased. Sands of terrigenous origin dominated the inner and middle shelves becoming terrigenous muddy sands and sandy muds as sampling moved towards the outer shelf and continental slope. Here we analyse the abundance and environmental data for a specific sediment type to determine whether infaunal biodiversity and species composition remain constant as depth fluctuates.

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A STUDY ON THE BIOECONOMIC FEASIBILITY OF KOI AND TILAPIA AQUAPONICS FOR THE SUSTAINABLE DEVELOPMENT OF AQUACULTURE IN SOUTH AFRICA

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Aquaponics is the integration of fish culture with hydroponic plant production in a freshwater recirculating system. This leap frog farming technology has the potential to become an effective advancement for improving the efficiency of food security delivery, combating water scarcity and land degradation through maximising land and water use. Farming both fish and crop species symbiotically is highly beneficial in a water-deprived country such as South Africa. An aquaponic system was operated to assess the crop producing potential of two different fish (koi, Cyprinus carpio and tilapia, Oreochomis mossambicus). Previous studies indicated that tilapia is a reliable species used in aquaponics, however, current regulations and a lack of knowledge make this a difficult species to promote in the leapfrog context. Conversely, little is known about the use of koi fish as a potential supplement and the effects of system engineering on crop viability and yield, it is however, a well-established and readily available fish through the pet shop trade. A constructed system consisted of koi and tilapia fish culture tanks, each connected to pumps that deliver water to hydroponic components. Water flowing from the hydroponic components then flowed by gravity to gravel biofilters and back to the fish tanks. The hydroponic component acted as a filter to manage water quality for the fish while the plants were provided with nutrients to satisfy their plant growth requirements. Outcomes from the study will be used to explore the feasibility and niche of aquaponic produce in local farms and South African economic markets.

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Influence of inbreeding depression on plant performance of mangrove populations occurring along the coast of South Africa.

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Mangroves reach the southernmost biogeographical limit along the African east coast in South Africa where they are distributed in isolated patches along various estuaries. Avicennia marina (A.marina), a widely distributed mangrove species, has lower genetic diversity and higher inbreeding levels when occurring in range-edge populations. Such studies support the central margin hypothesis which suggests that in general, the genetic diversity is found to be higher in range-optimum populations than in range-edge populations. The low genetic levels and high inbreeding levels observed in A. marina populations occurring along the coast of South Africa has been attributed to various factors such as population size, coastal geomorphology and estuarine dynamics. Inbreeding in plants may lead to inbreeding depression which may influence various attributes such as seed quality, seed germination, plant growth and survival, flowering and seed production. The objective of this study is to determine how inbreeding depression in A. marina populations could affect plant performance and ecosystem functioning by measuring the survival of saplings, changes in population size and structure, growth rates and documenting reproductive success in populations occurring at St Lucia, Mngazana, Wavecrest and Nahoon. So far changes in growth rates and propagule weight have been shown to change from more to less diverse forests but in unexpected ways. It is anticipated that with an increase in inbreeding there will be reduced plant performance and in turn lower ecosystem functioning. Determining plant performance is important in the conservation of mangrove populations as it may act as indicator of population resilience.

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Exploring the unique vegetation of the Kosi Estuarine Lake

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Kosi Estuarine Lake, South Africa's northern most estuary, consists of a series of four interconnected lakes exhibiting distinct vegetation zonation driven primarily by salinity. The estuary supports nationally important areas of swamp and mangrove forest and extensive submerged macrophyte habitats. The aim of this study was to provide updated estuarine plant species diversity and abundance at Kosi Estuarine Lake. This data, last updated in the 1980s, is used for understanding estuary health and for management purposes. Submerged macrophytes and macroalgae were abundant within the water column of the fresh Nhlange and Amanzimnyana, which were fringed by reeds and sedges behind which swamp forest occurred. The mangrove Lumnitzera racemosa occurred in the lower salinity lakes (Mtando Channel and Mpungwini) while the mangroves Bruguiera gymnnorhiza and Avicennia marina occurred in the saline Makhawulani Lake and estuary. Unlike the nearby St Lucia Estuary, which supports comparable plant diversity, the vegetation of Kosi Estuarine Lake is relatively pristine and requires appropriate conservation measures. Particularly considering the pronounced resource utilisation identified - evidence of burning and cattle grazing on the floodplain and harvesting of reeds, palms and mangroves. This study highlights the considerable botanical importance of the estuary and its sensitivity to future freshwater inflow reduction that would alter salinity patterns. It also recognised the need for further studies on specific habitats, notably mangrove population structure and submerged macrophyte diversity.

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Mesoscale/submesoscale features of Agulhas current origin in the South Atlantic Ocean

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The South Atlantic is essential for the Meridional Overturning Circulation, for equator-ward heat transport, and eventually the formation of the North Atlantic Deep Water. These occur due to its interconnection with the Indian Ocean through the Agulhas leakage. Although the South Atlantic is regarded the centre of global water cycle, it's only recently where a long term monitoring transect was put in place along 34.5˚S to track these interconnection of Indian and Atlantic Ocean. To understand the Indian-Atlantic interconnection, there is need for the understanding of the mesoscale/submesoscale features that influence this leakage. In situ observations between 2013 and 2015 was used to identify and characterize mesoscale/submesoscale features encountered along the transect. Thermosaligraph (TSG) showed that these features were mostly encountered between 9˚E and 17.5˚E, and in some instances characterized by surface temperature and salinity of 1.5˚C and 0.22psu higher that their surrounding environment respectively. Although Sea Level Anomalies showed that these features were persisting shore-ward, TSG only represented these features well with temperature and not salinity. Condusctive-Temperature-Depth data suggested a shoreward uplift of cool-less-saline subsurface water, which were observed from satellite data to maintain the cool character of the west coast of South Africa, and also varied from month-to-months. The energetic character of these features was shown by ship-borne Acoustic Doppler Current Profiler to mostly extend with depth and ranged between 0.5-1m/s, although those observed shoreward rapidly lost their energy within a few metres depth.

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Distribution changes in the demersal fish community of the Agulhas Bank, 1986-2016

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Anthropogenic climate change and fishery impacts modify marine species distributions. Understanding distribution changes (direction and mean velocity) are critical for adaptation by fishers and effective management of fishery resources and biodiversity. Yet few empirical cases have documented distributional trends in South African marine taxa. The last three decades (1986-2016) of research trawl survey data from the Agulhas Bank were interrogated for evidence of distributional changes in 44 commonly occurring fish species. Annual estimates were made of the centre of gravity (COG) in coordinate space and the effective area (EA) occupied by each population, using a species distribution function estimated by a geostatistical delta-generalised linear mixed model. Average trends over the study period were assessed using a Bayesian state-space model. Evidence of a trend in COG was found in nine species. The EA trends showed that two taxa reduced their area occupied, while one had expanded its extent. At the level of the entire community, average trends were shown as a westward shift in location and a reduction in extent (EA). Lacking knowledge on subsurface oceanographic changes on the Agulhas Bank makes interpretation of these distributional changes challenging and is identified as an urgent research priority. Nonetheless the westward COG and decreasing EA trends were interpreted as likely signals of climate forcing, whereas the eastward movement in average location of three taxa may be linked to fishing impacts. Projecting distribution changes and disentangling their causes promises to be a fruitful avenue of research that will benefit resource managers and fishers.

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Seasonal and spatial variability of pelagic fishes in relation to environmental variability in St Helena Bay

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The St Helena Bay Monitoring Line extends over 100 nautical miles off Elands Bay and is a long term project on environmental monitoring; it samples the nursery grounds and part of the transport zone for hydrology and productivity in areas that are important to early life stages of small pelagic fish resources. Acoustic data have been collected along the SHBML to obtain information on small pelagic fish abundance. However, because there was no directed midwater trawling to determine species composition and size distributions of acoustic targets during those cruises, closest trawls from the pelagic recruit surveys, commercial trawls or spawner biomass surveys have been used to identify acoustic targets. Seasonal patterns of small pelagic fish were determined and compared to zooplankton abundance and also to seasonal variation of environmental variables in the area. The results show that most offshore stations along the SHBML transect indicated high temperatures during summer, while lower temperatures were observed in winter. In contrast, temperatures at the nearshore stations showed the opposite pattern, with lower values found during summer, and higher values observed in winter. Most stations do not indicate considerable correlation between zooplankton and pelagic fish biomass but few stations provided useful abundance estimates of pelagic fish and zooplankton densities. All stations on SHBML from 2000 to 2009 have recorded surface dissolved oxygen that is constantly above 4 ml/l which is suitable for all marine creatures. A consistent high density of zooplankton nearshore during summer was also noticed.

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Organic carbon export and phytoplankton community composition across the Agulhas System Climate Array

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The Agulhas Current is a fast-flowing western boundary current and a key component of ocean circulation. The Agulhas System Climate Array (ASCA) transect, off the coast of East London, was developed to provide long-term observations of the hydrography of the greater Agulhas Current system. To investigate wintertime upper ocean fertility and carbon export across the ASCA transect, a series of biogeochemical parameters were sampled at two stations in the core of the current (MLD of 60-70 m) and two adjacent open ocean stations (MLD of 150-200 m). Euphotic zone nitrate concentrations were lower at the core stations (0.7-1.1 µM) than in the open ocean (1.5-1.6 µM), while ammonium concentrations were higher (0.40-1.10 versus 0.08-0.11 µM). Organic carbon biomass and chlorophyll-a were also elevated in the core of the current. Consistent with the in-current higher nutrient drawdown and biomass accumulation, primary production was elevated at the core stations compared to the open ocean (29.9 mmol.m-2.d-1 versus 24.8 mmol.m-2.d-1),largely due to high rates of ammonium uptake (“regenerated production”). At the open ocean stations, 15N-based experiments revealed that a greater fraction of the organic carbon biomass was potentially exportable (44-53%, versus 25-31% in the current) despite lower absolute rates of primary production. This suggests that although the core of the current was characterised by signs of higher productivity in winter, the biological pump was stronger offshore. To evaluate the potential driver(s) of these differences, flow cytometry and bright-field microscopy will be used to determine phytoplankton community structure and group-specific contributions to carbon biomass.

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Analysis of movement for Dissostichus mawsoni from the tag data.

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Tagging of tooth fish Dissostichus mawsoni has been taking place in the statistical sub area 48.6 of the Antarctica since 2006 an area managed by Commission for Conservation of Antarctic Marine Living Resources (CCAMLR). The tagging of fish serve various objectives in the management of the fishery in various jurisdictions and among other objectives of tagging is that it improves the knowledge of the parameters for stock assessment such as the stock abundance, validation of fish age parameters, tag shed rates, fish mortality, local movement patterns of the fish and other parameters such as local catchability and harvest rates.

In 2011/2012 fishing season CCAMLR initiated a tagging experiment in this region which is conducted by fishing vessels as platform to collect data to assess the potential of fishery in this area among the objectives of the research. The fishable areas within the sub area 48.6 has been designated and constrained by regular blocks and vessels were only allowed to fish within the designated blocks and more than 6000 were tagged and released of which more than 90 fish were recaptured including the within season recaptures. The four year time series of recaptures has been analysed for within and between block fish movements. This study confirms various other finding of similar kind that a large proportion (90%) of Dissostichus mawsoni move on average less that 20 kilometres where-as small proportion move large distances which on average is larger than 500 kilometres.

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Whole mounts method associated with maturity scale development of the shallow water hake Merluccius capensis in South Africa

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Abstract:

Development of the scientifically devised field maturity scale for M. capensis in South Africa entails macroscopic identification, histological validation and the whole mount analysis of the well-defined and simple characters throughout the physiological process of maturation. The study area was between 34°- 39 'South and 16°- 28 'East. Samples were collected from January 2014 and were processed and analysed in DAFF laboratories. Morphological criteria were selected in connection with the characteristics of ovary development and six maturity stages were determined. The maturity stage of each ovary was classified based on the presence of the most advanced oocyte, atresia and post-ovulatory follicles (POFs). Non-parametric and parametric tests were used to analyse the results. Results indicated a significantly high disagreement between purely morphological and microscopic readings, demonstrating that macroscopic readings cannot be used on its own, which is supported by other previous studies and is attributed to the subjectivity of the method and the inadequately developed morphological criteria. Fortunately, the application of the whole mount analysis showed further significant differences on cohorts in larger ovaries. The whole mount analysis can provide excellent six-step universal and ecological maturity scale for hake, especially when combined with simple and improved array of morphological characters.

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The absence of benthic algae coincides with a simplification of the food web structure in deep nearshore reef communities

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Owing to difficulties in sampling deep reef communities, the processes which regulate deep and shallow nearshore reefs are assumed to be the same. However, significant physical changes within the first few meters of the water column alter both reef macrobenthos and fish assemblages. We employed stable isotope (SI; δ13C and δ15N) and fatty acid (FA) analyses to establish if shallow (11-30 m) and deep (45-75 m) nearshore reef communities within the Tsitsikamma National Park Marine Protected Area differed in terms of trophic organization and nutritional condition. We found a temporal effect on the plankton FA with an enhanced supply of essential FA (EFA) to the deep reef compared to the shallow reef during November 2011. The pattern observed during November in the plankton FA was mirrored only to some extent in the tissues of the macrobenthos, with no difference in the nutritional condition of the fish. Community based metrics derived from SI data indicated that the shallow reef was characterised by significantly higher trophic diversity due to greater diversity of carbon sources at the base of the food web, as indicated by the higher combined carbon and nitrogen isotope values (δCN). Trophic level increased with depth for both macrobenthos and fish, and the EFA 20:4n-6 decreased with trophic level for fish. Our results show that simplification of deep-reef food webs, potentially due to a lack of benthic algal species and functional redundancy, could mean that deep reef communities are more vulnerable to exploitation.

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The effects of sex and season on the presence of broadnose sevengill sharks (Notorynchus cepedianus) along the South African coast

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Broadnose sevengill sharks are apex predators that are exploited by commercial and recreational fisheries in numerous areas. However, this species lacks adequate management throughout their range due primarily to a paucity of data on their behaviour and movement patterns. In order to investigate these we tagged 36 broadnose sevengill sharks in both False Bay (n=28) and Mossel Bay (n=8) and recorded presence on 48 acoustic receivers along the South African coastline from 2013 to 2016. All sharks tagged in False Bay were female while all those tagged in Mossel Bay were male. Total length of sharks ranged from 163 – 232 cm, with 40% of females and 100% of males classified as mature. Female sharks were most frequently detected on False Bay receivers, with peaks in late summer/autumn across all size classes, and a notable reduction in detections in this region in winter. Strong site fidelity was evident for females in False Bay with 68% recorded over consecutive summer seasons and a number returning to the bay after being detected in Hout Bay (2 individuals), Gansbaai (6 individuals) and Mossel Bay (1 individual). Of the 8 males tagged in Mossel Bay in spring, 3 were detected in False Bay the following summer, suggesting aggregation of both sexes in this region during summer. This study is ongoing, but early results suggest that similar to research on sevengill sharks in California and Tasmania, these sharks display site fidelity to shallow coastal bays during summer months, before dispersing along the coast in winter.

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The Population Genetics and Diversity of The Shortfin Mako (Isurus oxyrinchus)

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The shortfin Mako, Isurus oxyrinchus is a migratory species that is distributed worldwide throughout temperate and tropical waters. Shortfin mako is renowned for their speed and ability to leap out of the water which has led to the species becoming the most desirable and commonly retained game sharks. For years this species has suffered as bycatch and is now also retained for its meat and fins. Previous research has suggested that the species has undergone drastic declines in abundance over significant parts of its range. Regardless of the economic importance of this species and its vulnerable status, little is known about its population dynamics, habitat preferences and the level of genetic connectivity among different regions. This study aims to determine genetic diversity and population connectivity from South African waters using genetic approach and tagging data. Analyses of genetic differentiation in DnaSP from 128 individuals across the South African coast has shown homogenous genetic structure between populations from the Indian and Atlantic Oceans ($p < 0.05$) but very high haplotype diversity ($h = 0.92692$). The South African population shows high level of population connectivity across ocean basins. Furthermore, phylogenies also revealed similarities between local populations and the North Pacific Ocean populations.

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What we know about the Mlalazi Estuary and what we would like to know about it.

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This presentation describes the information needed for the WRC-funded project entitled 'The development of a Bayesian model of ecosystem and mouth dynamics for temporary open/closed estuaries' (WRC K5/2542).

The study area for this project is the Mlalazi Estuary, its floodplain and its catchment. For this catchment-to-sea study relatively little information is freely available from previous studies. The study entails the development of a suite of inter-linked hydrological models and a vegetation model. For the models we require, inter alia, detailed physical information – including topography of the catchment, of the the floodplain and of the estuary basin (bathymetry). We need catchment rainfall, estuary water levels, sediment inputs and losses, mouth condition and salinity patterns. Most of these are not available and we are collecting what we can as part of this study. We are also making use of the EKZNW/DWS monitoring data.

We are working at various time scales. This necessitates an understanding of the ecological history to highlight events that have caused ecological change.

The National Biodiversity Assessment would require similar information, which relates mainly to the physical structure and processes that control all the estuaries of South Africa. In addition, as nutrient enrichment is a problem of the future, monitoring of nutrients would also be required for the national assessment.

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The molecular systematics and biodiversity of Thouarella corals (Octocorallia: alcyonacea) of South Africa

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The Deep Secrets research expedition is a source of coral location data that has already provided much needed information on biodiversity hotspots and vulnerable deep-water marine ecosystems. Deep water corals in South African waters are an aspect of biodiversity that has not been well researched. Although there has been research to report on the taxonomy and distribution of octocorals, abundance data and molecular approaches constitute novel approaches in South Africa. Evidence suggest that there are more coral species in deep waters than in tropical reefs. In this study the genus Thouarella has been found to be the most dominant octocoral on the outer shelf and shelf edge habitats between Cape Town and Port Alfred in the 135m-600m depth range. Thouarella corals are an important structure-forming species in deep-sea environments, with specific species association such as scale worms and brittle stars and in South Africa fish eggs and larvae were found within their fronds during the Deep Secrets cruise. This suggest that Thouarella play a role as habitat forming taxa and may have relevance to fisheries. Despite their multitude of ecosystem services, Thouarella taxonomy and distribution remain poorly known in South Africa. This study will examine Thouarella taxonomy and diversity by using both DNA barcoding and morphology, as well as providing baseline data on its abundance in habitats from South African deep water systems.

Keywords: DNA barcoding, Thouarella corals, mtMutS, 28S, molecular Phylogenetics

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Hake (Meluccius capensis) stock separation in Namibia using otolith shape analysis, length-weight relationships and seasonality in spawning and fish condition.

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The fishing industry is an important resource in Namibia with hake contributing about a third of the total catch. Merluccius capensis, the shallow water hake forms the bulk of this resource. It's essential to know whether there is a separate stock in Namibia and South Africa for an adequate assessment and improved management of the resource. From previous studies on distribution of spawners and juveniles, several stock structure hypotheses have been proposed. It was hypothesized that there is a significant difference between the M. capensis otolith shape found in the Benguela. Correspondingly, there is a significant difference in the weight-length relationship, spawning seasonality of Gonadosomatic index (GSI) and hepatosomatic index. This study aims to investigate stock separation of shallow-water hake (M. capensis) by observing the geographic variability of otolith shape along the Benguela (South African and Namibian coast). Otoliths were collected along the entire Namibian coast (north to south 17°S- 27°S) as well as on the South African coast during demersal trawl surveys for three years over two decades, 1995, 2005 and 2015. The outline of each otolith was traced and analyzed for differences in shape with elliptical Fourier analysis. Multivariate analysis and multidimensional scaling will be used to determine if there are significant differences in otolith shape between the proposed three areas of sub-stocks. This study, together with future genetic studies as well as spawning seasonality will contribute to unravelling the stock structure of M. capensis in the Benguela

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Mesozooplankton communities associated with two shallow seamounts on the Madagascar Ridge (South-West Indian Ocean)

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Seamounts are thought to be hotspots of oceanic biodiversity and productivity. During June/July 2015, sampling was conducted on the RV Dr Fridtjof Nansen to assess zooplankton community structure associated with two seamounts on the Madagascar Ridge (South-West Indian Ocean), and to explore differences between these two areas. A total of eighteen stations were sampled, with sites including the open ocean, a northern Madagascar Ridge seamount (named MadRidge), a southern Madagascar Ridge seamount (Walters Shoals), and the region between the two seamounts. Mesozooplankton were collected using an obliquely-towed Multinet (1m2 opening, 180µm mesh) at 5 depths: 600-400m, 400-200m, 200-100m, 100m to the mixed layer depth (MLD), and MLD to the surface. Samples were split on board, with one half used to estimate dry weight, and the other half for species identification, both preserved in 4% buffered-formalin. Mesozooplankton abundance, biovolume and size spectra were evaluated using the ZooScan. Preliminary results show that mesozooplankton abundance ranged from 273 ind/m3 (MadRidge Pinnacle) to 1095 ind/m3 (Walters Shoals edge). Abundance was greatest in the upper Mixed layer and decreased with depth. Fifty-six zooplankton taxa were identified. They were dominated by Calanoida (55.6%), followed by Oncaeidae (12.7%), Oithonidae (8.9%), Corycaeidae (5.4%), crustacean eggs (3.2%), Chaetognatha (3.1%) and Ostracoda (3.1%). Mean SST was higher at MadRidge (23.80°C) compared to Walters Shoals (17.95°C), whereas fluorescence was higher at Walters Shoals (1.01 mg.m-3) compared to MadRidge (0.20 mg.m-3). Mesozooplankton abundance was significantly correlated to both fluorescence and temperature (Spearman's correlation, $p<0.001$, $n=41$).

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Evolution dictates gene flow in the Western Indian Ocean: a regional theme

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Genetic data reveals ancient secrets when interpreted from an evolutionary perspective. The rates at which substitutions are fixed in the genomes of marine organisms depend on the life history and genes of the organism analysed. This allows for interpretation of contemporary genetic diversity, and reasonable confidence in predicting historical demographic patterns. In this regional overview multiple marine organisms and their genetic data are compared across the Western Indian Ocean. This comparison includes vertebrates and invertebrates, both sessile and motile, as afforded by multiple studies in the region. Genetic differentiation amongst populations is explained in terms of contemporary drivers within the framework of ancient seascapes. We reveal evidence of gene flow within and between Madagascar and South Africa and discuss the implications to local marine life. Further, we examine patterns of genetic diversity in multiple species in terms of their evolutionary history.

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Functional and taxonomic structure of marine macrobenthos as a biodiversity surrogate for the KZN marine conservation planning.

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Biological traits relating to behaviour, morphology and life-history influence biotope ecological function. This approach is increasingly used in ecosystem studies along with traditional taxon-based analyses. Also, using habitat types as surrogates for biodiversity is growing in marine conservation planning and management. In KwaZulu-Natal the derivation of a marine conservation plan is well underway. The next step is to expedite the plan by investigating whether surrogates for biodiversity exist at different ecosystem levels, one being the infauna of unconsolidated sediments, mid-shelf 50-80m. This work presents an outcome of the ACEP 'Surrogacy Project', that assessed whether pre-defined biodiversity zones (biozones) represent the taxonomic/functional attributes of macrobenthic communities. Biozones were subdivided into various subclusters from Richards Bay to uMkomaas with 19 stations sampled during the winter of 2014 across the biozones to represent replicate 'treatments'. nMDS, PERMANOVA and PERMDISP using nine traits, across 51 categories from 632 taxa, showed that functional structure did not agree with KZN spatial planning biozones. Three main functional/taxonomic groups were found; off Thukela, Zinkwazi to Durban, and Durban to uMkomaas. The groups were characterised as being free-living carnivores, hard-skeleton direct-developing omnivores and soft-bodied or hard-shelled omnivores with planktotrophic larvae. These patterns were explained by the KZN shelf habitat complexity, including level of sediment organic and carbonate content and water column turbidity and dissolved oxygen. Our conclusion was that greater emphasis must be placed on refining the benthic habitat layer (including our validated sediment distribution) for KZN and that by combining functionally similar habitats, a better model is achieved.

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Larval fish biodiversity in relation to biozones off the KwaZulu-Natal Coast: Biodiversity surrogates for marine pelagic conservation planning

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The use of biodiversity surrogates in marine conservation planning is gaining increasing recognition. These surrogates may be physical (e.g. sea surface height and temperature, sediment properties, or chlorophyll concentrations) or biological (e.g. indicator species, species richness, guilds or taxon groups). This work evaluates the use of larval fishes as biological surrogates and their potential value in marine conservation planning and designing of pelagic marine protected areas in coastal waters off KwaZulu-Natal. Predefined biozones (reef and sand) were sampled for ichthyoplankton. A range of water quality parameters were measured in situ concurrent with plankton sampling. Over 15 000 fish larvae were identified comprising of 100 families and 352 species. Approximately 50% of the fish larvae were reef-associated species (e.g. sparids, lutjanids, haemulids, scorpaenids), 27% were mesopelagic species (myctophids, gonostomatids), 15% epipelagic (coryphaenids, bregmacerotids), and 8% sand-associated species (bothids). The most abundant species were Pagellus natalensis (24.4%), Bregmaceros sp. (6.4%), Myctophid sp36 (5.9%) and Pomadasys olivaceum (4.3%). Larvae of the sand soldier Pagellus were present at all stages of larval development (preflexion, flexion, postflexion), suggesting that spawning activity of this fish species was occurring within the study area and at certain sites. These preliminary results suggest that the biodiversity of abundant species, such as Pagellus, may play an important role as biological surrogates in the planning of marine protected areas on the coast of KZN. Analysis on the relationship between larval fish abundance, substrate types, species habitat categories, and water quality parameters will further our understanding of larval fish as biological surrogates.

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New age data of Namibian M. capensis using the fast growth hypothesis: consequences for stock assessment

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The Namibian shallow-water hake, Merluccius capensis is the most important commercial resource in Namibia. It is currently assessed using statistical catch at age analysis for which age data obtained from otoliths makes up an important component of the input data into the assessment model. Recent length-frequency analyses and age validation studies of M. capensis showed that growth may have been previously under-estimated and otolith zones overestimated. In this paper we investigated this "fast-growth hypothesis" by using measurements of translucent zones (numbered T1 to T10 from the core to the edge of the otolith) on survey otolith samples (collected in the years 2002 and 2005) covering the entire fish length range of this species. We compared three hypotheses of otolith zone formation with the growth rates described independent of otoliths and show that T2, T5, T7, T8, T9 and T10 are most likely to be annual growth zones ("true rings"). A conversion equation from the old age data using the results of 2002 and 2005 survey samples was developed: New age = Integer(0.5*(Old age + 0.5)). "Fast growth" age data were described from 1990 to 2016 using this equation. The weight-at age and maturity-at-age calculated using the fast growth hypothesis were described. These data using the fast growth hypothesis is finally used as a sensitivity analysis in the current assessment model and results discussed with regards to consequences to current hake fisheries management strategies.

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A regional scale estuarine resource allocation process using a scenario-based approach: The Mvoti to Mzimkulu WMA case study

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Urbanisation and industrial growth in South Africa increases the need for proactive strategic assessment and allocation of freshwater resources on a regional scale, with a focus on future estuary water quantity and quality requirements. We describe here the catchment-scale water resource allocation process that set long-term targets for resources condition and future use. This regional-scale study (64 estuaries) strategically assessed estuarine health, biodiversity importance and resilience to current and future pressures to guide the most suitable return on investment. Projected growth in the region was integrated into a range of coherent future dam development and wastewater discharge scenarios. Each estuary was then screened to assess its projected condition under the range of scenarios. The results showed that estuaries in the region were in a very poor condition around the urban centres, but in a good condition in the more rural areas. An overwhelming finding was that, as a result of their small size, most of the estuaries had very little resilience to changes in freshwater quantity and quality. In contrast, the larger systems targeted for dam development were freshwater-dominated for 90% of the time and only showed sensitivity during the low-flow periods and droughts when base-flow reduction caused mouth closure and increased sensitivity to changes in nutrient processes. Broadly, the study strived to find a balance between ecological requirements and socio-economic development, which meant that maintaining larger systems in relatively good condition would be at the expense of smaller systems that are mostly already in a poor condition.

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Demospongiae taxonomy and diversity of the Amathole region (Eastern Cape, South Africa)

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The Amathole region of the Eastern Cape falls within the Natal Ecoregion and encompasses three separate marine areas (Gxulu, Gonubie and Kei), which together form the Amathole Marine Protected Area. Historically, the sponge fauna of this region has been documented in a handful of taxonomic papers that describe new species or records, but lack detailed descriptions. According to the World Porifera Database, a mere 73 sponge species have been recorded from this ecoregion to date. Thus, as a component of the Imida Frontiers Project (ACEP IV; Grant Number 97969), the aim of this study is to investigate shallow-water Demospongiae diversity within the Amathole region. The connectivity between this area and adjacent regions will also be assessed, as will the spatial variability of sponge assemblages according to a bathymetric gradient. Sampling was undertaken in 2016, during two cruises aboard the RV Ellen Khuzwayo, and over one thousand specimens were collected using a roughed benthic dredge across depths of 20 to 200 m. In addition, 43 ROV dives were completed in January/February 2017, providing insight into in situ sponge assemblages and associated habitat types. This study is expected to discover range extensions and species new to science, with data used to identify ecologically sensitive areas.

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Progress in implementing the ecosystem approach to fisheries in South Africa in principle and in practice

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An assessment of the Marine Living Resources Act, (MLRA) and the South African Policy for Small-scale Fisheries (SSFP) revealed that, although these instruments recognize and contain elements of EAF, this management approach has not been adequately implemented. In practice, the status of implementation of EAF was assessed through the Southern African Sustainable Seafood Initiative (SASSI). Of the 65 assessments obtained, 18.4% were listed as Green, 50.8% were listed as Orange and 30.8% were listed as Red. Non-metric multidimensional scaling (NMDS), and cluster analysis were used for analysis. Results indicated that there has been progress in implementing EAF. There are however, major sustainability issues that still exist. Species in commercially important fisheries enjoy the bulk of research and management attention compared to other species, including by-catch species. Based on these results, four fisheries were chosen for further in-depth analysis using additional information found in ecological risk assessments (ERA): offshore trawl, inshore trawl, West Coast rock lobster and the line fishery. A Wilcoxon signed rank test conducted showed that there was a decline in implementation of EAF and reinforced the earlier conclusion that larger commercial fisheries, offshore and inshore trawl, were progressing in implementing EAF faster than West Coast rock lobster and line fisheries. Both progress and challenges appeared to be largely influenced by several common factors, which include the presence or absence of positive incentives, accessibility, co-management, management plans, compliance, economic importance, capacity, and the interests of rights holders and other stakeholders.

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Ecology and biodiversity of South African estuaries: a botanical assessment of published articles and research gaps

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Research on estuaries has been important in linking science, policy and management in South Africa. A total of 233 published articles on the botany of estuaries were collated and divided into five categories (microalgae, submerged macrophytes and macroalgae, salt marsh, reeds and sedges and mangroves). The number of articles published per decade were assessed and showed the highest number from 1981 to 1990 for submerged macrophytes / macroalgae as well as mangroves. Research on microalgae in estuaries only really began in the 1990s with a peak in publications from 2001 to 2010. The total number of papers published for the different categories is remarkably similar, in contrast to the notably lower number for salt marsh, reeds and sedges. A special issue of South African Journal of Botany focusing on estuaries in 2016 contributed a further 22 articles. Research gaps identified were the growing eutrophication problem, microalgal bloom species and their autecology. Tracking and understanding changes over time particularly of keystone species such as the seagrass Zostera capensis are important as well as genetic studies and investigations into emerging threats such as invasive species. South Africa remains a globally relevant site to investigate the interaction between salt marshes and mangrove expansion in response to warming temperatures and increases in sea level. It is important to identify those estuaries where habitats can expand, as many low-lying areas have already been developed due to “coastal squeeze”. A project is underway to quantify lost habitats and associated ecosystem services to guide future restoration initiatives.

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Is limpet–seaweed association habitat specific or species specific in non – territorial limpets?

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Limpets are major grazers in rocky shores. They atct as a substrate for seaweed attachment. However most studies focus on the limpet-seaweed association of territorial limpets, thus this study aimed to investigate whether there are any non – territorial limpets that have associations with seaweeds in two habitats. This was carried out in four nature reserves along the Wild Coast of South Africa. The study found some associations between limpets and seaweeds in outcrops of all four nature reserves. In Dwesa Siphonaria capensis was found to have a negative associations with seaweeds like Bryopsis flanaganii at (P=-0.560); Cordium lucasi with (P=-0.538) and Patella concolor was found to have a (P=-0.522) association with Ecklonia radiata. Other limpets like Patella oculus with (P=0.500) and Scutellastra cochlea were found to have associations with seaweeds such as Sargassum elegans, Chaetomorpha robusta and Ecklonia radiata, with (P = 0.764; P= 0,663; P = 0,724) respectively. Limpets in Mkhambathi, Silaka and Hluleka outcrops had negative and positive associations at (P= -1.000) and (P=1.000). There were also limpet seaweed associations found in rock pools of all sites i.e in Dwesa, Siphonaria capensis was found with Gelidium capense at (P= 0,542), Cellana capensis with E . radiata at (P= -0,535); Keyhole with Amphiroah ephedraea at (P=0,686). Associations in Mkhambathi pools were found at (P=0.655) between S. serrata and Dictiyota dicotoma at (P=-0655). Associations in Silaka and Hluleka pools were found at either (P=1.000) or (P= -1.000).
Keywords: Limpet-algal association, habitat, rock pools, outcrops, nature reserves.

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Deteriorating water quality in South Africa's estuaries threatens ecological resilience

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A national assessment indicates the increase in occurrence of both micro- and macroalgal blooms in South African estuaries. Deteriorating water quality caused by an increase in wastewater input and agricultural return flow needs urgent attention. Recent research has shown that estuaries such as the Sundays and Swartkops are now in a permanent eutrophic state compared with measurements made 10 years ago. Anoxia is regularly recorded and phytoplankton biomass is seldom lower than 20 µg Chl-a l-1. South Africa's most important estuary for biodiversity conservation, Knysna has eutrophic conditions in the Ashmead Canal where macroalgal blooms occur. Even the iSimangaliso world heritage site of St Lucia is threatened by agricultural inputs from the Mfolozi system. Assimilation and cycling of nutrients is an important ecosystem service that needs protection if ecosystem resilience is to be maintained. This is shown by the Wildevoelvlei and Zeekoevlei systems which are now in an alternate stable state characterised by toxic cyanobacteria blooms due to wastewater input and high water retention. Drastic and costly interventions, such as water level drawdown and dredging, are now needed to improve the status of these novel ecosystems as ecological resilience is lost.

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Optimal foraging strategies of African Penguins: relevance to resource competition and group foraging

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Optimal foraging strategies in marine animals provide important insights into factors that may limit these species' survival. The endangered African Penguin Spheniscus demersus is primarily a pelagic fish specialist that competes with purse-seine fishing for the same food source. Understanding the most profitable foraging conditions of these penguins is crucial to refining the potential impacts of fishing activities on this species' prey field. The recent rapid decline in the African Penguin population has also raised concerns of a potential Allee effect associated with the benefits of group foraging. In this study we deployed animal-borne video recorders to monitor the foraging performance of African Penguins offshore of Stony Point, Betty's Bay, the only known breeding colony of this species that has increased in recent years. Birds primarily fed on anchovy but the size of schools varied significantly and there was also considerable variation in the number of conspecifics in different foraging events. We assess the foraging success and the potential benefits of group foraging behaviour of African Penguins under contrasting prey fields. Our findings highlight the relevance of these findings to the influences of resource competition and a potential Allee effect.

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Analysis of shoreline change and coastal hazards: implications for a medium-scale embayment, Mossel Bay, Western Cape.

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Medium-scale embayments, with length-scales in the order of 1s to 10s of kilometres and limited by headlands, generally present significant alongshore variability in shoreline dynamics. This is often the result of smaller-scale variations in coastal processes determined by differences in geomorphological setting; including the nature of the nearshore and backshore, wave forcing gradients and sediment characteristics. Along developed coastlines human-induced modifications of the coastal environment also contribute to coastal variability, further enhancing the exposure of coastal communities to erosion hazards, property and infrastructure damage and disruption of the coastal economy.
Located along the Western Cape coast of South Africa, Mossel Bay is a medium-scale embayment, ca. 30 km-long, with striking alongshore coastal variability, significant natural values and expanding coastal economical activity. By exploring medium-resolution satellite imagery in a GIS environment we present an analysis of shoreline change in Mossel Bay and evaluate its relation to the nearshore wave field, computed for mean and extreme conditions using a numerical wave model. Satellite-based shoreline positions obtained every 5 years from 2000 to 2015 showed limited variation at an embayment scale, suggesting relative long-term shoreline stability. When considering changes at a higher temporal resolution, using monthly to bimonhtly images from 2016, shoreline changes associated with megacusp and rip channel migration alongshore may result in shoreline position variation of up to 30 m. The localized nature of shoreline changes allows for formation of erosional hotspots during energetic wave events, with implications for hazards in relation to coastal development.

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Effects of limpet-barnacle interaction on the shell morphology of limpets

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As on rocky shores worldwide, barnacle interaction affects the shell morphology of limpets. The aim was to investigate how limpet-barnacle interaction affects the shell morphology of limpets. The study was conducted along the east coast of South Africa (Wild Coast), inside four Marine Protected Areas (Dwesa-Cwebe, Hluleka, Silaka and Mkhambathi). Individuals of Scutellastra granularis and Cellana capensis were collected from two habitats, within barnacles and on open rock and shell dimensions (length, height and width) were measured. Separate linear regression analysis and 2-way ANOVA were performed using GraphPad 7.02 to test the effect of site and habitat on shell morphology of S. granularis and C. capensis on open rock and within barnacles. The results showed a significant habitat effect on the shell morphology of S. granularis and C. capensis. On slope (shell width/shell length) S. granularis were lower within barnacles and significantly greater on those found on open rock. On slope (shell width/shell length) were significantly greater in C. capensis found on open rock making them wider/broader than limpets found within barnacles. Similarly, slope (shell height/shell length) of C. capensis were significantly greater on open rock than within barnacles at all sites thus making the shell shape conical. Additionally, site had a non-significant effect on the shell morphology of C. capensis and S. granularis. However, Mkhambathi was significantly different from all sites. The findings indicated the important role species interaction and environmental conditions play in the modification of shell shape in intertidal limpets.

Keywords: MPA's, intertidal open rock, environmental conditions.

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Digital conservation: Scientists portal to connecting with the public?

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Effective communication of conservation issues has been identified as a major barrier between scientists and the general public. This has led to lack of social awareness and detrimental conservation behaviour. Scientific knowledge is usually presented in structured formats containing scientific jargon which is both inaccessible and incomprehensible to the general user. There is a recognized need that to change conservation approaches, to overcome this barrier. Knowledge-transfer and connectivism are educational frameworks that could be used. Knowledge-transfer is the dissemination of knowledge, ideas, skills, expertise and assets, while connectivism creates a lasting changed state (mental, emotional, psychological) focused on connecting individuals to information sets by using digital technology. Social media is used by 80% of South Africans to communicate. Conservation memes (interactive pictures which require individuals to respond to a call-to-action) pitched with the appropriate terminology were uploaded onto three platforms (Facebook ™, Instagram ™ and Twitter ™). Results showed that Facebook ™ was the most effective platform and that meme design plays a vital role in experiential learning. YouTube videos on biodiversity conservation were analysed for factors contributing to message impact, with the highest ranked factors being the absence of scientific jargon and pre-teen level of understanding. Two videos (one which included the highest- and lowest-ranked criteria) were compared using Likert Scale questionnaires to test the efficacy of message transmission. Effective science communication is not only about publication of scientific journals, but must be coupled with education methods to enhance knowledge transfer which ultimately promotes positive alterations for conservation-inclined lifestyle.

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Effect of sex and ontogeny on the trophic ecology of Antarctic and Subantarctic fur seals

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The Southern Ocean is inhabited by Antarctic fur seals, Arctocephalus gazella (AFS), and Subantarctic fur seals, A. tropicalis (SAFS). Both species show substantial differences between the sexes in morphology and life history. However, little is known about the influence of these factors on their trophic ecology and environmental role as indicator top predator species. We examined the effects of sex and ontogeny on the trophic ecology of these two species with a view to provide a more complete assessment of their ecological role, especially relevant as they are important apex predators. Pinnipeds exhibit incremental tooth growth, with the dentine being metabolically inert and deposited throughout an animal's life from molecules in its diet. Fine scale dentine sampling from all growth layer groups in teeth of AFS from Bouvet Island and SAFS from Gough Island provided longitudinal data. Carbon and nitrogen stable isotope analyses were completed. Preliminary data suggest that fur seals visited several water masses over their life as shown by longitudinal δ13C values. A slight change in trophic ecology in the first and second years of life could also be detected in δ15N values. Stable isotope ratios obtained for Antarctic fur seals from Bouvet Island resemble those obtained from seals originating from South Georgia. Differences between sexes are also expected considering the high level of dimorphism between males and females.

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Early stage ichthyofauna from shallow water habitats of the Angola-Benguela Frontal Zone

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Early stage fishes (larvae and early juveniles) were collected from shallow water habitats on the warm-temperate southern Angolan coastline (June 2014 - June 2015). This study provides new understanding of non-estuarine shallow water nursery habitat use by early stage coastal fishes from the region. In total, 51 species from 18 teleost families were observed. Fish density and diversity peaked in the wet season for all habitats, attributed to the influx of summer spawning species. The similitude of species highlights the historical connection of the warm-temperate study area with warm-temperate South Africa, before the formation of the Benguela Current vicariant barrier. Classifying the study assemblage into estuarine utilization categories showed that the surf zone hosted more exclusively marine species than comparable South African surf zones, attributed to the absence of estuaries in southern Angola. However, observation of the marine estuarine dependent Mugil cephalus in the study area devoid of estuaries suggests that estuarine dependency may be regionally specific for some taxa. It appears that the warm, sheltered, nutrient rich waters of Tombua Bay provide estuarine associated taxa with an alternative, non-estuarine nursery habitat. This study suggests that the importance of estuaries as critical nursery habitats has been overemphasized for some species. However, the absence of other marine estuarine dependent species from the study area suggests that some warm-temperate taxa do intrinsically rely on estuaries. Understanding true nursery habitat importance is critical in achieving sustainable fisheries objectives in an area with an ever increasing reliance on the ocean for food security.

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The role of Academia as South Africa takes over as Chair of the Indian Ocean Rim Association (IORA)

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The Indian Ocean Rim Association (IORA) was launched in 1997with the broad objective to promote the sustained growth and balanced development of the Region and of the Member States, and to create common ground for Regional Economic Co-operation. The Indian Ocean Rim Academic Group (IORAG) constitutes the academic arm of IORA and its role is to be both advisory and catalytic with the following objectives:

•To service the needs of Government and Business;
•To promote intellectual dialogue between the participating Member States;
•To serve as a vehicle for the development and dissemination of the Indian Ocean Rim concept; and
•To service the region by providing co-ordinated research.

South Africa is taking over as the Chair of IORA in October 2017 until 2019. As such, a South African Chapter of the IORAG (SA IORAG) has been established as an advisory body towards realising the priorities of South Africa as Chair and to assist the South African government in consolidating multilateral engagements that relate to topics covered under IORA and associated areas; post the IORA chair. The SA IORAG has established working groups which will focus on research in the following priority areas:

•Maritime Safety and Security,
•Trade and Investment Facilitation,
•Fisheries Management,
•Disaster and Risk Management,
•Academic cooperation, Science and Technology,
•Tourism and Cultural Exchanges,
•Transformation and Gender Equality (cross-cutting theme), and
•Blue Economy (cross-cutting theme).

It is hoped that the academic community will engage with the SA IORAG to help guide South Africa's leadership of IORA.

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Identifying and Mapping Strategic Fisheries Resource Areas to Support Marine Spatial Planning in South Africa

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South Africa is facing the challenge of maximising the social and economic potential of the ocean while maintaining food and job security. With the expansion and diversification of ocean activities, services provided by marine ecosystems could be threatened if their underlying environmental integrity is compromised. Addressing this challenge, South Africa is undertaking Marine Spatial Planning to ensure the sustainable use, growth and management of the ocean and its resources. In South Africa, food provisioning services from 22 marine fisheries sectors play an important socio-economic role. This study was undertaken to support maintenance of food and job security by developing key inputs to represent fisheries services in spatial planning and decision making. Strategic Fisheries Resource Areas were defined and mapped through spatial analysis. Cumulative effort and catch for the 12 largest fisheries were mapped to show the extent of fisheries activities and patterns in catch and effort. Results indicated that in the last 10 years, less than 10% of our ocean territory yields almost 90% of the total catch. In order to secure the provision of marine protein, this small area should be prioritized for fisheries and maintained in an ecological functioning state. Although these Strategic Fisheries Resource Areas make-up a small proportion of ocean space, their maintenance also depends on areas outside of these core areas. Further work examines broader areas that support these Strategic Fisheries Resource Areas drawing from spatial analysis of different life cycle phases for one species.

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Quantifying the effect of a resource pulse (turtle nesting phenomenon) on predator (ghost crab, Ocypode ryderi) populations

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Sandy beaches are nutrient-poor systems with food webs relying on allochthonous inputs. Consequently, a resource pulse could cause major changes to recipient sandy beach populations. We aimed to determine the population-level response of ghost crabs (Ocypode ryderi) in abundance, in three distinct areas varying in turtle-nest density (high, low and no turtle-nest density). It was hypothesized that increased availability of high quality food (turtle eggs and hatchlings), will support more crabs and thus result in greater abundances in high and low versus 'no' turtle-nest density areas. Nine sessions of pitfall traps and burrow counts between October 2015 and July 2016 were conducted. Mean catch per unit effort (CPUE) across all seasons was highest at the NTND areas and lowest at the HTND areas; in contrast, mean burrow density across all seasons was highest at the HTND and LTND areas and lowest at NTND areas. There was a decrease in the mean CPUE from the summer to winter months for all three areas, but mean burrow density increased from summer to winter for all three areas. The latter increase was dominated by small burrows, suggesting a recruitment pulse, which was not detected in pitfall trapping. Results suggest that the resource pulse (i.e. turtle nutrients) is not driving an increase in beach carrying capacity thereby not supporting more crabs, and highlights the need for multiple sampling methods when studying ghost crabs.

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Towards a National Framework of MPA Goals and Objectives

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Determining the extent to which marine protected areas (MPAs) and MPA networks meet their objectives, and identifying gaps and redundancies, are essential for improving planning and enabling adaptive management. However, while expansion of South Africa's MPA network is being fast-tracked, limited work has been undertaken to evaluate the effectiveness of current MPAs, most of which were designated without programmes in place to assess whether they perform useful functions. Listed objectives of existing MPAs were collated and evaluated in the light of national legislation as well as local and international frameworks for evaluating MPA effectiveness. Biodiversity protection accounted for 37% of objectives, fisheries enhancement/recovery for 17%, governance objectives for 16%, research and monitoring (reference sites) 8%, educational purposes 5%, cultural heritage protection 3% and ecotourism and other socioeconomic objectives, 14%. The prominence of protection functions perhaps reflects the legislative basis for the MPAs namely the National Environmental Protected Areas Act. However, given increasing global emphasis on multiple-use protected areas applied within an ecosystem approach context to help meet conservation, sustainable use and other goals, as well as increasing recognition of the need to take into account local communities, there may be a need to revisit MPA goals and objectives. Moreover, many of the current objectives were found to be vague or difficult to measure. Discussion in national level workshops has thus fed into the development of draft goals, objectives and associated indicators for MPAs that are measurable and representative of the various main categories of protected area objectives.

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SASDI and SDI as a catalyst to unlocking the oceans economy.

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The National Development Plan (NDP) spearheaded strategic initiatives such as Operation Phakisa to create an enabling environment for economic development in the oceans economy. Operation Phakisa aims to integrate an ocean governance framework to contribute to sustainable growth of the oceans economy. Authoritative sources of spatial data are required to inform the development of the oceans economy. The South African Spatial Data Infrastructure Act (Act 54 of 2003) (SDI Act) established a national technical, institutional and policy framework to facilitate the capture, management, maintenance, distribution and use of spatial information. The Act provides for institutions such as the Committee for Spatial Information (CSI committee).

One of the outputs of Initiative 6 of Operation Phakisa is the National Oceans and Coastal Information Management System (National O&C IMS), as well as the fledgling Marine Spatial Planning (MSP) Act 2016 with Marine Area Plans (MAPs). Operation Phakisa and the SDI Act creates an opportunity for ensuring return on investment in generating data in the national interest for systematic conservation planning, integrated coastal management and marine spatial planning. The CSI committee activities focus on data governance through custodianship for spatial data in the coastal and marine domain.

This paper will investigate the benefit of directed cooperative government by aligning the outputs of Initiative 6 with those of the SADSI. It is proposed that with a common purpose these frameworks create opportunity for public sector, civil society (research sector) and private sector to benefit from a coastal and marine spatial data infrastructure embedded in SASDI.

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Ranking the determinants of seaweed diversity along the rocky shores of the Wild Coast of South Africa.

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The Wild Coast boasts a high seaweed diversity of which little is known regarding the ecophysiological drivers. This study thus quantified the effects of different habitats, physicochemical parameters, shore levels and seasons on the diversity of seaweeds across six sites. The highest diversity was recorded in the low shore pools of Dwesa Nature Reserve (d=4.7778) and Nqabarha (d=3.9201) during summer. The lowest diversity was recorded on the mid intertidal zone of Nqabarha emergent rocks during autumn (d=0.21827) and summer (d=0.19613). ANOSIM revealed that the order of effects on seaweed diversity was habitat (R=0.581, p=0.001) >Site (R=0.081, p=0,001) >Shore level (R=0.081, p=0.001) > Seasons (R=0.014, p=0.093). SIMPER detected Hildenbrandia lacenallierii and H. rubra to be the major species contributing to the differences amongst emergent rocks diversity. While, Phymatolithon foveatum and Bryopsis flanaganii contribute to the differences observed inside intertidal rock pools. Physico-chemical parameters were correlated to seasons and sites. Seaweed diversity fluctuations were more pronounced on the emergent outcrops than inside intertidal rock pools.

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The value of Marine Protected Areas goes much further than support for fisheries management

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The view that improved fisheries management, not additional marine protected areas (MPAs), will better serve to improve ailing fisheries and global food security, has been aired recently in the context of gazetted proposals to expand South Africa's existing MPA network from 0,4% to 5%. Notwithstanding the numerous reasons why MPAs are useful fishery management tools, this paper examines the scientific arguments for the value of marine protected areas that go beyond fisheries management. The notion of a Blue Economy is at the heart of South Africa's flagship Ocean Economy Phakisa initiative. Unfortunately, marine environments globally are experiencing unprecedented threat. For the first time, in recent years, listings and trade restrictions for endangered marine species have been adopted at the CITES meetings of the CBD Conference of Parties. We argue that MPAs are the only viable way to ensure that some Blue Economy drivers do not overstep environmentally sustainable thresholds and threaten other key economy drivers, and are a key tool in Marine Spatial Planning frameworks. While the 5% interim Phakisa target has come under fire, scientific evidence emerging suggests that more like 30-50% of the ocean will need to be protected to ensure persistence and viability of the full representation of marine biodiversity and to sustain the health of the planet.

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Variability in the distribution patterns and diet of two common catsharks caught in demersal trawls off the coasts of RSA

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In recent times, fishing has resulted in substantial declines in shark numbers. Despite this, little is known about the effects of fishing-related shark mortality on trophic interactions in marine ecosystems. This study is the first attempt at understanding intra- and interspecific variability in the distribution patterns and diet of the two most common demersal catsharks (Holohalaelurus regani and Scyliorhinus capensis) caught as trawl by-catch around the coasts of South Africa. To do this, we analysed distribution data collected between 1994 and 2015 and stomach content data collected in 2014 and 2015. H. regani was more abundant on the West Coast whereas S. capensis was more abundant on the South Coast. Both catsharks were also observed to display size-based segregation by depth, with catshark size increasing with depth. In terms of their diet, both catsharks appeared to display high levels of dietary overlap, with individuals feeding on the most abundant crustaceans and cephalopods (in terms of occurrence in trawl by-catch) occurring on each coast. Although both catsharks consumed similar amounts of crustaceans, cephalopods and teleosts, the abundance of the different species within those categories appeared to differ between species. Ontogenetic shifts in the diets of both catshark species were also noted, with prey size increasing with catshark size. The results appear to indicate a strong relationship between habitat and diet, with food separation appearing to be largely a reflection of habitat separation. The possible/likely reasons behind the observed patterns of habitat and resource use will be discussed.

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Southern Ocean phytoplankton distribution and adaption: Assessing the co-limitation of light and iron on phytoplankton productivity and community composition

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The impact on and influence of the oceans in relation to global warming is a much-debated topic. The current research done in the Southern Ocean (SO) highlights the importance of marine phytoplankton as the biological pump, enabling CO_2 drawdown into the deep ocean and later sequestration into the sediment. The bioavailability of trace metals greatly affects the phytoplankton's ability to take up the CO_2, as the SO is characterised as one of the largest High-Nutrient Low-Chlorophyll zones (Arrigo 1999). Different phytoplankton groups have different biogeochemical requirements and physiological specifically different sinking rates which would affect the sequestration of CO_2 (Gibberd et al. 2013). This study found that Diatoms dominated surface waters in the Polar Frontal Zone and in Antarctic waters, while an iron-acclimated form of Phaeocystis antarctica dominated with increasing depth. Coccolithophores showed to be controlled by temperature variations within the different water masses and had the highest contributions in waters of >8°C. From incubations with light and iron (Fe) treatments, light seemed to be the controlling factor for productivity in low latitude waters and both light and Fe showed minimal control on the algal community composition. Within high latitude waters both light and Fe increased the productivity and only Fe controlled the composition. This study concludes that temperature, light, trace metals, macronutrients and water column mixing greatly influence the productivity and especially the composition of algal communities in the SO and therefore how the productivity would change with climate change and the phytoplankton's ability to sequester CO_2.

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Genetic investigation of reproductive philopatry in the raggedtooth shark (Carcharias taurus) along the South African coast

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Reproductive philopatry is a behaviour where animals remain or return to specific areas for mating, gestating or pupping. Philopatric behavior has been documented in various marine animals and previous studies have shown that shark populations may be characterised by regional genetic structure at scales of 100s of kilometres due to reproductive philopatry. The effects of overfishing, anthropogenic activities and environmental stressors could have a more dramatic effect on populations whose individuals are philopatric and depend on a specific locality, compared with those that are part of a larger homogeneous stock. Special efforts for conservation and management need to be applied for reproductively isolated females that might constitute partially independent reproductive units, each of which may exhibit distinct demographic processes. Due to restricted gene flow between these units, the probability of reproductive mixing and population recovery as well as genetic diversity is reduced. In this study, mitochondrial and microsatellite markers are used to investigate how reproductive philopatry shapes the genetic structure of raggedtooth sharks (Carcharias taurus) along the south-east coast of South Africa. By analysing DNA samples taken from young of the year and juvenile sharks with restricted movement outside of their specific nursery areas, we were able to disentangle genetic structure on a small geographic scale. The integration of genetic data with tagging data will further improve our understanding of this species' behaviour by delivering a more complete picture of migration and population connectivity. Ultimately, this project will guide management decisions for successful and sustainable conservation of these apex predators.

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Temporal analyses of demographic history and population genetics of the endangered Sphyrna lewini along the KwaZulu-Natal coastline, South Africa

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The scalloped hammerhead sharks (Sphyrna lewini) are highly targeted in illegal shark fin trade and vulnerable to exploitation due to their life history thus, globally listed as endangered by the IUCN and appendix II of CITES. In KwaZulu-Natal, S. lewini is caught in the KZNSB bather protection nets and as bycatch in prawn trawling along the Tugela Banks. Previous studies using catch data collected from the KZNSB bather protection nets prior to 2004 have suggested population decline in CPUE and lower effective population size of approximately 30005. This study analysed a mitochondrial control region (mtCR DNA) to determine if S. lewini still displays declining population size as previously suggested using CPUE and genetic approaches. A maximum-likelihood tree revealed that the South African populations were closely related to globally distributed populations from Australia, Gulf of Panama, Mexico, USA and Brazil. The population size estimates ranged between 31633-88025 (95% confidence interval), using a generation time of 15 years. The results suggest the population is relatively stable compared to estimates of 9000-30005 (95% confidence interval) prior to 2004. The results revealed 16% genetic variation amongst individuals; ($p = 0.478$) and lower haploid diversity ($h = 0.076$) compared to studies prior to 2004 ($h = 0.42$). The study suggests the population of scalloped hammerhead along the east coast of South Africa is relatively stable with lower haplotype diversity.

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Exploring Solutions for Ocean Plastics

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Small islands often experience large quantities of plastics due to the physical properties of the ocean washing debris to shore and the remote nature of islands, often far removed from mainland infrastructure and facilities. These factors frequently create an excess of plastics and few options to manage or recycle it. NGOs, community organizations, and celebrity personalities are focused on addressing the plastic pollution problem through source based management, cleanup, and education. These efforts help to keep plastics from entering the ocean and further harming ecosystems. Yet there is often a gap in what to do with the plastic post clean up. Additionally, ocean plastic cleanup is often a “do-gooder” initiative, with little or no economic incentive. However, a number of emerging technologies and companies are working to identify and implement solutions to permanently up-cycle plastics into products of greater value, using the material of plastics as a material to provide a localized recycling and economic incentive for cleanup. This study examines the common plastic compositions on small islands, obstacles faced in regards to waste management, circular economy principals applicable to plastic management, and viable solutions to up-cycle plastics. The study methodology applies a large-scale meta-analysis of existing data regarding plastic composition in small islands, existing technological solutions for plastic management and up-cycling, and circular economy principals. Furthermore, the study aims to further solution based approached to plastics by creating a tool for connecting entities focused on plastic remediation with localized solutions to up-cycle plastics through an online platform for connection.

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Taxonomic clarification of the moonshine worm in the Knysna Estuary

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A recent survey of baiting activity within the Knysna Estuary identified the moonshine worm as the second most popular bait worm after the bloodworm, Arenicola loveni. However, it is not known whether harvesting of this polychaete is sustainable. Furthermore, proper management of this species is inhibited by confusion over its identification. The aim of this study is therefore to provide taxonomic clarification for the moonshine worm in the Knysna estuary. Preliminary examinations confirm that the worm is a member of the genus Diopatra based on the presence of tentacular cirri in adults, comb setae, bidentate acicular chaetae, and the shape and distribution of the branchiae. We were, however, unable to identify it to species level using keys for local taxa since it has characteristics that match two species; D. neopolitana neopolitana and D. cuprea. With respect to comb setae teeth number, anterior dorsum colour pattern, animal size and the nature of tube construction the specimens most closely match D. neopolitana neopolitana. However, it matches D. cuprea with respect to pseudocompound hooks being strongly bidentate and hooded, flat comb setae and prostomium colour pattern. We also failed to identify the species using keys from different regions. The presence of interior brood pouches suggests a reproductive mode that is different from those reported for D. neopolitana neopolitana and D. cuprea. This suggests that this species might be new to science.

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Characterisation and mapping of the fish and invertebrate fauna associated with the Kei River estuary, fluvial fan and plume

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Catchment, specifically flow influences on the estuary, fluvial fan and plume of the Kei River are being investigated. Fluvial fans have been identified by the National Biodiversity Assessment (NBA) as crucial habitats for biodiversity (NBA 2011). One of the objectives of this study is to characterise and assess the roles of the estuary, fluvial fan and plume as a refuge and habitat for larval, juvenile and small pelagic fish and invertebrates. Both the Kei fluvial fan and plume are entrained to within 1 km of the shore by strong 3-5 knot currents but extend along the coast in radii of four to 20 km respectively. Preliminary analyses of the estuarine samples suggest one spawning event on the fluvial fan for spotted grunter, Pomadasys commersonii, in the early spring but at least three for dusky kob, Argyrosomus japonicus, corresponding with spring, summer and the late previous summer respectively. Further, most but not all, of these young-of-the-year fish appear to leave the estuary during late summer spates presumably to recruit to adjacent and more distant systems.

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Indications of ocean acidification in the Benguela Upwelling System

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In this study, we investigated the seasonal cycle of the carbonate system in the Benguela Upwelling System in order to assess the sensitivity of the system to ocean acidification. The study showed that low pH and aragonite saturation state (ΩA) prevailed in bottom waters of the northern Benguela, whereas seasonally recurring pools of water with such characteristics were constricted to the near shore environments of the southern Benguela. The partial pressure of carbon dioxide (pCO2) in the northern Benguela reached a maximum value of 1750 µatm, lowest ΩA of 0.61 in the middle shelf of line 26°S in January 2015. This highest pCO2 coincided with T of 12.11°C. Oxygen depleted waters with ΩA < 1 were observed in all bottom waters off Walvis Bay (line 20°S and line 23°S). The highest pCO2 of 2277 µatm observed in St Helena Bay in the southern Benguela in February 2015 coincided with the lowest DO of 8.85 µmol/kg, ΩA of 0.44 and T of 9.77°C. Our future estimates of ΩA show that bottom waters of the southern Benguela could reach undersaturation levels by the year 2050 while the northern Benguela seems already to approach tipping point and widespread undersaturation with respect to aragonite saturation state. Such conditions will have detrimental implications for fisheries, particularly of organisms with a calcified shell/exoskeleton.

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Applying functional data analysis to develop mesozooplankton indicators in the Southern Benguela

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Governments are charged with the responsibility of continuing to conserve, protect and sustainably utilise their resources within the natural environment. Underlying this function is reliable knowledge based on good scientific tools. One such tool is ecological indicators, providing a measure of something important to governance. The method of data collection by which scientists develop and maintain indicators are through continued environmental monitoring. This project aims to apply the technique of functional data analysis to mesozooplankton data within the southern Benguela mainly along the St Helena Bay Monitoring Line (SHBML). Mesozooplankton is indicative of the food environment for many different species, it is an essential link in the foodweb and biochemical cycling and one of the first to respond to environmental stress. Therefore robust methodologies of simple monitoring indicators are essential for this group. 13 years of abundance data along the 14 stations of SHBML was analysed by fitting smooth curves using functional data analysis. There was a decadal pattern showed a 6 year cycle but requires further data and analyse to corroborate this. The seasonal pattern showed the stations group into an inshore, midshelf and offshore groups. Based on this a spatio-temporal sampling strategy will be determined i.e. priority stations and minimum sampling times per year, that will be used to continue to monitor mesozooplankton.

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A first remote imagery survey to determine patterns of diversity for benthic macrofauna of False Bay, South Africa.

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Anthropogenic pressures on our oceans have amplified the focus on an ecosystem-based approach to conservation. The identification of key environmental drivers and their influence on how biodiversity is distributed may contribute to evidence-based marine spatial planning, as part of this approach. Relationships between biodiversity and the environment are complex, and the collection of adequate data to explore these links in temperate systems is limited. False Bay in the Western Cape of South Africa is a pertinent study site to test novel methodologies for deciphering these linkages and using them towards conservation planning: its long history of human-use has impacted its marine biodiversity. This study records the relative abundance, diversity and distribution of benthic, macroinvertebrates in False Bay using a “jump camera”. A camera attached to a sampling quadrat, deployed from a boat, took still photographs of the seafloor at set intervals. Eight transects were sampled from 8 m to 84 m depth across reef and sand habitat types. Fifty seven species representing 8 phyla were recorded in 400 photographs. This survey builds on benthic distribution patterns discerned from dredge and dive surveys conducted by Morgans (1959, 1962). The methodology introduces a feasible non-extractive sampling technique across a wider range of habitats, but may be limited by visibility, camera quality and height above the seafloor to identify all records to species level. However, this study suggests that for sampling in False Bay, where relationships between biodiversity and environmental predictors can be determined, this methodology is a useful addition for further development.

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BUILDING SCIENTIFIC KNOWLEDGE AND CAPACITY THROUGH PARTNERSHIP: THE OCEAN STEWARDS INITIATIVE

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The Ocean Stewards Program is a partnership between Wildlands and two African Coelacanth Ecosystem Programme (ACEP) east coast projects. These projects, Spatial Solutions and Biodiversity Surrogacy, focus on gathering biodiversity data to support conservation planning and marine protected area expansion decisions on the east coast of South Africa. The Ocean Stewards program aims to catalyse the emergence of a strong cohort of offshore marine scientists, launched in recognition of the need for increased capacity for effective ocean protection. Central to the Ocean Stewards' experience is the opportunity for marine science students to participate in offshore research cruises working alongside field scientists, where they are exposed to different sampling techniques and equipment. This includes ACEP's Remotely Operated Submersible Vehicle (ROV) which has taken some of the first images of the deep reef and soft sediment habitats in the proposed uThukela, Protea Banks and Aliwal Shoal MPA and the Baited Remote Underwater Videos (BRUVs) which are used to analyse the fish communities. This work has also provided important baselines for future monitoring of trends and impacts. Some preliminary results as well as the benefits and challenges of direct coupling of field research with participative science capacity-building are evaluated and discussed in the following paper.

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Booms, bins and bags: the B3 solution to the BIGA problem!

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Books, Ideas and General-knowledge don't lead to Action. This is the "BIGA" conservation problem. People know that plastics are bad, yet we produce 300 million metric tons per year of mostly single use plastic items, much of which ends up in the oceans. Durban Solid Waste removes 1 ton of plastic a day from the Durban mile. However when MACE Lab and Roxy's SCUBA School run beach cleanup operations irrespective of the person's age and season the average amount of plastic picked up from Vetches Beach is 1.1kg per person per hour. Litter is collected at low tide after DSW beach clean-up has occurred. The composition of which is different to DSW waste. Straws, ear buds, plastic bottle tops and smaller broken plastic pieces are main items found. Targeting plastic pollution in river systems may considerably reduce the amount of plastic in the oceans. DUCT working on the Umhlangane and Umgeni rivers removes 300 bags of PET in low rainfall months but this increases to 1300 bags in 40 mm of rain, through boom trapping and collection from river banks. If these plastics get to the beach they will breakdown to form microplastics so DUCT together with MACE lab and Paddle for the Planet launched an initiative called Booms, Bins and Bags to tackle river plastic pollution. This is a pilot project and it is hoped that if successful can be rolled out to include other river systems nationwide to significantly reduce the amount of plastic litter entering the oceans.

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The uptake of microplastics by an important ecosystem engineer from KwaZulu-Natal

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Microplastics are plastic particles with diameters <5 mm, and are derived from industrial production for their use in cosmetics and household products, as well as from the breakdown of larger plastic items. Microplastics in marine environments raise increasing concern as they are available for ingestion by important lower trophic lever organisms. Additionally, microplastics may potentially be contaminated with toxicants such as heavy metals and Persistent Organic Pollutants (POP's) present in the ocean, which may bioaccumulate in the marine food web. Sea urchins are considered to be important ecosystems engineers, as they have the ability to modify the marine ecosystems in which they live. Through transforming biotic and abiotic materials from one physical state to another, sea urchins create habitats for other marine organisms and control biodiversity. Sea urchins are greatly threatened by microplastic pollution as there are potentially two routes through which these organisms can take up microplastics. Tripneustes gratilla, a species of sea urchin inhabiting the rocky shores along KwaZulu-Natal, takes up microplastic fibres into their water vascular system through their madreporite pores. It has also been observed that seaweed, which is the primary food source for sea urchins, can become contaminated with microplastics. It is currently being investigated whether the uptake of various concentrations of microplastic fibres will have an effect on the water vascular system of T. gratilla. The investigation also aims to determine whether microplastic fibres will be taken up by T. gratilla through feeding on microplastic contaminated seaweed.

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pH distribution in surface seawater off the west coast of South Africa in February 2017.

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The uptake of anthropogenic CO2 by the oceans has already reduced the global ocean pH by approximately 0.1 units pointing out the need for monitoring long-term changes. Here, we show the pH distribution off the west coast of South Africa measured onboard the RV Algoa in February 2017. The measurements were taken using a newly installed pH sensor incorporated into an Idronaut OCEAN SEVEN On-Line module. The results show that the pH in the near-shore area ranged from 7.23 to 8.56. The lowest DO value of 1.18 ml/l associated with a pH of 7.51 and temperature of 10.57 °C was found on the 1st station of St Helena Bay monitoring line. High surface pH values with a maximum value of 8.56 and DO values reaching a maximum of 12.69 ml/l were measured across patches of a red tide found in St. Helena Bay. Off-shore areas had an average pH value of 8.12. Salinity near-shore was low with values between 34.57 to 34.81 PSU whilst high values reaching 35.42 PSU were observed offshore. Low pH waters with low DO and low temperatures observed in the near-shore area suggest that the conditions were caused by both physical (upwelling) and biological processes (local degradation of organic matter). The results show that extremely low pH waters occur in the near-shore zone of the west coast of SA, making this region predisposed to the effects of ocean acidification. Moreover, organisms may have to adapt to chemically changing environments due to the addition of atmospheric CO2.

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Long-term trends in Cape fur seal mortality from stranding data along the Eastern Cape coast

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Marine mammals inhabit an environment that is difficult for human observers to access and therefore much of their life history remains relatively little known. This is also true for those that are partially terrestrial, such as pinnipeds. Thus, dead animals that wash ashore present a valuable opportunity to obtain further information on the biology of various species. We assessed causes of mortality of Cape fur seals Arctocephalus pusillus pusillus by examining a long-term dataset on the distribution and frequency of animals recorded ashore on the Eastern Cape coast since 2006. A total of 229 animals were found ashore. Two periods with higher than average numbers of dead seals were recorded, with the most recent being the 2016/2017 summer. Carcasses were not evenly distributed spatially with the majority of the increase being found in eastern St. Francis Bay. This coincides with the distribution of the main inshore spawning grounds of chokka squid (Loligo reynaudii) where commercial fishing activity was observed. The fact that many of these animals were recovered with gunshot wounds indicates that their mortality may be the result of conflict with local fisheries. Further information is required to assess the impact of this conflict on the Cape fur seal population and the fisheries. This study shows that important insights that can be gained through long-term data collected by systematic stranding response programmes, such as that run by the Port Elizabeth Museum.

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The economics and logistics of a research ship servicing the Operation Phakisa initiatives – the RV Algoa as a pioneer

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South Africa undertook a very extensive and ambitions initiative namely, Operation Phakisa, that seeks to define societal problems experienced by the majority of the country's problems such as poverty, joblessness, health and illiteracy. After defining these societal problems the government explored proven methodologies to fasttrack the implementation of solutions on the societal problems that were seen as inhabitants to the development of the country. Operation Phakisa – Oceans Economy (OP-OE) was a project (also known as a lab) with an aim of unlocking the economic potential of South Africa's oceans and coasts in a sustainable manner.
The only sustainable way in which the economic potential can be unlocked is if we know information and data about our oceans. The RV Algoa is a government-owned platform that has been collecting oceanographic information and data in support of several initiatives of the Oceans Economy labs. Since the launch of the OP-OE, a minimum of 30 million South African Rands (R30m) (2017 value) has been spent on at least four (4) research cruises over a period of three years around the South African coast. For the first time, intimate details pertaining to the running of the RV Algoa's, that is, operational and logistical costs (ship's time, equipment, scientific and technical personnel, crewing, logistics, losses, etc.) will be presented with the possible comparison to the demonstratable benefits borne from Operation Phakisa-Oceans Economy.

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SeaKeys: Lessons and Results from the First Large Collaboration on Foundational Marine Biodiversity Science

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The SeaKeys project aimed to generate marine biodiversity knowledge for uptake through the co-ordinated digitisation and dissemination of species occurrences locked in historical collections, taxonomic research, capacity building and designing of new workflows. A total of 26 national species checklists were generated; 17 new for South Africa. Newly digitised occurrence records totalled 143 011 and 260 species pages were compiled. Barcoding efforts need improvement but mutually beneficial collaborations with molecular researchers can help. Data management of South African research projects lags behind global best practice with respect to adoption of protocols, workflows and practices based on international standards. SeaKeys has been an effective vehicle for testing collaborative desire to adopt standards that render the data interoperable for online sharing, and utilisation of automated data cleaning and enrichment methodologies for improving data fitness-for-purpose.

Some project successes include; new genera and species, bio-prospecting discoveries, and use of data in sensitive area mapping, collating and mapping monitoring efforts and application in policy advice. Generally, however, use of the information has been challenging as many institutions grapple with standards and agreement on the taxonomic backbone to support integrated biodiversity databases, national species checklists and collation of very large distribution data sets for applied research. The utility of the SeaKeys approach (including collective planning, adoption of standardised data templates, automated data cleaning and collaboration) to increase quality data discovery, mobilisation, generation and use of foundational biodiversity data and uptake for decision making is highlighted but this will need buy-in from the broader marine science community.

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PALAEOSHORELINE DEPOSITIONAL HISTORY FROM MIS 6 (TERMINATION II) TO MIS 3 ON THE SOUTHERN MARGIN OF SOUTH AFRICA

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The major Southern Hemisphere landmasses ("far-field" locations) are important for understanding sea-level changes and offer the opportunity to reconstruct long-term eustatic sea-level fluctuations where tectonic stability can be demonstrated. Here, we describe a succession of subaerial to submerged Pleistocene deposits along the South African South Coast. Palaeoshoreline deposits in this study comprise both palaeodunes and palaeobeaches extending to water depths of up to 55 m on the mid-shelf. Five sedimentary facies were identified and correlated to modern depositional environments of Mossel Bay, which include dune, upper shoreface, foreshore, intertidal swash and back-barrier settings. The stratigraphy and chronology of the succession preserves a record of initial deposition during Termination II meltwater events preceding and leading to MIS 5e, during multiple regressions between MIS 5d and MIS 4, and deposition at the end of MIS 4 and commencement of MIS 3, which is marked by Heinrich Event 6. Optically stimulated luminescence ages obtained for ten samples from the raised deposits all form a single cluster of ages. The lowermost and oldest dune unit date to 131±7 ka. The ages obtained for the rest of the raised deposits, all dated to between 121±7 ka and 118±7 ka, suggest a rapid sequence of deposition during MIS 5e. The ages obtained for twelve samples from the submerged deposits show a much longer time-span and form five discrete age clusters dating to ~130, ~110–115 (MIS 5c), ~95, ~80 and ~60 ka. Both regressive and transgressive depositional cycles are well preserved in the succession.

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Optimising Marine Protected Area design to increase benefits to conservation and people

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South Africa's Protected Area Policy calls for a representative network that includes components of all ecosystem types. Momentum gained from the establishment of SA's first MPA in 1964 waned with only 0.42% of mainland marine territory falling within MPAs. Marine protected areas have proven to be a useful management tool and found to protect fragile habitats, spawning grounds, and replenish fish stocks into adjacent areas. Their establishment in SA has also excluded communities reliant on the marine resource giving MPAs a bad reputation and signalling a need to design MPAs differently. Operation Phakisa, a cross-sector initiative by the presidency with the main aim of unlocking the ocean economy, has created a platform for MPA expansion as part of sustainable ocean development. In 2016, 22 new MPAs were gazetted for public consultation. This study examines the changes in marine ecosystem and key species protection levels and identifies ways of optimising MPA design to increase benefits to conservation and people to support the identification of further areas for protection. A preliminary protection level assessment indicates that the proposal to increase protection to 5% would advance protection levels for 25 ecosystems and provide the first protection for 47 of the 136 ecosystems that are currently represented in the existing MPA network. To support the identification of further priority areas to increase MPA benefits in South Africa using Marine Spatial Planning, several categories of non-consumptive benefits of MPAs were identified: ecotourism, cultural and heritage sites, education and citizen science.

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Reconstructing the palaeo-Agulhas Plain: clues from the continental shelf

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The South African continental shelf varies considerably in width from the narrow sheared east coast margin to the broad passive margin of the south- and west coasts. The resultant response in depositional systems contrasts accordingly and this is shown in the marine geophysical record. Considering the magnitude of Quaternary sea level fluctuations and the associated duration of glacials and interglacials, a vast proportion of these marine isotope stages have been dominated by lowered relative sea levels compared to the modern elevation. In this study, we examine the continental shelf, which can be considered key in understanding the palaeoenvironments when it was exposed as a vast coastal plain and in the aim to understand the transition from glacial to interglacial periods.
The shoreline is a geologically, sedimentologically, climatically and biologically complex zone and Quaternary deposits preserved on mid-latitude coastlines have long been studied as indicators of past sea levels. With the rapid advancement in marine geophysical and hydrographic techniques, however, margin successions can be used to decipher sea-level changes and these deposits are increasingly being mapped and studied on continental shelves. We show that this relatively narrow littoral zone band migrates with falling sea levels onto what is now the continental shelf. Although the rate of erosion in the marine environment is typically high, preservation of fragments of palaeoshorelines in the offshore record allows a window of opportunity to map and unravel the sequence of events associated with sea level regressions and subsequent transgressions.

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Determining the effects of light, temperature and formaldehyde concentration on phytoplankton using a flowcytometer

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Phytoplankton forms the basis of any marine food network and sustains every organism in the marine environment from zooplankton to whales. There is a 30 year sample store of phytoplankton samples within the Department of Environmental Affairs. It is essential to develop an appropriate methodology to analyse them or develop a more effective method of sample collection and analysis. This study was conducted across four transect lines strategically placed to cover the Southern Benguela Current. The first five stations of the Kleinsee Monitoring line, the Namaqua Monitoring Line, the St Helena Bay Monitoring Line, and the Scarborough Monitoring line was sampled. Samples were taken to determine the differences in the following: 2mL formaldehyde kept in light, 2mL formaldehyde kept in the dark, 2mL formaldehyde frozen at -20°C, 7mL formaldehyde kept in light, 7mL formaldehyde kept in the dark, 7mL formaldehyde frozen at -20°C, 10mL formaldehyde kept in light, 10mL formaldehyde kept in the dark, 10mL formaldehyde frozen at -20°C, 20mL formaldehyde kept in light, 20mL formaldehyde kept in the dark and 20mL formaldehyde frozen at -20°C. Samples were analysed using a flowcytometer and FlowJo to determine the cell count of each preservation method. Results show that the frozen preservation method was effective at conserving phytoplankton cells with the 7mL and 10mL formaldehyde solutions showing comparable results which were significantly different to the 2mL and 20mL formaldehyde solutions. It is recommended that the DEA replace its current methodology with 7mL formaldehyde at -20°C to give a reliable count of phytoplankton cells.

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Impacts of controlled subsistence harvesting on rocky shore communities at the Dwesa-Cwebe Marine Protected Area

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The Dwesa-Cwebe Marine Protected Area (MPA) is located along the Wild Coast on the East Coast of South Africa. The area is home to communities whose livelihoods had traditionally depended on harvesting marine resources. As a result of ongoing community-conservation conflict and increasing pressure for access to marine resources, this historic no-take MPA was re-zoned in December 2015 to allow controlled levels of subsistence harvesting. This study examined the changes in population densities and size distributions of harvested rocky shore species and potential shifts in rocky shore community structure on two rock-ledges between November 2015 and December 2016. Prior to the re-zonation, the mid and low intertidal zones at Dwesa were dominated by upright coralline, green and encrusting algae, which remained dominant under controlled harvesting conditions. Patches of Perna perna mussel bed were only abundant on low-shore ledges, suggesting that the re-zonation had little effect on this stock. At Cwebe, the high shore was characterized by the oyster Saccostrea cucculata, which remained common after a year of harvesting. These and other results demonstrate that the re-zonation of this MPA had little effect on rocky shore community structure and densities of the majority of harvested species, which is either a reflection of stocks having been depleted prior to the formal opening of the MPA, or the fact that harvesting was controlled at sustainable levels. Ongoing monitoring of harvested intertidal species is essential to determine the effects of the re-zonation on rocky shore communities over the long-term.

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Shifts in benthic community structure following a sweepstake recruitment event of alien mussels

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In February 2016 an unusual mass recruitment event of the invasive alien mussel Semimytilus algosus occurred at Elands Bay. A carpet of tiny mussel recruits formed over the lower shore of a rock ledge smothering all benthic life under a layer of sand trapped by mussel recruits. To characterise shifts in community structure following this invasion, three transects spanning the low shore were permanently fixed and community structure monitored monthly along those transects. Results from these surveys show that communities were functionally transformed from grazing-dominated to filter feeding assemblages, until winter storms cleared large portions of the mussels. New clearings got overgrown by opportunistic algae (Ulva sp., Porphyra sp.), which – under reduced grazer abundance – only slowly decreased in abundance. To additionally assess the impacts of the alien invasion on the survival of the indigenous limpets Cymbula granatina and Scutellastra granularis, all mussels were removed from five experimental clearings, and densities of different size classes of limpets monitored in clearings and adjacent un-cleared (control) plots. Results from monthly observations of limpet numbers show that densities of limpets in un-cleared plots initially decreased drastically following the invasion, while densities in adjacent clearings increased, suggesting that experimental clearings acted as refuges for limpets when surrounding rock space was scarce. As winter conditions cleared large portions of the alien mussels, densities of limpets normalized in both cleared and un-cleared plots. While not previously reported for South African shores, such sweepstake recruitment events can have profound long-term effects on coastal communities.

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Developing the field of biodiversity informatics in South Africa through using primary data and informatics tools to address biodiversity challenges

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"Target 19" of the CBD indicates that, by 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, will be improved, widely shared, transferred, and applied. This goal can realistically be achieved only through broad implementation of Biodiversity Informatics. Here, I present an overview of Biodiversity Informatics and discuss ways that SANBI-GBIF aims to assist SA in reaching its target, through HCD and informatics platforms.

SANBI supports a knowledge-management platform, and is a major publisher of biodiversity data. Because it is important that the data have direct relevance to science and key policy issues, I illustrate these ideas via examples of how digital accessible knowledge can be relevant to current research questions. I will use ecological niche models to characterize current, past, and likely future geographic ranges of fish species, thereby permitting identifications of range contractions and expansions under different climatic scenarios. This project will seek to improve "fitness for use" of data, for analysis, interpretation, and assessment. This work is novel, as the biodiversity informatics techniques used has not largely been applied to the marine environment in South Africa and few studies have been done globally.

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E3C - Effects of climate change on cetaceans in the Western Cape– mapping dolphin distribution using citizen science

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Changing environmental conditions is affecting distributions of many taxa, including cetaceans, whose response to changes has been relatively poorly studied globally, and to date, not at all in South Africa. Opportunistic data has become an efficient and cost effective method to study these highly mobile animals. This study aims to map dolphin distribution in the south-western Cape using citizen science, and relate this to environmental/biological factors to understand what limits their ranges as a basis for predicting future changes. Opportunistic records dating back several years were collated and new sightings generated from dedicated water users (commercial operators, scientific water users, general public) via various platforms. Local Ecological Knowledge was generated by interviewing experienced fisherman and other water users. Preliminary results derived from a shark diving operator recorded nine cetacean species in False Bay from 1997-2015 (five dolphins and three whales). The most sighted dolphin was the common dolphin (Delphinus delphis) encountered 652 times out of 2239 trips. A seasonal trend was observed with most sightings occurring from autumn to early winter, yielding congruent results to new sightings generated by citizen scientists over the past year. Furthermore, there was a general increase in sightings from 2007 with peaks in 2011 and 2012, correlating to peaks in SST recorded on the boat. Further analyses are currently underway to investigate all trends and the environmental variables driving them. Interviews are still underway. Other preliminary results support existing knowledge of the occurrence of cetacean species and have produced congruent results to dedicated boat surveys.

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Molecular species identification of two South African endemic shark genera, Haploblepharus and Poroderma

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Accurate species identification is paramount for effective conservation and management strategies for sharks, particularly for species affected by fisheries. South Africa is a shark biodiversity hotspot, including a large proportion of endemic species, particularly within the catshark family, Scyliorhinidae. Some species, particularly Haploblepharus species, display a high degree of intra-generic morphological conservation, with many diagnostic morphological characters overlapping between congeners. Molecular approaches, such as DNA barcoding using the CO1 gene, can be used to evaluate the degree of molecular differentiation between species. DNA barcoding and other molecular species identification markers can be used in conjunction with classical taxonomy for species identification, and to verify taxonomic assignment.

We sampled three Haploblepharus species (Haploblepharus pictus, H. edwardsii, and H. fuscus) and two Poroderma species (Poroderma pantherinum and P. africanum) from multiple locations throughout their distribution range. We used sequence data from three mitochondrial genes (CO1, NADH2, and cytochrome b), one nuclear gene (ITS2) and microsatellite loci data to differentiate between Haploblepharus and Poroderma species. We evaluated the most suitable combination of molecular markers for species identification. All molecular markers were able to differentiate between Poroderma species, with fixed nucleotide differences observed between Poroderma species in all gene regions. However, little to no variation was observed between Haploblepharus species using multiple molecular markers. No markers adhered to barcode gap analyses or sufficient inter-specific distances to delineate Haploblepharus species. Future research on Haploblepharus will incorporate an integrative approach to species identification, combining morphometric and meristic analyses with a genetics and genomics approach.

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Satellite tagging of humpback whales Megaptera novaeangliae off the east coast of South Africa

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Humpback whales Megaptera novaeangliae breed off the coast of Mozambique (including the Mozambique Channel Islands), Madagascar and the Mascarene Islands collectively recognized by the International Whaling Commission as “Breeding Stock C”. Migration and dispersal through South African waters is not well understood, but needed in order to improve regional and basin-wide scale management and conservation efforts. In the winters of 2015 and 2016, eight transdermal satellite tags were deployed on humpback whales off the East coast of South Africa with the goal of identifying migration destinations and stock structure. Tags were monitored for an average and median of 53 days (range 12-169, median 34 days). Except for one animal that completed its migration north into Mozambique in 2016, all other tagged whales did not complete their northward migration. Three of these whales were monitored until they undertook their southward migration. Locally, the animals mostly kept to the shelf edge moving between Port Elizabeth and St Lucia. This study revealed that there is a component of Breeding Stock C that does not complete their migration to the known breeding grounds further to the north. Furthermore, the study has illustrated that humpback whales migrating through the east coast of South Africa migrate to high-latitude areas around Bouvet Island, a feeding ground also used by humpback whales wintering in the western South Atlantic (IWC Breeding Stock B). The reported local movement patterns are crucial for better managing potential conflicts between whales and anthropogenic activities (e.g. oil and gas explorations) through Marine Spatial Planning.

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A paradigm for sandy beach macroinfaunal connectivity

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Sandy beaches represent the most common intertidal habitat in the southern hemisphere, providing goods and services of ecological and economic importance, yet receive comparatively little attention by population geneticists. Already the effects of overexploitation, habitat destruction, climate change and associated range shifts are evident. Population connectivity is fundamental to the persistence of (most) species; genetics is the most practical tool available to study (effective) dispersal among invertebrate populations to assess population resilience. Here, genetic (COI) connectivity in beach macroinvertebrates was assessed as a function of life history (pelagic -, benthic lecithotrophic, and direct development), zonation patterns (supratidal, mid-intertidal and low-intertidal), and biogeographic ranges. Analyses revealed low to moderate genetic structure among most intertidal taxa, including pelagic -and benthic developers, but strong differentiation among supratidal species. With some exceptions, genetic differentiation coincided with biogeographic breaks; genetic diversity showed no clear correlation with latitude. Most species showed evidence for recent demographic and spatial expansions. Among South African species, the Mossel Bay area revealed high genetic diversity in several species, supporting the notion that this is a region of genetic interest. Contemporary, local effects (salinity, hydrology), and natural selection, were shown important in driving population structure in a beach clam, while historic sea level changes could explain population structure in a benthic lecithotrophic larval developer and a supratidal brooder. Genetic connectivity is driven largely by historic demographic events, suggesting low contemporary genetic (and demographic) connectivity in particularly non-pelagic larval dispersers. COI may be more useful in elucidating contemporary connectivity in pelagic larval dispersers.

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Discovery of humpback whale Megaptera novaeangliae “Super-Groups”: Low latitude feeding in the Benguela Current Ecosystem

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Feeding in Southern Hemisphere humpback whales (Megaptera novaeangliae) is believed to be limited to the southern polar region, where Antarctic krill (Euphausia superba) is the primary prey item. Three research cruises during spring/summer of 2011, 2014 and 2015 identified previously undocumented large tightly-spaced groups (20 to 200 individuals) of feeding humpback whales aggregated over at least a one-month period across a 220 nm region of the southern Benguela System. Feeding behaviour was identified by lunges, strong milling and repetitive and consecutive diving behaviours, defecations and the pungent “fishy” smell of whale blows. Although no dedicated prey sampling could be carried out, the entrapped Euphausia lucens in two of the suction cup accelerometry tags deployed in November 2015, collection of E. lucens in the region of groups and the full stomach contents of mantis shrimp from both a co-occurring predatory fish species (Thyrsites atun) and one entangled humpback whale mortality suggest these may be the primary prey items of at least some of the feeding aggregations. Reasons for this behaviour remain speculative, but may relate to; a) increasing summer humpback whale abundance in the region b) alterations in prey availability leading strategy c) a restoration of a previously unobserved feeding strategy d) an increase in the probability of detection of super-group behaviour as abundance increases. The discovery of the “Super-Groups” is a conservation milestone and of particular interest in light of the partial recoveries of certain Southern Hemisphere humpback whale stocks from severe whaling last century.

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UNDERSTANDING THE IMPACTS OF GLOBAL CHANGE ON COASTAL FISHES – FROM PATTERN TO PROCESS

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Researchers from a range of institutions have been studying the impacts of climate change on southern Africa's coastal fishes for the last ten years. This research has included the observation of patterns in response to changing temperatures and these the rapid poleward distributional shifts, the first documented case of a warming driven marine hybridization event, changes in the reproductive scope of resident species, alterations in predator feeding patterns and intraspecies variation in thermal tolerance. While the initial work has focussed on identifying patterns of change in the field, the development of the SAIAB/Rhodes aquatic ecophysiology laboratory has provided several opportunities for examining the processes driving these observed changes. Our results thus far have shown that the growth, development and survival of the early life stages of marine fishes may be susceptible to increased pCO2 as a consequence of the increased energy required for acid-base regulation when the gills develop at metamorphosis. Another study has demonstrated that linefish in a marine protected area have a physiological resilience to the impacts of climate compared with those from exploited areas. These findings are discussed in the context of developing our understanding of the impacts of global change and their implications for our coastal ecosystems and ecosystem services.

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The Competency Group: An experiment in co-producing knowledge for coastal zone policies

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The research project 'Knowledge for Coastal Change' challenges the conventional model of knowledge production for coastal zone policy, which assumes that only scientists have the appropriate knowledge to inform policy. It argues that an alternative model for 'co-producing knowledge' is necessary which recognises that science is insufficient to provide solutions for complex societal and environmental (coastal) problems. The model assumes that there are many other sources of expertise with scientific knowledge no longer privileged. The experimental research used the method of 'Competency Groups' (CGs) to provide an alternative collaborative science to inform policy making for the central Durban beachfront. The paper discusses the design parameters to 'negotiate and deliberate' science and local knowledge, and questions if this method is appropriate for coastal governance in the South African context of a developing, transforming society.

The team of social and natural scientists worked together to design the process iteratively. Six CG meetings were held with a focus of the controversy of water quality. Participants with tacit, professional and academic knowledge were invited after an extensive sampling process. There was difficulty in sourcing tacit knowledge holders and there were very few black knowledge holders due to apartheid history. Six meetings were too short but evidence showed trust building and social learning taking place. Noticeably, participants were embedded in the 'stakeholder representation' mode seeking to promote their individual interests. A space was created where all knowledge holders contributed to the knowledge production showing the potential to co-produce knowledge for coastal zone policy.

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Hypersalinity cycles drive connectivity amongst small estuaries on the West Coast.

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Environmental water requirements of five small predominantly closed West Coast estuaries Buffels, Swartlintjies, Spoeg, Groen and Sout were assessed. Invertebrate diversity, abundance and community structure in all five estuarine systems were a function of changes in groundwater inflow, frequency and magnitude of floods, frequency and duration of breaching events (10–100 years) and salinity gradients, including cycles within long periods of hypersalinity. Fish diversity, abundance and community structure in all five estuarine systems relies on "suicidal" recruitment that is largely a function of connectivity with the sea and driven by the frequency and duration of floods and breaching events and the degree of overwash during high seas. Fish survival depends mostly on groundwater inflow maintaining a salinity gradient and at least some areas with hypersalinity not exceeding 40 psu. Safe return to the sea is usually during flood events and depends on a quick breaching and fish not suffocating in sediment-laden water backing up against the berm. The Swartlintjies, Sout and currently Groen are hypersaline each with a high biomass of brine shrimp Artemia sp. that hatch at salinities above 40 psu and encyst sinking to the bottom when salinities exceed 150 psu. Consequently, available biomass of Artemia in all three estuaries is cyclic according to salinity as is the diversity, abundance and occurrence of flamingos and other birds that feed upon them.

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10% by 2020 and beyond: the role of marine protected areas in a changing world

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At the World Summit on Sustainable Development in 2002, held in South Africa, coastal nations committed to establish national networks of marine protected areas (MPAs) by 2012. The UN Convention on Biological Diversity added detail, with nations resolving to protect 10% of the sea by the same year. The target was missed, but was rebooted as 10% ocean protection by 2020, a key element of UN Sustainable Development Goal 14. This time around, with a slew of large-scale MPAs established or promised, progress is brisk. We now appear likely to get to 10% within a couple of years of 2020. But as 'success' is within our grasp, new science indicates that 10% – always a political target – will be too little to safeguard ocean biodiversity and ecosystem processes, or sustain fisheries. Higher targets are now being promoted, 30% by 2030 or 50% by 2050. Such bold ambitions, science tells us, are more likely to achieve the desired outcomes. However, major challenges remain. There is no agreed mechanism to create MPAs in the 58% of the sea beyond national jurisdiction, although negotiations to fill this void are underway at the UN. Furthermore, MPAs have been much criticised lately for failures of ambition, implementation and management, especially on highly populous coasts. In this presentation, I will discuss how best to resolve these problems, exploring how MPAs can help us navigate a sustainable path through the next half century, which will be one of the most difficult periods in human history.

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Oceanic eddies as transport vectors for biological connectivity between southern Madagascar and the African continent

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This paper establishes the hypothesis that explains the seemingly similar coastal biology that exists between the south-east coast of Madagascar and the south-east coast of Africa — in particular the coast south of the Delagoa Bight (Maputaland), and serves as the basis for the ACEP III Suite Case Project. It proposes that biological materials produced along the south-east coast of Madagascar are on occasion swept from the shelf and entrained into cyclonic eddies (suite cases) that form in the East Madagascar Current retroflection. These cyclones zonally advect westwards south of the Mozambique Channel to reach the African slope after some three months, where according to model experiments, they leak water containing captured Madagascan biological materials into coastal waters there enabling recruitment. The concept of ocean eddies acting as transport vectors is not new, and indeed, substantial evidence exists to support this notion. Eddies bring together the three processes of enrichment (through upwelling of nutrients from ocean depths), concentration (through inward converging flow) and retention (through closed recirculation) that have been associated with favourable habitat for reproduction and recruitment of many fish species (Bakun, 2006, 2010; Condie et al., 2011), i.e. they are transient mini ecosystems. Satellite observations and models show between 4-5 dipole eddies to form south of Madagascar annually, and that the cyclonic eddy component is always adjacent to the shelf, and at times, can be seen to draw coastal water into the periphery of the vortex. Similarly, considerable satellite observations show Madagascan cyclones brushing along the east coast of South Africa. The ACEP III Suite Case Project aimed to test this hypothesis, and in doing so further our understanding of the biogeography of the region. Key overarching questions were:

1. Can larvae from south-east Madagascar be entrained, sustained, and deposited in sufficient time for survival + settlement on the east coast of SA?
2. What evidence is there for connectivity – how similar are the communities from the two regions, are the species the same/connected?

A point of particular interest, is whether the westward moving cyclones crossing the southern Mozambique Channel become less productive with age?

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Plankton distribution within a cyclonic eddy off south-western Madagascar

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Mesoscale eddies are major features in ocean dynamics that significantly influence ocean production depending on their polarity, life-stage, location and time of formation. Eddies in the south-west Indian Ocean have been the focus of many studies, especially in the Mozambique Channel where southward-moving cyclonic and anticyclonic eddies feed into the Agulhas Current. However, eddies formed south of Madagascar that move westwards towards the coast of South Africa have been much less studied, despite their significant contribution to the Agulhas Current. This study aims to understand how the plankton communities (i.e. pico-, nano-, phyto-, microzoo-, mesozooplankton) are distributed amongst the different zones of a cyclonic eddy generated off southern Madagascar. We also investigate the possibility that eddies may enable connectivity between the Madagascar shelf and the South African coast. Temperature, salinity, fluorescence, nutrient concentration and plankton abundance were measured at 25 stations spaced at 18.5 km intervals across a cyclonic eddy, and at three locations on the Madagascar shelf, in July 2013. The core of the eddy was significantly richer in chlorophyll a (91 mg m-2 vs. 64 mg m-2) and had more diatoms (40 cells mL-1 vs. 23 cells mL-1) than the eddy periphery. Zooplankton followed a contrasting pattern with higher biomass in the periphery compared to the core (10 mg m-3 and 3 mg m-3, respectively). The mesozooplankton species composition at the periphery of the eddy showed greater similarities with the Madagascar shelf than with the eddy core or the regions outside the eddy. Abundances of picoplankton, nanoplankton, ciliates and dinoflagellates were very similar within and outside the eddy and were in the same range as those usually found in oligotrophic areas. We suggest that the eddy core was influenced by upwelling of nutrients, which stimulated growth of diatoms that are well-adapted to respond rapidly to nutrient input. The eddy periphery seems to have been primarily influenced by a strong current propagating from the southern shelf of Madagascar which then wrapped itself around the eddy core. This current may be the origin of the high zooplankton biomass in the eddy periphery, thus explaining the similarities in community composition between the eddy periphery and the shelf.

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Paella connectivity across the Mozambique Channel

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Brown mussels and two species of fish were collected from the south west Indian Ocean region in order to test levels of genetic connectivity across the Mozambique channel. The island of Madagascar separated from the now East African coast about 182 million years ago, and thus we expect a measure of resemblance between the coastal floral and faunal populations. However, we may test the relationship between populations of organisms employing molecular methods and evolutionary theory. The oceanography in the Southwest Indian Ocean is complex as the island of Madagascar interrupts the movement of water masses from the equator and results in the formation of eddy currents in the Southwest Indian Ocean. This oceanography also affects the distribution and connectivity of marine species in Mozambique, Madagascar and South Africa. Co-occurrence of many conspecifics has been described for Madagascar and South Africa, and includes the fishes Diplodus capensis, Neoscorpis lithophilus and brown mussel, Perna perna. The present study was aimed at examining the connectivity of populations of these two fish and the invertebrate mussel. This connectivity was investigated using both mitochondrial DNA (mtDNA) markers and microsatellite markers identified and sequenced using Next-Generation sequencing techniques.

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Seamount ecosystems in the South West Indian Ocean : the MAD-Ridge project

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Seamounts cause discontinuities in the oceanic flow with potential impact on ecosystem functioning. This is particularly true for shallow seamounts located in highly dynamic oceanographic region where flow/topography interactions generate physical processes such as eddy-shaped recirculation cells above the seamount summit, upwelling along the seamount slope or internal waves. These processes may enhance biological production in the vicinity of the seamount, mainly due to advection of nutrients or retention processes, for instance. This will affect all trophic compartments, from phyto- and zooplankton up to marine top predators, making seamounts a favorable foraging ground for migrating fauna (pelagic fish, seabirds and marine mammals) and therefore targeted by fisheries. Seamount ecosystems play a critical role in term of food supply which is especially important in an oligotrophic ocean such as the Indian Ocean. Another important research aspect focuses on resources management and their particular sensitivity to overexploitation.

The MAD-Ridge project, a component of the WOURI/IIEO2 programme, focuses specifically on seamount ecosystems in the South West Indian Ocean. Three shallow seamounts, located along a latitudinal gradient (from the north-west of La Réunion Island to the southern edge of the Madagascar Ridge) were recently studied during dedicated scientific cruises, namely La Perouse (19°40'S, 54°E, depth 55m, September 2016), MAD-Ridge (27°25'S, 46°15'E, depth 240m, November-December 2016) and Walters Shoals (33°10'S, 43°50'E, depth 25m, April-May 2017). The three cruises were jointly conducted by French and South-African teams. They were multidisciplinary, covering physics, biogeochemistry, plankton and micronekton sampling, and seabird and marine mammal's observations. The cruises objectives, design and operations as well as some descriptive and preliminary results will be presented, mostly on the environmental context during the MAD-Ridge cruise.

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On the circulation over the Madagascar Ridge using Satellite Data

Dr Patrick Vianello

The circulation around the Madagascar Ridge is dominated by the westward flowing East Madagascar Current (EMC) and the eastward flowing East Madagascar Return Current (EMRC). However, the region experiences many mesoscale eddies (cyclonic and anti-cyclonic) which are important for the transport of water from east to west over the ridge. Daily (Aviso) satellite altimetry is employed to analyse the currents from the northern part of the Madagascar Ridge (where the Eddy Kinetic Energy is large) down towards the Walters Shoal (depth of 18 m) in the south where the Eddy Kinetic Energy (EKE) is substantially weaker. From satellite altimetry “virtual moorings” are deployed in 7 areas over the Madagascar ridge from north to south. 4 years (2011 – 2014) of satellite geostrophic velocities (every 4 days) are analysed to examine the nature of the EMC, EMRC and mesoscale eddies. Certain case studies are analysed (horizontal structure of the current field in the vicinity of the ridge) to examine the nature of the EMC, EMRC and mesoscale eddies on daily time scales. Additionally, variability is examined on daily, weekly and monthly time scales. 2 seamounts (a pinnacle in the northern region of the Madagascar Ridge and the Walters Shoal in the south) are potential “hotspots” for nutrient rich waters. Using certain dispersion methods, satellite data is used to analyse the distance and direction of a theoretical particle released at the seamount. In order to verify the analysis, the geostrophic velocities are compared to drifter data and L-ADCP current data.

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Influence of eddy dynamics and substrate type on larval fish assemblages around seamounts in the SWIO Region.

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The Seamounts Project is situated in the SWIO region and includes the MAD-Ridge, La Perouse, and Walters Shoal seamounts. The MAD-Ridge seamount is an area of elevated topography with strong mesoscale turbulence related to the East Madagascar Current and its retroflection and is considered as an Ecologically and Biologically Significant Area (EBSA). La Pérouse seamount is a fishing area for the longline fisheries and has moderate mesoscale dynamics. Walter's Shoal is an isolated topographic structure that peaks at 15m below the sea surface and has been exploited mostly by demersal fisheries. We report on the influence of mesoscale dynamics on the composition, abundance and distribution of the larval fish assemblages around these seamounts. Ichthyoplankton samples were collected during cruises in 2016 and 2017 using oblique bongo (500 µm) nets within the upper 500 m. Sampling stations were situated along perpendicular transects crossing over the focused seamount, in both N-S and W-E directions. Larval fish assemblages were compared between the stations, and were also examined in relation to environmental data such as temperature, salinity, oxygen, nutrients and chlorophyll a. Current data obtained using shipboard and lowered acoustic doppler current profilers (ADCP) was used to infer larval transport patterns. Oceanic taxa dominated the catches with mesopelagic species belonging to the families Myctophidae being most abundant, but epipelagic families such as Bregmacerotidae, Coryphaenidae, Carangidae, Nomeidae and Scrombridae were also relatively abundant. The occurrence of neritic-benthic and reef larvae (e.g. bothids, lutjanids, mullids, tetraodontids, pomacanthids, labrids and serranids), at different larval stages, indicates possible entrainment and entrapment of fish larvae around the seamounts. Interestingly preflexion larval stages of sunfish (Molidae) were also present in the samples. Fish larvae concentrations were greatest at stations closest to the seamount. All larval developmental stages (Preflexion, Flexion, Postflexion) were present in all seamount regions, but postflexion larvae were the most abundant. These findings indicate that mesoscale dynamics and substrate types around seamounts influence the composition, abundance and distribution of larval fish assemblages. It is hypothesized that eddies trapped over seamounts help retain pelagic fish larvae and maintain the local fish populations.

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Phytoplankton of the South-West Indian Ocean

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Phytoplankton in the South-West Indian Ocean show a strong latitudinal gradient from the tropics down to the Antarctic Front. Concentrations of oxygen, nitrate, nitrite, soluble reactive phosphorous as well as phytoplankton biomass (measured as chlorophyll a) increases while salinity and temperature decreases with an increase in latitude. The chlorophyll a maximum becomes shallower at higher latitudes, changing from a depth of ~150 m in the tropics, to ~85 m in the subtropics to ~35 m in the Southern Ocean. The mixed layer depth also increases from ~50 m in the subtropics to ~100 m at higher latitude stations. The phytoplankton community also shows a latitudinal gradient with decreasing diversity and a change in dominance from flagellates in the tropics to diatoms towards the Southern Ocean. Nutrients exhibited an inverse linear relationship with temperature and salinity. In the Mozambique Channel the highest phytoplankton biomass was recorded at the shelf edge as a result of the interaction of the mesoscale eddies with the continental slope. No difference in community composition was recorded between mesoscale features. Diatoms and coccolithophores are also associated with increased nutrient concentrations and decreased temperature and salinity concentrations, typical of upwelled water or inshore coastal waters. Despite the significant hydrographic differences, the results indicate that different mesoscale features are not characterised by different phytoplankton communities. The environmental drivers most strongly linked to observed differences are nitrate, temperature and oxygen. These environmental drivers display a clear latitudinal gradient unaffected by mesoscale variability of eddy fields.

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Law of three seamounts in the Indian Ocean

Prof Patrick Vrancken[1]
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The presentation provides a background, context and outline of the legal regimes applying to 3 seamounts studied during 3 oceanographique cruises in the Indian Ocean: La Perouse (54.15˚E, 19.725˚S), Mad-Ridge (46.266˚E, 27.46˚S) and Walters Shoals (43.9˚E, 33.2˚S)

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Indian Ocean Fisheries - some perspectives

Dr Sean Fennessy[1]
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Indian Ocean fisheries are dominated by small-scale participants: in 2005, there were estimated to be 5.9 million participants in the major (by volume) Indian Ocean fisheries, of which over 70% were small-scale fishers; but this is not reflected in the catches: annual landings of these fisheries were estimated to be 8.2 million tonnes, split approximately evenly between industrial and small-scale sectors. Based on reconstructed catches from 1950-2010, Indian Ocean coastal fisheries can be broadly divided into three zones: Western Indian Ocean (WIO) fisheries are characterised by low production values, and catches are dominated by non-industrial fisheries relative to industrial; Northern Indian Ocean (NIO) fisheries are 10-20 times more productive than SouthWest IO fisheries, have 4-6 times greater fishing effort than in the WIO and an order of magnitude greater fishing effort than SouthEast Indian Ocean fisheries; non-industrial catches in the NIO and WIO are approximately double that of industrial catches, whereas the levels of industrial and non-industrial catches in the East IO are similar. Patterns in fisheries productivity are not necessarily clearly attributable to patterns in net primary productivity. The levels of fishing effort reflect declines in maximum size of fishes/invertebrates from the 1950s to the 1990s. There is little scope for expansion in fisheries - of the 85 identified fish/invertebrate stocks in the region, only 47 had sufficient information to evaluate their status; of these, 41 were considered to be moderately to fully exploited; at a sub-regional scale, many stocks were considered over-exploited. Notwithstanding initiatives by regional fisheries projects, there is a need for improved monitoring and management of Indian Ocean fisheries.

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Modeling the fate of sea turtle hatchlings oceanic dispersal in South Africa

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Sea turtles are conservation dependent species that rely extensively on protection measures for their survival and recovery. Active conservation efforts in South Africa for the past 50 years has facilitated a population expansion for one of the two nesting species (loggerhead and leatherback turtles), while other population in the IO are still decreasing despite protection. There is a general paucity of information on sea turtle early life history (post-hatching oceanic dispersal), where young at-sea turtles are transported by ocean currents. Surface ocean currents play a crucial role in the dispersal of sea turtle hatchlings but studies in the South Western Indian Ocean (SWIO) are lacking. The Agulhas Current is the main feature within the SWIO, however very little is known of how it affects neonate turtle dispersal and survival. This study aims to identify potential dispersal pathways and investigate the effects of varied thermal environments on hatchling growth, fitness and dispersal ability. This will be achieved by using numerical simulation models to infer current-driven trajectories.

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Plankton measurements in the Western Indian Ocean since 1975 – the Nansen voyages

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This presentation provides an overview of measurements of plankton biomass and production conducted during surveys by the RV Dr Fridtjof Nansen in the Western Indian Ocean (WIO). The WIO is relatively low in terms of productivity, especially in surface waters. Exceptions are coastal embayments such as around Madagascar, and productive continental shelves such as Delagoa Bight. In general, high chlorophyll a concentration was associated with high zooplankton biomass, although this was not always the case. Highest zooplankton biomass was measured off the Somali Coast, reaching approximately double the highest biomass found elsewhere in the region. The second highest biomass was recorded over the Sofala Bank during the rainy season, followed by the Seychelles Bank, but these were all for relatively shallow depths (40-50 m) where biomass is more concentrated. In addition to variability in sampling depths (40-500 m), regional comparisons are complicated by the use of different mesh sizes (180–500 µm), particularly during the early surveys. From 2007 onwards there was an effort to standardise methods, and the use of a Multinet (180 µm mesh) enabled an equitable comparison of zooplankton biomass in the upper 200 m for the Mozambique, Mascarene and Seamount regions. Using this methodology, highest mean biovolumes were associated with eddies in the Mozambique Channel (0.4 ml m-3), and lowest mean biovolumes were recorded over the southern Mascarene Ridge (0.05 ml m-3). The ecosystem-focused surveys in the SWIO since 2007 have provided important baseline data and yielded new insights into this largely oligotrophic and under-studied region.

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How to assess the role of zooplankton at the basin-scale in the South West Indian Ocean ecosystem? Is the ZooScan the way forward?

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Semi-automated instruments are becoming increasingly effective and relevant for zooplankton community analyses. The lack of taxonomist expertise results in broad zooplankton community descriptions that rarely extend to species level, and in important discrepancies depending on who analyses the samples. This is a considerable barrier to basin-scale data analysis, which is crucial to understand potential impacts of climate change on pelagic ecosystem functioning.
Since the early 2000s, there has been an increased effort by various programmes and institutions (e.g. ACEP, ASCLME, EAF-Nansen Project, other international programmes) to collect zooplankton samples in the South West Indian Ocean (SWIO). Are we perhaps reaching the point where we should aim to analyse all these samples in a comparable way, using the same methodology, to investigate climate change and ocean basin-scale related hypotheses relating to zooplankton community structure?
Zooplankton samples from three recent cruises in the SWIO (2009, 2010 and 2013) were analysed using a laboratory based semi-automated instrument, the ZooScan, to investigate differences in zooplankton communities and productivity based on the size spectrum theory. We highlight the pros and cons of this methodology and discuss the outputs of such an approach (i.e. size and biovolume distribution, size diversity indices and other indices obtained using the normalised biomass size spectrum). We would also like to hear whether there is a need and an interest from the oceanographic community to collaborate and to expand this approach by including samples from past and future cruises. This potentially large database could be an important contribution to the 2nd International Indian Ocean Expedition.

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A new research program: Sustainable Oceans, Livelihoods and food Security Through Increased Capacity in Ecosystem research in the Western Indian Ocean (SOLSTICE-WIO)

Prof Michael Roberts[1]
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This project is about climate change, a changing Indian Ocean (IO), and the impacts on people and communities along the coasts of southern and eastern Africa. Here subsistence and artisanal fisheries play a major role in supporting large, poor populations along the coasts of Somalia, Kenya, Tanzania, Mozambique, Madagascar and South Africa. These poor communities are most vulnerable to the impacts of climate change and marine ecosystem shifts, and have the lowest adaptive capacity. A lack of research capacity throughout the WIO region however hinders the collection of data, knowledge and insights required to predict trends, influence policy and plan mitigation measures.

In essence, SOLSTICE is a brand new, large-scaled, ocean physics-to-fish-to-people project that tackles these challenges by growing people-based marine research capability in these countries using latest technologies in Earth Observations, Robotics, and Ocean Models, and moreover, builds lasting and mutually beneficial research partnerships between UK science, regional centres of excellence, NGOs and government agencies in the WIO. SOLSTICE forms a strong component of the IIOE2 Western Indian Ocean Upwelling Research Initiative (WIOURI).

Delivery is through a dual mechanism: An 'Innovation Bridge' between the world-class National Oceanography Centre and University of Southampton in the UK, and a regional centre of excellence established in South Africa at the Nelson Mandela University (Ocean Science & Food Security), which rapidly imports and establishes top-end skills and technologies. Regional integration is then acquired through partnerships with WIOMSA in Zanzibar — the leading regional marine science capacity building NGO— and two research centres (Institute for Marine Science in Zanzibar and the Kenya Marine Fisheries Research Institute in Mombasa). The second delivery mechanism is a research program in the form of two specially chosen case studies each focused on pressing fisheries and local community problems at either end of the Western Indian Ocean region — South Africa and Tanzania/Kenya — involving participants from all WIO countries. A core component of these is the demonstration of ocean gliders and autonomous underwater vehicles, intended to overcome the lack of research vessels in the region. The talk will give more detail on these case studies.

The 4-year project will grow a new cohort of well trained, well connected, researchers equipped with leading edge technology and knowledge to work on local and remote impacts of climate change and ecosystems in the WIO ultimately ensuring sustainable or alternative livelihoods. This cohort includes upskilling of existing career scientists in the region. SOLSTICE will leave a legacy in the form of a self-sustaining, strongly UK-allied regional centre of excellence at the Nelson Mandela University in Ocean Sciences and Food Security, that in collaboration with WIOMSA, will continue to build research capacity, set agendas and undertake research in the region.

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Valuing and Managing Marine and Coastal Ecosystem Services

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Ecosystems are connected to human well-being in a number of complex ways at multiple time and space scales. Marine and coastal ecosystems are among the most valuable in providing these services. The challenge of ecosystem services science (ESS) is understanding and modeling these connections, with a range of purposes including raising awareness and providing information to decision-makers to allow them to better manage our natural capital assets. In order for ecosystem services (the benefits provided to humans by ecosystems) to occur, natural capital (natural ecosystems and their products that do not require human activity to build or maintain) must be combined with other forms of capital that do require human intervention to build and maintain. These include: built or manufactured capital, human capital (e.g., human labor and knowledge); and social capital (e.g., communities and cultures). Thus ESS is inherently an integrated, transdisciplinary science that is concerned with the way these four forms of capital contribute to human well-being and the synergies and trade-offs among them. The process of valuation of ecosystem services is about quantifying and modeling these synergies and trade-offs to allow better management. It requires a deeper understanding of the interconnections among human psychology and decision processes, ecosystem processes and functions, and economic production and consumption processes at multiple time and space scales. The challenges of ESS are huge and will require a significantly more transdiscipinary approach than our current academic institutions are comfortable with. But the payoffs are also huge. Our future depends on making rapid progress in this area.

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Morphological adaptations of sea turtle hatchlings in response to predation

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Prey vulnerability is partly determined by body size and represented by the chance to encounter and be captured by predators. Predators are limited in prey range by morphological features such as gape width, with attack success decreasing as prey body size increases. Numerous studies have been conducted to determine the relationship between carapace dimensions; however, none have investigated the relationship between flipper and carapace growth rates. This study aims to investigate the variation in and determine the relationship between carapace and flipper growth rates of loggerhead (Caretta caretta) turtles from iSimangaliso Wetland Park, Kwa-Zulu Natal. Morphometric parameters were measured across different size classes (determined by carapace length) and the dimensions include carapace length, width and height, flipper length and width, and body weight. Results suggest that allometric growth takes place during developmental stages when predation rates are highest, i.e. post-hatchling and hatchling phases and that front-flipper length increases proportionally to carapace length. Morphometrics also change over time with horned central scutes present in the first few years, 'normalize' when gape-limited predators are outgrown (at a carapace length of approximately 30 cm). The study demonstrates the morphological response of prey to non-lethal predator pressure and the importance of maintaining community dynamics in marine ecosystems.

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The origin of immature loggerhead (Caretta caretta), green (Chelonia mydas) and hawksbill (Eretmochelys imbricata) turtles frequenting South African waters

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On the IUCN Red List of Threatened Species loggerhead turtles are listed as vulnerable, green turtles are endangered and hawksbill turtles are critically endangered (IUCN, 2016). The conservation status of these marine turtle species emphasizes the importance of better defining the boundaries of their Regional Management Units (RMU's). Green and hawksbill turtles do not nest in South Africa but mature and forage along the South African coast. The question is: Which populations do they belong to? Mitochondrial DNA analysis was used to infer natal homing and determine the RMU/stocks that the green and hawksbill turtles in South African waters belong to. This study used 100 skin biopsy samples collectively of said turtle species. A combination of polymerase Chain Reaction (PCR) and gel electrophoresis were used to visualize the DNA. mtDNA sequence analysis (D-loop) was used to analyse genetic data; sequences were aligned and edited using Mega. Haplotype distribution maps were generated using HaploViewer. The haplotypes of the immature turtles sampled in South Africa are still to be assigned to specific rookeries in the Indian Ocean basin. I anticipate that most loggerhead turtles in South African waters are from the SWIO RMU nesting in South Africa or Mozambique, whereas green turtles originate from larger rookeries in the Mozambique Channel, and hawksbills from Seychelles. Once the rookery of origin is known, the boundaries of the RMU's for these species can be redefined and conservation efforts adjusted.

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Determinants of ectoparasite loads in African Penguins (Spheniscus demersus) admitted for rehabilitation

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African penguins (Spheniscus demersus) breed exclusively off the Namibian and South African coast have experienced declines in breeding pairs since the 20th century. This has been attributed to activities such as egg and guano collection, recent purse-seine fishing targets on anchovy (Engraulis encrasicolus) and sardine (Sardinops sagax) stocks, and predation from an ever-increasing protected Cape fur seal (Arctocephalus pusillus) population. Limited research focus has been placed on the effect of ectoparasite loads as a hindrance to population recovery in African penguins or the conditions under which these loads will be most detrimental in relation to their present threats. This study focuses on determining the relationships between ectoparasite loads and determinants such as body condition, age group, colony size and collection date. Ectoparasites from each sample will be collected through the process of dust-ruffling, followed by identification and species abundance counts to determine their loads. It is predicted that ectoparasite loads will be highest in penguins with a lower body condition, from larger colonies and younger age groups. These results will provide a guideline by which African penguin conservation efforts can determine the conditions under which conservation is critical and most successful.

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Aspects of the life history of Sparodon durbanensis with implications for the development of slot limit regulations

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The endemic white musselcracker (Sparodon durbanensis) is a very popular target species in the marine recreational fishery in South Africa. This popularity combined with life history characteristics such as slow growth, late maturation and longevity make the species susceptible to the impacts of recruitment overfishing. Despite this, there is a lack of contemporary biological data on the species making decisions regarding management difficult. This study will involve the collection of biological data with the aim to provide updated information for management. White musselcracker carcasses and gonads will be collected from the catches of fishermen and spearfishermen from Port Elizabeth in the Eastern Cape of South Africa. Dendrochronology methods will be applied to the contemporary otolith collection to determine the relative annual growth rate and will be compared to a historical collection. This information will be used to examine trends in the growth rate of the species between the 1950's and present day. The estimated fecundity will be used to develop a fecundity/length curve, while the age frequency of the specimens will be used to estimate total mortality. This information will be incorporated into a model to determine optimal minimum and maximum size limits, so that a slot limit regulation can be implemented for the species. It is hypothesised that the growth rate of the contemporary collection will be slower than the historical collection as a result of increased fishing pressure and it is expected that the optimal minimum size will be 60cm FL and 75cm FL for the optimal maximum.

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Diversity, abundance and distribution of juvenile fishes in mangrove and non-mangrove estuaries during peak summer recruitment in temperate South Africa.

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Mangroves in tropical and subtropical regions have been well studied, and their value in the life histories of many important fishery species is well-known, while the role of temperate mangrove systems for fishes is yet to be determined. The study aimed to investigate the importance of mangroves by comparing the diversity, abundance and distribution of juvenile fishes in mangrove and non-mangrove estuaries in warm temperate South Africa. Four estuaries were sampled (Gonubie, Qora, Nahoon, and Xhora- the latter two having mangroves present), using a 50m (12mm mesh) seine net over three summer seasons when recruitment of juveniles into estuaries is highest. All fish captured were identified and measured prior to being released. The abundance and diversity of fishes was similar despite the presence of mangroves Temperate ichthyofauna have not needed to evolve a dependence on mangrove systems in terms of the food, refuge, and other ecological services since other refuge opportunities such as saltmarsh creeks and Zostera beds also perform this function. Moreover, food is the limiting factor in seasonally mediated ecosystems making specific niche use a limitation in broader foraging regimes typical of many marine fishes using estuaries.

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Plankton dynamics associated with a microalgal bloom under eutrophication conditions in the Sundays Estuary

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In South Africa, estuarine eutrophication is a growing concern, but little is known about its effects on the planktonic community. The purpose of the study is to determine the knock-on effects of algal blooms, particularly the mildly toxic dinoflagellate Heterosigma akashiwo, on key zoo- and ichthyoplankton species in Sundays Estuary, South Africa. Previous studies suggest that planktonic animals are responding by altering their distribution and density. Physico-chemical and biological data were collected over a period of one month during summer at three sites within the highly productive mesohaline zone in the estuary. Plankton samples were collected from surface and bottom waters at night using modified WP2 plankton nets. Data on phytoplankton was obtained from a botanical survey, which ran concurrently. Two dominant copepods (Pseudodiaptomus hessei and Paracartia longipatella), one mysid (Mesopodopsis wooldridgei) and one ichthyoplankton species (Gilchristella aestuaria) will be quantified and related to the physico-chemical factors and algal bloom conditions. International studies found that zooplankton and ichthyoplankton decrease in density in bloom zones due to lowered dissolved oxygen during decomposition and the possibly toxic and/or unpalatable nature of blooming species. Subsequently, planktonic animals are also expected to shift in their distribution and density in response to blooms in the Sundays Estuary. Plankton forms the base of the estuarine food web and drives secondary productivity in estuaries. Adverse effects on plankton community dynamics have potentially far-reaching consequences for estuary food chains.

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The Tsitsikamma Marine Protected Area – winners and losers

George Branch, Dr Jean Harris, Ian Durbach, Dr Judy Mann, Bruce Mann, Prof Mandy Lombard

The Tsitsikamma National Park was proclaimed in 1964, making it South Africa's (and Africa's) oldest marine protected area (MPA). However, this proclamation, and the subsequent complete ban on fishing implemented in 2001, were not subject to a full stakeholder consultation process, and the fishing ban has been challenged over the years, particularly by local anglers who opposed the top-down approach. In 2015, after years of an escalating polarisation of stakeholders, some for and some against shoreline fishing, the Department of Environmental Affairs (DEA) gazetted a proposal to open sections of the MPA to recreational shore angling and invited public comment. At the start of the comment period, however, the DEA opened sections of the MPA to "experimental" fishing. It reversed this decision after losing in court to a non-governmental organisation, who challenged the legality of the decision. A year later, in December 2016, this time after a stakeholder consultation process, the DEA opened 20% of the MPA's coastline to fishing, despite overwhelming scientific evidence in support of maintaining its "no-take" status, and unprecedented public support for the no-take MPA. This decision has raised many questions, with most scientists maintaining that it was untransparent and politically motivated, and ignored the majority of public comments received. Local anglers are also not satisfied with the size or placement of the opened sections of coast, and the authority tasked with managing these open areas (South African National Parks) has had to request significant funds from treasury to monitor compliance.

Is the Tstisikamma problem a "wicked" one (i.e. difficult or impossible to solve)? Did the DEA reach a rational solution with the information available to them, or are all stakeholder "losers"? Were there alternative solutions that could have performed better, for most objectives, for more stakeholders, not only the local anglers but the wider community? We explore the different objectives at play (conservation, economic, social and political) and the rationality of DEA's decision using statistical and decision analytic tools that evaluate the alternative decision options and their consequences for each of the objectives. We conclude that the Tstisikamma problem is not "wicked", but that many alternative decision scenarios perform better for a number of objectives than the decision that is currently being implemented, and better outcomes could have been achieved for the local anglers, and that many more stakeholders could have been "winners". We advocate that, in future, such a rigorous, meaningful and transparent multi-stakeholder consultative approach be applied to decisions regarding the management of South Africa's MPAs.

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Population genetics and phylogeography of Panulirus homarus rubellus in the south-west Indian Ocean.

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Marine animals which have a long pelagic larval phase are often thought to have high dispersal capabilities resulting in high demographic and genetic connectivity. In the Southwest Indian Ocean, the Mozambique Channel potentially forms a barrier to gene flow between south-east Africa and Madagascar. Population genetic and phylogeographic analyses of microsatellite data from 21 loci and two mitochondrial markers indicate that P. h. rubellus populations from the southwestern Indian Ocean exhibit genetic connectivity. The COI pseudogene from a previous study revealed that P.h. rubellus samples from Madagascar may be a separate population from the African shelf samples, however, both the microsatellite data and mitochondrial COI and Control region sequence data from this study indicate that alleles are being shared across the Mozambique Channel.

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ACEP – TRANSFORMING EAST COAST SCIENCE TO MEET THE DEMANDS OF THE BLUE ECONOMY

Dr Angus Paterson[1]
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The African Coelacanth Ecosystem Programme is a well-established, East Coast coastal and marine research programme that provides competitive access to research infrastructure along with bursaries and running expenses. The various ACEP thrusts (ACEP Open Research Call, ACEP Infrastructure Provision and Transformation) are evaluated and their successes and challenges outlined. The vision for the ACEP 2020 programme is discussed with particular emphasis on its relevance to the development of the Blue Economy.

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Consortium for Estuarine Research and Management

Mr Guy Bate[1]
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The Consortium for Coastal Research was started in the early 1990's with a membership of about 10 drawn from researchers in the Eastern Cape, Western Cape and KwaZulu Natal. Members were mostly drawn from the Universities but the CSIR, WRC and private consulting groups were also instrumental in its beginning. We received an initial grant of R3000 from the WRC. Since those days CERM has grown to over 80 members with many of the earlier members retaining their interest from the UK, The Netherlands, Australia, USA and the Far East. CERM functions because CERMers want to remain in touch with one another and it gives a "home" for discussions. We have a constitution because maybe one day we might need one! We do not have any funds which is probably why we are all still friends. If you are interested in becoming a member – Join!

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National Biodiversity Assessment 2018: Scope, Data requirements & Progress

Ms Lara Van Niekerk[1]
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The National Biodiversity Assessment (NBA) 2018 under the leadership of SANBI is currently in progress. The NBA is a collaborative effort to synthesise the best available science on South Africa's biodiversity to inform policy and decision making in a range of sectors, and contribute to national development priorities. The NBA addresses ecosystem, species and genetic diversity across all realms – terrestrial, freshwater, estuarine and marine & coastal. This information, when combined with information on pressures on biodiversity and ecological condition, allows for the assessment of the state of biodiversity. Wherever possible, spatially explicit information is used in the Assessment. The NBA also addresses the range of responses by government and civil society to the pressures on biodiversity.

The NBA consists of detailed technical reports for each realm and genetic diversity, a synthesis report, and a summary for general audiences. The NBA is a multi-author and multi-stakeholder project. The Council for Scientific and Industrial Research (CSIR) is leading the freshwater and estuarine components with support from a range of research organisations and government departments (e.g. NMMU, DAFF, ORI).

Currently work underway in the NBA: Estuaries Realm includes:
• Standardising the rules for delineating the Estuarine Functional Zone and applying it to all estuaries (e.g. include all estuarine associated habitats);
• Collating/updating estuary habitat data;
• Collating/updating estuary species data;
• Collating/updating information on invasive species;
• Collating/updating of pressure data (e.g. flow modification, pollution, habitat destruction, fishing);
• Collating/updating Estuary Condition data;
• Development of the NBA Estuarine Management and Response data base (including Fish kill register);
• Spatially depicting information where possible (WRC K5/2464 project); and
• A particular challenging need is the development of an updated Classification system for SA estuaries (e.g. identification and incorporation of micro-estuaries, Temporarily open/close systems into more categories).

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Progress with estuary management plans

Mr Pierre De Villiers[1]
[1]*Cape Nature*

Estuaries are complex ecosystems that include a range of sub-systems, micro habitats or management fields. In many instances the management of these are linked to specific sets of legislation, e.g. freshwater and the National Water Act, estuarine area and the Integrated Coastal Management Act, recreational activities and the Municipal Act to name but a few. The estuary management plan needs to identify and include all fields or systems that require management. This can be done within the process implemented to develop a Situation Assessment. The planning process also needs to identify the associated legislation. Once this has been achieved a vision can be developed for the estuary which creates a common goal for all stakeholders and role players. This is the high level start to the process. The implementation of the plan should incorporate all stakeholders in order to get their understanding and support as this is a diverse set of people. A formal process is needed to co-ordinate this and cannot be taken for granted. Management staff need to be geared for conflict management and change management. The estuary planning process and the implementation thereof using estuary forums as an example will be discussed using case studies.

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Micro-estuaries and future research

Prof Alan Whitfield[1]
[1]*SAIAB*

A collaborative multi-disciplinary project started in 2015 to define the position of micro-inlets and micro-estuaries in the range of aquatic ecosystems on the South African coast to answer the fundamental question – when and under what conditions does a micro-inlet become a micro-estuary ? This presentation will discuss the progress so far as well as the future of research on micro-estuaries. The researchers from SAIAB, SAEON, NMMU and RU completed a comprehensive study of 10 of these systems in the central part of the Eastern Cape Province. Based primarily on size, five of these systems have been provisionally classified as micro-inlets and five as micro-estuaries. Seasonal sampling in each system covered all the major biotic categories, from birds, fish, zoobenthos and zooplankton to aquatic macrophytes, epipsammic microalgae (diatoms) and phytoplankton. Apart from detailed physico-chemical measurements in each system on each sampling occasion, the scientists will also be able to draw on hourly recordings of salinity and temperature data using submerged automated loggers installed by Dr Shaun Deyzel (SAEON Elwandle Node) that are uploaded every three months.

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Lake St Lucia: Ecological monitoring and rehabilitation

Prof Renzo Perissinotto[1]
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After over a decade of unprecedented drought conditions in the region, leading to mouth closure, desiccation of over 80% of the lake's surface and the development of hypersaline levels in excess of 200 psu, the St Lucia estuarine lake experienced some recovery during a brief wet phase from 2011 to 2014. Unfortunately, the drought has returned much earlier than anticipated, with a repeat of the desiccation/hypersalinity state in 2015-2016. This has triggered renewed research efforts aiming at understanding and mitigating the effects of this unprecedented developments on the biodiversity and ecological functioning of this critical ecosystem for the region. Outcomes of a recent multidisciplinary project sponsored by the Global Environment Facility of the World Bank, have led to a gradual programme of intervention aimed at reconnecting the St Lucia Estuary to the Mfolozi River – historically the major supplier of freshwater to the St Lucia Estuary. The two systems were artificially separated in the early 1950s, in order to avoid the complete siltation of the St Lucia Estuary. After the initial excavation of a beach spillway between the two systems in 2012, a fully-fledged removal of the island of dredge spoil that had been accumulated over a period of 70 years began in 2016 and is now proceeding to the second phase. In total over one million cubic meters of sand should be removed by the end of June 2017, leading to a full and hopefully permanent reconnection of the two systems. As shown by recent flood events in the Mfolozi catchment, the potential siltation of the system remains an issue of concern. The process of monitoring key biodiversity, ecological and hydrodynamic parameters that started in 2004 needs to continue, in order to assess the developments of this rehabilitation process.

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Water quality changes in the Knysna Estuary

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The Knysna Estuary is an estuarine bay that is permanently open to the sea. It has been classified as South Africa's most important estuary in terms of its conservation priority. This status mostly owed to its biodiversity importance which is based on fish, birds, plants and invertebrates (NBA, 2012). The estuary can be divided into four regions, namely the upper reaches extending from the N2 bridge, the middle reaches between the railway bridge and N2 bridge, the lower bay and Ashmead channel. In particular Ashmead channel has undergone a trophic change from a previously oligotrophic system 15 years back to its current eutrophic state. An increase in population in the area and associated impacts, waste water treatment works overloading, decreased sediment quality (anaerobic) and poor catchment management of two river tributaries entering Ashmead has led to the current state of degradation. The above state culminated in a green tide (Ulva lactuca) occupying this niche for over two years. Recycled nutrients specifically, NH+4 and SRP, from the benthos and input from the nearby waste water treatment works acted as a consistent source of nutrients that enabled the bloom to persist in the Ashmead channel. The larger estuary continues to remain oligotrophic despite these pressures. DIN and DIP levels range between 5 to 10 µM and 1 to 3 µM in the water column of the main channel. Strong tidal exchange through the heads supports a well oxygenated water column seldom dropping below 6 mg l-1.

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Blackwater in estuaries

Mr Guy Bate[1]
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One of the earlier studies that referred to blackwater in South Africa was an unpublished note in 1959 by G.F van Wyk on the Buffels (Wes) estuary. Then there was the big work by Begg in 1978 on the Estuaries of Natal. Since then, there were the studies by the CSIR published as ESTUARIES OF THE CAPE. Synopsis of available information on individual systems. The conclusions reached largely referred to the part played by peat and humic acids in the production of blackwater. A more likely cause is the tannins leached from the leaves shed from vegetation growing in peat swamps. The interest in blackwater is that its presence or absence stems from the vegetation growing in the rivers that produce blackwater estuaries. We need work on blackwater estuaries because the strength of the black signal is a reflection of the status of the terrestrial vegetation

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Recurrent harmful algal blooms and the causative role of catchment agricultural practices

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A review of microalgae as indicators in South African estuaries highlighted the need for (1) an explicit assessment of eutrophication, (2) adequate sampling frequencies and intensity, (3) detailed investigations of microalgal communities, (4) autecological studies of harmful species, and (5) 'hypothesis-driven', fine-scale experimental research. Geared at addressing these knowledge gaps, a three-year sampling programme was initiated in the agriculturally-influenced Sundays Estuary. Here we provide a synthesis of the core research outputs, encompassing studies performed at multiple temporal scales. The key findings from these investigations were as follows:
• Annual study: Confirmation of the eutrophic nature of the Sundays Estuary, and verification of a proposed estuarine eutrophic condition index.
• Seasonal study: Elucidation of persistent undesirable disturbances, including: summer bottom-water hypoxia (< 2 mg l-1) and exceptional proliferations (> 550 µg Chl-a l-1) of two harmful algal bloom (HAB) species (Heterosigma akashiwo and Heterocapsa rotundata).
• Daily study: Identification of inorganic nutrient availability and mesohaline conditions as key bottom-up controls influencing the magnitude and duration of H. akashiwo spring/summer blooms.
• Hourly study: Verification of diel vertical migration and rapid nutrient uptake/biomass accumulation as competitive advantages that facilitate the dominance of H. akashiwo.

These studies demonstrate the consequences of shifting an ecosystem into a new stable state. An element of 'unpredictability' should be restored to the hydrological and chemical makeup of the Sundays Estuary to prevent the continued exacerbation of eutrophic symptoms. Potential management interventions include the restoration of riparian zones, reclamation of nutrient-rich irrigation return flows, scheduled dam releases to mimic natural flushing events, and periodic reductions in freshwater inflow to restore the marine-dominated state.

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Predator-prey interactions on sandy beaches?

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Open ocean beaches are physically harsh ecosystems with the ecology dominated by animal adaptations to changes in sand, waves and tides. The most extreme habitat condition is the reflective beach state with impoverished macrofaunal communities. On the other extreme are dissipative beaches, tending to ultra-dissipative states with large tide ranges. These states have fine sand, gentle beach slopes and long swash periods. The biota is richer with high diversity, abundance and biomass. If biological interactions, such as competition or predation, have any structuring effect on beach communities, it is expected to operate towards the dissipative extreme. Predator avoidance responses have been demonstrated for tidal flats; here, clams burrowed deeper into the sediment in the presence of crabs. This project will take an experimental approach to test if predator-avoidance behaviour is present among sandy beach molluscs. Wild Bullia spp. and Donax spp. individuals will be collected and brought to the laboratory where it will be exposed to three different (potential) predator cues; water from holding tanks with sandsharks, swimming crabs Ovalipes and gull faeces. The relationship of burrowing depth with time in the presence/absence of the predator cue will provide insight into the behavioural response of beach molluscs to different predators, and the role of biological interactions in force structuring beach communities.

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INSCRIPTION OF THE PONTA DO OURO PARTIAL MARINE RESERVE ON THE UNESCO WORLD HERITAGE SITE LIST

Ms Cristina Louro[1], Marcos A.M Pereira[1], Tânia I.F Pereira[1], Raquel S. Fernandes[1]
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Throughout the years, the outstanding ecological and natural values of the southern coastline of Maputo Province, in southern Mozambique, have been greatly recognized by the declaration of three conservation areas: (1) the Maputo Special Reserve (MSR, 1936); (2) the Inhaca Island Natural Reserve (1965); (3) the Ponta do Ouro Partial Marine Reserve (POPMR; 2009). The declaration of the POPMR has resulted in the strengthening of the Ponta do Ouro – Kosi Bay Transfrontier Conservation Area (TFCA), proposed in 2000, as the first marine TFCA in Africa. This TFCA extends from Cape St. Lucia in South Africa to Maputo Bay, in Mozambique, encompassing the iSimangaliso Wetland Park World Heritage Site (iSWP – WHS), inscribed in 1999 on the UNESCO World Heritage List. Nonetheless, the POPMR faces a series of threats, such as poorly planned tourism and coastal develpment (e.g highway KaTembe – Ponta do Ouro and the Techobanine Port). The combined and cumulative impacts, threaten the integrity, functioning and resilience of the TFCA as a whole. In 2008, as a means to preserve the interconnected ecological values of this TFCA as a whole, the POPMR was placed on the Mozambique´s World Heritage Tentative List 2, by the Ministry of Education and Culture in coordination with the Ministry of Coordination of Environmental Affairs, for future inscription on the World Heritage List. As per the recommendations within the feasibility study for the nomination of the POPMR as an UNESCO World Heritage Site, Centro Terra Viva (CTV) produced a literature gap analysis. This resulted in the compilation of approximately 638 references, which will provide the scientific and technical basis for the second phase of the process, which is the preparation of the Nomination Document for the inscription of POPMR/MSR on the UNESCO World Heritage List. The Nomination Document is the basis upon which the Committee considers the inscription of the properties on the World Heritage List.

Keywords:Nomination Document, Ponta do Ouro Partial Marine Reserve, Transfrontier Conservation Area, World Heritage List.

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Impacts of plastic pollution on post-hatchling loggerhead turtles

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Sea turtles are vulnerable to most forms of pollution including floating, solid waste resembling jellyfish; Material such as plastic bags, bottle tops or other objects are readily ingested but nor regurgitated, and consequently end up in the digestive system or body cavity. Some of these fractions pass through the gut but frequently don't, causing intestinal obstructions or internal injuries. Resultantly, these turtles strand along the coast in poor body condition or ill health. The number of turtle hatchlings that have stranded along the South African coast during the last few years (2014 – 2015) increased disproportionately to the rate of increase in the adult population. In 2015, more than 300 hatchlings stranded along the coast, with the majority of these in the Western Cape. Necropsies revealed that 99% of the fragments found in the guts were from plastic with 77% being inflexible, hard plastic mostly white or blue in colour. Mortality of at least 11 hatchlings were directly related to plastic ingestion. Small fragments erode or brake to have very sharp edges or points, puncturing the internal organ. So, while nesting turtles and nests are well protected, surviving the migration away from the nesting ground seems to be a growing challenge.

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The influence of Pleistocene Dynamic on the South African salt marsh species Sarcocornia pillansii (Amaranthaceae): Inferences from Phylogeography and Species Distribution Modeling.

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Glacial–interglacial climate oscillations during Pleistocene had a significant role in dramatically shifting species distributions. During this period (26 500 – 19 000 years ago) the sea level was 120 m lower than it is currently with large areas of Southern African continental shelf being exposed. This resulted in a barrier to cold-water dispersal of various aquatic organisms between the west and east coast. This study explores the influence of past climatic conditions on the salt marsh species Sarcocornia pillansii using species distribution modelling and multi-locus phylogeography. A combination of species distribution models (BIOCLIM, GLM, GAM, Maxent, and Random Forest) projected onto downscaled climate simulation of the Last Glacial Maximum (LGM) indicated greatest habitat suitability in estuaries along the west (Orange River Estuary to Langebaan) and east (Algoa Bay to Keiskamma). This pattern is mirrored in phylogeographic analysis (maximum parsimony) where greater haplotype diversity was found in estuaries west and east of the greater continental shelf. The results also indicate that species survived in these estuaries (as refugia) during Pleistocene climate cycles. Post-LGM increases in sea level along the south coast allowed confluence between isolated river systems, offering opportunities for dispersal among populations. These results also have implications for estuarine genetic conservation and it is suggested that estuaries such Olifants, Verlorenvlei, and Keiskamma, Swartkops, Kariega, Bushmans need to be prioritized for conservation as it contains ancient unique haplotypes.

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Is small-scale abalone (Haliotis midae) seeding event in the intertidal region around Hamburg, Eastern Cape a viable option for ranching?

Ms Anelisa Yako[1], Dr Neil Vine[1], Prof Peter Britz[1]
[1]*University of Fort Hare*

South African abalone (Haliotis midae) attains high prices in Asia and consequently the local fishery is under severe pressure due to rapidly declining population in its natural environment as a result of illegal overfishing. Currently, abalone are farmed in tanks which require large coastal-based farms and high energy inputs. Ranching of abalone is viewed as a potential alternative to aquaculture and a possible conservation strategy since abalone is an endangered species. Adults are spawned in hatcheries, then as juveniles are placed into the ocean to grow under natural conditions. This approach promises to be less expensive than aquaculture. H.midae will seeded in the intertidal region along the coast of Hamburg, Eastern Cape, which is part of the process of abalone ranching. The baseline assessment of the seeding habitat will help us to acquire knowledge of the macroalgae and invertebrate for better understanding of the area's intertidal community structure. Suitability assessment of the seeding strategy, survival and movement of cultured abalone to establish themselves in the intertidal zone will be determined. Initial survival counts will be performed the following day after seeding, while long-term survival will be assessed 15 weeks later. Abalone growth will be compared to those from the same cohort but maintained under farm conditions for the same period. The experiment contributes towards the biological, practical and economic viability of seeding H. midae into the intertidal zone.

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Small-Scale Fisheries: A catalyst for radical socio-economic transformation in coastal fishing communities?

Mr Craig Smith[1]
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In 2016 DAFF conducted the first registration process for small-scale fishers in South Africa. A total of 22,601 people participated in the registration process from 316 fishing communities distributed in the four coastal provinces. In addition to the registration process a socio-economic baseline survey was conducted for these communities, which further emphasized the plight of these communities. Eastern Cape produced some of the most disturbing results with 53% of interviewees earning less than R1,000 per month. Forty-seven percent of interviewees are dependent on government grants. Literacy levels are generally poor with 60% of interviewees not completing their primary schooling. Infrastructure is poor with only 53% of dwellings having electricity and 33.1% having piped water. Thirty-seven percent of Eastern Cape interviewees indicated they skip one or more meals per week. Overall, approximately 90% of all interviewees were from previously disadvantaged backgrounds and up to 90% of interviewees (in KZN) indicated sole reliance on marine resources for their livelihood. Open disclosure of poaching by community members was also common throughout the provinces. It is in this context that government is compelled to establish the new small-scale fishing sector. The presentation explores why government is compelled to establishing this sector from an international, legal and fisheries management perspective, and whether it can be a catalyst for providing radical social-economic transformation for these communities? The presentation will provide the background to the small-scale fishing sector, the vision of the new sector, the architectural design, progress of implementation and the need for collaboration.

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Top-down vs Bottom-up forcing: algal succession on rocky shores

Christopher McQuaid[1], Dr Jeff Hean

Intertidal rocky shores are subjected to numerous biotic and abiotic stressors that shape species distributions and abundances. Amongst these, nutrient availability and herbivory are among the most important for algal communities, but few studies have investigated their interaction, or how they may drive algal succession. We used a simple block design utilizing a 4:2:1 (N: P: K) slow release fertilizer and herbivore exclusion (5mm plastic mesh) to manipulate levels of nutrient availability and grazing over 9 months in 25cm X 25cm plots in the high and mid-shore zones of a temperate shore on the south coast of South Africa. Algae grew quickly in all control and treatment plots. Algal biomass in the mid shore was significantly higher than on the high-shore, but algal growth trends were similar in both zones. Fertilizer addition (F+), grazer exclusion (G-) and fertilizer plus grazer exclusion (F+/G-) treatments all had significant positive effects on algal growth. Algal biomass was significantly higher in G- and F+/G- plots than in F+ plots, but did not differ significantly different between G- and F+/G- plots. While elevated nutrient availability did have a significant positive effect of algal growth and biomass, the full effect was probably diminished by wave action and water flow. Additionally, there may have been an increase in grazing intensity from limpets and gastropods in fertilizer addition plots feeding on newly available high quality forage. Consequently, it appears that consumer mediated control exerted by limpet and gastropod grazers within the intertidal zone is a primary regulatory force of the algal community, particularly for early successional stages.

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Defining the potential ecological roles of three sea turtle species (Caretta caretta, Chelonia mydas and Eretmochelys imbricata) along the eastern seaboard of South Africa

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Sea turtles were once considered as key species, driving ecosystem processes and energy flows. However, the past decline in sea turtle abundance and subsequent loss of their ecological roles have resulted in reduced ecosystem function. Therefore defining the past and present ecological roles of sea turtles is a global research priority for sea turtle management and conservation. While South African sea turtles are relatively well-protected through the combination of a successful, long-term sea turtle conservation program and coastal marine protected areas, the ecological roles of these turtles have never been investigated. This study aimed to evaluate the ecological roles of two non-breeding foraging species (Chelonia mydas and Eretmochelys imbricata) and one breeding species (Caretta caretta) along the eastern seaboard of South Africa. A multi-technique approach that incorporated the use of satellite telemetry, stomach content and stable isotope analyses were implemented to examine key ecological features such as habitat use, trophic position and diet. Satellite tracks revealed that all species formed aggregations in the near-shore environment. While this is typical of the breeding species, the continued use and aggregation by the non-breeding foraging species are indicative of residency. Algae was the predominate food item for C.mydas, sponges for E.imbricata, while C.caretta stomachs were usually empty, consistent with capital feeding during breeding. All species appear to occupy similar ecological isotopic niches which suggests trophic redundancy. This study elucidates the importance of ecological roles fulfilled by sea turtles, strengthens the on-going conservation efforts and provides an ecological framework for future regional studies.

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Making ‘shared’ meaning of environmental change: challenges and opportunities.

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The wicked challenges confronting society are necessitating a re-examination of how knowledge is framed, organized and used. Wicked challenges are those that are not usually easily resolved with linear responses and often require more emergent, ‘messy’ approaches.

In the field of global change, particularly climate change, this journey has been an interesting one. Examples of some of the changes, challenges and opportunities that have confronted (and are arguably still challenging) scientists will be explored in this paper. Some local and international cases will be examined.

There are a number of barriers and opportunities in working in such spaces including the transdisciplinary space. The transdisciplinary space includes not only working across disciplines but also across and with different knowledge holders. Issues such as joint co-framing of agendas and research, ethical challenges when working in such spaces and suggestions for some of the actions that may be required are finally provided.

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Small-scale fisheries: assessment, management and drivers of change

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Small-scale fisheries (SSFs) account for 40% of world fish catches and provide direct employment to 40 million fishers (supporting some 400 million dependents), mostly in developing countries. Since over half of the total catch in these developing countries is produced by SSFs, they play a critical role in providing food security and poverty alleviation. SSFs in developed countries are generally well assessed, whereas most developing country fisheries are data poor and lack formal stock assessments. These data-poor fisheries are generally in poor condition: stocks continue to decline due to an exponential increase in fishing intensity, even under diminishing catch rates, because of low operating costs and easy access to stocks, which makes regulatory efforts expensive and ineffective. SSFs will be in the spotlight, especially with respect to poverty alleviation and food security, and their scientific assessment needs to be prioritized. Strong fisher participation through community based data collection initiatives is shown as a cost-effective and a realistic solution to the problem of collecting data. This approach has also been shown to enhance community empowerment and increase compliance with regulations. The combination of weak governance, globalization of markets, fishing pressure and climate change has exacerbated depletion patterns. Increasing market prices exceeded low harvesting costs and, together with illegal trade and poor enforcement, have driven populations of some species to local extirpations. The lack of stock responses to long term fishery closures suggests that some systems have exceeded critical thresholds (i.e., tipping points). Long term studies suggest that successful SSFs occur when several management attributes are present, due to management redundancy. The active participation of fishers through co-governance, combined with clear incentives through catch shares and conservation through protected areas, have promoted successful SSFs and improved the livelihoods of communities depending on them.

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Jellyfish: a celebration through culture and science

Mark Gibbons

Although the word jellyfish has only been around for the last couple of hundred years, the animals themselves are embedded in our culture and, increasingly, in our science. This presentation does not have a beginning and an end but is rather a rambling combination of Zoology 101 and Classics 101, with a liberal does of media hype. There is some science c/o PNAS, Nature, the Royal Society and Science (itself) but the aim here is celebrate in all but dance, the kings of the Cambrian.