



**19–23 August 2024**

**Mpekweni Beach Resort, Eastern Cape**

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# BOOK OF ABSTRACTS



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**25**

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# Welcome to the 6<sup>th</sup> SAMLS

The organising committee and hosts, Rhodes University, Two Oceans Aquarium and the South African Institute for Aquatic Biodiversity, are honoured to welcome delegates to the 6<sup>th</sup> Southern African Marine Linefish Symposium (SAMLS) and to the Eastern Cape.

Organised under the auspices of the Marine Linefish Research Group (MLRG), from 19-23 August, the 6<sup>th</sup> SAMLS will be full of learning and networking opportunities. Our program profiles three keynote speakers presenting their perspectives on a broad diversity of aspects associated with linefish and fisheries management. In addition, we have nine theme sessions with 60 oral presentations that cover a breadth of topics on linefish research and management. We hope that these will stimulate discussions, ideas and collaborations and ultimately set a course for improved management of the linefishery.

Although the linefish symposium is generally considered to be a conference that focusses on student participation and development, we have tried to balance this agenda during this 6<sup>th</sup> edition. To do this, we have attempted to encourage stakeholders from all sectors of the linefishery to participate in the hope that they will receive constructive advice and in return offer seasoned insights from their respective fishery sectors. We are also excited to host undergraduate and postgraduate students from several universities across southern Africa. We would like to not only welcome them but hope that their experience will inspire future research careers in the marine sciences.

We are extremely grateful to our excellent keynote speakers and really appreciate them taking the time to prepare their addresses and for being willing to attend the symposium. Thank you also to the National Conference Bureau, the National Research Foundation's Knowledge, Interchange and Collaboration Fund, Two Oceans Aquarium Foundation, the South African Institute for Aquatic Biodiversity's African Coelacanth Ecosystem Phuhlisa Programme and Innovasea for providing financial support for this conference and therefore, helping to encourage an improved understanding and management of linefisheries around southern Africa. Finally, a big thank you to Nicolette Whitehead and her team at Mpekweni Beach Resort for hosting us and sorting out all of the conference administration.

**Bruce Mann**

*Chairperson of the Marine Linefish Working Group*





# 6<sup>th</sup> Southern African Marine Linefish Symposium



## PROGRAMME

Monday, 19 <sup>th</sup> August 2024: Arrival	
Time	Event
13:30	Conference registration (desk open until 18:00)
14:00	Linefish & Netfish Scientific Working Group Meeting (to be confirmed)
15:00	Innovasea equipment demonstration (all welcome)
18:30	<b>Ice-breaker</b>
Tuesday, 20 <sup>th</sup> August 2024: First day of conference talks	
Time	Event
08:00	Welcome (Mann)
08:30	House rules and keynote introduction (Mann)
08:45	<b>Keynote address: Colin Attwood - Population dynamics from 40 years of monitoring fish in the De Hoop MPA</b>
09:30	<i>Session I - Fish movement studies (Chair: Daly)</i>
09:30	Talk1: <b>Murray</b> - How acoustic telemetry can aid in management of important linefish species
09:45	Talk2: <b>Dixon</b> - Longshore movements of giant kingfish
10:00	Talk3: <b>Mann</b> - Movement patterns of white musselcracker
10:15	Talk4: <b>Knight</b> - Movement behaviour of dusky kob
10:30	<b>Tea time</b>
11:00	<i>Session II - Fish movement studies (Chair: Murray)</i>
11:00	Talk5: <b>Mukhari</b> - Movement and habitat use of the Kowie Estuary by four mullet species
11:15	Talk6: <b>Pollard</b> - Movement of blacktail in a shallow rocky cove
11:30	Talk7: <b>Gennari</b> - Smoothhound shark movements
11:45	Talk8: <b>Zaza</b> - Learning to detect anomalies in acoustic telemetry data with unsupervised learning
12:00	<b>Innovasea presentation</b>
13:00	<b>Lunch</b>
14:00	<i>Session III - Life history and ecological studies (Chair: Fennessy)</i>
14:00	Talk9: <b>Adams</b> - Mapping essential habitats of seventy-four
14:15	Talk10: <b>Mohamed</b> - Description of growth, reproduction and feeding of the false jacoever
14:30	Talk11: <b>Hempel</b> - Physiological metrics to inform classification of phenotypes using dusky kob
14:45	Talk12: <b>James</b> - Seagrass density and macroalgal heterogeneity influence nursery quality for sparids
15:00	Talk13: <b>Veii</b> - Long-term growth rate changes of west coast steenbras caught by Namibian anglers

<b>15:15</b>	<b>Tea time</b>
15:45	<i>Session IIV - Monitoring estuaries and MPAs (Chair: James)</i>
15:45	Talk14: <b>Dixon</b> - Mystery of giant kingfish aggregation in Mtentu Estuary
16:00	Talk15: <b>Dames</b> - Port of Ngqura: Concrete seascapes and the fish that took advantage of them
16:15	Talk16: <b>Nodo</b> - Linefish nursery areas in Algoa Bay and their response to dissolved oxygen
16:30	Talk17: <b>Swart</b> - Galjoen CPUE in exploited and unexploited zones of the Table Mountain MPA
16:45	End – back to accommodation
<b>19:00</b>	<b>Linefish quiz evening (Chaired by Romina Henriques)</b>

<b>Wednesday, 21<sup>st</sup> August 2024: Second day of conference talks</b>	
<b>Time</b>	<b>Event</b>
08:00	Admin and keynote introduction (Potts)
<b>08:30</b>	<b>Keynote address: Kieran Hyder - Embedding marine recreational fisheries in stock assessment and management</b>
<i>09:15</i>	<i>Session V - Fisheries monitoring (Chair: Farthing)</i>
09:15	Talk18: <b>Winkler</b> - Utility of recreational fishing competition data to monitor coastal elasmobranchs
09:30	Talk19: <b>Rowell &amp; van Huyssteen</b> - Estimating natural mortality of dusky kob from length-frequency data
09:45	Talk20: <b>da Silva</b> - Applying deep learning methods to electronic monitoring data: automated catch event detection for longline fishing
10:00	Talk21: <b>Hewett</b> - Comparisons of current and historical catch rates in the marine recreational shore fishery
10:15	Talk22: <b>Lamberth</b> - Monitoring and measuring illegal gillnet catches in South Africa
<b>10:30</b>	<b>Tea time</b>
<i>11:00</i>	<i>Session VI - Fisheries management (Chair: Winkler)</i>
11:00	Talk23: <b>Potts</b> - Review of recreational fisheries research to identify critical revisions needed to improve governance
11:15	Talk24: <b>Kerwath &amp; Yemane</b> - The South African linefishery in 2024 - An overview
11:30	Talk25: <b>Kerwath &amp; Yemane</b> - The South African linefishery in 2024 - An overview
11:45	Talk26: <b>Farthing</b> - Global systematic review of the lethal and sublethal impacts of catch-and-release fishing
12:00	Talk27: <b>Bova</b> - Informal synergy between subsistence and recreational fishers on the Wild Coast
12:15	Talk28: <b>Rees</b> - Development of a management strategy for ETP species in the tuna pole-and-line fishery
12:30	Talk29: <b>Wilhelm</b> - Growth rates of west coast steenbras in Namibia using different approaches
<b>12:45</b>	<b>Lunch</b>
<i>13:45</i>	<i>Session VII - Angler engagement (Chair: Mann)</i>
13:45	Talk30: <b>Jordaan</b> - The ORI Cooperative Fish Tagging Project - celebrating 40 years down the line
14:00	Talk31: <b>Mann-Lang</b> - What about the taggers?

14:15	Talk32: <b>Munting</b> - Understanding the impacts of MPAs on the commercial linefishing sector in KZN
14:30	Talk33: <b>Gusha</b> - Key research areas to promote co-management and sustainability of the Namibian marine recreational fishery
14:45	Talk34: <b>Winkler</b> - Use and abuse of social media in the management of the South African marine recreational linefishery
15:00	Talk35: <b>Lehloenya</b> - Catch-and-release norms, attitudes and perceptions in the South African marine recreational shore fishery
<b>15:15</b>	<b>Tea time</b>
16:00	<i>Session VIII - Genetics (Chair: Duncan)</i>
16:00	Talk36: <b>Henriques</b> - Using molecular data in connectivity and forecasting studies on marine coastal fishes in South Africa
16:15	Talk37: <b>Groeneveld</b> - Insights from genetic and ecological knowledge for conservation management of rhino rays
16:30	Talk38: <b>Olivier</b> - Re-assessment of genetic diversity and connectivity of recreational linefish species in South Africa
16:45	End – back to accommodation
<b>19:00</b>	<b>Celebration of the 40th year of the ORI-Cooperative Fish Tagging Project</b>

<b>Thursday, 22<sup>nd</sup> August 2024: Third day of conference talks</b>	
<b>Time</b>	<b>Event</b>
08:00	Admin and keynote introduction (Childs)
<b>08:30</b>	<b>Keynote address: Philile Mbatha - Fish, fishers and the future: a spotlight on small-scale fisheries</b>
09:15	<i>Session IX - Climate change (Chair: Childs)</i>
09:15	Talk39: <b>Potts</b> - Promoting fish of the future - Developing a strategy to mitigate the impact of climate change on our linefish populations
09:30	Talk40: <b>Wilhelm</b> - Growth rate extremes of a sciaenid in an ocean warming hotspot
09:45	Talk41: <b>Duncan</b> - A new physiological model to forecast the climate response of linefish
10:00	Talk42: <b>van Heerden</b> - Can thermal metabolic information predict fish behaviour observed on BRUVs? - A case study on fransmadam
<b>10:15</b>	<b>Tea time</b>
10:45	<i>Session X - Climate change (Chair: Potts)</i>
10:45	Talk43: <b>Daly</b> - Living on the edge: climate change induced intensification of upwelling impacts on threatened species at their range limit
11:00	Talk44: <b>Frachet</b> - Thermal tolerance of wild caught dusky kob
11:15	Talk45: <b>Ngcefa</b> - Development of ecological niche models to predict future distribution of blacktail
11:30	Talk46: <b>Mlotshwa</b> - Assessing the effects of exploitation on the activity of roman in a thermally variable environment
11:45	Talk47: <b>Ziko</b> - Adaptability to climate change induced temperature changes and behavioural responses of two estuary dependent mugilids
12:00	Talk48: <b>Edworthy</b> - The influence of habitat association on the tolerance of coastal fish to future acidification
12:15	Talk49: <b>MacKenzie</b> - Increasing thermal variability may reduce the survival of larval blacktail
<b>12:30</b>	<b>Lunch</b>
13:45	<i>Session XI - Fisheries (Chair: Mann-Lang)</i>

13:45	Talk50: <b>Childs</b> - Project CAREZONE: An approach to assess spatial connectivity of South Africa's marine shore-based linefish species
14:00	Talk51: <b>Greenwood</b> - Linefish bycatch in the trawl fishery: trends, areas and species associations
14:15	Talk52: <b>Farthing</b> - A conservation strategy to halt the decline of kob populations in South Africa
14:30	Talk53: <b>Wilhelm</b> - Two decades of catch trends of 5 teleost species in the recreational shore fishery in Namibia
14:45	Talk54: <b>Fennesy</b> - Fishy business in Richards Bay
15:00	Talk55: <b>Mmonwa</b> - SASSI rating of the linefishery: theoretical scoring or practical improvement
<b>15:15</b>	<b>Tea time</b>
<b>15:45</b>	<b>Session XII - Genetics (Chair: Henriques)</b>
15:45	Talk56: <b>van Staden</b> - From west to east: genetic diversity and population structure of two endemic <i>Acroteriobatus</i> species
16:00	Talk57: <b>Ntuli</b> - Genomic implications of hybridization in the southern African kobs ( <i>Argyrosomus</i> spp.)
16:15	Talk58: <b>Ndou</b> - Assessing the role of MPAs in maintaining evolutionary resilience in roman <i>Chrysoblephus laticeps</i>
16:30	Conference wrap up (Mann)
16:45	End – back to accommodation
<b>19:00</b>	<b>Gala dinner</b>

### Friday, 23<sup>rd</sup> August 2024: LinefishConnect Workshop

08:00	Welcome - background and intention of the workshop
08:30	Introduction from management and conservation agencies
09:30	Introduction on datasets available from scientists
<b>10:15</b>	<b>Tea time</b>
10:30	Facilitated session
12:30	Closing and way forward
13:00	End of workshop



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## **LinefishConnect: Workshop on Collaborative Monitoring and Assessment of the South African Marine Shore-Based Fishery**

**Hosts:** Amber-Robyn Childs, Warren Potts, Matthew Farthing, Alexander Winkler, Christopher Bova, Natanah Gusha

**Date:** Friday 23 August 2024, Time: 08:00–13:00

**Location:** Mpekweni Beach Resort (during the 6<sup>th</sup> SAMLS)

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Marine shore-based fisheries provide considerable economic, livelihood and health benefits, but their governance is generally poor, with the overexploitation of most stocks attributed to excessive harvest. South Africa's inshore linefishery resources are heavily exploited by a large marine shore-based recreational fishery which has reduced the abundance of these species and the opportunities for a growing small-scale fishery. Given the vast participation rate and the dispersed nature of the fishery, monitoring and assessment of the marine shore-based linefishery remains a challenge. The limited catch and effort information, which is necessary for understanding the spatio-temporal trends in fish populations and which limits the potential for stock assessments, leaves managers with little understanding of fishery trends.

The aim of this workshop is to discuss some of the options for monitoring the shore-based fishery, evaluate the potential of competitive angling databases as monitoring tools and discuss priority areas for monitoring and assessment of our inshore linefish populations. It also seeks to formalise a collaborative network, **LinefishConnect**, comprising researchers, managers, conservationists, and local stakeholders to encourage cooperation for the collection of the socio-ecological data necessary for improved governance of a linefishery. This network will be dedicated to promoting sustainable fish populations, habitats and ecosystems, supporting the livelihoods and well-being of fishers, and enhancing economic potential in the face of overexploitation and climate change.

To achieve this, the agenda of the workshop will follow four themes:

- (i) Existing monitoring programs for the marine shore-based fishery
- (ii) Fisheries-dependent data and data sharing agreements
- (iii) Future of fisheries-independent inshore/coastal monitoring
- (iv) Future of **LinefishConnect** community of practice (COP)

The workshop will focus on identifying the needs of stakeholders, provision of scientific support (e.g. what can the science community do to support plans and needs of government agencies), identifying data collection methods (i.e., how can the science community tailor our data collection to support management and conservation needs?) and formulating plans for the development of **LinefishConnect** COP.

The workshop is supported by the NRF Marine and Coastal Research grant (MCR210429598107), Project **CAREZone**: Promoting sustainability in South Africa's marine shore-based fishery by filling key research gaps through the investigation into the potential of catch-and-release zones as a complimentary conservation strategy.





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## **LinefishConnect: Workshop on Collaborative Monitoring and Assessment of the South African Marine Shore-Based Fishery**

### **WORKSHOP AGENDA**

Mpekweni Beach Resort | Friday, 23<sup>rd</sup> August 2024 | 08h00–13h00

I.	08h00	<b>WELCOME</b>	Background to the workshop Intentions of the workshop
II.	08h30	<b>INTRODUCTION FROM MANAGEMENT AND CONSERVATION AGENCIES</b>	To be confirmed
III.	09:30	<b>INTRODUCTION ON DATASETS AVAILABLE FROM SCIENTISTS</b>	To be confirmed
<b>10h15 TEA BREAK</b>			
IV.	10h30	<b>FACILITATED SESSION</b>	<b>Core Discussion Points:</b> <ul style="list-style-type: none"> <li>Existing monitoring programs for the marine shore-based fishery</li> <li>Fisheries-dependent data and data sharing agreements</li> <li>Future of fisheries-independent inshore/coastal monitoring</li> </ul>
V.	12h30	<b>CLOSING AND WAY FORWARD</b>	Future of <b>LinefishConnect</b> community of practice   <b>LinefishConnect</b>
	13h00	<b>END OF WORKSHOP</b>	

# ABSTRACTS

(Listed alphabetically by surname)

## **Mapping essential fish habitats of *Polysteganus undulosus***

Luther Adams (Rhodes University [RU], South African National Biodiversity Institute [SANBI], South African Institute for Aquatic Biodiversity [SAIAB]), Anthony Bernard (SAIAB), Kerry Sink (SANBI, Nelson Mandela University [NMU])

Theme: *Life history and ecological studies* | Talk 9

Mapping marine biodiversity is essential and underpins marine spatial planning process and the implementation of representative networks of protected and conserved areas. Essential fish habitats are the waters and substrate necessary for a fish to reproduce, grow and feed. Knowledge on the benthic habitats and invertebrate communities that support the life history of threatened reef fish species such as *Polysteganus undulosus* is known anecdotally but not identified or described using empirical evidence. This study aims to map the essential habitat for *P. undulosus* on the eastern continental shelf of South Africa. Archived remote underwater camera imagery will be processed and computer vision will be leveraged to optimise image processing efficiency for benthic invertebrate communities and a reef fish. The objectives are threefold. The first objective will be to build and use computer vision models for *P. undulosus* and transferring the models between remotely operated vehicle images and Baited Remote Underwater Video (BRUV) images. The second objective will be to use computer vision to map benthic invertebrate communities (habitats) from remotely operated vehicle imagery. The third objective will combine the outputs from the computer vision models and habitat mapping exercise to identify, describe and map the essential fish habitats of *P. undulosus*. It is anticipated that this project will advance the understanding of habitat and benthic invertebrate community affinities of this threatened linefish and present a model that can be applied to other priority fish species in South Africa. The outputs of this project will also be relevant to offshore marine protected area management and expansion in South Africa.

## Population dynamics deduced from 40 years of monitoring protected surf-zone fishes at De Hoop

Colin Attwood (University of Cape Town [UCT], Lieze Swart (Department of Forestry, Fisheries and the Environment [DFFE]), Denham Parker (Commonwealth Scientific and Industrial Research Organisation [CSIRO])

**Theme: Keynote address | Tuesday 20<sup>th</sup> August 2024**

Marine protected areas (MPAs) offer an opportunity to understand the undisturbed population and community dynamics of fishes that are elsewhere exploited and depleted. A catch-per-unit-effort (CPUE) survey of surf-zone fishes began at Koppie Alleen in De Hoop, one year before its proclamation as a 50 km long no-take MPA in September 1985. The survey was expanded in 1988 to include Lekkerwater, a second site in the MPA, 11 km away. We analyse 40 years of survey data to reveal density and local recruitment patterns over time and between sites. Standardised CPUE data reveal annual coefficients of variation (CV) in post-recovery, undisturbed CPUE at each site between 0.3 and 0.5, reflecting a combination of sampling error and natural fluctuation. Correlations in CPUE and mean size between the two sites suggest that the density and population structure of most species co-vary spatially by between 40 and 70%. Mean size correlations between sites are typically stronger than CPUE correlations. For galjoen *Dichistius capensis*, an age-structured model was fitted to catch-at-length survey data to estimate local recruitment strength from 1984 to 2023. The apparent initial increase in density at Koppie Alleen can partly be explained by a relaxation in fish vigilance. The recruitment vectors reveal a (1) 50% agreement in recruitment variation between sites, (2) post-protection cycle periods of ~20 and ~5 years at both sites, and (3) a (possible) Ricker dynamic. The CV on local galjoen recruitment is in the order of 0.33, without evidence of a log-normal distribution. Estimates of age-structure for per-recruit analyses should come from samples that cover at least 5 years for this species. Natural mortality is estimated at  $0.4 \text{ y}^{-1}$ , a high estimate that could reflect genuine mortality or emigration at carrying capacity. The model of galjoen suggests a maximum sustainable effort far below typical effort levels measured in the Western Cape.

## **Smooth-hound shark *Mustelus mustelus* movements dictated by context: higher residency in South African Marine Protected Areas**

Eugin Bornman (Oceans Research Institute [OCRI], [Enrico Gennari](#) (OCRI, SAIAB, RU) and Neil Hammerschlag (Rosenstiel School of Marine and Atmospheric Science)

Theme: *Fish movement studies* | Talk 7

The movement patterns of commercially valuable smooth-hound sharks *Mustelus mustelus*, within and outside marine protected areas (MPAs) in the southern Cape, South Africa were investigated using seven years of passive acoustic telemetry data. This study assessed the impact of individual, ecological, and environmental factors on the distances travelled per day by 43 tagged sharks (10 male and 33 female). Results indicate that most sharks exhibited high residency within MPAs, with home ranges typically less than 1 km, punctuated by sporadic long-distance movements of up to 12.3 km per day. However, significant intra-specific variability in movement behaviour was observed, with some individuals demonstrating responsiveness to upwelling events, resulting in extended excursions beyond MPA boundaries. These excursions increase the vulnerability of these sharks to fishing activities once outside protected areas. The findings suggest that MPAs, if strategically located to encompass nursery areas, could yield considerable benefits to fisheries through spill-over effects. However, it is noted that existing MPAs often fail to overlap spatially with habitats critical for threatened chondrichthyans globally. Successful conservation efforts thus necessitate MPAs that not only target specific species but also incorporate context-specific knowledge of movement and habitat use. This study underscores the importance of integrating ecological, environmental, and individual factors in MPA design and management to effectively conserve marine biodiversity and sustainably manage fisheries.

## **The informal synergy between subsistence and recreational fishers on the Wild Coast**

Christopher Bova (RU), Michael Pyle (RU), Gavin Fraser (RU), Warren Potts (RU)

Theme: *Fisheries management* | Talk 27

Researchers are often focused on the negative interactions between fishing sectors. This is especially true in South Africa, where competition for various linefish species between those that fish for fun and those that fish for provisions and livelihoods result in impulsive calls for resource allocation. However, often missing from the context is the relationship between recreational fishers and rural coastal communities. Using structured face-to-face surveys with recreational fishers and semi-structured interviews with local fishing community members in the Wild Coast region of South Africa, a very different narrative was revealed. Here, recreational fishers support local economic development through tourism expenditures that would not otherwise inflow to the communities. However, much of the money spent in these communities immediately flows back out due to economic leakage. Interestingly, the expenditures that are retained in the area are directly linked to the subsistence and small-scale fishers in the area that sell fish and bait to the recreational anglers or provide guiding services. While there may be limited competition between the sectors for fisheries resources in the region, the beneficial economic relationship is clear. Recreational fishers rely on the local informal fishing communities for food and bait, and the informal fishing communities rely on the recreational fishers for livelihoods. This relationship underscores the importance of examining conflicts between fishing sectors through a more holistic lens and can provide important information to contribute to the much-needed redevelopment of small-scale fisheries policy in South Africa.



## **Project CAREZONE: A trans- and multi-disciplinary approach to assess spatial connectivity of South Africa's marine shore-based linefish species**

Amber-Robyn Childs (RU), Warren Potts (RU), Matthew Farthing (RU), Alexander Winkler (RU, SAIAB), Christopher Bova (RU), Matthew Parkinson (SAIAB), Taryn Murray (SAIAB), David Kaplan (Ifremer, France [IRD]), Nicola James (SAIAB), Romina Henriques (University of Pretoria [UP]), Bruce Mann (RU), Kyle Smith (South African National Parks [SANParks]), Kerry Sink (SANBI), Judy Mann-Lang (Two Oceans Aquarium Foundation [TOAF]), Montagu Du Toit (RU), Nonhle Mlotshwa (RU, IRD), Samkele Ngcefa (RU), Thomas Knight (RU), Kata Lehloenyana (RU), Mike Mackenzie (RU), Josh Frachet (RU), Christian Hempel (RU), Wilfred Olivier (UP), Kyle Hewitt (RU), Elmar Oosthuisen (UP), Elijah Jule (UP)

Theme: *Fisheries* | Talk 50

Marine shore-based fisheries provide considerable economic and livelihood benefits, yet their governance is poor, particularly in developing countries, with the overexploitation of most stocks attributed to excessive harvest. South Africa's inshore fishery resources are heavily exploited by a large marine shore-based recreational fishery which has reduced the abundance of these species and the opportunities for a growing small-scale fishery. Research on this fishery has focused on life history and stock assessment of some species, but critical knowledge gaps on the ecological, human dimensions and governance aspects of the fishery still exist. An improved understanding of how to conserve nearshore linefish species is necessary for the persistence of coastal fish populations and livelihoods dependent on them. While compliance is poor with most fisheries regulations (i.e. traditional output controls), closed areas appear to be relatively well respected by shore-based recreational anglers, but come at a socio-economic cost. This research highlights the potential for other effective conservation measures, such as non-consumptive catch-and-release zones, which may yield considerable benefits for species targeted in this fishery. Given that knowledge on the spatial distribution and connectivity of fish is critical for spatial-based management and conservation strategies, this research highlights the valuable role that both traditional and innovative methods, such as fishery catch data, species distribution modelling, ecophysiology, population connectivity, acoustic telemetry and angler perceptions and attitudes can play in assessing marine protected area connectivity in our shore-based linefishery. It is hoped that this trans-and-multi-discipline approach will provide a framework for linefish research, management and conservation in our changing climate.

## **Living on the edge: Climate change induced intensification of upwelling impacts threatened and endemic species at their range limit**

Ryan Daly (Oceanographic Research Institute [ORI], SAIAB), Nicolas Lubitz (James Cook University [JCU]), Amy Smoothey (Sydney Institute of Marine Science [SIMS]), Patrick Vianello (NMU), Michael Roberts (NMU), David Schoeman (University of the Sunshine Coast), Marcus Sheaves (JCU), Paul Cowley (SAIAB), Laurent Dagorn (IRD), Fabien Forget (IRD), Marc Soria (IRD), Victor Peddemors (SIMS), John Filmlter (SAIAB), Paul Butcher (SIMS, Southern Cross University), Greg Brett (East London Museum), Adam Barnett (JCU, Biopixel)

Theme: *Climate change* | Talk 43

The impacts of climate change on marine ecosystems by secular warming are well established. Recently, the lasting effects of extreme heatwaves have emerged as an additional threat to marine communities. In contrast, the impacts of extreme cold events are poorly understood. Using a multi-method approach we present the first evidence of climate-change induced intensification of upwelling on the coast of South Africa and its impacts on threatened migratory marine species, using the bull shark as a model species. We document intense upwelling events with substantial temperature declines that killed 81 species on the South African coast. Large and mobile marine species occurring near their thermal limits showed behavioural changes, likely to enhance survival of cold events when transiting through upwelling zones. Increases in frequency and intensity of upwelling could result in “bait-and-switch-systems”, where secular climate change expands species distributions, while simultaneously exposing climate-migrants to cold-stun events at distributional limits. This might increase mass mortalities, have severe impacts on range restricted species and potentially reverse range expansions. Our results highlight the complexities and context-dependence of climate change effects on marine ecosystems. We forecast that intense upwelling events will become more frequent on the South African coast and discuss the implications for threatened and endemic fish species.

## **Port Ngqura: Concrete seascapes and the fish that took advantage of them**

Vivienne Dames (RU), Anthony Booth (RU) and Matt Dicken (KZN Sharks Board)

Theme: *Monitoring estuaries and MPAs* | Talk 15

The Port of Ngqura, located 20 km east of Gqeberha (South Africa), underwent significant transformation through extensive dredging of the Coegha River mouth, resulting in its completion in April 2006 and operational status by the end of 2009. This development has created a diverse range of microhabitats within the port including dolosse, rock armour, shallow profile reefs, vertical quay walls, and a small sandy beach at the mouth of the Coegha River. The incredible diversity of fish species recorded within the Port bears no resemblance to what previously existed along this coastline. These species likely utilise the warmer, calm, deep waters of Port Ngqura, where adjacent shores are typically rough. A long-term dart tagging programme has produced a massive dataset and shown incredible biodiversity in this artificial man-made seascape. A total of 12 987 catches have been recorded across 71 species, with 7 722 of those fish tagged. Port Ngqura has become a significant habitat for fish species, serving diverse roles. These roles include enhanced estuarine services, open niches, nursery habitats, and refuge during unfavourable conditions in Algoa Bay. Visual observations and the use of stereo-BRUVs continue to add to the species list and our understanding of why fish species have identified Port Ngqura as a critical habitat. Overall, the Port of Ngqura presents a compelling case study of how human-made alterations to coastal environments can profoundly impact local marine biodiversity, particularly for at-risk species. Understanding the dynamics and ecological roles of line-fish within an artificial seascape is crucial for informed conservation efforts in the face of changing coastal landscapes.

## **An encouraging first attempt at applying deep learning methods to electronic monitoring data: automated catch event detection for longline fishing**

Charlene da Silva (DFFE), Nikki Chapman (WildOceans), M. Rio (University de Lille), Wendy West (DFFE), Anthony Booth (RU), Stephen Lamberth (DFFE), Sven Kerwath (DFFE)

Theme: *Fisheries monitoring* | Talk 20

Accurate fisheries catch data are essential if fisheries are to be sustainably managed. In South Africa, many fisheries have compulsory observer programmes but the coverage is low (<5%) and with poor spatial coverage. Smaller fisheries, such as the demersal shark longline fishery, have been historically bereft of observer coverage except for a few months in 2008/2009. This gap in observer data could be filled by an electronic monitoring system (EMS). The demersal shark longline fishery has been controversial since its inception and has been the focus of negative press around allegations of high mortality rates of Endangered, Threatened and Protected (ETP) species. To improve observer coverage and to monitor ETP species, the DFFE in collaboration with WildTrust and the fishery initiated a collaborative project to install an EMS on an active vessel. To date, 13 665 videos have been collected since December 2023 with 3 538 videos processed for still images. An initial run analysed 113 still images of sharks, batoids, and teleosts from the processed videos were uploaded to BIIGLE, resulting in 337 annotations and then analysed in YOLOv5, an object recognition algorithm. The initial model was trained using 75% of the images and tested with the remaining 25%. Unannotated images were also used to evaluate the model's performance and feasibility. Species-level identification was not feasible due to the limited number of images. The model, however, successfully differentiated batoids, sharks, and teleosts from each other with a precision of about 72% and recorded a higher species diversity than logbook data. The precision and rate of recall will improve with additional training images. The next stage of the project will use additional deep learning methods to automatically extract video segments of catch events, which would substantially reduce storage space and review time by analysts.

## From movement to management: Results and applications from a longshore movement study on giant kingfish *Caranx ignobilis*

Russell Dixon (RU, SAIAB), Taryn Murray (SAIAB, RU), Bruce Mann (RU, ORI), Paul Cowley (SAIAB, RU), Ryan Daly (ORI, SAIAB), John Filmalter (SAIAB)

Theme: *Fish movement studies* | Talk 2

Giant kingfish *Caranx ignobilis* are iconic, apex marine predators with high importance to tropical and subtropical ecosystems and fisheries. During summer, adults aggregate for spawning, making them vulnerable to overfishing. The world's largest *C. ignobilis* aggregation has been recorded in southern Mozambique, but the year-round movements of these fish required further investigation. To assess movement patterns of *C. ignobilis* along the southern African coast, 36 adult fish were acoustically tagged and monitored along the east coast between Santa Maria in southern Mozambique and Port St Johns in the Eastern Cape, South Africa, for over 5 years using an extensive passive acoustic receiver array. Outside the migration season, South African-based fish showed consistent inter-annual fidelity to individual linear areas of space use (mean = 92 km) equivalent to home ranges. All analysed fish were recorded in southern Mozambique between November and January each year (with minor exceptions), migrating distances up to a maximum of 632 km in one direction, highlighting the importance of the aggregation site for both Mozambican-based and South African-based fish. These movements were fast and direct, with maximum travelling speeds of up to 130 km per 24-hr period. Findings from this study are not only of global ecological relevance but have also contributed to improved local fisheries management. The recently imposed prohibition on targeting or keeping *C. ignobilis* during the summer spawning season in the Maputo National Park where the aggregation occurs is an important intervention for evidence-based management and for the future of this species in southern African waters.



## Unravelling the mystery of a unique giant kingfish *Caranx ignobilis* aggregation in the Mtentu Estuary

Russell Dixon (RU, SAIAB), Bruce Mann (RU, ORI), Taryn Murray (SAIAB, RU), Paul Cowley (SAIAB, RU), Ryan Daly (ORI, SAIAB)

Theme: *Monitoring estuaries and MPAs* | Talk 14

A globally unique and unexplained recurring summer aggregation of up to ~1 000 giant kingfish *Caranx ignobilis* in the surface waters of South Africa's Mtentu Estuary, which forms part of the Pondoland Marine Protected Area, has warranted investigation for both scientific intrigue and management purposes. With the aim of understanding various aspects of their movement patterns, 10 individuals ranging from 430 to 1 030 mm FL were tagged with acoustic transmitters in the estuary and subsequently monitored by passive acoustic receivers in the estuary and adjacent coastal environment for up to 3.6 years. Results showed clear patterns, including repeated daily migrations between the upper estuary (~4km upstream) during the day and the sea or mouth region at night. Statistical modelling revealed that sea temperature was the main environmental variable influencing their daily presence/absence in the estuary. During summer, the daytime temperature in the surface waters of the deep and thermally stratified Mtentu Estuary may be 3 to 6 °C warmer than subsurface waters, providing a more suitable thermal environment for this tropical to subtropical species. Notwithstanding the possibility of other drivers, we propose the hypothesis that adult *C. ignobilis* utilise the near pristine Mtentu Estuary during periods of cold coastal upwelling primarily as a thermal refuge, specifically for daily re-warming after nocturnal feeding in cold water. The maintenance of this site as a no-take (no fishing) zone, as well as encouraging tourism-linked incentives to increase local custodianship, are strongly recommended to protect this vulnerable aggregation.

# A new physiological model to forecast the climate response of linefish

Murray Duncan (University of Seychelles)

Theme: *Climate change* | Talk 41

Climate change is driving warming and deoxygenation of the world's oceans, directly affecting physiological rates of organisms and the fitness related processes they regulate. When conditions become sub-optimal, species may shift their distributions to maintain physiological functioning, but the direction and magnitude of these shifts in relation to environmental change is variable, complicating proactive management. Temperature and oxygen dynamics are particularly variable along South Africa's coastal zone driven by upwelling dynamics. Forecasting focal species distribution responses through physiological frameworks can improve accuracy and inform these management policies, but a generalizable physiological model that can discern a thermal optimum and incorporate effects of oxygen availability does not exist. Here we build on principles of metabolic physiology and develop an absolute metabolic index ( $\Phi_A$ ) that quantifies a species' absolute aerobic scope, but with higher explanatory power across the entire range of oxygen and temperature conditions animals are exposed to in the wild. We show that  $\Phi_A$  has strong predictive utility for discerning the environmental optima for marine species. Furthermore, we apply this new framework to previously published metabolic data for the endemic roman seabream *Chrysolephus laticeps*, showing that  $\Phi_A$  has more predictive skill than aerobic scope models. This study highlights the important role of oxygen availability in setting the thermal preference and limits of aquatic species. Since South Africa's oxygen and temperature dynamics are predicted to become even more variable in the future; it is important that studies assessing focal species' climate resilience consider both these environmental variables.

# The influence of habitat association on the tolerance of coastal fish to future coastal acidification

Carla Edworthy (NMU), Nicola James (SAIAB)

Theme: *Climate change* | Talk 48

Although the nursery function of vegetated coastal habitats (such as seagrass and macroalgae) for economically important coastal fish species is well documented, other ecosystem services provided by these important habitats have received less research attention. The influence of global carbon dioxide emissions on global seawater chemistry resulting in ocean acidification (OA) has been broadly documented and there has been a recent increase in research that acknowledges the potential for marine vegetation, such as macroalgae and seagrass, to modulate local pH conditions through biotic processes and thereby serve as ocean acidification refugia for marine organisms. The majority of research on this has focused on marine invertebrates like bryozoans, foraminifera and coralline algae, and much less has been done on fish. Our research has shown much greater variability in pH in vegetated macroalgal and seagrass habitats than in sandy habitats in Algoa Bay and St Francis. Although blacktail *Diplodus capensis* is found in a range of coastal habitats, vegetated habitats (seagrass and macroalgal reef) provide high quality nursery habitats for this species (shelter and food). Late-stage blacktail larvae caught in vegetated reef were shown to be physiologically and behaviourally tolerant of extreme pH variability (8.2 – 7.2 pH) that far exceeds what is expected from coastal acidification alone. This may be a result of the exposure of this species to high variability in pH in its nursery habitats, and the physiological plasticity of this species which enables it to tolerate this variability in the absence of other stressors. However, there is a need to investigate the physiological link between habitat association, most likely related to food availability and energetic trade-offs, and individual fitness. Expanding this understanding to individuals from other juvenile habitats as well as to other coastal species is essential information for the conservation of coastal fisheries species and the habitats they depend on.

# Global systematic review of the lethal and sublethal impacts of catch-and-release fishing

Matthew Farthing (RU), Alexander Winkler (RU), Warren Potts (RU), Simon Weltersbach (Thunen Institute of Baltic Sea Fisheries), Keno Ferter (Institute of Marine Research), Kieran Hyder (Centre for Environment, Fisheries and Aquaculture Science [CEFAS]), Zachary Radford (CEFAS), Robert Arlinghaus (Humboldt-University), Sean Tracey (University of Tasmania)

Theme: Fisheries management | Talk 26

There is burgeoning global consensus that recreational fisheries (RFs) are of conservation concern. Evidence now suggests that RFs are larger and more impactful than previously assumed. While harvest by RFs is acknowledged as a source of significant biomass removal, the lethal and sublethal impacts of catch-and-release (C&R) fishing are generally poorly understood. This hampers effective management by: limiting the incorporation of RFs into stock assessments and quota allocations; precluding incorporation of C&R as a management tool in strategic conservation planning; and by driving stakeholder conflict in regions where welfare concerns affect RFs social license and the societal acceptance of C&R as a sport or management measure. It is known that the impact on fishes subjected to C&R depends on many factors, including fish biology and physiology; environment and context; fishing techniques; and the angler's behaviour, attitudes and practices. Since the last seminal reviews (ca 2005-2007) of C&R impacts, interest in assessing the impact and factors associated with C&R has grown exponentially. Recent works have expanded the list of species and factors assessed, as well as the experimental methods used to assess impacts. This study will build on methods of previous C&R literature assessments to undertake a global systematic review of trends and factors associated with lethal and sublethal impacts of C&R across taxa, gears, techniques, fisheries and environmental conditions. We will include peer-reviewed and grey literature using structured and reproducible database searches. Following this, we will undertake a quality assessment of C&R studies to date using the ICES WGMEDS critical review framework for discard studies (ICES 2021). This work is expected to provide the most comprehensive synthesis of C&R research to date and will provide a much-needed database of quality-weighted, post-release mortality estimates for various species, fisheries and environments.

## **A conservation strategy to halt the decline of kob (*Argyrosomus* spp.) populations in South Africa**

Matthew Farthing (RU), Aidan Wood (Gleneagles Environmental), Amber-Robyn Childs (RU), Bruce Mann (RU, ORI), Romina Henriques (University of Pretoria [UP]), Taryn Murray (SAIAB), Natasha Karenyi (UCT), Alex Winkler (RU), John Filmlalter (SAIAB), Jock Currie (SANBI), Margit Wilhelm (University of Namibia [UNAM]), Warren Potts (RU), Stephen Lamberth (DFFE), Lara van Niekerk (CSIR, NMU), Sean Fennessy (ORI), Seah Ying Giat (IUCN, CDFRLA), Sven Kerwath (DFFE), Natasha Besseling (SANBI), Kerry Sink (SANBI, NMU)

Theme: *Fisheries* | Talk 52

Sciaenids in the genus *Argyrosomus* (known as kob in South Africa) are important to global temperate and tropical coastal fisheries. *Argyrosomus japonicus*, *A. inodorus* and *A. thorpei* are highly desirable in southern African fisheries. These threatened southern African endemics (IUCN; stocks collapsed by 1990s) continue to be heavily exploited, primarily by a complex, multi-sectoral linefishery. Additionally, susceptibility to climate change, altered ecological processes (e.g. fluvial discharge) and declining essential fish-habitats (e.g. estuaries) are concerning. This prompted a planning initiative (IUCN SCS framework) to develop a strategy to recover these species in South Africa. Using multi-stakeholder workshops, a team of sciaenid experts, NGOs, managers and researchers developed an action-oriented strategy to recover South African kob stocks to sustainable population levels. Amidst the myriads of direct threats identified, growth and recruitment overfishing by the marine recreational sector is perhaps the most significant. Inadequate management, perceived illegitimacy of management agencies, inadequate regulations, poor enforcement, increasing non-compliance, declining fear of penalty, poor behavioural norms, poor catch-and-release practices, data-deficiencies and species confusion are some of the significant constraints and drivers of this threat. Whilst the traditional stock-assessment approach to management of the South African Linefishery is suitable for the commercial and small-scale sectors, it has failed to adequately manage the recreational fishery, which is by far the largest (>450 000 participants). Consequently, alternative management strategies are essential for a swift response to population declines. At the core of strategic actions planned is a Community-Based Social Marketing intervention to promote otherwise unenforceable behaviours to the recreational angling community. Drawing from the latest research on improving angler behaviour, this intervention will use a suite of behaviour change tools including voluntary institutions, social nudges, normative interventions and communication campaigns curated specifically for the user communities adjacent to critical habitats, as well as those groups defined by their style-of-participation.



## Fishy business in Richards Bay

Sean Fennessy (ORI)

Theme: *Fisheries management* | Talk 54

As part of a catch and effort survey of commercial and recreational marine linefisheries in Richards Bay some years ago, an interview-based survey of shoppers at a mall was undertaken to assess patterns in consumer demand for linefish. A total of 170 consumers were interviewed, with slightly more female than male interviewees, and about half the interviewees were white; ethnicity was reasonably representative of the population of Richards Bay at the time. Household size was 4.1 people, and an average of 1.1 people per household fished in the sea or estuaries; an average of 3.6 people per household ate fish of some type. Only 5% of interviewees said their households did not consume fish of any sort while 28% said their households did not consume linefish. Almost half the interviewees said that their household consumed fish 2-5 times per month. Of the 122 interviewees who said that they ate linefish, the majority said that they mostly/sometimes bought their linefish from supermarkets or fish shops, but many also said that they mostly/sometimes caught their own linefish, or were mostly/sometimes given linefish; only 13% said that they bought their fish from recreational anglers. Based on the volume of catch made by commercial ski-boats in Richards Bay, and the volume of locally caught fish by commercial ski-boats in Richards Bay, it appears that consumers must be buying considerable quantities of fish from recreational anglers.

## **Thermal tolerance of wild caught dusky kob *Argyrosomus japonicus* individuals**

Josh Frachet (RU), Amber-Robyn Childs (RU), Warren Potts (RU), Matthew Farthing (RU), Alexander Winkler (RU)

Theme: *Climate change* | Talk 44

Globally fish are facing the increasing pressures of various anthropogenic activities which influence fish directly and indirectly. One of the direct activities influencing fish populations and communities is fishing pressure. In South Africa, the marine shore-based recreational fishery places a significant direct pressure on fish stocks. Stock declines are exacerbated indirectly by climate change pressures such as ocean acidification, increasing sea surface temperatures, thermal variability, and intensifying upwelling cells. Coastal fisheries in South Africa are crucially important economically, socially, and ecologically, and their sustainability is crucial for livelihoods. Fishing is known to remove the fittest individuals able to tolerate greater temperature extremes. Understanding how the remaining fish will respond to changing temperature, (behaviourally and physiologically) is crucial to knowing the possible adaptive capacity of these exploited populations. Ectothermic fish have been shown to develop behavioural adaptations as a first response to changing environmental conditions. These behaviours however are driven by physiological processes. Therefore, an individual's physiological and behavioural phenotype will determine adaptability to rapidly changing environments. Populations with a large phenotypic diversity will likely have increased resilience to climate change. This study examines the link between physiology and behaviour of dusky kob *Argyrosomus japonicus* to understand their adaptive capacity. We will capture 20 dusky kob individuals from the Kowie Estuary, Eastern Cape, assess their thermal tolerance to classify individuals into physiological phenotypes. They will then be tagged using acoustic transmitters and released at their capture site, and their movement will be monitored in relation to their physiological phenotype and in-situ temperature. This will contribute to the existing knowledge on fish physiology and improve our understanding of the adaptive capacity and resilience of important coastal species to the ever-increasing impacts of human-induced global change.

## Linefish bycatch in the trawl fishery: trends, areas and species associations

Kim Greenwood (UCT), Colin Attwood (UCT)

Theme: *Fisheries* | Talk 51

The inshore trawl fishery has traditionally caught a wide variety of species on the shallow Agulhas Bank, despite the nominal hake and sole targets. Included in the catch are several species which overlap with the traditional linefishery, and which are caught in similar volumes by both fisheries. We examine trends in abundance, areas of capture and species associations in the trawl fishery for silver kob *Argyrosomus inordorus*, carpenter *Argyrozona argyrozona* and white stumpnose *Rhabdosargus globiceps*. Standardised catch-per-unit-effort (CPUE) trends since 1990 for silver kob show cyclical variation, but no long-term trend. In contrast, carpenter and white stumpnose both show dramatic recent recoveries. The two seabreams may have recovered after a relaxation of trawl effort, first by the Japanese foreign fleet and secondly by the South African inshore trawl fleet. Silver kob and white stumpnose are trawled predominantly in winter, between Cape Infanta and Mossel Bay and off Algoa Bay. Carpenter are trawled in cooler water on the central Agulhas Bank and off Tsitsikamma. Each of the three species appear in distinct species assemblages in trawl catches, suggesting different habitat associations and an opportunity to use spatial management to adjust pressure on these stocks without impacting the overall hake catch. Sole and silver kob co-occur in catches, unfortunately. Spatial overlap with the linefishery is greatest for silver kob and white stumpnose. Competition between the fleets is most intense for the red-listed silver kob, as trawlers catch young fish, while linefishers catch mature fish.

## Insights from genetic and ecological knowledge for conservation management of rhino rays from the Western Indian Ocean

Mia Groeneveld (Stellenbosch University [SU]), Juliana Klein (SU), Rhett Bennett (Wildlife Conservation Society), Aletta Bester-van der Merwe (SU)

Theme: Genetics | Talk 37

Rhino rays are highly threatened by overfishing (mostly as bycatch, but increasingly retained and targeted for their fins and meat), combined with climate change and low reproductive productivity. Catch and landing rates suggest drastic declines throughout most of their distributions. Yet, a lack of species-specific knowledge and taxonomic uncertainty persists, particularly for guitarfishes (*Acroteriobatus* spp.) and wedgefishes (*Rhynchobatus* spp) in the Western Indian Ocean (WIO). Delineating populations and understanding the genetic connectivity of exploited species are important for their conservation management. When biological data from different species are pooled, species-specific fishery and demographic data can be overestimated or underestimated. This study investigated the population genetic structure of *Rhynchobatus djiddensis* and *R. australiae* from different locations across the WIO using a dual marker approach: (1) two mitochondrial gene regions (*COI* and the control region; n = 117), and (2) nine nuclear microsatellite markers (n = 146). The two species were delineated based on both marker types. For *R. djiddensis*, the sampling locations of South Africa and Mozambique were genetically homogeneous. For *R. australiae*, significant differentiation was found between sampling locations, with Madagascar and Tanzania being genetically the most similar. This information provides critical insights into the distribution range and stock structure of the whitespotted wedgefish species complex, highlighting priority populations and supporting the sustainable management of wedgefishes. However, detailed molecular attention is still necessary to resolve taxonomic issues and define appropriate spatial scales and stocks for rhino ray management. As such, further research will focus on expanding species-specific information for guitarfishes and wedgefishes within the WIO region using molecular taxonomy, population and seascape genomics, and community-based surveys. By combining scientific findings with local ecological knowledge from water users like fishermen and divers in coastal communities, a more realistic and equitable approach to conservation management of rhino rays can be taken.

## **Identifying key research areas, angler compliance and perspectives on current regulations that aim to promote co-management and sustainability of the marine recreational fishery in Namibia**

Natanah Gusha (Department of Fisheries and Ocean Sciences, [DFOS], UNAM), Angelika Veii (DFOS), Ndinehafo Nghipangelwa (DFOS), Arariky Shikongo (DFOS), Christopher Bova (RU), Alex Kanyimba (UNAM), Georg Engelhard (University of East Anglia), Kieran Hyder (CEFAS), Bernadette Snow (University of the Highlands and Islands, UK), Warren Potts (RU), Margit R. Wilhelm (UNAM)

Theme: *Angler engagement* | Talk 33

Recreational fishing is popular worldwide, but many low- and middle-income countries (LMICs) are experiencing increased participation and reduced catches. Like other LMICs, the recreational fishery in Namibia is facing concerns regarding its sustainability. Empirical evidence suggested limited knowledge of the fish and fishery as one plausible cause. Fisheries management using knowledge of stock status have been mostly applied through a traditional top-down approach. In isolation, this approach is unlikely to work for recreational fisheries, where there are various stakeholders at different levels. A combined bottom-up-ecosystems-based approach is therefore necessary. However, this is challenging as it requires a shift in social science understandings of fishing towards context and interrelationships between fishers, the environment, and legislative bodies. This however does not exist for most fisheries. In an effort to address this, we carried out an onsite survey of shore-based angling in Namibia to evaluate angler compliance, behaviour and perceptions towards the regulations, management, and opinions regarding catch. Approximately 40% of anglers are motivated to fish for livelihood support. From the 235 anglers interviewed, there was a high level of non-compliance, which appears to be largely attributable to poorly defined regulations, and a lack of enforcement and limited access to information. Many anglers had limited knowledge or were confused by the complexity of some regulations (e.g. bag limit of maximum size). In addition, most had little appreciation of good handling practices, possibly due to the information not being readily available. Respondents highlighted issues such as the need for stricter regulations for both recreational and commercial fisheries, inclusion of volunteer anglers in enforcement, and re-evaluation of bag and size limits. We therefore recommend use of fisher ecological knowledge as critical point of synergy among anglers, scientists, and government to support and improve future management of coastal angling and sustainability of Namibian recreational fisheries.

# **An assessment of physiological metrics to inform the classification of phenotypes within fish populations, using dusky kob, *Argyrosomus japonicus* as a case study**

Christian Hempel (RU), Warren Potts (RU), Amber-Robyn Childs (RU)

Theme: *Life history and ecological studies* | Talk 11

The anthropogenic impacts of climate change and overharvesting are threatening coastal ecosystems and the maintenance and diversity of our marine, coastal and estuarine fish resources. Since coastal fisheries are important socially, politically, economically and ecologically, their sustainability directly impacts the livelihoods and well-being of coastal communities. It has been shown that fishing removes fit individuals from populations (i.e., those fish which are better able to cope with temperature extremes), leaving behind individuals that are less likely to cope with these changes. Understanding how fish, especially exploited populations, will respond behaviourally and physiologically to temperature extremes will provide crucial information on the potential adaptive capacity of exploited populations to climate change. This study aimed to develop a framework in which one can assess the link between physiology and behaviour of fishes and improve our understanding of the adaptive capacity of our coastal fishery species to climate change. We sought to identify the most benign physiological laboratory-based assessment that can be used to categorise a fish's physiological phenotype so that they can then be tracked (using acoustic telemetry) in the wild to better understand the link between environmental drivers and fish physiology and behaviour in the wild. Repeated measures respirometry was carried out across a range of temperatures on individual dusky kob, *Argyrosomus japonicus* using an intermittent flow methodology to capture discrete metabolic rates which includes the standard metabolic rate, maximum metabolic rate and aerobic scope. Dynamic thermal tolerance experiments were then conducted on the same individuals to estimate their critical thermal maximum (CT<sub>max</sub>) and minimum (CT<sub>min</sub>) temperatures. The range of metrics collected will then be compared (using a percentile method) to assess their utility in classifying physiological performance phenotypes within the population.

# **On the importance of including molecular data in connectivity and forecasting studies of marine coastal fishes in South Africa**

Romina Henriques (UP), George Brett (UP), Phindile Ntuli (UP), Kelvin Hull (UP)

Theme: *Genetics* | Talk 36

Ongoing climate change is rapidly transforming marine ecosystems and communities throughout the world's oceans. Changes in sea surface temperatures and pH are considered two of the main drivers of latitudinal distribution shifts in marine fishes. Forecasting models that predict range shifts are thus essential to anticipate and mitigate potential conflicts and the subsequent socio-economic impacts of a moving resource. In order to distinguish among the multiple drivers behind range shifts it is necessary to understand the evolutionary dynamics that shaped current patterns of diversity, and, in particular, to identify the genomic basis of how fish are adapted to their local environmental niche. Understanding such local adaptations might aid forecasting models to predict which populations are likely to persist, expand or disappear under different climate scenarios and under which time frame. Furthermore, the contribution of fisheries to current levels of genomic diversity, as well as its adaptive significance, needs to be taken into consideration when establishing the vulnerability of a species to climate change, as decades of exploitation are likely to incur evolutionary consequences. In South Africa, genetic research of marine coastal species has generally relied on a handful of neutral markers, either mitochondrial DNA or nuclear introns and microsatellites, with majority of species studied showing extensive connectivity across the region. However, recent sequencing advances, which allow thousands of genome-wide markers to be obtained, have revealed evidence of local adaptation and cryptic population structure in regional marine species. Inclusion of genomic data into marine spatial planning and forecasting models also highlighted regions previously unrecognized as important for conservation of local marine biodiversity. Therefore, genomic data needs to routinely be included in species distribution models and marine spatial planning actions.

## Comparisons of contemporary and historical catch and effort estimates of the recreational marine shore-based fishery

Kyle Hewett (RU), Christopher Bova (RU), Kieran Hyder (CEFAS), Warren Potts (RU)

Theme: *Fisheries monitoring* | Talk 21

The recreational marine shore-based fishery in South Africa (MSBF) has more active participants than any other sport in the country and generates more than ZAR 14 billion in economic activity per year. Unfortunately, not all the impacts of recreational fishing are positive and to better manage the fishery, careful attention needs to be paid to monitoring and managing the fishers themselves. The aim of this study was to determine estimates of catch and effort of the MSBF mostly by replicating methods used by Brouwer et al. (1997) to retain comparability. A total of 641 four-hour patrols were conducted from May 2022 to May 2023 in the Eastern and Western Cape. A total of 1 001 (92% acceptance rate [AR]) and 811 (74% AR) anglers were interviewed in the Eastern Cape and Western Cape, respectively. The modal age class of anglers was 41-50 years of age and 97% were male. Overall angler density increased from 0.39 anglers per km in 1997 to 0.90 anglers per km in the Eastern Cape but decreased from 1.29 anglers per km (1997) to 0.88 anglers per km in the Western Cape. The dominant species observed in the catch were blacktail *Diplodus capensis* (n = 184), shad *Pomatomus saltatrix* (n = 105) and white steenbras *Lithognathus lithognathus* (n = 65) in the Eastern Cape and galjoen *Dichistius capensis* (n = 59), blacktail (n = 53) and lesser guitarfish *Acroteriobatus annulatus* (n = 51) in the Western Cape. The number of fish captured and the catch-per-unit-effort (CPUE) in the fishery were significantly lower than when compared to 1997. The changes in effort distribution, species composition and CPUE reflect a highly dynamic fishery that requires careful monitoring and management.



# Embedding marine recreational fisheries in stock assessment and management

Kieran Hyder (CEFAS, University of East Anglia [UEA])

**Theme: Keynote address | Wednesday 21<sup>st</sup> August 2024**

Fisheries are complex social-ecological systems that have strong cultural significance, support livelihoods, and provide food. Marine recreational fishing (MRF) is an important component of this system as it is high-participation activity with large economic value and social benefits globally, but can impact on fish stocks. The diverse and dispersed nature of the activity alongside the variety of motivations, means that these fisheries are often not well studied. Recreational and commercial fisheries exploit common stocks, bringing them into conflict due to competing and different needs, especially where stocks are depleted and boundaries between sectors are unclear. Despite their importance, MRF can be excluded from fisheries assessment and management, which may impact on the ability to manage fish stocks within sustainable limits and maximise societal benefits generated from this common pool resource. This talk will examine the challenges associated with embedding MRF in fisheries governance and provide examples of successful approaches from across the globe. Bespoke solutions are needed that may vary between species and locations. A lens will be thrown on Europe to illustrate learning from recent attempts to embed MRF. However, there is no simple solution with similar challenges resulting in common problems and few solutions across the. The South African linefishery is uniquely complex making embedding MRF particularly challenging. As a result, co-designed social-ecological systems approaches are needed to effectively manage stocks and maximise societal benefits.

## Growth rate extremes of a sciaenid in an ocean-warming hotspot

Charmaine Jagger (UNAM, DFOS), Warren Potts (RU), Brett Pringle (RU), M. Hadi Bordbar (Leibniz Institute for Baltic Sea Research Warnemünde), Romina Henriques (UP), Niall McKeown (Aberystwyth University), Margit R. Wilhelm (UNAM, DFOS)

Theme: *Climate change* | Talk 40

In this study we developed a 34-year otolith biochronology for silver kob *Argyrosomus inodorus*, a cool-water Sciaenid, found in the northern Benguela off Namibia, making up the highest catches in the recreational shore-based fishery. The linear mixed-effects models fitted to the *A. inodorus* otolith biochronology indicated that the best linear unbiased predictor of growth was significantly positively affected by mean sea surface temperatures (SSTs) in September of the year of formation and significantly negatively affected by mean summer SSTs (in November each year) in the central Namibian area (20-24 °S, 12-14 °E). Thus, faster annual growth was observed during warmer spring temperatures (increasing up to 15 °C), but slower growth was noted when exposed to warmer summer temperatures above 16 °C. This indicates a low thermal tolerance plasticity of *A. inodorus* and highlights the vulnerability of this species to future enhanced ocean warming predicted for this hotspot at the northern boundary of the northern Benguela. Thus, our findings suggest future narrowed distribution ranges and consequently temporary higher catch rates, and potentially recruitment failures. Our findings further suggest that fisheries selectivity likely influenced *A. inodorus* growth rates, which implies that fisheries-induced evolutionary changes had occurred in this heavily exploited Sciaenid found along the Namibian coast.

## Seagrass density and macroalgal heterogeneity influence nursery quality for sparids in nursery seascapes

Nicola James (SAIAB), Janine Adams (NMU), Amber-Robyn Childs (RU), Christian Hempel (RU), Lucienne Human (South African Environmental Observation Node [SAEON]), Shirley Parker-Nance (SAEON), Thembanani Mkhize (NMU), Taryn Murray (SAIAB), Anusha Rajkaran (University of the Western Cape [UWC]), Gavin Rishworth (NMU), Paul-Pierre Steyn (NMU), Rebecca Welch (SAIAB)

Theme: *Life history and ecological studies* | Talk 12

Habitat features that create site-specific or local variability in nursery quality for exploited species need to be examined to help prioritize management efforts to halt the decline of key habitats and fish abundance in particular areas. This information is critically important to both understand global change threats to the nursery function of habitats and managing, conserving and restoring high-quality nursery habitats as a means to replenish adult fish populations in particular areas. Juvenile fish are thought to actively use/select habitat within nursery seascapes based on food availability and predation risk, with high quality nurseries providing both shelter and food for juveniles. Using a multi-disciplinary approach, we showed that shallow littoral habitats dominated by submerged macrophytes (eelgrass *Zostera capensis* and red algae *Plocamium* spp. and *Laurencia* spp.) in Algoa Bay are important nursery habitat for several sparids exploited in the shore-based linefishery. Seagrass provides abundant food resources (epiphytes and invertebrates) for juvenile Cape stumpnose, with juveniles actively selecting dense seagrass for shelter. In contrast to seagrass beds, which are often overwhelmingly dominated by one macrophyte species, on sublittoral reefs several different macroalgal species may occur offering a variety of resources, camouflage and refuge spaces. On rocky sublittoral reef, low growing macroalgae (*Laurencia* spp. and turf algae) provide more food resources for juvenile strepie *Sarpa salpa* and blacktail *Diplodus capensis*, than canopy-forming *Plocamium* spp. However, canopy forming algae offers greater shelter from predation than low growing algae, with high habitat heterogeneity (structural complexity and composition) promoting nursery function for strepie and blacktail. The location of sparid nursery habitats at the interface between the terrestrial and aquatic environment makes these habitats particularly vulnerable to anthropogenic impacts. Loss or modification of habitat features that promote juvenile fitness may ultimately impact adult population viability.

## The ORI Cooperative Fish Tagging Project – Celebrating 40 years down the line

Gareth Jordaan (ORI), Bruce Mann (ORI, RU)

Theme: *Angler engagement* | Talk 30

Fish tagging has a history dating back to the mid-1800s. In South Africa, numerous tagging projects have been initiated, yet many have failed to produce substantial results, often leaving data unpublished or unused. The ORI Cooperative Fish Tagging Project (ORI-CFTP), however, stands out as a notable exception. Celebrating its 40<sup>th</sup> anniversary in 2024, the ORI-CFTP has evolved from what started off as a simple idea of tagging elf/shad *Pomatomus saltatrix* to try and better understand their movements, into one of the longest ongoing operational and most successful citizen science projects of its kind in Africa, ranking with many other top volunteer tagging projects from around the world. With more than 386 000 tag releases, 24 600 (6.4%) tag recaptures and 7 370 tagging members, this project has not only allowed anglers to actively participate in collecting scientific data, but has provided collaboration between fishermen, managers and scientists, and has helped increase our knowledge and improved management of many important linefish species. Furthermore, the project has made a considerable contribution towards improving the conservation ethics and behaviours of marine recreational anglers in South Africa. The large number of anglers that have joined the project have not only learnt about tag and release, but also about the importance of correct fish capture and handling procedures to ensure their greatest chance of survival. This presentation will look at the history of the ORI-CFTP, the improvements that have been made 40 years down the line, the goldmine of data that has been collected and its incredible achievements, including how this project has changed the attitudes and behaviours of anglers over the years.

## The South African linefishery in 2024 - An overview

Sven Kerwath (DFFE), Dawit Yemane (DFFE), Charlene da Silva (DFFE), Stephen Lamberth (DFFE)

Theme: Fisheries | Talks 24 + 25

“Linefishing” is used loosely as a term describing a multitude of fishing sectors in South Africa and includes commercial fishing from large cabin boats with a dozen crew as well as recreational estuarine angling. In its broadest definition, the linefishery is South Africa’s largest fishery, by spatial extent, species and number of participants: Its footprint spans from estuaries up to 50 km inland, to the border of the EEZ, around the entire South African coast. Its catch contains ca. 300 species and approximately 0.5 million fishers participate in linefishing in its various forms. Keeping track of the population status of linefish species is a formidable task and only around 20% of species in the linefishery have ever been assessed. Given the varying availability of input data the linefish stocks are assessed on a tiered system. Eight linefish- and two shark species can be assessed with tier 1 type models JABBA and JABBA-select, as catch-and-effort time series from multiple fisheries, length frequency- and biological data are available. Another 20 to 30 species can be as assessed by tier two assessment models e.g. JARA, using abundance time series and biological information, as their total catch is unknown. For the remaining species, tier three length-based assessment models are the only option to assess their stock status. In this contribution we will provide an overview of the current status of the linefishery, its dynamics, the data and the methods available to assess it, as well as opportunities and challenges for the linefishery in the future.

## **Assessment of the movement behaviour of dusky kob (*Argyrosomus japonicus*) using 39 years of tag-recapture data from the Oceanographic Research Institute's Cooperative Fish Tagging Project**

Thomas Knight (RU), Matthew Farthing (RU), Alexander Winkler (RU), Amber-Robyn Childs (RU), Warren Potts (RU), Bruce Mann (ORI, RU)

Theme: *Fish movement studies* | Talk 4

The dusky kob *Argyrosomus japonicus* is an estuarine-dependent species of great fisheries importance. Previous stock assessments show that ~1.3% of pristine stocks remain after overexploitation, habitat degradation and mismanagement. Conserving *A. japonicus* is challenging due to its similar appearance to three other *Argyrosomus* species, each having different life histories. Understanding *A. japonicus* movement behaviour is critical for effective conservation planning. Previous catch-per-unit-effort (CPUE) data suggested that *A. japonicus* undertake an annual spawning migration from the Eastern and Western Cape to KwaZulu-Natal (KZN). However, recent evidence from acoustic telemetry studies suggests that adult *A. japonicas* are more resident than previously assumed. This study, therefore, aimed to use 39 years of dart tag and recapture records from the ORI-CFTP to assess the movement behaviour of *A. japonicus*. The ORI-CFTP database (1984-2022) contained  $\pm 24\ 500$  *A. japonicus* tagging records, with  $\pm 1\ 600$  (6.5%) recaptures. Because most taggers are unable to correctly distinguish between the three kob species, records were screened using a decision tree to remove records with potential misidentifications. After screening,  $\pm 18\ 500$  (75%) records with 1 420 recaptures (7.7%) remained, comprising mostly sub-adults (52.7%), followed by juveniles (34%) and adults (13%). Of those recaptured, 84% of juveniles and 80% of sub-adults showed no movement, with limited movement in the remainder (juveniles  $\bar{x} = 13$  km; sub-adults  $\bar{x} = 21$ km), suggesting low dispersal before maturation. Of the 184 adults recaptured, 115 (63%) showed greater movement ( $\bar{x} = 65$ km). To assess whether adults undertook a spawning migration to KZN, fish at liberty for <365 days were analysed (n = 61). Only six of these showed movement, and only two displayed characteristic northward migration into KZN during the spawning season (July to September). Results therefore support the shifting paradigm of partial migration, higher levels of residency than previously assumed, and a potential metapopulation structure of *A. japonicus* in South Africa.

## Monitoring and measuring illegal gillnet catches in South Africa

Stephen Lamberth (DFFE), Charlene da Silva (DFFE), Jennifer Olbers (Wild Oceans), Santosh Bachoo (Ezemvelo KZN Wildlife), Sven Kerwath (DFFE)

Theme: *Fisheries monitoring* | Talk 22

Gillnets were introduced to South Africa in 1885 for the targeting of large nomadic, migratory fish such as geelbek *Atractoscion aequidens* on the West Coast. Shark directed gillnetting began in the 1940s driven by the demand for shark liver oil and Vitamin A. The harder/southern mullet *Chelon richardsonii* gillnet fishery expanded in the 1960s as cheaper monofilament gillnets became available. Management became more formal in the 1970s, gillnetting was then restricted to harders and St Joseph shark *Callorhynchus capensis* with limited bycatch allowed. There were several “exploratory” marine and estuarine gillnet fisheries throughout the coastline until the early 2000s, whereupon it became policy to phase out all estuarine gillnetting and restrict the legal marine gillnet fishery to Yzerfontein northwards on the West Coast. Since then, the illicit gillnet fishery has increased substantially throughout the coast in estuaries and the sea. The illicit estuarine gillnet fishery has more participants due to accessibility and less sophisticated gear and vessel requirements than for the sea. However, targeting of large linefish and sharks has increased on the West and South coasts driven by a lucrative market, no restrictions on net ownership or sales and cheap availability of large-mesh gillnets imported from elsewhere. Catch data are limited by the illicit nature of the fishery so comprise mostly that from confiscated nets and catches. Catch estimates are bolstered by extrapolating known catch-per-unit-effort (CPUE) from comparable research gillnetting to lengths (and mesh) of nets confiscated. From 2010 to 2018, mean annual estuarine gillnet catch doubled from 1 134 t to 2 267 t or 60% of the total estuarine catch across all fisheries. Most of this increase occurred in KZN. Since then, there’s been a similar increase in gillnetting throughout the Eastern Cape and total estuarine gillnet catch is now likely to exceed 3 000 t per annum. Illegal marine gillnetting is more sophisticated, concealed and difficult to measure. Nets are deployed permanently as well as stored at sea to avoid detection, with catches being laundered through other fisheries. Each operation may work more than 2 km or more of nets and confiscated catches suggest individual catches of up to 200 t per annum.

## **Catch-and-release norms, attitudes, and perceptions among anglers in the recreational marine shore-based fishery in South Africa**

Kata Lehloeny (RU), Christopher Bova (RU), Amber-Robyn Childs (RU), Matthew Farthing (RU), Warren Potts (RU), Alexander Winkler (RU)

Theme: *Angler engagement* | Talk 35

Overfishing has significantly impacted global fish stocks in recent decades, leading stakeholders to invest in both traditional (e.g., gear restrictions and marine protected areas) and alternative conservation and fishery management strategies (e.g., catch-and-release [C&R] zones and depth/distance-based management). Among traditional methods, marine protected areas (MPAs) are extensively researched and proven effective. However, MPAs are not always favoured by adjacent communities who rely on shore fisheries for sustenance, income, or recreation. Recreational anglers are the dominant stakeholders in South Africa's marine shore-based fishery (MSBF) and their activities negatively impact fish resources. While recreational C&R zones offer a compromise between the conservation benefits and unrestricted access to the MSBF normally associated with an MPA, their efficacy is largely dependent on the perceptions and attitudes of the participants. Reverse beach sweep surveys were conducted to gather information on South African recreational anglers' C&R practices and their attitudes towards C&R zones. Participants were asked about their targeted species, fishing frequency, C&R practices, perceptions of others' C&R practices, motivations for participation, and factors contributing to their satisfaction and enjoyment while angling. Additionally, the survey explored their attitudes towards MPAs, C&R zones, and related processes and their support for implementing C&R zones. The survey was conducted over three months (May – Jul 2024) and targeted anglers in the Eastern Cape Province at popular fishing areas. Participants were randomly chosen within these areas, and an online version of the survey was advertised on an angler-focused Facebook page. Preliminary results indicate support for C&R zones among those currently practicing C&R, although angler motivations seem to influence these support levels.



## **Increasing thermal variability may reduce the survival of larval blacktail seabream *Diplodus capensis***

Michael Mackenzie (RU), Cuen Muller (RU), Warren Potts (RU), Amber-Robyn Childs (RU)

Theme: *Climate change* | Talk 49

Understanding the thermal tolerance of marine fishes is crucial in the face of climate change where ocean temperatures are becoming more variable. Coastal species are expected to experience dramatic changes in thermal regimes over the coming years, the early- or larval-stages of these species are anticipated to be most negatively impacted. This study compared the critical thermal maxima (CT<sub>max</sub>) and minima (CT<sub>min</sub>) of late-stage larval blacktail *Diplodus capensis* acclimated at 18 °C and 22 °C, simulating average contemporary and moderately elevated temperatures for their environment, respectively. Lengths (mm total length) of specimens ranged from 10.6 mm to 20.2 mm (mean = 13.2 mm ± 2.5 SD). After capture, larvae were acclimated for one week prior to experimentation where the water temperature was either increased or decreased by 3 °C/hour until each fish reached their CT<sub>min</sub> or CT<sub>max</sub>, characterised as a loss of equilibrium. The CT<sub>min</sub> and CT<sub>max</sub> of larvae acclimated at 18 °C ranged from 6.3 °C to 8.0 °C and 33.1 °C to 34.7 °C, respectively. In contrast the CT<sub>min</sub> and CT<sub>max</sub> of larvae acclimated at 22 °C ranged from 7.7 °C to 10.9 °C and 34.1 °C to 35.8 °C, respectively. The thermal endpoints of larvae acclimated at 22°C were significantly higher than the endpoints of larvae acclimated at 18 °C ( $p < 0.01$ ). These findings suggest that while *D. capensis* may be able to acclimate to gradual directional changes in temperature, the increasing variability (i.e., increase in frequency and intensity of marine heatwaves and cold upwelling events), predicted in its primary distribution could pose a considerable threat to larval survival. Understanding these thermal responses is vital for predicting how climate-induced temperature changes may impact the survival and distribution of coastal fish populations.

## **The movement patterns of white musselcracker *Sparodon durbanensis* (Family: Sparidae) along the South African coast determined from dart tagging**

Bruce Mann (ORI, RU), Gareth Jordaan (ORI), Wesley Dalton (uShaka Sea World), Ryan Daly (ORI, SAIAB)

Theme: *Fish movement studies* | Talk 3

The white musselcracker *Sparodon durbanensis* is an iconic angling fish species endemic to the east coast of South Africa. Surprisingly little research has been conducted on the movement behaviour of this species and work done up to now has largely focused on small juveniles. Using tag-recapture data stored on the ORI Cooperative Fish Tagging Project, this study investigated movements of fish larger than 25 cm fork length (FL). A total of 3 378 musselcracker were tagged between 1984-2023 (39 years), of which 96 individuals (2.8%) were recaptured. Most fish were tagged and recaptured within marine protected areas (MPAs) such as Tsitsikamma and De Hoop. Results showed that juveniles less than 350 mm FL ( $L_{50}$ ) were highly resident with high site fidelity. However, after reaching maturity, adults showed a significantly greater degree of movement. This movement appeared to be seasonal, suggesting a northward spawning migration up the east coast during winter, with some evidence of a return migration during summer. This pattern of spawning migration has been identified for several linefish species found along the east coast of South Africa and is likely linked to the Agulhas Current and the southward dispersal of eggs and larvae. Future management for this species should include the introduction of a slot size limit as well as the identification of possible spawning aggregation sites which should receive greater protection. Use of fisher environmental knowledge (FEK) could be used to assist this process.

## What about the Taggers?

Judy Mann-Lang (TOAF, RU), Bruce Mann (ORI, RU), Gareth Jordaan (ORI)

Theme: *Angler engagement* | Talk 31

Research has proven the value of the Oceanographic Research Institute's Co-operative Fish Tagging Project (ORI-CFTP) to biological and fisheries research, with more than 95 published manuscripts based on data from the ORI-CFTP. This study was designed to review the ORI-CFTP from the perspective of the participating anglers. A total of 267 members of the ORI-CFTP responded to an online survey designed to gather data on the profile of tagging members, their preferred methods of communication, attitudes towards fish tagging and fish conservation in general, changes in angling behaviour since becoming a member of the Project and support for the continuation of the ORI-CFTP. The results reveal that the ORI-CFTP has made a considerable contribution towards improving the conservation ethics and behaviour of marine recreational anglers in South Africa. Improved communication with anglers – both taggers and non-taggers – through the ORI-CFTP has the potential to amplify much needed conservation information to the broader angling community and thereby enhance environmental awareness. The presentation will also provide recommendations on how to improve the ORI-CFTP and other angling-related marine citizen science projects.

# **Fish, fishers and the future: a spotlight on small-scale fisheries**

Philile Mbatha (UCT, One Ocean Hub)

**Theme: Keynote address | Thursday 22<sup>nd</sup> August 2024**

In underlining the need to promote sustainable fishing, conserving marine and coastal areas and reducing marine pollution, SDG 14 directs our focus to 'life below water' in order to conserve and sustainably use ocean and marine resources. However, what happens 'above water' (i.e., above oceans, rivers and seas), as well as in coastal areas is arguably just as important as this is where people and livelihoods that depend on fisheries exist. There are many misperceptions and misunderstandings about small-scale fishers and their livelihoods when small-scale fisher livelihoods are multi-faceted and complex. For instance, some argue that small-scale fishers fish because they are poor, while others argue that small-scale fishers are poor because they fish. However, for many, small-scale fishing is not a means to an end – it is rather a way of life. Small-scale fisher livelihoods are intertwined with complex histories, socioeconomics, political and other contextual factors that influence their identities, values, customs and norms that inform where, how and why they fish. Needless to say, in various global South and North contexts, the rights of small-scale fishers have been progressively undermined by various interventions and decision-making processes over the centuries and decades, and more recently, various fisheries, ocean and coastal governance tools, strategies and processes continue to undermine the customary tenure, human rights and access of small-scale fishers. These and other challenges facing small-scale fisheries at the global scale, including (but not limited to) climate change and blue economy expansion, have made it necessary to promote the implementation of global tools that spotlight the rights of small-scale fishers within the broader fisheries agenda. The Food and Agriculture Organisation (FAO) *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication* (SSF Guidelines) are useful not just as a set of tools, but exemplary principles for comprehensive small-scale fisheries governance that should be embraced by actors including governments, private sector and civil society. Although significant strides remain to be made in promoting the implementation of SSF Guidelines in country and regional contexts, there is a significant role that academic communities and civil society can play in supporting small-scale fishers and the implementation of the SSF Guidelines at local levels.

## Assessing the effects of exploitation on the activity of a reef dwelling sea bream, *Chrysolephus laticeps* in a thermally variable environment

Nonhle Mlotshwa (RU), Amber-Robyn Childs (RU), Warren Potts (RU), Alexander Winkler (RU)

Theme: *Climate change* | Talk 46

South Africa's coastal environments are changing rapidly with some parts displaying extensive thermal variability. These rapid changes in temperature may push marine fish beyond their thermal tolerance threshold which could lead to shifts in species distribution. Exacerbating the effects of climate variability is exploitation. Recent evidence has shown that exploitation reduces the population's resilience to environmental stressors by reducing physiological diversity within populations through removing physically fit individuals. A recent study compared the relationship between field metabolic rate (FMR) and in-situ temperature of an exploited and unexploited population of a reef-associated commercial fishery species, red roman *Chrysolephus laticeps*, and found that the FMR and activity of fish in the exploited population was lower than that of the unexploited population, particularly at thermal extremes. The aim of this study was to augment our understanding of the impact of exploitation on the activity of *C. laticeps* across a thermal gradient by assessing a different exploited and unexploited population of *C. laticeps* in South Africa. To do this, *C. laticeps* were tagged with accelerometer transmitters in both sites. We found that temperature had a significant effect on the activity of fish in both populations ( $p < 0.05$ ). Fish from the exploited population were less active than those from the unexploited population at warmer temperatures. These findings highlight how exploitation removes high thermal performance phenotypes, compromising the resilience of exploited populations against thermal variability. Our findings highlight the importance of marine protected areas for the promotion of fish populations' resilience in the Anthropocene.

## WWF-SASSI rating of the linefishery – is it theoretical scoring or practical improvements in the fishery?

Kolobe Mmonwa (World Wide Fund for Nature–South Africa [WWF-SA]), Pavitray Pillay (WWF-SA), Craig Smith (WWF-SA)

Theme: *Fisheries management* | Talk 55

The WWF Southern African Seafood Initiative (WWF-SASSI) undertakes regular annual assessment of local fishery resources to guide consumers and retailers on sustainable seafood choices and promoting implementation of sustainable fishery practices. In 2023, 14 linefish resources were reassessed using a newly revised marine common assessment methodology (MCAM) fishery standard. MCAM standard assesses sustainability of the fishery based on three main categories: stock status of the targeted species, ecosystem and habitat impact of the fishery, and management of the fishery. The current method is different to the previously applied standard in that it considers whether there is data available or not to make assumptions on stock status. Furthermore, multiple independent questions are asked on the environmental impact of the fishery including ecosystem and habitat impact, risk and management of ghost fishing gear. Of the 14 linefish resources assessed last year only two species showed improved SASSI rating, namely geelbek *Atractoscion aequidens* improved from red (2015) to orange rating, and catface rockcod *Epinephelus andersoni* improved from orange (2014) to green rating. The remainder of the linefish species retained the same SASSI rating since their preceding assessment undertaken in 2014/2015. In this paper, we show that availability or lack of data and knowledge on the stock status of the linefish resources remains the key criteria in determining WWF-SASSI rating, not necessarily scoring criteria or technicality of the standard. Significant strides have been made in advancing our insights on environmental impact and management of the fishery, but limited knowledge on stock status of several species hinders improvement on WWF-SASSI rating.

## Description of the growth, reproductive biology and feeding habits of the false jacobever *Sebastes capensis*

Taahir Mohamed (UCT), Colin Attwood (UCT)

Theme: *Life history and ecological studies* | Talk 10

The genus *Sebastes* (rockfishes) is a speciose group of marine viviparous fish, of which false jacobever *Sebastes capensis* is the only South African member. *Sebastes capensis* has been confused with jacobever *Helicolenus dactylopterus*, a deeper, trawl caught species. *Sebastes capensis* was the original jacobever, having got its name from a likeness to a ship captain of similar appearance. *Sebastes capensis* occurs on reefs down to at least 100 m on the west coast, but is found also at Tristan da Cunha, Gough Island and off Argentina. The deep body and bright colours are consistent with its deep water habitat. It is caught as bycatch in the snoek handline and lobster trap fisheries. To obtain life history information on this largely unknown species, 266 specimens were caught and dissected. The length–mass relationship suggests isometric growth:  $\text{Mass(g)} = 1.54 \times 10^{-5} \text{ TL(mm)}^{3.026}$ . The best fit von Bertalanffy growth model is  $\text{TL(mm)} = 340.6 \times (1 - e^{-0.169(t + 2.75)})$ . Growth rate is at least 50% faster, and  $L_{\infty}$  30% smaller, than reported at Tristan da Cunha. Males dominate the sex ratio (2.69:1). Males reach 50% maturity at 3–4 years of age (216 mm TL), while females reach 50% maturity at 5 or 6 years (251 mm TL). There is evidence that *S. capensis* may be a multiple brooder, with an estimated fecundity of over 50 000 larvae per batch. *Sebastes capensis*' diet consists primarily of malacostraca (%PSIRI = 80), followed by teleosts (%PSIRI = 17). *Sebastes capensis* is a slow-growing, late-maturing species. It is likely vulnerable to overfishing, as is the case with rockfishes generally.

## Effects of environmental variables on movement and habitat-use of four Mugilidae species in the Kowie estuary, South Africa

Dinah Mukhari (RU), Bantony Ziko (RU), Matthew Parkinson (SAIAB), Amber-Robyn Childs (RU), Taryn Murray (SAIAB)

Theme: Fish movement studies | Talk 5

Estuaries function as critical transition zones connecting freshwater and marine ecosystems. These environments are highly valuable due to their fish resources, which contribute significantly to high-protein food supplies, income generation, and recreational activities for local communities. In South African estuaries, smaller-bodied fish species, particularly those within the Mugilidae family, are predominant and are frequently harvested for subsistence purposes or as bait for larger fish species. These Mugilidae species, while estuarine-dependent, also utilize adjacent freshwater and marine habitats at various life stages. Their movement patterns are influenced by environmental variables (e.g., temperature, salinity, tidal cycles) and biological factors (e.g., size, life stage). This study utilized acoustic telemetry to examine the movement patterns and habitat use of four mugilid species within a permanently open estuary in South Africa. A total of 52 individuals—comprising 21 flathead mullet *Mugil cephalus*, 14 striped mullet *Chelon tricuspiciens*, 12 grooved mullet *Chelon dumerili*, and six southern mullet *Chelon richardsonii* were tagged and monitored over a one-year period. Home range estimation (95% Kernel Density Estimation) indicated a variety of habitat use patterns by all the species with some individuals (two *C. tricuspiciens*, two *C. richardsonii*, four *M. cephalus*) exhibiting return movements to adjacent estuaries. *Mugil cephalus* demonstrated a more extensive home range encompassing the entire estuarine length, however, the other species showed evidence of habitat partitioning. These findings are consistent with the existing literature, which documents the extensive movements of *M. cephalus* across diverse temperature and salinity gradients, an adaptive strategy that facilitates their widespread distribution. Understanding the environmental and biological determinants of these movement patterns is essential for predicting fish movements and ensuring the protection of critical habitats.



## **Knowledge to power: understanding the impacts of marine protected areas (MPAs) on the commercial linefishing sector in KwaZulu-Natal as a first step towards sustainable MPA governance**

Enya Munting (RU, SAIAB), Anthony Bernard (SAIAB), Jessica Cockburn (RU), Bruce Mann (ORI, RU)

Theme: *Angler engagement* | Talk 32

Marine protected areas (MPAs) in South Africa are typically gazetted with stated objectives. Recovery of linefish resources and fisheries sustainability is the third most stated objective countrywide and is gazetted for all KwaZulu-Natal's (KZN) MPAs. Another common objective among them is maintaining cultural heritage. My MSc looks at providing a baseline from which to measure the impacts of the MPAs in KZN on the commercial linefishing sector – one of the oldest fishing sectors in the country. These impacts were measured from an ecological and social perspective for a holistic understanding. To measure ecological effectiveness, Baited Remote Underwater Stereo-Video (stereo-BRUVs) footage was used to compare fish populations inside and outside five MPAs, focusing on species found on mesophotic reefs which are important to the commercial linefishing sector. However, indicators of ecological progress in conservation projects are no longer enough: in the Anthropocene, we must consider humans as part of the systems we manage. MPAs are a case in point: compliance plays a disproportionate role in determining their effectiveness, and the perceptions of communities living adjacent to MPAs are strongly linked to their willingness to support and abide by their rules. Therefore, the perceptions of commercial linefishers regarding the ecological and social impacts of MPAs and their management were gathered by means of open-ended, face-to-face interviews. Initial results indicate that most MPAs are ecologically effective, with no-take areas containing more and bigger linefish species than exploited areas. However, fishers' expert knowledge indicates that the sustainability and overall effectiveness of the MPA network are compromised by insufficient and ineffective enforcement, as well as insufficiently diverse sources of information for decision-making processes. The future management of MPAs in KZN would benefit from greater stakeholder inclusion and better adaptive management planning.

## **Movement and management: How acoustic telemetry can aid in the management of important coastal linefish species**

Taryn Murray (SAIAB), Matt Parkinson (SAIAB)

Theme: *Fish movement studies* | Talk 1

Fisheries management, while straight forward in theory, is a complicated process incorporating multiple layers of data. Electronic tracking is providing unprecedented insights into the movement behaviour of aquatic species. While fisheries science acknowledges the importance of these data, the uptake of this information into fisheries management has been slow. South Africa's collaborative nationwide network of marine and estuarine acoustic receivers – the Acoustic Tracking Array Platform (ATAP) – is currently monitoring the movements of 39 species of recreational and/or subsistence/commercial importance, including 13 fishes, 17 sharks, one skate and eight rays. Together, these animals have amassed more than 25 million detections, representing a significant amount of data. These data are useful to management authorities in that they provide presence/absence data over time, how important certain areas are to multiple species, information on connectivity between different habitats, stretches of coastline and between marine protected areas, and timing of longshore and/or inshore/offshore movements and/or migrations. Additionally, the environmental drivers behind these movements can be identified, which is important for understanding how the distribution and movements of coastal fishery species may change given a changing climate. This presentation will showcase some of the movement research conducted or currently being conducted in South Africa, and how these data can be incorporated into relevant management plans.

## **Assessing the role of Marine Protected Areas in maintaining evolutionary resilience in Roman (*Chrysolephus laticeps*) in South Africa**

Mannnda Ndou (UP), Warren Potts (RU), Amber-Robyn Childs (RU), Peter Teske (University of Johannesburg), Jaco Greef (UP), Tuan Duong (UP), Romina Henriques (UP)

Theme: *Genetics* | Talk 58

The red roman *Chrysolephus laticeps* is a South African exploited endemic marine fish, classified as Near Threatened by the IUCN Red List of Threatened Species. Previous research suggests that fishing pressures are altering its physiological response, with fish caught outside Marine Protected Areas (MPAs) exhibiting lower resilience to increases in temperature when compared to fishes caught inside MPAs. Given the high residency of adults, the observed changes may have a genotypic component and may impact evolutionary resilience in Roman, particularly in the context of changing oceanographic conditions. We generated an Oxford Nanopore reference genome data and Whole Genome Sequence data for 140 samples collected from two well-established MPAs (Tsitsikamma and Goukamma) and five non-MPA areas (Port Alfred, Gqeberha, St Francis, Struis Bay, False Bay), to characterize genome-wide diversity levels, differentiation, as well as to identify loci associated with physiological capacity between MPA and non-MPA areas along the South African coastline. This study connects ecological and genomic research to enhance conservation management of an iconic South African endemic fish, to arrest further declines.

## Development of ecological niche models to predict the future distribution of *Diplodus capensis* in South Africa

Samkele Ngcefa (RU), Warren Potts (RU), Nicola James (SAIAB), Amber-Robyn Childs (RU)

Theme: *Climate change* | Talk 45

Changes in sea temperature, resulting from anthropogenic climate change, is one of the leading causes of shifts in the distributional range limits of fish populations globally. Shifts in the distribution of marine fishes will not only have large-scale ecological consequences, but also impact the fishers that depend on these resources for their livelihood. While the development of adaptation plans to reduce these consequences is critical, this can only be achieved with sound and robust predictive information on the expected environmental changes on our linefish species. Blacktail *Diplodus capensis* is one of the dominant species in the shore-based marine fishery and is particularly important for the livelihoods of people in many coastal communities. The aim of this study was to develop an ecological niche model to map the current and predict the future distribution of *D. capensis*. To do this the spatial distribution of *D. capensis* was modelled using occurrence data from the Rock and Surf Super Pro League (RASSPL) competitive database (catch-per-unit effort [CPUE] data), the Oceanographic Research Institute's Cooperative Fish Tagging Project (ORI-CFTP), and occurrence data from the South African Institute of Aquatic Biodiversity (NRF-SAIAB). These occurrence data were correlated with existing environmental data (including *in situ* temperature data from the South African Environmental Observation Network [SAEON], Acoustic Tracking Array Platform [ATAP]) and available sea surface temperature data (e.g. Copernicus and BIO-oracle) along the South African coastline to develop a contemporary species distribution model for this species. Respirometry trials on adult caught *D. capensis* are also being conducted to determine the species thermal performance and thermal thresholds to inform the ecological niche model and improve its accuracy in predicting future distributional shifts under climate change. The information collected in this project is critical for marine spatial planning initiatives which are adaptable in our changing climate. While the physiology work is still in progress, the fish distribution data is being used to develop correlative ecological niche models for the species. Preliminary model outputs show that the species will experience distributional shifts in its core ranges by 2050 and 2100. Future analysis will include bathymetry and physiological indices for more robust predictions of the future distributions of this important fisheries species.

## **Linefish species in the Algoa Bay estuarine to marine seascape: Nursery areas and their response to low dissolved oxygen events**

Phakama Nodo (SAIAB), Nicola C James (SAIAB), Amber-R Childs (RU), Paula Patrick (SAEON)

Theme: Monitoring estuaries and MPAs | Talk 16

Assessing fish distribution and abundance across estuarine and marine nearshore habitats is vital for identifying ecologically important nursery habitats and developing effective management strategies for coastal fish populations, many of which are important fishery species. Although these coastal ecosystems serve as important nursery areas, they face many challenges. For example, hypoxia (owing to nutrient enrichment and subsequent eutrophication) is a major threat to the functioning of coastal ecosystems, particularly estuaries. This study assessed the soft-bottom benthic shallow-water seascape in Algoa Bay (inclusive of the Swartkops, Sundays and the marine nearshore) to determine core nursery hotspots for demersal linefish species. In addition, given the ever-increasing anthropogenic pressures facing our fish resources within coastal habitats, with the two study estuaries (Swartkops and Sundays) being heavily polluted, the effect of hypoxia and associated shifts in the spatial distribution of fish species was also investigated. The greatest abundance of early life stage fishes was observed in the lower reaches of the Sundays Estuary and the upper reaches of the Swartkops Estuary as well as nearshore sites located close to freshwater outlets, particularly during spring and summer. Low oxygen, hypoxic waters (0.5 mg/l) were recorded in the middle reaches of the Sundays Estuary mostly during summer, and in the Swartkops Estuary, the lowest dissolved oxygen (DO; 2.4 mg/l) was recorded in the upper reaches during spring. These low DO conditions decreased fish abundance and diversity in both estuaries, with zero catches at hypoxic areas in the Sundays Estuary. These results provide much-needed insights into core nursery habitats for demersal linefish species in Algoa Bay and the impact of low DO and hypoxic conditions on the abundance and distribution of linefish species in estuaries.

## **Unravelling two million years of evolution due to climate change: Genomic Implications of hybridization in the southern African kob (*Argyrosomus* spp.)**

Phindile Ntuli (UP), Romina Henriques (UP), Warren Potts (RU), Pierre-Alexandre Gagnaire (University of Montpellier)

Theme: *Genetics* | Talk 57

The great biodiversity seen in the coastal seas of southern Africa includes the *Argyrosomus* spp. (kob), which are seriously threatened by oceanographic alterations brought about by climate change. To develop successful conservation efforts, it is imperative that we comprehend the effects of these modifications on the genetic composition and distribution of the kob species. This study attempts to fill that knowledge gap. Ocean warming has led to a northward shift in the distribution of the southern west coast dusky kob *Argyrosomus coronus*, causing it to overlap and hybridize with the closely related Namibian species, silver kob *A. inodorus*. Preliminary evidence suggests this hybridization may promote adaptation to warming conditions, though the cold Lüderitz Upwelling Cell appears to constrain both species, potentially subjecting *A. inodorus* to a "coastal squeeze". This research aims to evaluate the genomic patterns of hybridization between the southern African kob species including *A. inodorus*, *A. coronus*, dusky kob *A. japonicus* and squaretail kob *A. thorpei*. Further, genomics data will be used to evaluate genetic diversity, selection pressures, population sizes, and hybridization levels to provide crucial insights for the adaptive management of these threatened linefish species in the face of climate change.

## Reassessment of genomic diversity and connectivity of recreational line-fish species in South Africa

Wilfred Olivier (UP), Romina Henriques (UP), Amber-Robyn Childs (RU)

Theme: *Genetics* | Talk 38

Marine ecosystems are at risk due to human-mediated pressures such as overexploitation and climate change. For example, in South Africa, many of the fish species that are commonly targeted by the marine shore-based fishery (MSBF) are severely overexploited and have thus been listed on the IUCN Red List of threatened species with statuses that range from Least Concern to Critically Endangered. The species addressed in this project, blacktail *Diplodus capensis*, is an endemic species from southern Africa, with a range from southern Angola to Mozambique, and is predominantly targeted in the MSBF throughout their distribution range. Management of this species is not only important for maintaining the livelihoods of shore-based small-scale fishers but also for the conservation of endemic fish fauna. Research on the MSBF has focused primarily on the life history and stock assessment of some species, leaving gaps in the critical knowledge needed for management, including genetic diversity levels and population sub-structuring patterns. Therefore, determining genomic diversity levels, long-term population structure, and the likelihood of fisheries-induced evolution in priority MSBF species is a prerequisite to the vital regulation and ultimately conservation of South African marine biodiversity. This project will employ sequencing-based genotyping tools and multivariate statistical approaches to do so.

## Residency and movement behaviour of blacktail in a shallow rocky cove using acoustic telemetry

Melissa Pollard (NMU, SAIAB), Nicola James (SAIAB), Amber-Robyn Childs (RU), Taryn Murray (SAIAB), Janine Adams (NMU)

Theme: *Fish movement studies* | Talk 6

To understand the ecology of a certain species, it is essential to understand the movement behaviour and connectivity among different habitats of the species, especially when it comes to identifying areas that are important for different life-history stages such as the early-life stage. Due to advances in telemetry technology, transmitters have been miniaturized, allowing for tagging of the juvenile stages of species. In this study, we used acoustic telemetry to quantify the juvenile movement patterns and residency of blacktail *Diplodus capensis* within a shallow rocky cove known as Flat Rocks, which is located off the eastern shore of Cape Recife. Two main benthic habitats are present in the cove; high-profile reef comprised of rocky outcrops dominated by canopy forming algae and low-profile reef dominated by low growing algae morphotypes interspersed with small sand patches. Previous studies have shown that the mosaic of habitats within the cove provide both shelter and food for juvenile sparids, particularly blacktail. Twenty-five blacktail ranging in size from 95–298 mm total length were tagged with Innovasea V5 180 kHz tags. Three acoustic receivers were moored in the cove in high-profile reef, low-profile reef and sand, and two receivers were deployed outside the cove in deeper reef and in an adjacent area of shallow reef. Individuals were tracked between August and December 2021, recording a total of 654 767 detections within the array. The residency index ( $I_R$ ) showed that blacktail were highly resident in the cove with only the bigger fish moving into deeper waters. Contrary to previous studies in subtidal gullies, where juvenile blacktail show a lower degree of site fidelity, this study shows that juvenile blacktail are highly resident to Flat Rocks, utilizing all the habitats within the cove. This reaffirms the nursery value of this cove as a nursery hotspot for this species.



## **Review of recent recreational fisheries research to identify critical revisions needed to improve governance**

Warren Potts (RU), Christopher Bova (RU), Kieran Hyder (CEFAS), Kyle Hewett (RU), Aidan Du Preez (RU), Alexander Winkler (RU), Matthew Farthing (RU), Amber-Robyn Childs (RU)

Theme: Fisheries management | Talk 23

The South African linefishery is a complex socio-ecological system that has a considerable impact on the coastal marine environment while generating social and economic benefits for fishers in the commercial, small-scale and recreational sub-sectors. Although the recreational sub-sector is the largest in the linefishery, there is a dearth of information on the distribution of its effort, its catch, the status of its target species, the characteristics of its participants, the societal benefits that it generates, and this is reflected in the poor governance of this sector. This presentation gives a summary of the body of recreational research work done as part of the One Ocean Hub (OOH) Project that aimed to fill the gaps in our knowledge of South African recreational fisheries and provides several recommendations to strengthen policy and governance of this sector. Important findings included considerable changes in the effort distribution and catch composition of the shore-based sector since the last national survey in the mid-1990's, the broad demographic composition and motivations of recreational fishers, the massive potential for socio-economic development through the economic spend of the fishery, and the existence of policy, management agency structures and processes that limit effective governance. The OOH project also co-developed two long-term catch and effort databases for current and future stock assessments of the shore-based fishery. Together this work is used to make recommendations for policy reform, structural changes, and management guidelines that, if implemented, should promote sustainability in the entire linefishery.

## Promoting fish of the future – development of a strategy to mitigate the impact of climate change on our linefish populations

Warren Potts (RU), Cuen Muller (RU), Lauren Bailey (RU), Michael Skeeles (Deakin University), Murray Duncan (University of Seychelles), Alexander Winkler (RU), Xolani Nabani (RU), Nonhle Mlotshwa (RU), Nicola James (SAIAB), Amber-Robyn Childs (RU)

Theme: *Climate change* | Talk 39

With climate change rapidly influencing our linefish in several ways, it is essential for us to find ways to mitigate their likely responses and maintain resilient fisheries. Over the last eight years our research group has been trying to understand how exploitation selectively removes certain physiological phenotypes from fish populations. We were only able to do this research because of our large, old no-take marine protected areas (MPAs) and our findings have not only demonstrated how hook and line fishing reduced the potential of fish populations for physiological adaptation to the impacts of climate change, but also that no-take MPAs have the potential to retain “fish of the future” (FOF) that will promote adaptation. Using red roman *Chrysolephus laticeps*, as a model species, this presentation aims to explain the mechanism driving selection by hook and line and its impact on the evolution of our linefish. We then look more closely at how a well-designed network of no-take MPAs or even “catch-and-release zones” can reduce these impacts by retaining and exporting FOF and facilitating the physiological adaptation of fish populations to a changing climate.

## **Development of a management strategy for Endangered, Threatened or Protected (ETP) species encountered in the albacore tuna pole-and-line fishery, South Africa**

Adam Rees (Anchor Environmental Consultants [AEC]), Dr Ken Hutchings (AEC)

Theme: *Fisheries management* | Talk 28

The albacore (a.k.a. longfin) tuna (*Thunnus alalunga*) pole-and-line (TPL) fishery in South Africa is a socio-economically important fishery, contributing to the local economy and providing employment opportunities. The fishery was selected as one of five WWF-SA Fisheries Improvement Projects, which take a multi-stakeholder approach to improve fishing practices and management so that species, habitats, and people can all thrive. The fishery is regarded as a relatively 'clean' fishery regarding its ecological impacts in terms of bycatch and Endangered, Threatened or Protected (ETP) species interactions. However, quantitative information on these impacts is not readily available and the activities of this fishery are known to warrant improvement. Here, we present work on the development and implementation of an ETP management strategy for South Africa's albacore TPL sector, which, until now, has been lacking. Drawing on stakeholder engagement, and informed by global practice, we have developed a range of measures to improve reporting within the sector, as well as a number of preventative and mitigation measures for the industry, within a comprehensive strategy. We demonstrate how this strategy is working towards multiple wins for the sector. These wins include economic (e.g., eco-label accreditation, cost effective technology use), operational, and environmental (e.g., ETP interactions reduced) wins, while helping to satisfy national and international protection targets for at risk species. We argue this buy-in increases the likelihood of Permit Conditions being met in a fishery where enforcement is challenging. If nothing else, this strategy will improve data collection on ETP species caught in this fishery, many of which are currently under threat from overfishing.

# Estimating the natural mortality of dusky kob from length-frequency data: A simulation-based approach

Dylan Rowell (UCT), Ben van Huyssteen (UCT), Res Altwegg (UCT), Colin Attwood (UCT)

Theme: *Fisheries monitoring* | Talk 19

The natural mortality rate ( $M$ ) for a species of fish can be defined as the instantaneous rate of death due to all natural factors, excluding fishing. In this report, we explore the Von Bertalanffy growth model (with consideration for fish greater than the asymptotic length,  $L_\infty$ ) and log-linear regression as they pertain to dusky kob *Argyrosomus japonicus*. These models are fitted to historical age-length data from Griffiths & Hecht (1995) and are subsequently used to predict an age distribution from the length-frequency data spanning multiple decades, obtained via the shore-based angling programme in the De-Hoop Marine Protected Area. This length-frequency data is considered a random sample from the length distribution of an unexploited population, such that the mortality estimate obtained from the catch-curve analysis applied to the predicted age distribution can be considered an estimate of  $M$ . Distributions for  $M$  are obtained through various model-specific simulation-based techniques. The  $M$  distributions overlap heavily between model simulations and the collation of the simulation results returned a distribution with mean estimate of  $0.164 \text{ yr}^{-1}$  with 95% interval of (0.12, 0.22) for  $M$  along the full descending limb of the catch-curves. The simulation results for dusky kob older than 6 years, returned a mean estimate of  $0.108 \text{ yr}^{-1}$  with 95% interval of (0.07, 0.15). We propose that these methods can be extended to other species (in particular resident reef species where migration outside of the MPA will not have a large effect on estimated  $M$ ) and can also be used to calculate total mortality in exploited areas, without necessitating an age distribution.

## **Galjoen catch per unit effort and dispersal between exploited and unexploited zones of the Table Mountain National Park MPA**

Lieze Swart (DFFE), Elelwani Nemanashe (DFFE)

Theme: *Monitoring estuaries and MPAs* | Talk 17

The status of galjoen *Dichistius capensis*, the national fish of South Africa, has previously been assessed as Collapsed (2003) and Near Threatened (2016). Galjoen are confined mostly to shallow water where they are often found in rough surf amongst rock close to shore. They are mainly a resident species, although a small percentage of the population have been shown to be nomadic. As such, it can be expected that marine protected areas (MPAs), in particular no-take zones, will be effective for the conservation and recovery of local populations of galjoen, and enable spill-over to adjacent unprotected areas. An ongoing tag-and-release monitoring study (started in 1999) in the Table Mountain National Park (TMNP) MPA collects data that can be used to test this hypothesis. Here, we report results for comparison of catch-per-unit-effort (CPUE) and size data of galjoen between a restricted (unexploited) and a controlled (exploited) area of the TMNP MPA, specifically at Olifantsbos and Pegram's point, respectively. Significant interannual variability in CPUE for both areas were recorded over the years especially in the unexploited area, and CPUE declined towards the end of the time series for both areas. On average, mean CPUE in the unexploited area was higher than in exploited area in most years and was significantly higher overall. This supports that the no-take zone is effective for galjoen, but declining trends and fluctuations suggests that environmental factors are an important driver of variability and change. Further insights on the effects of spatial management for the galjoen resource in the MPA were obtained from comparisons of size at maturity of individuals caught in the exploited versus the unexploited areas, and modelled movements of fish based on the tag-recaptures between areas.

## **Can thermal metabolic physiology information predict fish behaviour observed on Baited Remote Underwater Video? Case study on fransmadam *Boopsoidea inornata***

Bradley van Heerden (RU), Amber-Robyn Childs (RU), Warren Potts (RU), Bontle Mateboge (UCT), Anthony Bernard (SAIAB)

Theme: *Climate change* | Talk 42

Globally, climate change is placing fish populations under pressure through multiple environmental stressors including increasing thermal variability. Fish may respond to these stressors through physiological acclimation, altering their behaviour or shifting their distributions. However, since there is a link between the physiology and behaviour in fishes, it may be possible to use physiology research to predict the behavioural response of fishes in the wild. This study aimed to improve our understanding of the link between metabolic physiology and wild behaviour of the fransmadam *Boopsoidea inornata*. Forty-five sub-adult and adult fransmadam were collected from Cape St Francis using hook and line. Fish were transported to the Aquatic Ecophysiology Research Platform laboratory and the standard metabolic rate (SMR), maximum metabolic rate (MMR) and aerobic scope (AS) of fransmadam was estimated at 8 °C, 12 °C, 16 °C, 20 °C, or 24 °C using flow-through respirometry techniques. The relationship between these metabolic rates and temperature were modelled using a second order polynomial relationship. These findings were compared to behavioural information (MaxN and T1st events: time to appear, time to feed) collected from existing stereo-BRUV videos (with Event Measure software) at temperatures between 10 °C and 18 °C by the Marine Remote Imagery Platform in the Eastern Cape. The results revealed a link between the physiology and wild behaviour of fransmadam, with peak AS performance, highest MaxN and fastest T1st events all observed at 16 °C. Similarly, the lowest AS, lowest mean MaxN and longest T1st events was observed at 10 °C. These findings demonstrate a link between metabolic physiology and wild behaviour in fishes. This suggests that stereo-BRUV videos may provide an abundance of valuable information for predicting the response of fishes to climate change. However, it is necessary to collect this information at a greater range of temperatures to better predict the likely response of fishes to a changing climate.

## **From the west side to the east side: Genetic diversity and population structure of two southern African endemic *Acroteriobatus* species**

Michaela van Staden (SU), Juliana D. Klein (SU), Charlene da Silva (DFFE), Aletta Bester-van der Merwe (SU)

Theme: *Genetics* | Talk 56

Guitarfishes (family Rhinobatidae) belong to the most evolutionarily distinct and threatened chondrichthyan lineages. Despite this, they remain poorly studied and undermanaged on a global scale. Along the southern African coastline, frequent misidentification has contributed to poorly defined distribution ranges and previous studies have highlighted the possibility of substantial population structure. In this study, a restriction site-associated DNA sequencing approach was used to generate single nucleotide polymorphisms (SNP) for specimens of lesser guitarfish *Acroteriobatus annulatus* and bluntnose guitarfish *A. blochii* sampled along the South African coastline. Given the frequent occurrence of misidentification, the morphological identifications of specimens were confirmed prior to investigating the distribution of inter- and intraspecific genetic diversity. Genetic clustering patterns were congruent with the morphological identifications of specimens, with a substantial divergence observed between sampling locations on the west coast and all other regions. The levels of intraspecific genetic diversity estimated were significantly different among the sampled regions, with *A. blochii* harbouring lower genetic diversity in comparison to *A. annulatus*. The population structure of *A. annulatus* was investigated through the use of putatively neutral SNP loci as well as loci putatively under selection to elucidate whether multiple evolutionary forces (adaptive and non-adaptive) are involved with the contemporary distribution of genetic variation within this species. While low levels of genetic differentiation were observed based on the neutral dataset, the presence of a genetic cline is evident across the continuous coastline from west to east for the outlier dataset. Although further analysis is necessary to test specific hypotheses about environmental factors driving selection, the contemporary distribution of genetic variation in *A. annulatus* has likely been shaped by more than geographical distance or non-adaptive evolutionary forces.

## **The long-term growth rate changes of west coast steenbras *Lithognathus aureti* caught by anglers off Namibia**

Angelika Veji (UNAM), Arariky Shikongo (UNAM), Margit R Wilhelm (UNAM)

Theme: *Life history and ecological studies* | Talk 13

Otolith bio-chronologies allow us to reconstruct long-term growth series from otoliths in the absence of the collection of past biological data and assess the response of marine fish populations to environmental variability and fishing pressure simultaneously. With Namibian waters being subjected to the highly environmentally variable Benguela Current system which impacts individual physiology, growth and survival of the marine species in this area, it is essential to document the physiological responses of species within this area to be able to predict potential consequences of climate change. Endemic to southern Africa, west coast steenbras *Lithognathus aureti* faces over-exploitation due to slow growth, late maturation, and protandrous hermaphroditism. Updated biological data vital for its conservation, especially as the second most important shore-angling species in Namibia, is essential to understand its response to environmental variability. Samples were collected from fish caught by anglers off the shore of Namibia, where otoliths were removed and fish length, fish weight, sex and maturity of the fish were recorded. The 44-year BLUP, developed from mixed linear models of mean annual growth (mm) calculated from 1491 increment measurements from 158 fish, was compared to sea surface temperature (SST) and upwelling (wind) indices, as well as annual catch-per-unit effort and total catches to indicate which factors significantly influence growth variation of West Coast steenbras. There was a positive correlation between the growth rate and SST from south and central areas in February to April, and March to May, respectively. For the upwelling index a positive correlation was observed for the northern and central regions during June and July (Winter) and a negative correlation for the southern region during February. No relation with southern oscillation index or steenbras catch-per-unit-effort (CPUE). Thus, it can be concluded that SST and upwelling are impacting the growth of West Coast steenbras.



## Two decades of catch-per-unit effort and catch trends of five teleost species in the recreational shore-angling fishery in the northern Benguela

Margit Wilhelm (DFOS, UNAM), Natanah Gusha (DFOS, UNAM), Christopher Bova (RU), M. Shipanga (DFOS, UNAM), Kieran Hyder (CEFAS), Warren Potts (RU)

Theme: Fisheries | Talk 53

Catch-per-unit-effort (CPUE) data are important in assessing stock status to provide information for specific management regulations in each fishery. In this study, we used roving-creel survey data of recreational shore-angling collected by the Ministry of Fisheries and Marine Resources, Namibia between Terrace Bay and Walvis Bay from October 1995 to September 2017 (1995/1996-2016/2017 fishing season). Between 95 and 105 days were sampled over 22 sampling strata (five beaches with 4 strata each, plus two) per year/season. From 28 October 1995 to 24 September 2017, 2 135 surveys were undertaken with 52 030 angling groups, consisting of 155 936 anglers, interviewed; 137 415 fish counted and 54 297 of them measured. CPUE and catch time series were calculated for five teleost species, silver kob *Argyrosomus inodorus*, west coast steenbras *Lithognathus aureti*, galjoen *Dichistius capensis*, blacktail *Diplodus sargus* and barbel/sea catfish *Galeichthys feliceps*. Long-term CPUE trends revealed that all stocks, except for blacktail, had declined severely in CPUE, beginning in the early 2000s, with up to a 30% decline by the end of the time series. For west coast steenbras, the CPUE remained at 30% of the initial values in 2017. CPUE of silver kob recovered slightly but remained at 50% of the initial values by 2017. CPUEs of both barbel and galjoen recovered to initial values by 2017. Blacktail CPUE started increasing in 2010 and in 2017 was at 200% of the initial values. This indicates that silver kob and especially west coast steenbras are severely overfished and management actions need to be taken immediately. This dataset is unique in time series length of CPUE data in any recreational fishery in the world. It should be used as input into updated stock assessments for silver kob and west coast steenbras and for initial stock assessments of galjoen, blacktail and barbel.

## **Growth rates of Namibian west coast steenbras, an over-exploited sparid, analysed using novel bootstrapped length-at-age (otoliths), length-frequency, and tag-and-recapture approaches**

M. Wilhelm (DFOS, UNAM), A. Shikongo (DFOS, UNAM), A. Veii (DFOS, UNAM), R. Schwamborn (Federal University of Pernambuco)

Theme: *Fisheries management* | Talk 29

West coast steenbras *Lithognathus aureti*, an overexploited coastal sparid in Namibia, are believed to consist of two genetically distinct, highly resident stocks, one in the north (17-24 °S) and one in the south (24-26 °S) and are protandric. Here, we used three data sources: length-at-age (LAA) derived from otoliths (2019-2023), northern and southern stock, tag-and-recapture (T&R) data (2004-2011, 2020-2022), and length-frequency data (2004-2011), both southern stock to obtain von Bertalanffy growth function (VBGF) parameters (K and  $L_{\infty}$ ) and their bootstrap confidence intervals (CI) and compare these between methods (length-frequency analysis, LFA, T&R, LAA), between stocks (LAA only) and between sexes (males, females and hermaphrodites, LAA only), using the “fishboot” R package. No significant differences were found between medians of parameters K and  $L_{\infty}$  by method, stock, or sex ( $p > 0.05$ , bootstrapped two-sample test). In contrast, significant differences were found in precision, i.e. CI widths, between methods (interquartile range test,  $p < 0.05$ ). LAA was by far the most precise method for estimating K, explained by the low uncertainty regarding the age of each individual, leading to an overall low uncertainty in instantaneous growth rates. However, LAA was the least precise method, and LFA was the most precise method for estimating  $L_{\infty}$ . This may be explained by the much larger sample sizes of large-sized fish (> 50 cm fork length) for LFA, than for LAA and T&R. Thus, even when LAA or T&R are available, LFA is still useful for estimating recruitment.

## **The use and abuse of social media in the management of the South African marine recreational fishery**

Alexander Winkler (RU, SAIAB), Matthew Farthing (RU), Christopher Bova (RU), Amber-Robyn Childs (RU), Warren Potts (RU)

Theme: *Angler engagement* | Talk 34

The influence of social media in our daily lives can arguably not be ignored. Its use in both regulating, monitoring and facilitating natural resource use efficiency, is less understood but beginning to be acknowledged. Importantly the use of social media platforms amongst recreational fishers is fast becoming the norm, allowing fishers to disseminate information, boast about catches or simply research new fishing areas. While this may seem trivial the effects of this information dissemination have greatly increased the catch efficiency of many recreational anglers, unfortunately, to the detriment of the fish resources they target. More recently, it has also been used to facilitate recreational fisheries IUU (illegal, unreported and unregulated), whereby recreationally caught fish is making its way into informal markets over social media platforms. Despite these concerns, social media platforms also allow managers and researchers to both monitor current recreational fishing activities and easily disseminate important conservation-orientated information. In this talk, we use real-world examples to highlight how social media can both be abused by recreational anglers and used by scientists and managers to achieve complex conservation goals.

## **Anglers as eyes, determining the utility of recreational competition data to monitor the size frequency and abundance of coastal elasmobranchs in South Africa**

Alexander Winkler (RU, SAIAB), Matthew Farthing (RU), Matthew Parkinson (SAIAB), Amber-Robyn Childs (RU), Warren Potts (RU)

Theme: *Fisheries monitoring* | Talk 18

The marine shore-based linefishery (MSBF) in South Africa is the largest fishery (in terms of participation) in South Africa and generates enormous economic activity. Sharks and rays are frequently captured in this fishery by anglers who specifically target them or through incidental capture. Although some anglers retain sharks and rays, most are released. However, as the catch-and-release handling practices are generally poor, their post-release mortality may be relatively high. With recent studies suggesting that many coastal sharks and rays are at risk from impacts of overexploitation, it is critical that their populations be carefully monitored. Presently, the MSBF is not monitored; however, competition angling data may provide a valuable source of information to monitor the population trends of these species. In this study we attempt to examine the utility of two competitive recreational competition datasets, the Rock and Surf Super Pro League (RASPPL) and the South African Shore Angling Association (SASAA). Both these organised angling groups periodically fish throughout the South African coastline with catch data going back ten years for RASSPL and for some franchises up to 30 years for some of the SASAA provinces. Here we contrast the RASSPL and SASSA data and examine their utility for monitoring shark populations. As the RASSPL scoring system motivates anglers to target a diversity of sharks, has no minimum size limit and does not reward highly for weight, this dataset may provide information to monitor the size frequency and relative abundance of smaller shark and ray species (including several endemics), and the juveniles of some larger shark species. In contrast, as the SASAA scoring system does not count sharks smaller than 2 kg and rewards anglers for total weight caught, this dataset may provide standardised information to monitor the size frequency and relative abundance of larger, coastal shark and ray species.

# AcousNomaly: Generating aquatic acoustic telemetry data from real data while learning to detect anomalies with unsupervised learning

Siphendulwe Zaza (RU), Marcellin Atemkeng (RU), Taryn Murray (SAIAB)

Theme: *Fish movement studies* | Talk 8

Acoustic telemetry data play a vital role in understanding the behaviour and movement of aquatic animals. However, these datasets often contain anomalous detections that can pose challenges in data analysis and interpretation, but identifying these manually can be time-consuming and may not be feasible given large datasets collected over multiple years. As such, there is considerable potential for the development of machine learning algorithms that can assist with these tasks. This study focuses on automating anomaly detection in telemetry datasets using machine learning and artificial intelligence models, using a combined approach of Long Short-Term Memory (LSTM) models and autoencoders to construct an efficient anomaly detection system. A large multi-year dataset (>3 million detections) stemming from the long-term detection of 50 acoustically tagged dusky kob *Argyrosomus japonicus* in the Breede Estuary was used to develop the models. Results indicate that the fine-tuned model proficiently learns normal patterns and distinguishes between normal and anomalous behaviour, although detections of slowly deviating anomalies is proving difficult. Despite this, the model effectively locates anomalous entries. Ongoing refinement and optimization, particularly with memory-based LSTM-AE could further improve its accuracy and reliability. The model has already achieved over 98% in accuracy, precision, recall, and F1-score across preliminary tests, highlighting the usefulness of this model in large datasets, which also have application in large datasets for other species.

## **Will I survive? Investigating the adaptability to climate change induced temperature changes and behavioural responses of two estuary-dependent mugilids**

Bantony Ziko (RU), Dinah Mukhari (RU), Matthew Parkinson (SAIAB), Amber-Robyn Childs (RU), Taryn Murray (SAIAB)

Theme: *Climate change* | Talk 47

Determining the thermal threshold limits for fishes is crucial in understanding their future persistence when faced by the increase in the frequency and intensity of extreme weather accelerated by anthropogenic climate change. The critical thermal maxima/minima (CTM) method was used to determine the critical thermal tolerance limits of two estuary-dependent mugilids; the grooved mullet *Chelon dumerili* and the flathead mullet *Mugil cephalus* captured in Kowie Estuary, South Africa. In addition, the ventilation frequency was evaluated at every 2 °C change during thermal trials and the associated behavioural responses. Our results indicate that both species are tolerant to a broad range of temperature changes (5.7-36.7 °C for *C. dumerili* and 2.6-38.3 °C for *M. cephalus*). Although, these thermal limits are far from current predictions of temperatures change along the Southern African coast, an increase in the intensity of coastal upwelling as a result of climate change may be a threat to certain individuals in the population due to a thermal induced performance decrease. The rate of temperature change was positively correlated with opercular gill movements which ranged from 48 beats/minute at 10 °C to 337 beats/minute at 36 °C for *C. dumerili*. Results also showed that extreme temperatures induced stress resulting in decreased swimming ability. This decrease in performance may decrease the ability for fish to evade extreme temperatures which ultimately affects the population. This study provides essential information on the potential effect of climate change on estuarine fishes.

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