Overview to South Africa's marine biodiversity and resources

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iziko museums of South Africa

an agency of the Department of Arts and Culture

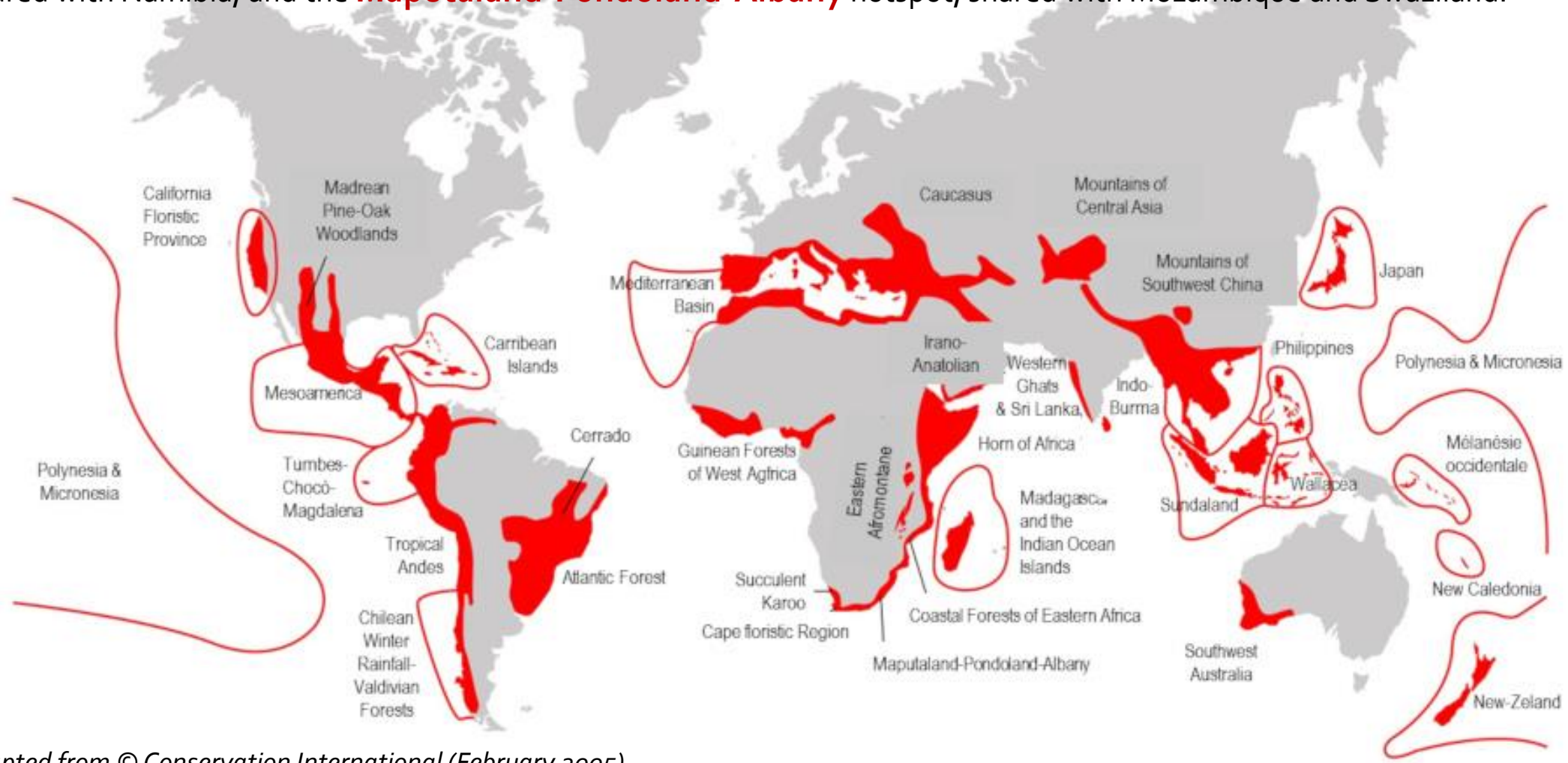
South Africa's remarkable diversity

- SA covers only 2% of the world's land area, but is home to over 95 000 known species, contributing a significant proportion to world plant species (6%), reptile species (5%), bird species (8%) and mammal species (6%), with more species regularly discovered (CBD, 2014).
- Also, recognised as one of only 17 megadiverse countries.
- Globally, SA ranked as the third biologically diverse region with 15.3 spp/area (km^2), after South Korea (32.3 spp/km^2) and China (26.9 spp/km^2) (Costello et al. 2010).

Pincushions (*Leucospermum* sp.)

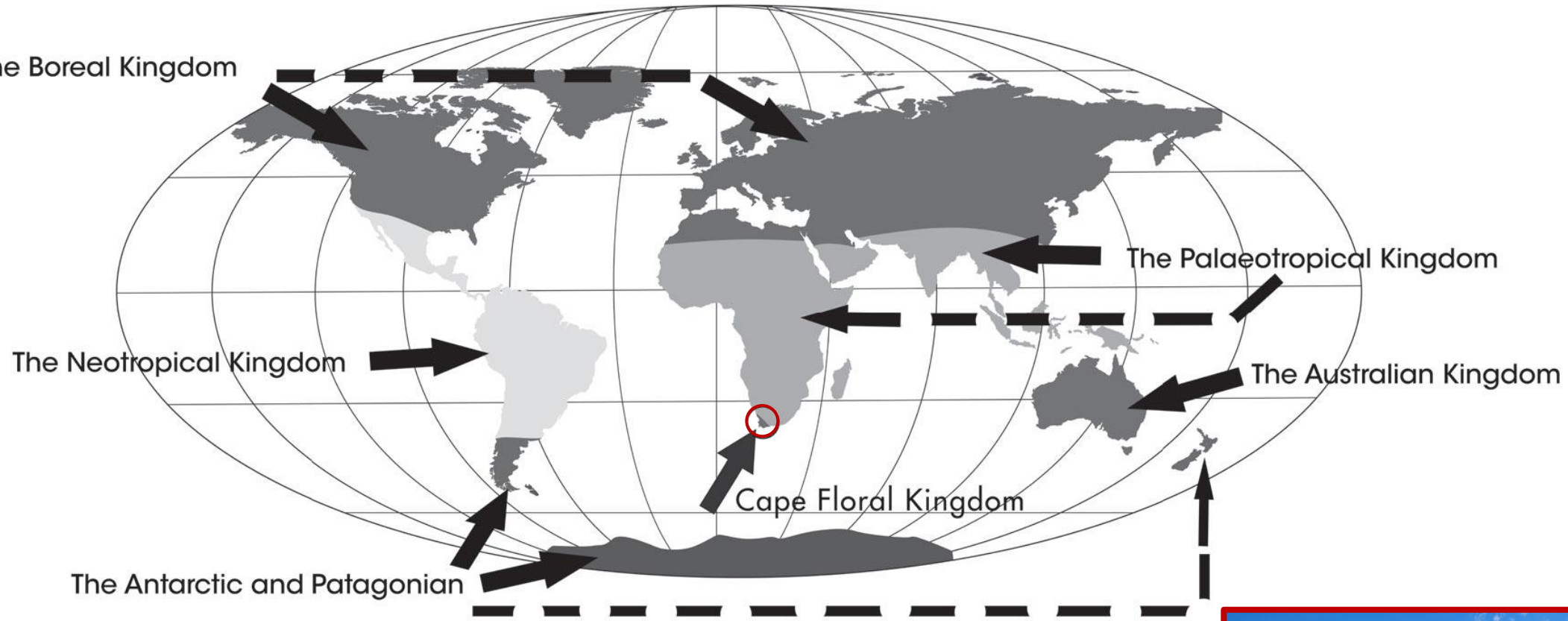
Biodiversity hotspots around the world

Three globally recognised biodiversity hotspots in South Africa: the **Cape Floristic Region (CFR)**; the **Succulent Karoo**, shared with Namibia; and the **Maputaland-Pondoland-Albany** hotspot, shared with Mozambique and Swaziland.



Adapted from © Conservation International (February 2005).

WORLD FLORAL KINGDOMS



A world map indicating the minute size of the Cape Floral Kingdom , a biodiversity hotspot, compared to the other five plant kingdoms

Image from: https://cederbergpark.com/conservation/

Terrestrial realm

- SA is home to over 23 000 plant species, of which more than half of these are endemic (CBD, 2014).
- With over 9 000 plant species – of which 70% are endemic – the Cape Floristic Region (CFR) is the smallest and richest of the world's six floral kingdoms (Goldblatt & Manning 2002).
- > 2 000 indigenous plant species have been documented for traditional medicine uses (NBA, 2018).

Dune Aloe (*Aloe thraskii*)

King Protea (*Protea cynaroides*)

'Halfmens' tree (*Pachypodium namaquanum*)

Marine realm

- South Africa has nearly 10% of the world coral species and almost a quarter of the global cephalopod species such as octopus, squid, cuttlefish.
- SA hosts ≈ 12 915 marine species with 33% endemics (Griffiths et al. 2010).
- Most speciose taxa are molluscs (3 154 spp), crustaceans (2 331 spp) and fish (2 000 spp).
- Of the most iconic species are Galjoen, South African Abalone* and West Coast Rock Lobster*.

*Resources are in crisis due to highly overexploited stock status and escalated poaching (NBA, 2018).

Galjoen (*Dichistius capensis*)

West Coast Rock Lobster (*Jasus lalandii*)

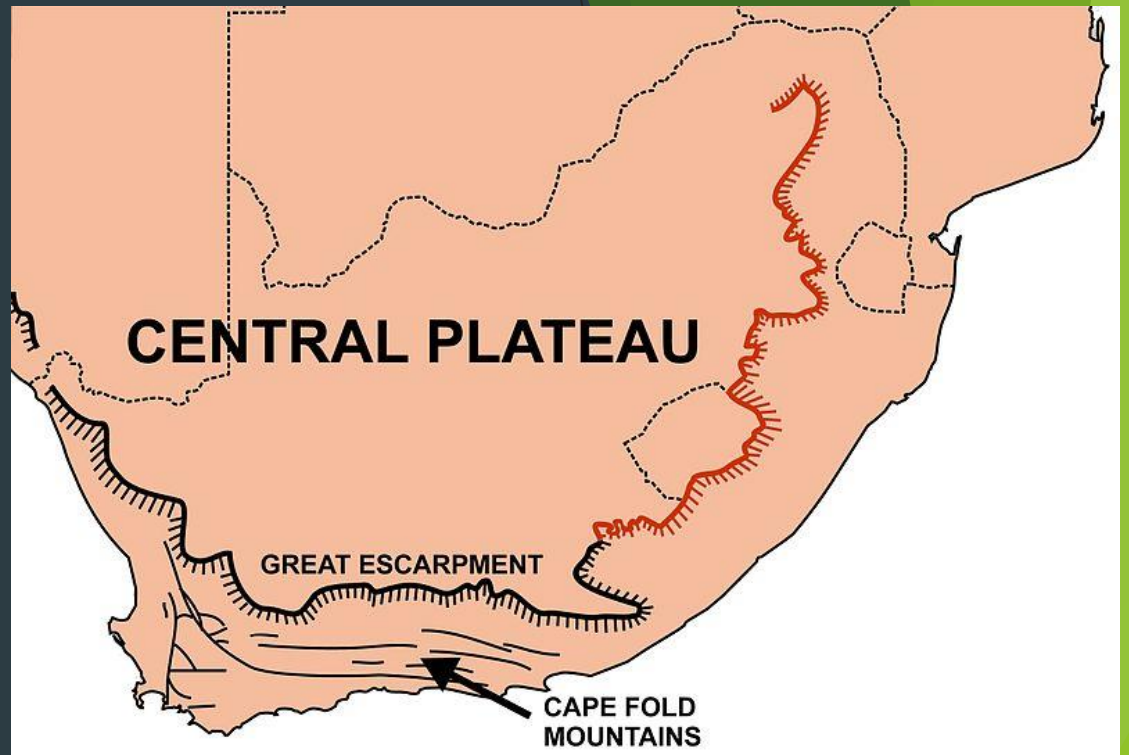
Abalone (*Haliotis midae*)

What makes South Africa unique?

The high level of endemism is a result of the complex **geological history of the area** in combination with distinct environmental gradients (partially caused by **geographic placement**) as well as past climatic changes (Skoulikidis et al. 2009).

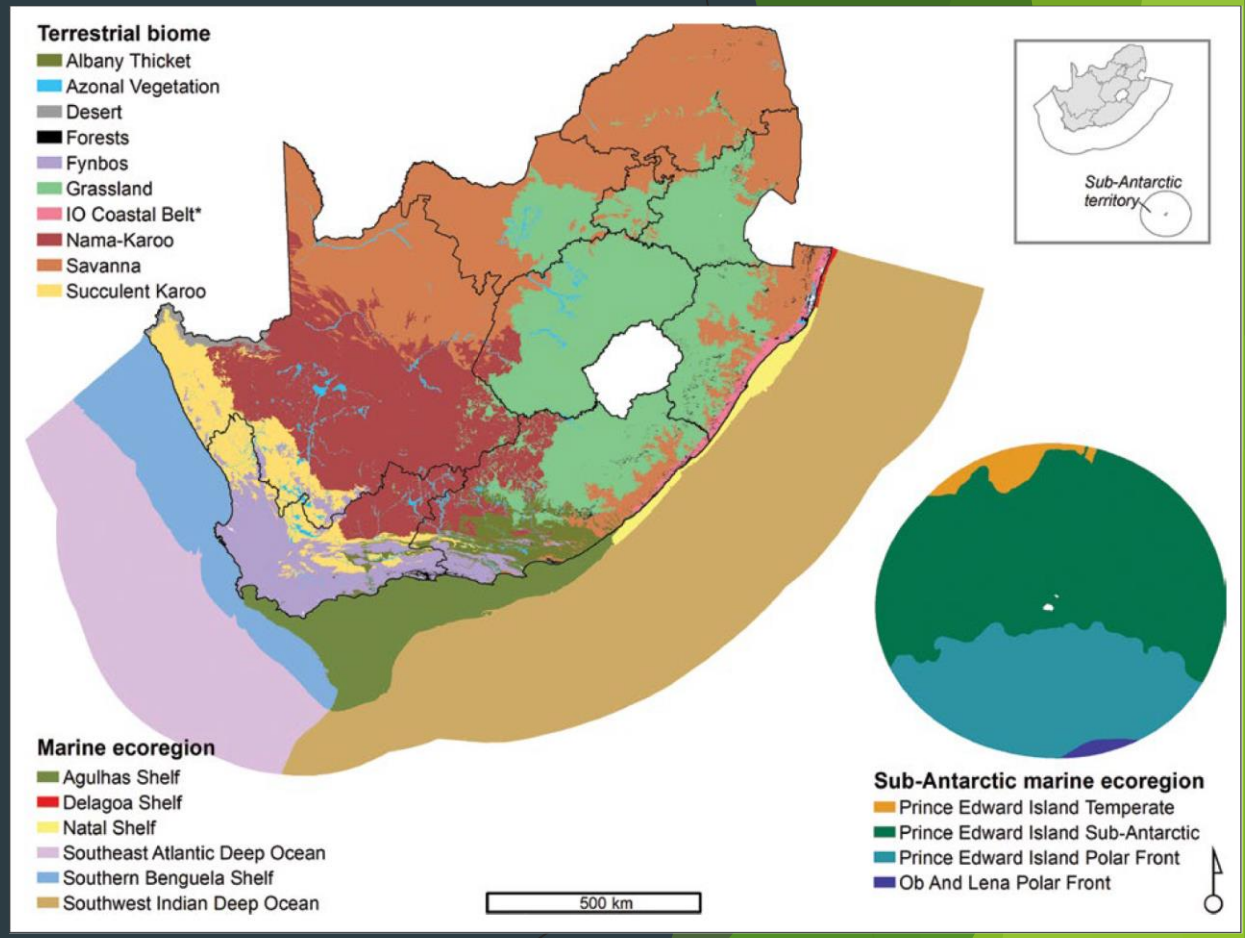
1. Geological history of southern Africa

- The Great Escarpment is a major topographical feature in Africa that consists of steep slopes from the high central southern African plateau surrounded by coastal lowlands.
  - Drakensberg
  - Schwarzrand and edge of the Khomas Highland in Namibia
  - Serra da Chela in Angola
- The Cenozoic (extending from 66 million years ago to the present day) was characterised by tectonic uplift and a cooling climate = the Alpine-Himalayan orogenic belt & Atlas Mountains of northwestern Africa



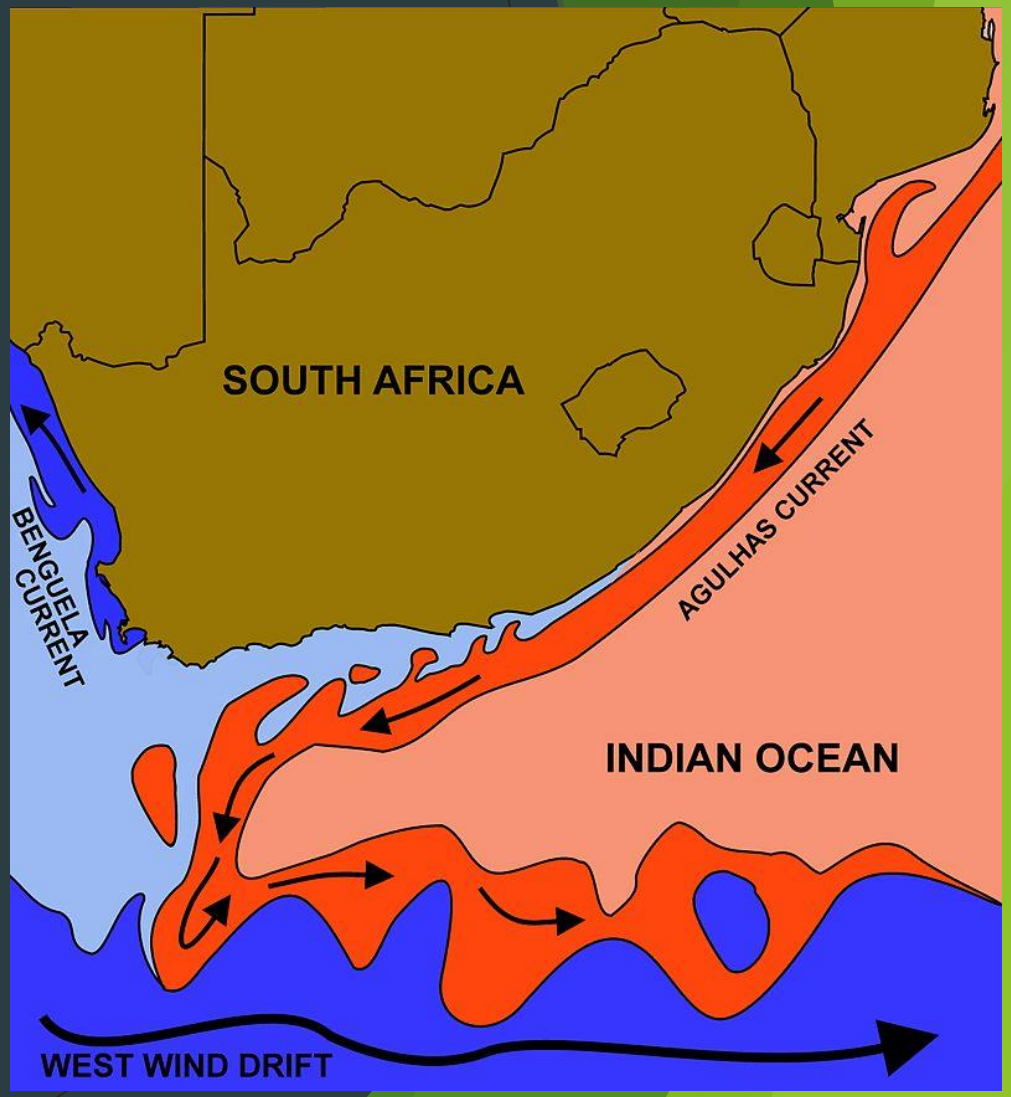
2. Geographic placement

- 9 terrestrial biomes (Savanna approx. 47%); 6 marine ecoregions
- SA's seas straddle three oceans, the Atlantic, the Indian and the Southern Ocean – resulting in an exceptional range of habitats, from cool-water kelp forests to subtropical coral communities.
- Climatic conditions vary noticeably between east and west:
  - Mediterranean in the southwestern corner;
  - temperate in the interior plateau;
  - subtropical in the northeast; and
  - a desert climate in a small area in the northwest.



2. Geographic placement (cont.)

- According to UNESCO "Large Marine Ecosystems (LME's) are regions of the world's oceans, encompassing coastal areas from river basins and estuaries to the seaward boundaries of continental shelves and the outer margins of the major ocean current systems."
- SA is surrounded by the Benguela Current (BC) and Agulhas Current (AC) LME's:
  - BC draws icy-cold waters from the Southern Ocean and carries them northward along the coast of Africa.
  - AC brings warm tropical Indian Ocean water southwards which modulates the rainfall along the east coast and interior regions.



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Biodiversity supports human and societal needs

- This includes food and nutrition security, energy, development of medicines and pharmaceuticals and freshwater, which together underpin good health.

Biodiversity supports human and societal needs

- This includes **food and nutrition security**, energy, development of medicines and pharmaceuticals and freshwater, which together underpin good health.

The ocean could provide **six times more food than it does today** - including more than two-thirds of the protein needed to feed the future world population - provided it is sustainably managed.

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Article | Published: 19 August 2020

The future of food from the sea

Christopher Costello, Ling Cao, Stefan Gelcich, Miguel Á. Cisneros-Mata, Christopher M. Free, Halley E. Froehlich, Christopher D. Golden, Gakushi Ishimura, Jason Maier, Ilan Macadam-Somer, Tracey Mangin, Michael C. Melnychuk, Masanori Miyahara, Carryn L. de Moor, Rosamond Naylor, Linda Nøstbakken, Elena Ojea, Erin O'Reilly, Ana M. Parma, Andrew J. Plantinga, Shakuntala H. Thilsted & Jane Lubchenco

Nature **588**, 95–100 (2020) | Cite this article

68k Accesses | **165** Citations | **819** Altmetric | Metrics

Matters Arising to this article was published on 09 March 2022

Biodiversity supports human and societal needs

- This includes food and nutrition security, **energy**, development of medicines and pharmaceuticals and freshwater, which together underpin good health.

- Ocean is constantly moving through waves, tides, and currents.
- Offshore wind energy has great potential to help nations achieve a clean, independent (renewable) energy source for the future.

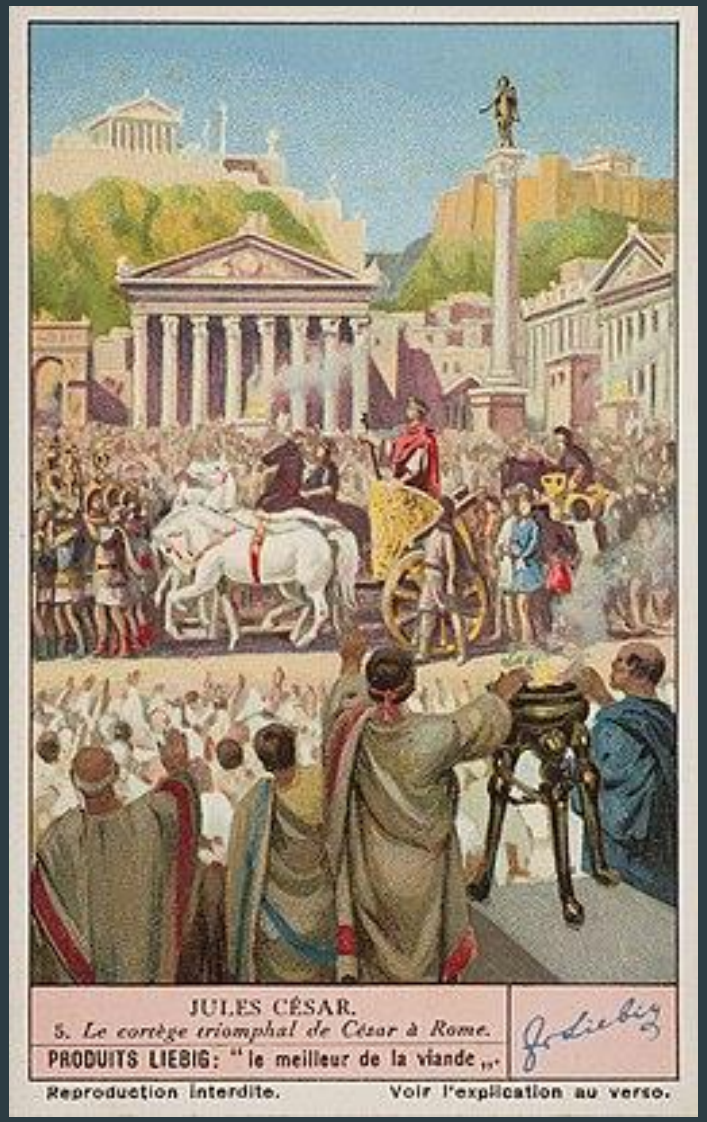
Image credit: TebNad/Shutterstock.com

Orange tree sponge (*Ptilocaulis* sp.)

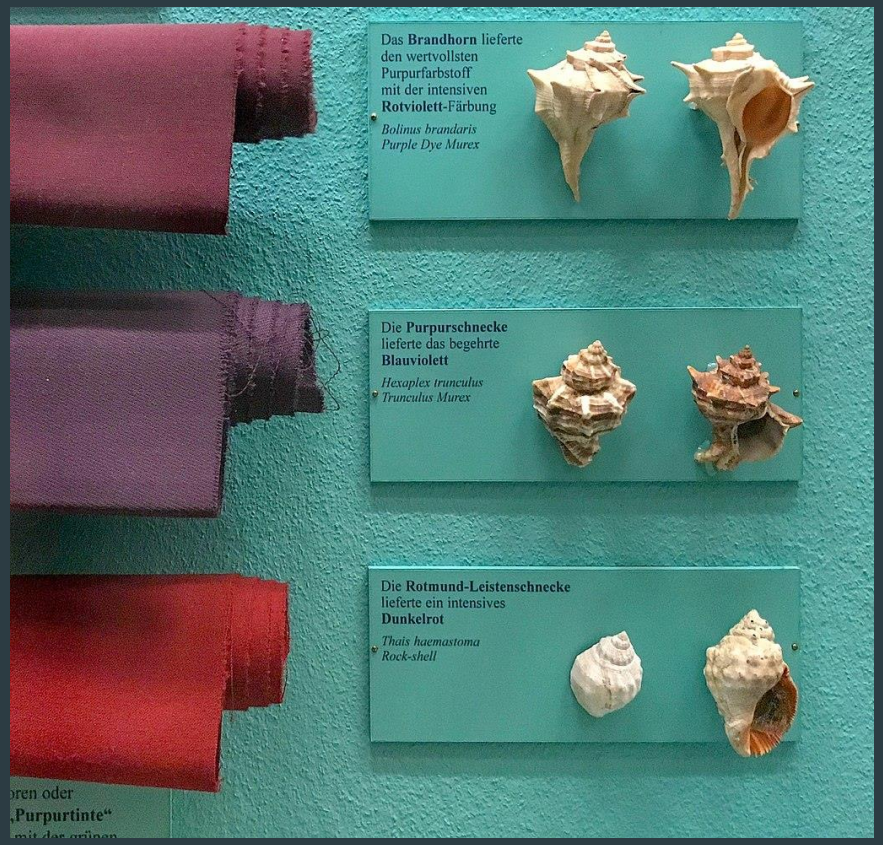
Biodiversity supports human and societal needs

- This includes food and nutrition security, energy, development of **medicines and pharmaceuticals** and freshwater, which together underpin good health.

- Living conditions differ fundamentally from those in terrestrial environment.
- The production of specific secondary metabolites is an important adaption mechanism of marine organisms to survive in the sea.
- These metabolites possess biological activities which make them interesting as possible drugs for humans (Lindequist, 2016).



- From a historical perspective, the oldest marine product was the dye Tyrian purple extracted from marine molluscs by the Phoenicians about 1600 BC (Lindequist, 2016).
- It is a secreted by several species of predatory sea snails in the family Muricidae, rock snails originally known by the name 'Murex'.



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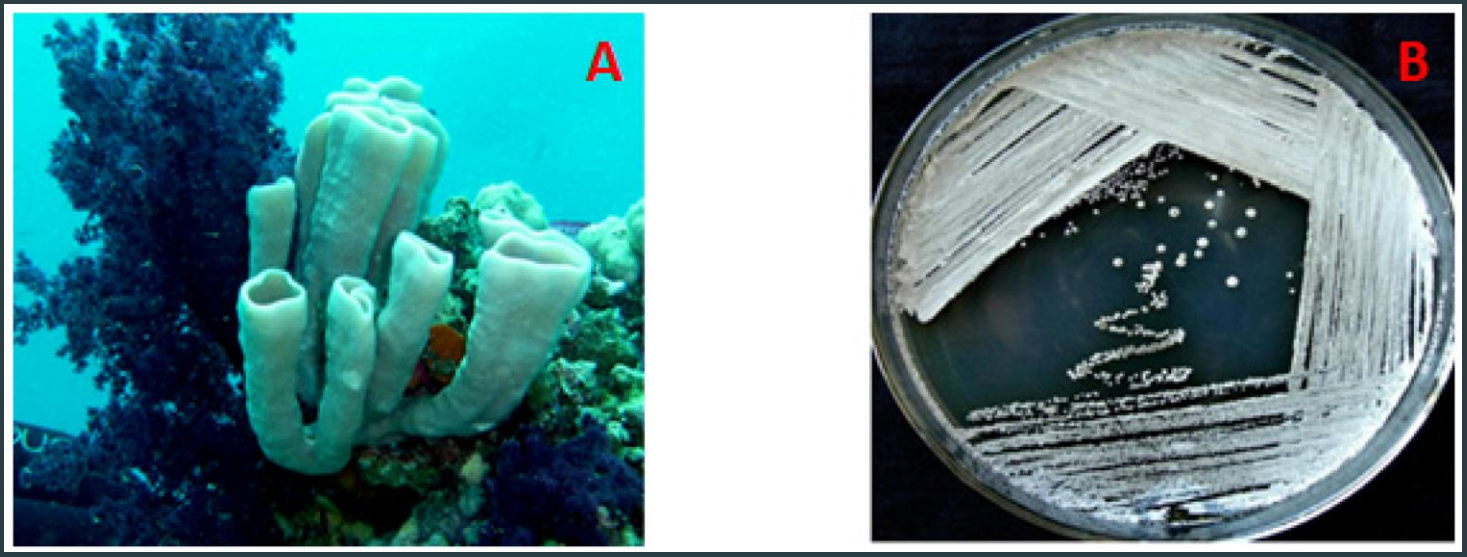
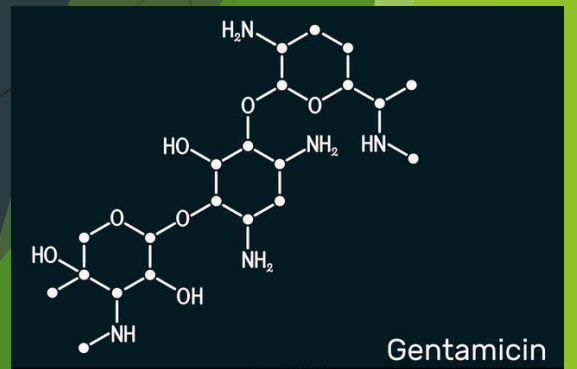


Shaala et al. 2020

- For a long time, the marine natural products (MNPs) field focused on metabolites from fish and marine algae.
- Famous examples are marine biopolymers like agar and carrageenan, the vitamins A and D from fish liver oil.
- The real marine drug development started in the 1950s with the discovery of spongothymidine and spongouridine (antiviral activity) from the Caribbean sponge *Tectitethya crypta* (de Laubenfels, 1949).
- **Most compounds have been isolated from marine invertebrates** (Lindequist, 2016).



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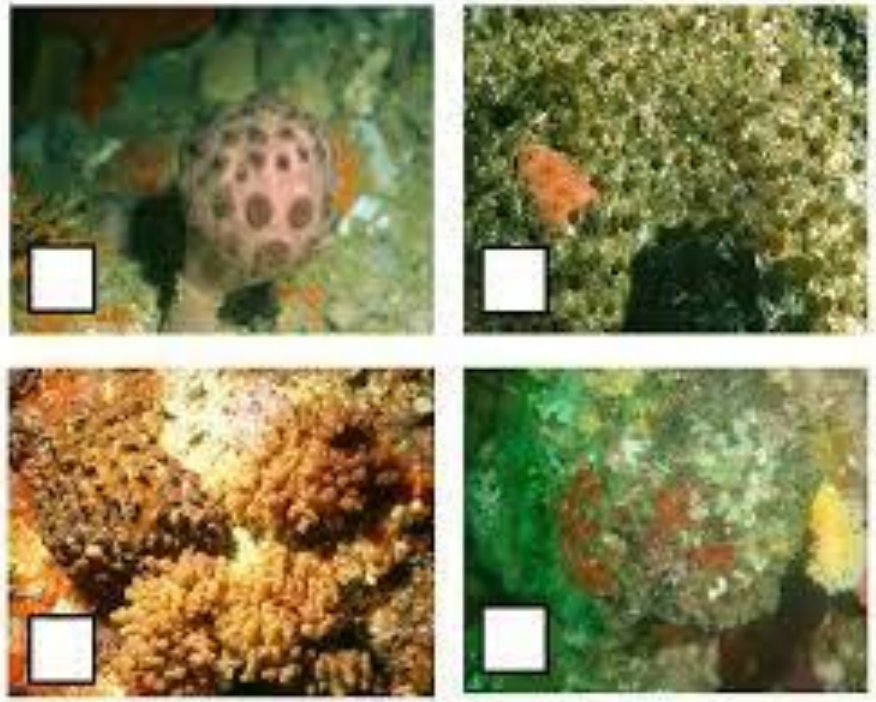
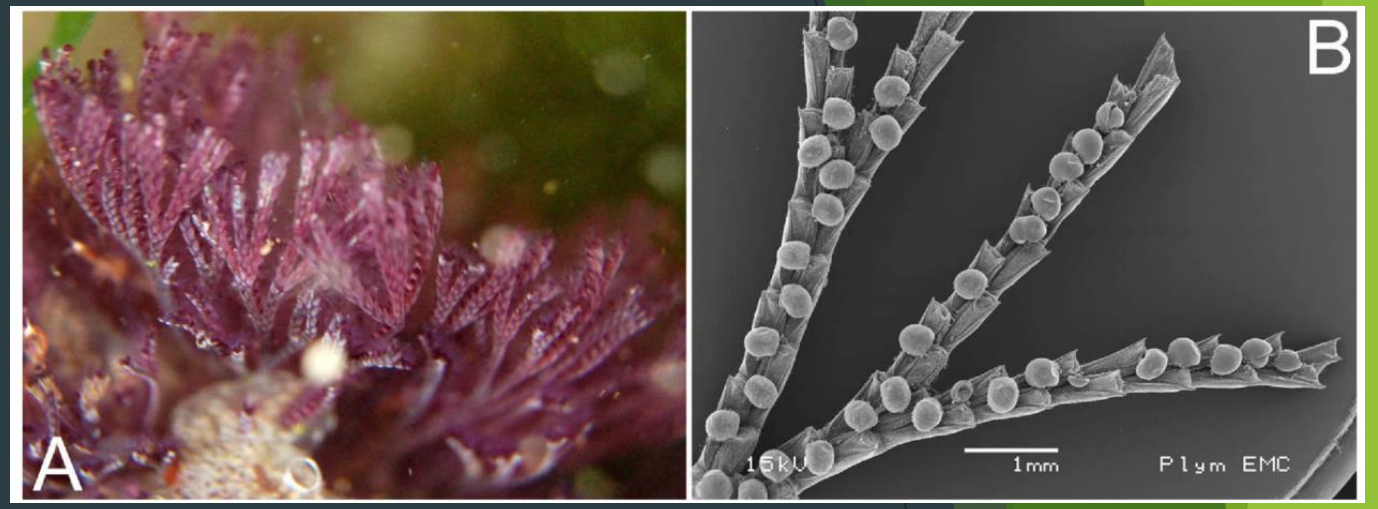
South African Journal of Science

The colourful chemistry of South African latrunculid sponges

- Prof Michael Davies-Coleman, Prof Edith Antunes, Dr Denzil Beukes (UWC) and Dr Toufiek Samaai (DEA) published on 29 May 2019.
- Latrunculid sponges (Family Latrunculiidae) produce toxic chemicals which may have the ability to destroy cancer cells, but they also destroy normal cells.



- Some bryozoan species that produce secondary metabolites and the usefulness of these products is being explored for a potential Alzheimer's disease and cancer drug (Sharp et al. 2007).
- *Bugula neritina* Linnaeus, 1758, for example, has received considerable attention for the compound bryostatin-1 used for anti-cancer research (Winston & Woollacott 2008).



Images from: Ryland et al. (2011)

- It also supports **economic opportunities**, and **leisure activities** that contribute to overall wellbeing.

State of the Ocean

Human activities are causing unprecedented marine biodiversity loss.

Biggest problems:

- ✔ Over- and illegal fishing
- ✔ Marine pollution
- ✔ Climate change

Eliminate plastic pollution and reduce your carbon footprint.
#SaveOurOcean

UNITED NATIONS OCEAN CONFERENCE

REPUBLIC OF SOUTH AFRICA

GOVERNMENT GAZETTE

STAATSKOERANT

VAN DIE REPUBLIEK VAN SUID-AFRIKA

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Vol 395 CAPE TOWN, 27 MAY 1998 KAAPSTAD, 27 MEI 1998 **No. 18930**

OFFICE OF THE PRESIDENT

No. 747. 27 May 1998

It is hereby notified that the President has assented to the following Act which is hereby published for general information:—

KANTOOR VAN DIE PRESIDENT

No. 747. 27 Mei 1998

Hierby word bekend gemaak dat die President sy goedkeuring gehegg het aan die onderstaande Wet wat hierby ter algemene inligting gepubliseer word:—

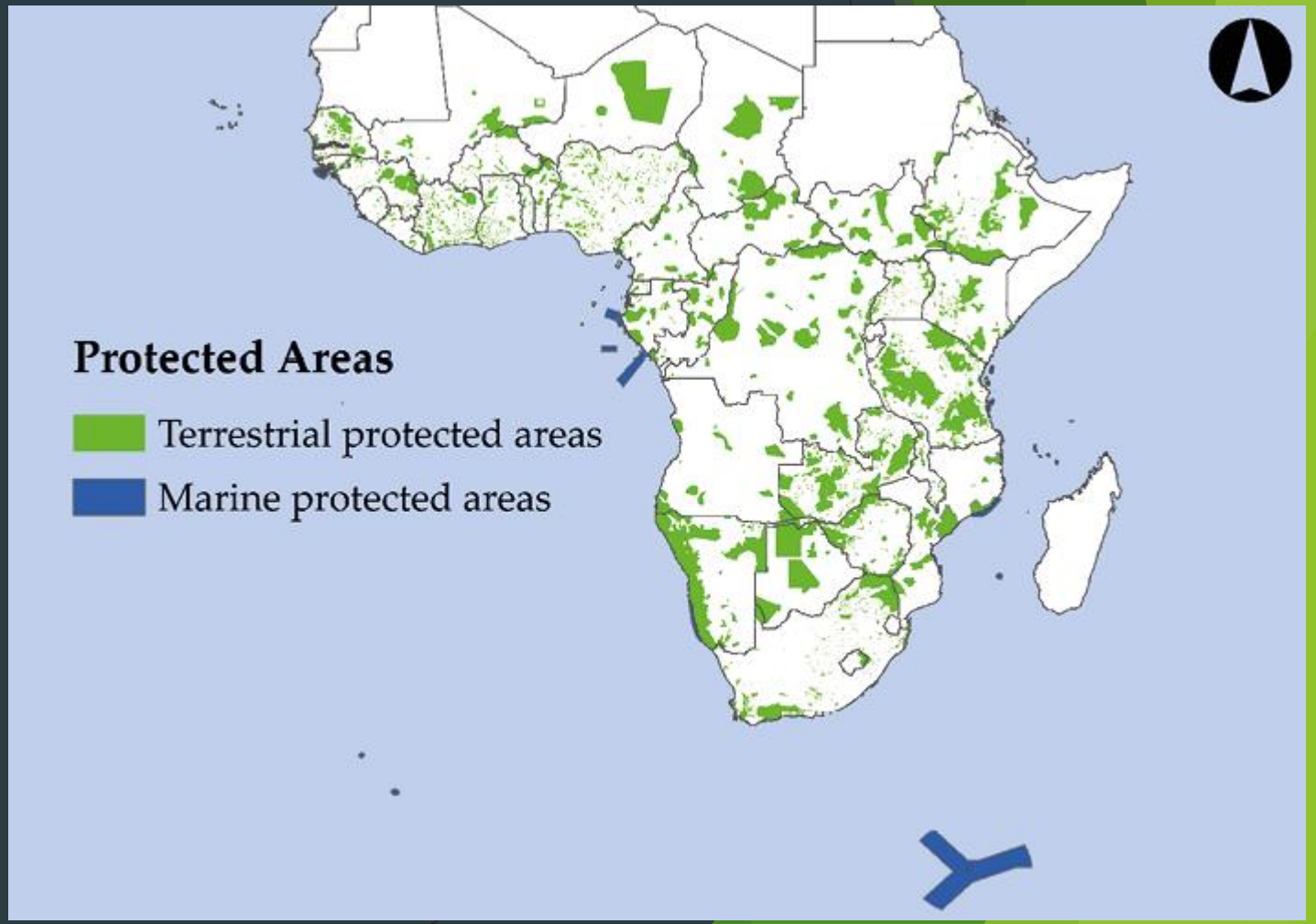
Legislation

- In South Africa, the two pieces of Legislation most commonly used in the management of MPA's is the **NEMA PAA (National Environmental Management Act – Protected Areas Act)** and the **MLRA (Marine Living Resources Act of 1998).**
- These Acts are enforced by MPA staff who are appointed as FCO's (Fishery Control Officers) to enforce the MLRA Regulations and EMI's (Environmental Management Inspectors) to enforce the NEMA PAA Regulations

A neglected system: marine protected areas

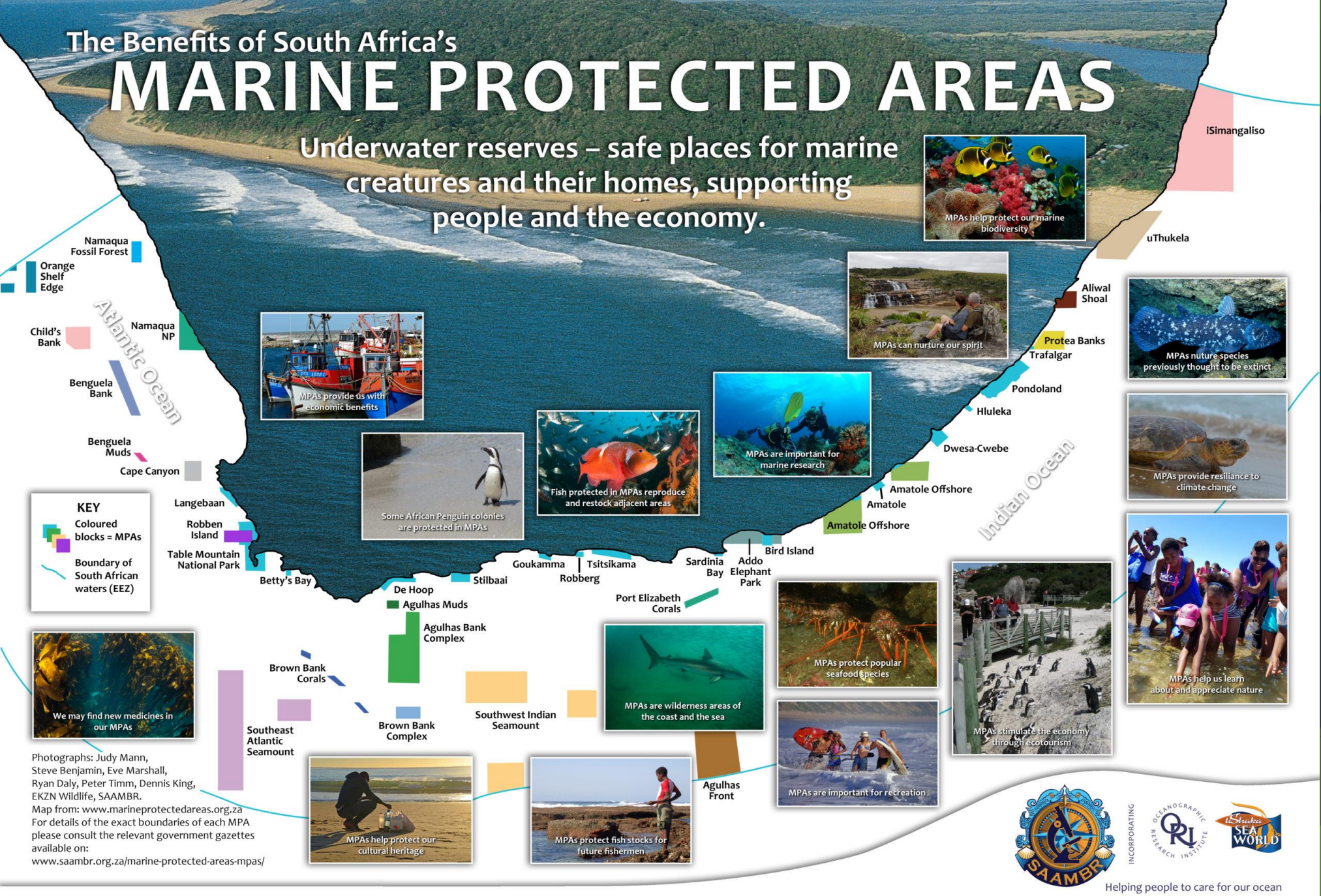
- The country with the largest number of protected areas is South Africa with over 1 500 protected areas **(= only 8%)** (Wilson & Primack, 2022).
- International Aichi Biodiversity Targets for global conservation area reads (https://www.cbd.int/sp/targets):

"By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, … are conserved … and integrated into the wider landscape and seascape."



The Benefits of South Africa's MARINE PROTECTED AREAS

Underwater reserves – safe places for marine creatures and their homes, supporting people and the economy.



Photographs: Judy Mann, Steve Benjamin, Eve Marshall, Ryan Daly, Peter Timm, Dennis King, EKZN Wildlife, SAAMBR.
Map from: www.marineprotectedareas.org.za
For details of the exact boundaries of each MPA please consult the relevant government gazettes available on: www.saambr.org.za/marine-protected-areas-mpas/

SAAMBR INCORPORATING OCEANOGRAPHIC RESEARCH INSTITUTE uShaka SEA WORLD

Helping people to care for our ocean
www.saambr.org.za

41 mainland MPAs = only 5%

How do we unlock existing Foundational Marine Biodiversity Information?

A collaborative effort between scientists, decision makers and citizen scientists

Currently data is inaccessible, not standardized and incomprehensible = “Locked away”

Dr Butch Hulley
Lanternfish Scientist

Michael Bougaardt
Collections Manager: Fishes

Citizen Science projects

Unlocking data = Adopted & implemented global standards + Taxonomic examination/Geo-referencing/Genetic resolution + Digitisation/DNA barcoding/ Data cleaning + Dissemination through accessible platforms

How do we ensure that Foundational Marine Biodiversity Information is accessible?

Embracing old and new technology to make a difference

Dissemination of “Unlocked” foundational marine biodiversity knowledge & information is currently being made available through:

Data Web Portals

Online Species Pages

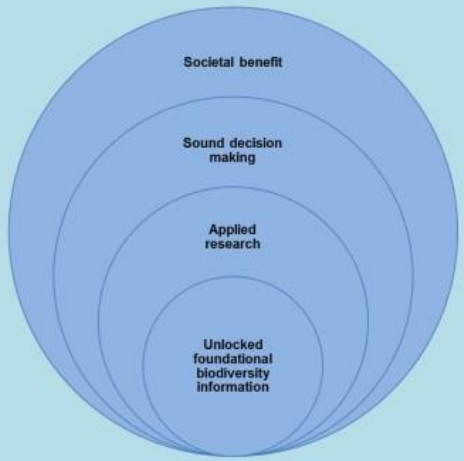
Technical Reports

Peer Reviewed Publications

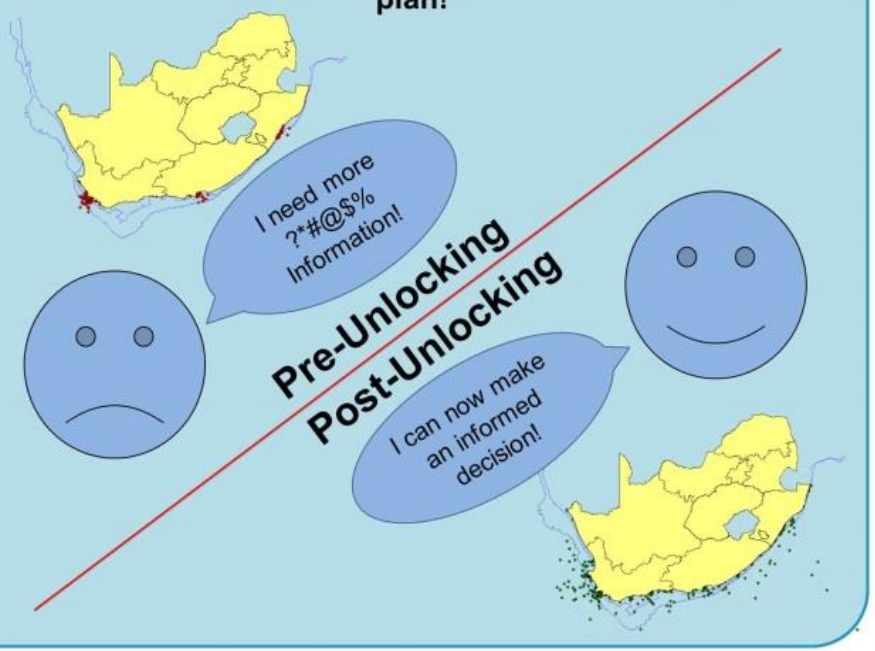
What will the Societal Benefit of Unlocking Foundational Marine Biodiversity Information be?

Applied Marine Biodiversity Research, Decision Making and Societal Benefit

Appropriate, Good quality, accessible information allows for credible applied research informed policy, planning and sound decision making, which will ultimately lead to societal benefit.



Mr Manager, we need a marine biodiversity management plan!



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Novel taxa of Cheilostomata Bryozoa discovered in the historical backlogs of the Iziko South African Museum

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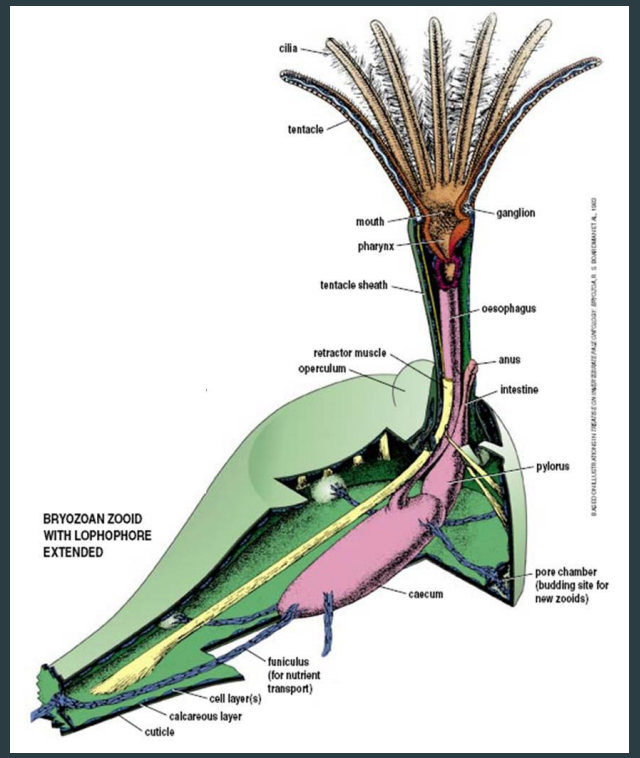
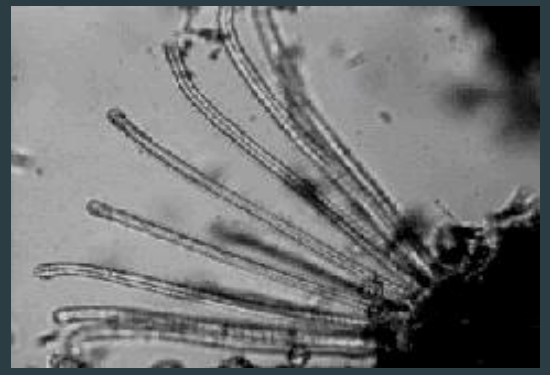
Abstract

Non-studied museum collections are hidden treasures—a source of information for various research fields. The novel taxa presented here were discovered during taxonomic examination of the backlogs of Bryozoa (Cheilostomata) from the Iziko South African Museum. We describe one new genus, *Khulisa* **n. gen.**, and nine new species of bryozoans from South Africa. The new species are: *Biflustra adenticulata* **n. sp.**, *Aspidostoma sarcophagus* **n. sp.**, ?*Micropora erecta* **n. sp.**, *Trypostega richardi* **n. sp.**, *Khulisa carolinae* **n. gen. et n. sp.**, *Adeonella assegai* **n. sp.**, *Hippomonavella lingulata* **n. sp.**, *Phidolopora chakra* **n. sp.** and *Reteporella ilala* **n. sp.** Three genera, *Biflustra*, *Phidolopora* and *Triphyllozoon*, are recorded for the first time from South Africa. This study highlights the importance of examining existing backlogged material lodged in museum collections.

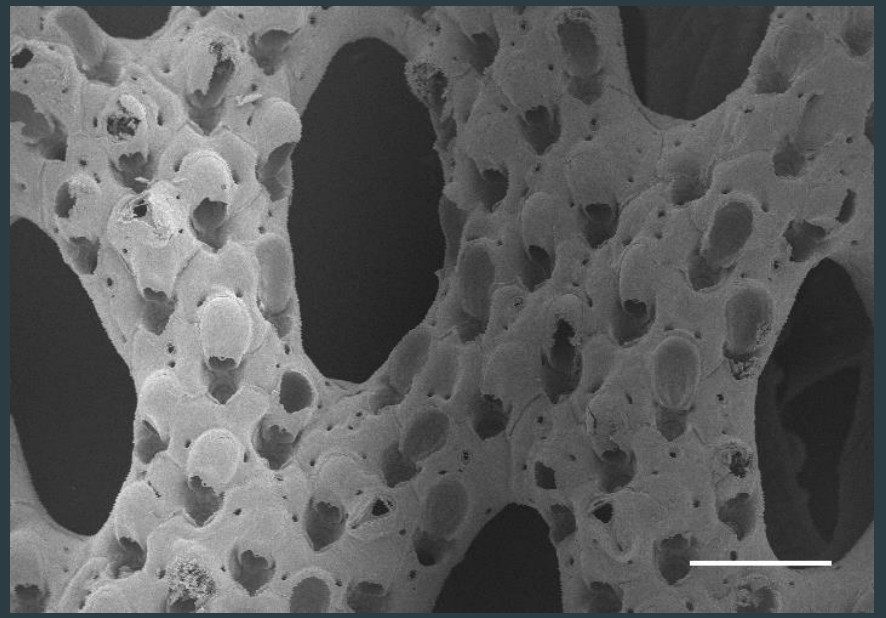
what are bryozoans?

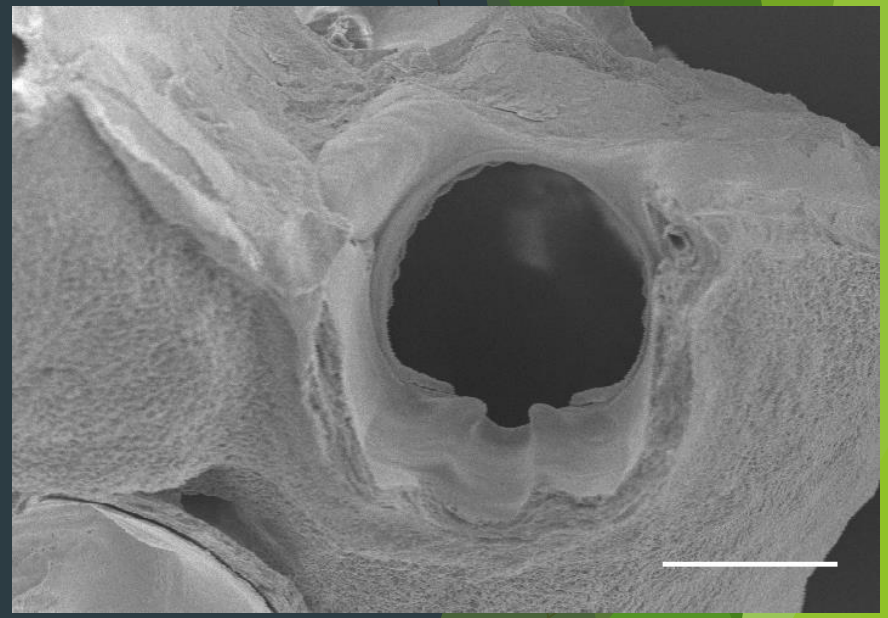
- In Greek “bryo” and “zoa” means “moss animals”.
- Invertebrates, colonial, sessile fauna, predominantly marine.
- Although zooids are microscopic, sometimes less than 1 mm in height, colonies may range in size from 1 cm to over 1 m across.





novel taxa from museum backlogs





Phidolopora chakra Boonzaaier-Davids, Florence & Gibbons 2020. Left. Colony (scale bar = 10 mm). Middle. Ovicelled zooids (scale bar = 0.4 mm, magnified x50). Right. Young orifice with beaded rim and weak sinus (scale bar = 0.05 mm, magnified x500).

About the Marine Sciences Curriculum

- Marine Sciences is a relatively new CAPS school subject developed by the Two Oceans Aquarium's education team and first offered in three node schools in the Western Cape in 2019.
- In 2020 it was recognised as an official school subject and in 2021 was included in the official school curriculum.
- Since then, a number of students have been receiving tutelage/instruction in the subject, both at the node schools, as well as through the Aquarium Foundation's online learning programme.
- The subject is made up of four pillars: Marine Biology, Oceanography, Ocean Ecosystems, and Humans and the Ocean.

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Dankie! Nkosi! Niyabonga!
Thank you!