**The Application of a Remotely Operated Vehicle in Ecosystem Classification to support Marine Spatial Planning and MPA Expansion.**

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Background

This presentation reviews the application of Remotely Operated Vehicle (ROV) technology in offshore research on the East Coast of South Africa. In 2000, three deep mixed gas divers discovered a living population of coelacanths off Sodwana Bay on the East Coast of South Africa. This catalysed the African Coelacanth Ecosystem Programme (ACEP) which has developed a marine platform that facilitates and supports coastal and offshore research in South Africa. ACEP collaborated the Jago team from Germany in three successful submersible based operations between 2002 and 2004 but in 2005, a Remotely Operated Vehicle was hired in the first application of ROV technology for marine research in South Africa. The ROV was used to investigate the feasibility of this approach for coelacanth surveys and canyon exploration in the iSimangaliso Wetland Park in northern KwaZulu-Natal. This proved effective and in a week long expedition, the first coelacanth was sighted on the first day with 7 more observed over a week long period.

The aim of this presentation is to share experience in the use of the ACEP ROV in coastal and marine management. Advances in the application of this new technique from 2005 to 2018 will be described and progress, key challenges and recommendations will be shared.

Methods

In 2009, ACEP acquired its own ROV. A SAAB Seaeye Falcon, equipped with a Subsea Imaging 1Cam high definition video and stills camera with laser scaling. This is the same type of ROV as was trialled in 2005 and is capable of working to a maximum depth of 300m. The first 2 years were dedicated to training pilots and developing logistical experience to conduct offshore surveys, a key investment needed for this type of research to succeed. In 2011, the ROV became available on ACEP's open competitive research grant call for the first time, and has since been supporting ROV based projects around South Africa's East Coast. While projects have been multidisciplinary in nature ranging from biodiversity and fish surveys to biological collections for pharmaceutical use, each has aimed at answering specific questions in their respective geographic location. In 2013, another dedicated coelacanth survey was undertaken with ACEP pilots managing to navigate challenging terrain and enter the submarine caves. In 2015, the technical team started collecting marine invertebrates using a hydraulic manipulator arm and fitted claw. This provided samples for taxonomy, barcoding, population genetics and bio-discovery research. In 2017, a new purpose built coastal research vessel, the RV Phakisa, a 15m Legacy Cat with Twin Hamilton Jet Engines was acquired enabling greater manoeuvrability and station holding. This improved research operations and facilitated the first application of long transects for seabed surveys in the challenging conditions imposed by the Agulhas Current.

Results

ROV technology has been used to study coelacanths, fishes, marine invertebrates and marine ecosystems in South Africa. More than 15 student projects have been facilitated through visual surveys and biological collections. ROV footage was collected at over 220 locations in the 30m to 250m depth range between Algoa Bay and northern KwaZulu-Natal from 8 different projects. Methods of filming varied based on the requirements of the individual projects, however all collected high definition video and high resolution photo quadrats of the benthic environment. Close-up photographs of dominant fauna were taken as well as photo quadrats and seascape photographs. This allowed for morphotype scale classification of dominant fauna which were used to support the classification, mapping and assessment of marine ecosystem types in South Africa. The foundational information gathered was applied in the National Biodiversity Assessment which included the description and imagery of several ecosystem types that were sampled for the first time. The Visual seabed surveys were also applied in the identification and mapping of potential Vulnerable Marine Ecosystems. The ecosystem classification work and identification of sensitive ecosystem types supported the development of twenty new Marine Protected Areas for South Africa as supported by the South African Cabinet in 2018. The photographs and video were used to showcase this work to decision makers including the South African Cabinet and were a key element in a positive communication campaign aimed at supporting Protected Area expansion.

Over the past nine years, there have been challenges that have been overcome and others that still require work. On the technical side, the greatest challenge was learning to operate in the strong Agulhas current. The use of a 150kg clump-weight system designed to reduce the effects of drag on the umbilical allowed for operation in currents up to 2.5 knots, however this requires sound communication and quick responses between ROV, vessel and deck teams, especially in steep areas. On the data analysis side, the biggest challenge has been estimating area coverage of transects and quadrats. Although, the ROV has laser scaling, analysis is time consuming and needs calibrated computer software to support area estimates.

While close-up photographs have been useful for morphotype scale classification of fauna, collections have proven extremely useful and are being used in the identification and description of sponges in Algoa Bay. With the use of the ROV manipulator arm, individual specimens can be collected, however, there is currently no way of storing and bringing up a number of samples at a time. This makes collections slow, especially when operating in deep water. This is an area requiring further innovation.

## Conclusion

The Investment in the ACEP ROV has been worthwhile in facilitating descriptive and applied research that has supported management and decision making in South Africa. Increasing the depth range of this technology is needed to address priority research questions in deeper water (300-600m) ecosystems such as the shelf edge, where there are many cumulative pressures associated with the economic growth of the country.