NELSON MANDELA UNIVERSITY

Coastal and Marine Research

Term 2 News

The Institute for Coastal and Marine Research (CMR) enjoyed a very successful and rather busy first term! This newsletter highlights the CMR's recent activities, and shares news on upcoming events. Enjoy!

Successful Conferences

The CMR arranged and hosted the **3rd International Indian Ocean Conference** from 11-15 March at the North Campus Conference Centre, as well as the cocktail function at the Ocean Sciences Campus. A major objective for this gathering was to bring the **Second International Indian Ocean Expedition (IIOE-2)** community into the Western Indian Ocean (WIO) region to promote exposure and research undertaken by WIO institutions, as well as to promote and facilitate the building of new relationships through ocean science. The aim of the IIOE-2 was to promote the science that advances our understanding of the Indian Ocean, and the role that it plays in the Earth System. Such an understanding informs decisions in support of the development and the well-being of humankind. Over 100 delegates from 21 countries attended this very successful event. Two newspaper articles concerning the conference were published in *The Herald* during the week of the conference.

The SANOCEAN Conference (South Africa – Norway Co-Operation on Ocean Research) ran from 25-27 March. The CMR played a prominent role in arranging this international conference that took place at the North Campus Conference Centre. The CMR hosted the cocktail function at the Ocean Sciences Campus. The objective of this gathering was to strengthen existing relationships and to encourage further joint research, innovation and business development between Norway and South Africa in the ocean science field.

Workshops

A WIOMSA Plankton Identification Workshop took place in Zanzibar from 23-28 February. In total, ten students received zooplankton identification training and 10 were trained in ichthyoplankton identification. These 20 students were from eight countries. Professor Nadine Strydom led the specialist larval fish identification component.

A **Water Quality Management Course** was held from 4-6 March at the Harold Porter Botanical Garden in Bettys Bay. This course was organised by the Nelson Mandela University and members of the CMR, CapeNature, MCL, the Western Cape government, CSIR and DAFF. Professor Janine Adams facilitated this course, which will be developed into a University Short Learning Programme. Over 40 people participated, coming from NGOs, local, provincial and national authorities (DEA, DAFF, DWS). Topics covered were how to calibrate measurement instrumentation, abiotic and biotic indicators of water quality change and a discussion on available data and monitoring plans of participants. On the third day course participants went on a field trip to the Bot Estuary where in-situ measurements were taken from a boat.

A **Swartkops Estuary Research Symposium** took place on 19 March. This event was hosted by the SARChI Shallow Water Ecosystems and the CMR at the Dolphin's Leap Conference Centre, with funding from the DEA and BCLME. It brought together over 40 researchers and stakeholders from different government departments and universities (Nelson Mandela, Rhodes, Western Cape, Witwatersrand). The theme was improving estuary health for the delivery of multiple ecosystem services.

Estee Vermeulen, a PhD Candidate with the SARChI Marine Spatial Planning represented the CMR at the Réunion Island Blue Economy Week (25 & 26 March) and at the 2nd International MSPglobal Forum (27-29 March). At the Blue Economy Week, Estee presented on the Marine Spatial Planning process in South Africa, including the Algoa Bay Project, and how it can contribute to the Blue Economy. The MSPglobal Forum was organised by UNESCO's Intergovernmental Oceanographic Commission (IOC-UNESCO) and the European Commission's Directorate-General for Maritime Affairs and Fisheries (DG MARE). This forum invited marine spatial planners to discuss issues, solutions and challenges related to marine spatial planning in different countries. This forum aims at improving marine spatial planning by sharing examples of different planning processes worldwide, including national objectives, priorities and actions being undertaken or planned.

Dr Bernadette Snow represented the CMR at a Garden Route Workshop, entitled Towards Research Working Groups for the Western Cape Biosphere Reserves. This event took place at the Nelson Mandela University George Campus on 4 April. The key note address was a discussion around innovative implementation of the UNESCO MAB Programme in South Africa towards the advancement of sustainable landscapes. An additional presentation included the role of monitoring, evaluation, reflection and learning processes in enabling research and learning in landscapes. This was followed by a number of dialogues concerning:

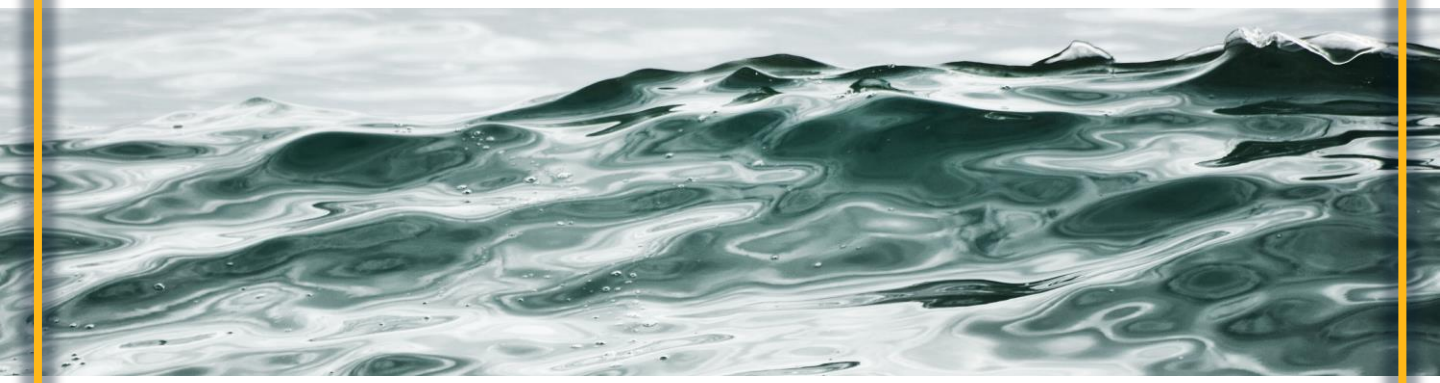
- How working groups can drive research in the Western Cape Biosphere Reserves;
- Defining roles and operations of the working group;
- Research approaches and strategies.

Graduation

Congratulations to all CMR postgraduate students that graduated during the April graduation ceremonies at the Nelson Mandela University George and Port Elizabeth campuses! This is a huge achievement worthy of celebration. Congratulations to all the academics involved in these successful student projects, and thank you for your dedication and investment into our students.

Upcoming CMR Workshop

The CMR is hosting a **SASUF Workshop** (South Africa – Sweden University Forum) with the theme **Sustainable Aquaculture Development for Coastal Communities and Food Security**. This will take place from 13-14 May at the Dolphin's Leap Conference Centre. Day 1 is a seminar series, and the invitation to attend or to send abstracts for presentation consideration was sent to CMR academics, Research Associates, associate members and postgraduate students. Day 2 consists of a collaborative proposal writing workshop for partnerships towards sustainable development, and this is for invited persons only. This workshop forms part of the SASUF Conference Series, and takes place after a conference in Stellenbosch.



Competition

World Oceans Day is celebrated on 8 June. This is a global day of ocean celebration and collaboration for a better future. To mark this important day, the CMR is hosting a photo competition open to all CMR members and the greater University community. The categories are **Spectacular Seascapes** and **Coastal Companions**. Photographs depicting diversity in the marine environment and diversity in people enjoying the ocean, are encouraged. The winning photograph in each category will be printed on a pull-up banner for use by the CMR at events. Photographs will also feature in the CMR's glossy report. Competition details will be circulated in due course. For more information on World Oceans Day, please see https://www.worldoceansday.org.

Science Celebrations

Congratulations to Dr Gavin Rishworth and his stromatolite team on the description of a new species of Tanaid, discovered in the local stromatolite pools. The paper describing this critter, *Sinelobus stromatoliticus*, was published online during February 2018 in the journal *Marine Biodiversity*. Dr Magdalena Błażewicz from the University of Łódź in Poland was a collaborator on this paper. This species, commonly called the Stromatolite Tanaid, was named amongst the **Top Ten Marine Species of 2018** by the World Register of Marine Species (WoRMS).

Professor Janine Adams is congratulated on the role she played in the publication of an article entitled *Wetland carbon storage controlled by millennial-scale variation in relative sea-level rise*, published in **Nature 567: 91-95**. This is a very exciting achievement for the CMR and Prof. Adams' Shallow Water Ecosystems Research Chair. The lead author, Professor Kerrylee Rogers from the School of Earth and Environmental Science and GeoQuest Research Centre at the University of Wollongong, Australia, is a close collaborator of Prof. Adams' team.

LETTER

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Wetland carbon storage controlled by millennial-scale variation in relative sea-level rise

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Coastal wetlands (mangrove, tidal marsh and seagrass) sustain the highest rates of carbon sequestration per unit area of all natural systems[1,2], primarily because of their comparatively high productivity and preservation of organic carbon within sedimentary substrates[2]. Climate change and associated relative sea-level rise (RSLR) have been proposed to increase the rate of organic-carbon burial in coastal wetlands in the first half of the twenty-first century[3], but these carbon–climate feedback effects have been modelled to diminish over time as wetlands are increasingly submerged and carbon stores become compromised by erosion[4,5]. Here we show that tidal marshes on coastlines that experienced rapid RSLR over the past few millennia (in the late Holocene, from about 4,200 years ago to the present) have on average 1.7 to 3.7 times higher soil carbon concentrations within 20 centimetres of the surface than those subject to a long period of sea-level stability. This disparity increases with depth, with soil carbon concentrations reduced by a factor of 4.9 to 9.1 at depths of 50 to 100 centimetres. We analyse the response of a wetland exposed to recent rapid RSLR following subsidence associated with pillar collapse in an underlying mine and demonstrate that the gain in carbon accumulation and elevation is proportional to the accommodation space (that is, the space available for mineral and organic material accumulation) created by RSLR. Our results suggest that coastal wetlands characteristic of tectonically stable coastlines have lower carbon storage owing to a lack of accommodation space and that carbon sequestration increases according to the vertical and lateral accommodation space created by RSLR. Such wetlands will provide long-term mitigating feedback effects that are relevant to global climate–carbon modelling.

Broad biogeographic drivers, such as vegetation, climate, topography or water chemistry, are often emphasized as important global-scale controls on organic matter accumulation, decomposition and carbon stocks within tidal wetlands[2]. However, relative sea-level trends over the Holocene varied across the globe, principally on the basis of distance from maximal ice-sheet extent during the last glacial period, and have a profound influence on the contemporary character of coastal wetlands[4,5]. In Europe and North America, where studies of coastal wetland sea-level rise (SLR) impacts are concentrated, sea levels have been rising over the past few millennia at a decelerating rate up to the present (Fig. 1a, b). Tidal marshes in these locations, particularly when sediment supply is low–moderate, are often characterized by deep sediments that are highly organic[4,10,11], in contrast to coastal wetlands in locations where the sea level has been stable for the past few millennia[12], in spite of similarities in floristics[13].

We review published data, contribute new observations on soil-carbon concentrations (%C) in tidal-marsh sediments and compare %C values over the active root zone (0–20 cm) and sub-surface depths (20–50 cm, 50–100 cm and >1 m) for 345 locations that vary in rates of SLR over the late Holocene (Supplementary Information). We find that variation in RSLR over past millennia is a primary control on carbon storage. Overall %C varies consistently between RSLR zones (areas spatially differentiated on the basis of consistent patterns of RSLR, fall or stability over the past 6,000 years) with concentrations in the upper 1 m significantly higher ($P < 0.001$) in zones subject to high rates of RSLR over the late Holocene (that is, zones I–II and II in Fig. 1) compared with zones subject to relative sea-level stability over the same period (that is, zones IV and V; Fig. 2, Extended Data Tables 1, 2). The upper metre of soil is the standard endorsed by the Intergovernmental Panel on Climate Change (IPCC) for tidal-wetland carbon-stock estimation[14], and in stable-sea-level zones it integrates processes over several thousand years[15,16]. Where data at depths exceeding 1 m are available, we find that this pattern of high storage in zones exhibiting RSLR over the past few millennia persisted (Fig. 2). Furthermore, the decline in %C with depth was greater in zones where sea level was relatively stable (that is, IV and V), yet remained relatively high in zones where rates of RSLR were high (Fig. 2, Extended Data Table 3; $P < 0.001$ for all pairwise comparisons). Trends were consistent with these findings in zones I and III, as well as in transitional regions, although relatively few data were available from these locations (Extended Data Fig. 1, Extended Data Table 3).

Models emphasizing biotic controls over coastal wetland elevation response to SLR have been largely derived from coasts with ongoing long-term SLR[11,17], where the vertical space available for mineral and organic material accumulation (henceforth termed 'available accommodation space') continued to expand as the sea rose over the past few millennia (Fig. 1c). In these situations, high rates of RSLR had the combined effect of promoting accumulation of mineral and organic matter and slowing rates of decomposition. That is, because sedimentation is positively correlated with patterns of inundation frequency[18], rapid accumulation of mineral and organic material is an outcome of the effect of RSLR on increasing inundation. Material that accumulates under conditions of RSLR becomes progressively submerged, creating more anoxic conditions that inhibit more rapid aerobic pathways of organic-matter decomposition. A substantial proportion of the world's tidal marsh[19] occurs in locations regarded to be relatively tectonically and isostatically stable, and their capacity to respond to accelerated RSLR has received little attention. For these coastal wetlands, several millennia of sea-level stability (Fig. 1d) provided considerable time for decomposition of organic material; as organic material was progressively stored near the limit of tidal inundation, decomposition increased under comparatively aerobic conditions.

The available accommodation space is a useful framework for considering the response of tidal wetlands to SLR because it integrates the influence of both tide range and position within the tidal frame[20]. We describe the effective accommodation space within tidal coastal wetlands as being bounded by the bedrock basement, highest astronomical tides (HAT) and hydrodynamic conditions that favour vertical accretion or lateral progradation, rather than sediment entrainment (Fig. 1e). As mineral and organic sediments accumulate, the available accommodation space diminishes (that is, a portion of the effective accommodation space is converted from available to realized

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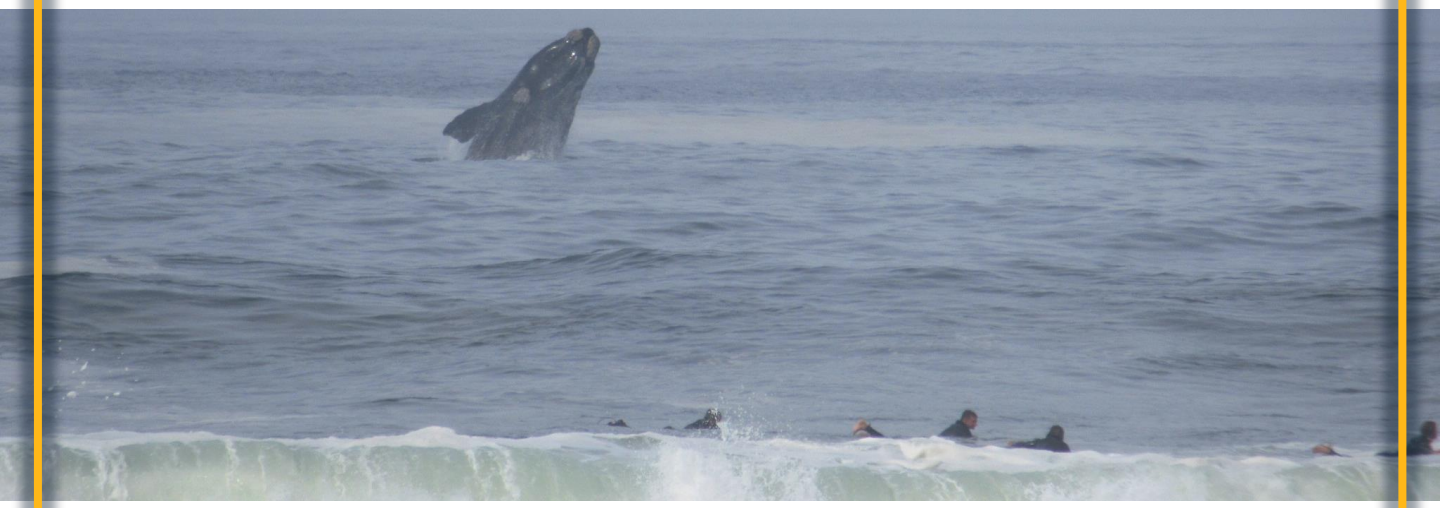
Dates to Diarise

The Celebrating the Whales Festival is set to take place on 16 June at the Pine Lodge Resort. The aim of the festival is to educate people about these magnificent animals and the important role they play in the ocean, and how they boost the Eastern Cape economy. The CMR will have a number of representatives at this event.

The CMR's annual Research Symposium is planned for 13 November. This year, the CMR celebrates all aspects of Diversity: Environmental, Social, Economic, Systems, Ocean and Coastal Management. This promises to be a very informative event for University staff and students, stakeholders and members of the public alike. The Symposium will take place during the same week that the CMR is hosting delegates from the University of Oldenburg, Germany, as part of the Helmholtz Exchange Programme, giving this day an international component.



A Sad Farewell

It is with sadness that we share the news of the passing of Professor Theagarten Lingham-Soliar, affectionately known as Prof. Solly. After a long illness, Prof. Solly passed away on the morning of 10 March. Prof. Solly joined the CMR in 2014, having relocated to the Nelson Mandela University from the University of KwaZulu Natal. Prof. Solly was known for his strict evidence-based approach to science, and he dedicated many years of his life to the study of the integumentary system. He also studied birds and sharks. He published widely in prestigious journals, and recently authored two volumes of *The Vertebrate Integument*. Condolences are extended to his friends and family.

Housekeeping

CMR Members are kindly reminded to include the CMR in all affiliations and addresses. This is particularly important with regards to academic publications. Please use the full **Institute for Coastal and Marine Research** title.

Information on CMR membership and templates for documents and presentations are available at: https://cmr.mandela.ac.za/Members-Page

Thank You

Thank you to our members for details on 2018 activities. The CMR's Annual Research Report is ready for submission, and we are proud of all our accomplishments!

If you have any news or exciting events to share, please send details to Liza by e-mail (Liza.Rishworth@mandela.ac.za) and she will include this in the next newsletter.

Kind regards,
Berny Snow
CMR Director

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