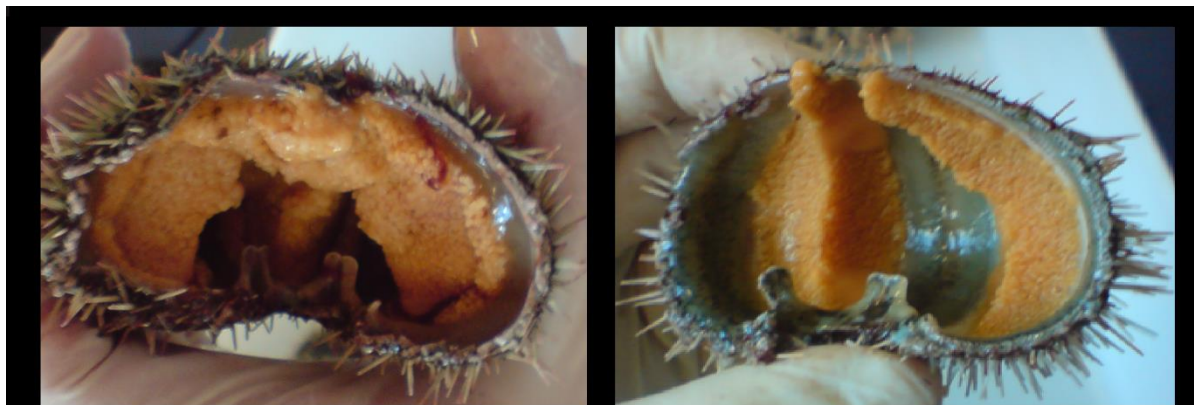
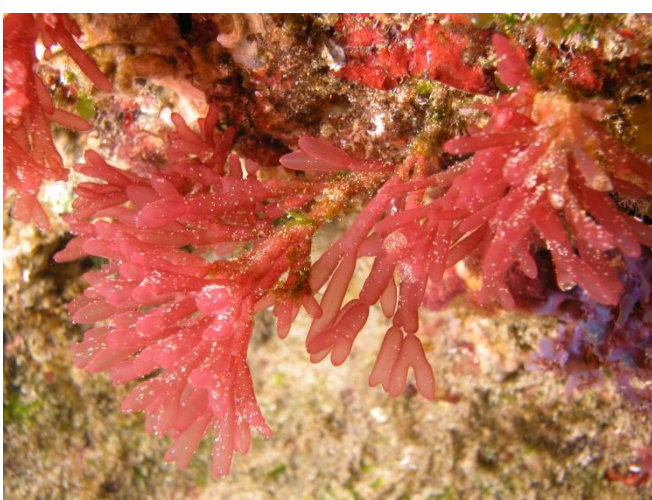


Marine biogeography and South Africa

John Bolton, Biological Sciences, University of Cape Town

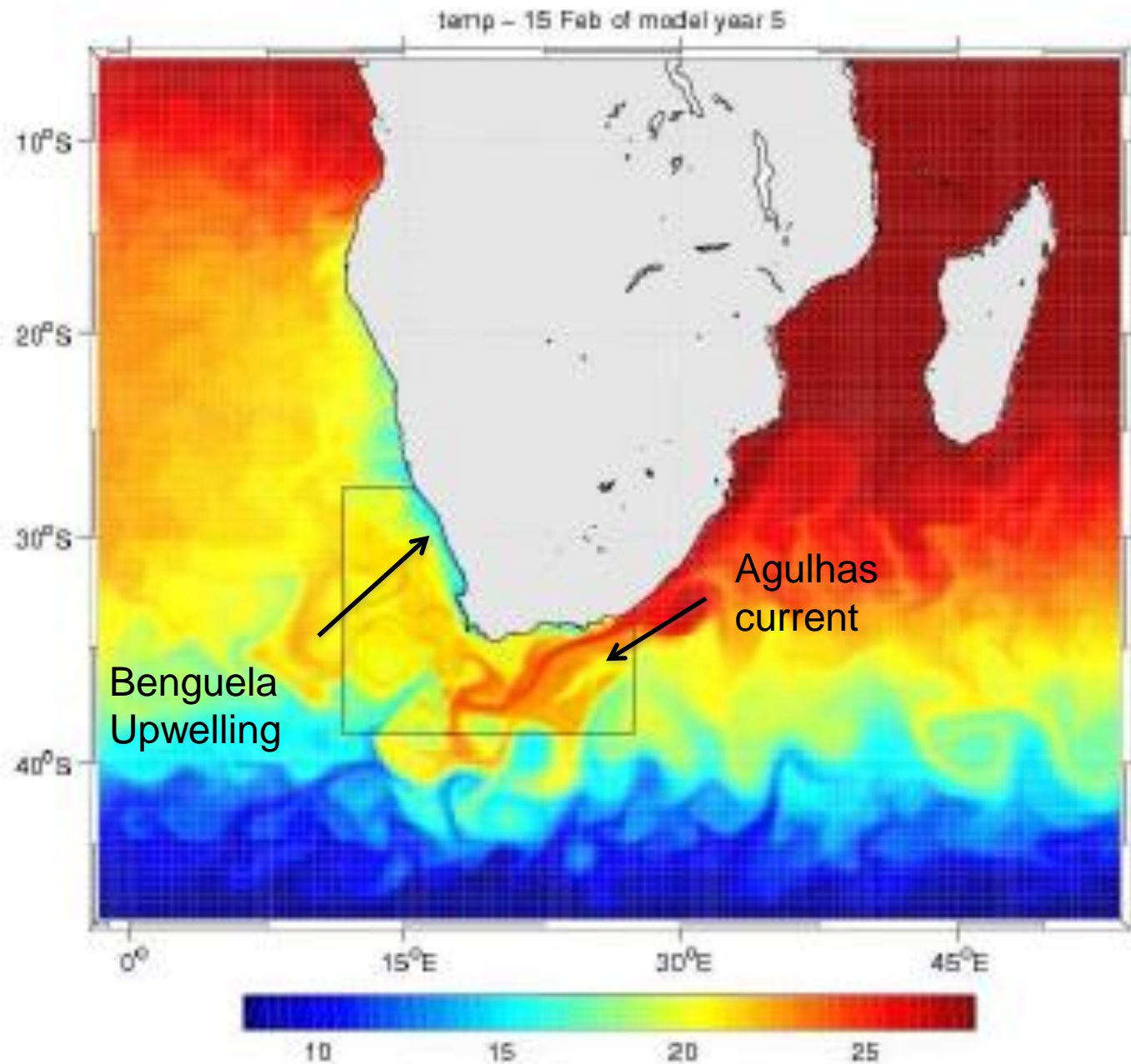


Marine biogeography and South Africa

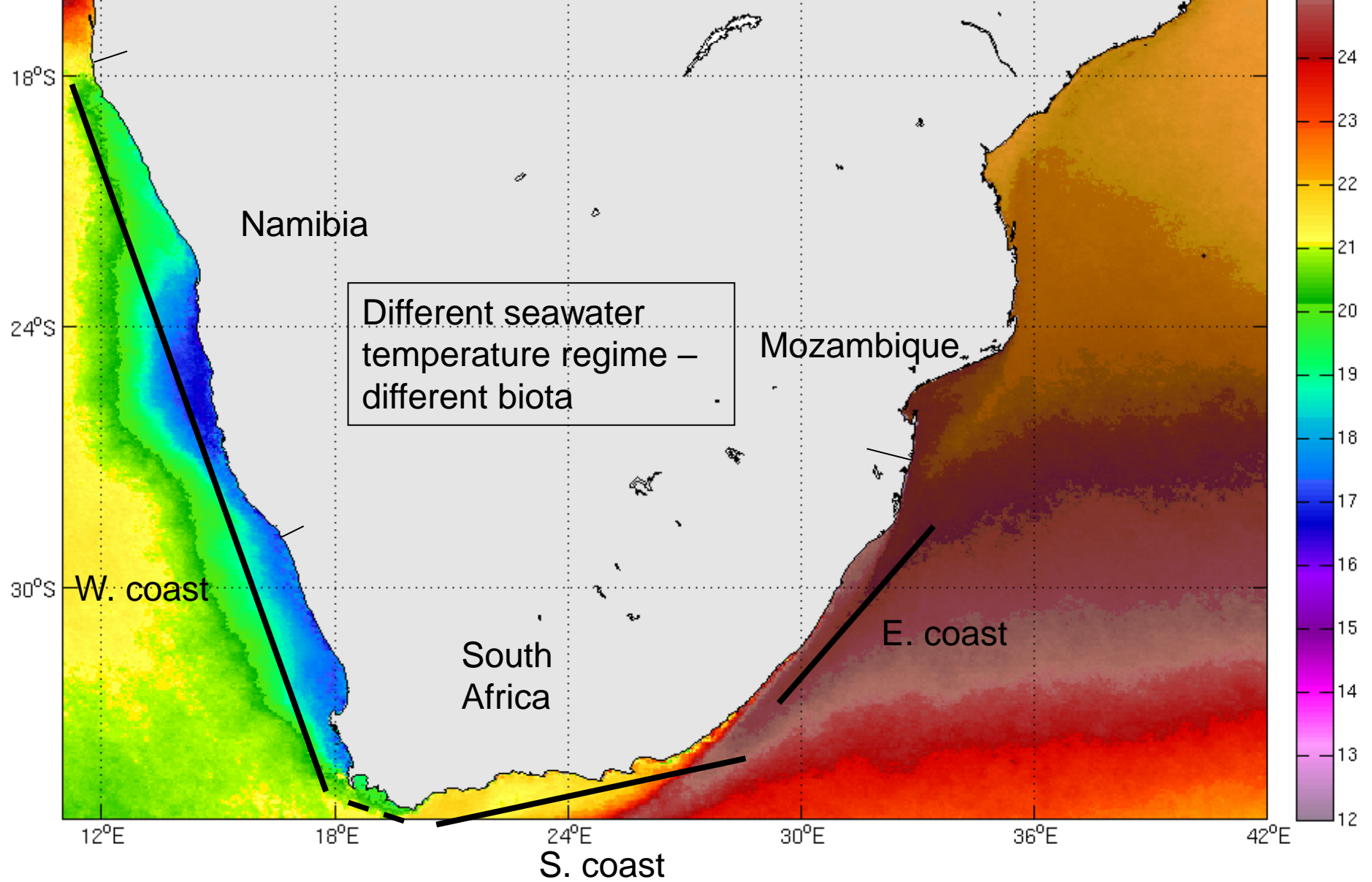
- What is marine biogeography?
- Not the same as distribution of marine organisms. Biogeography implies large scale.
- What are marine biogeographic regions/provinces/boundaries?

Seawater temperature regime

- An overwhelming environmental factor which best correlates with the distribution of INSHORE marine species at a BIOGEOGRAPHICAL SCALE (50-100km units) is SEA WATER TEMPERATURE (inversely correlated with nutrients)
- SUBSTRATUM also important (particularly offshore).
- Other factors determine ecological dominance of species (e.g. wave action, depth/light etc., biological interactions).



Dominated by two major marine systems:(Benguela & Agulhas)



Satellite sea surface temperature data: maximum monthly mean (Pathfinder): Data from François DuFois (MA-RE, UCT)

Review

Marine Biodiversity in South Africa: An Evaluation of Current States of Knowledge

Charles L. Griffiths^{1,2*}, Tamara B. Robinson¹, Louise Lange¹, Angela Mead¹

¹ Zoology Department, Marine Biology Research Centre, University of Cape Town, Rondebosch, South Africa, ² Zoology Department, Centre for Invasion Biology, University of Cape Town, Rondebosch, South Africa

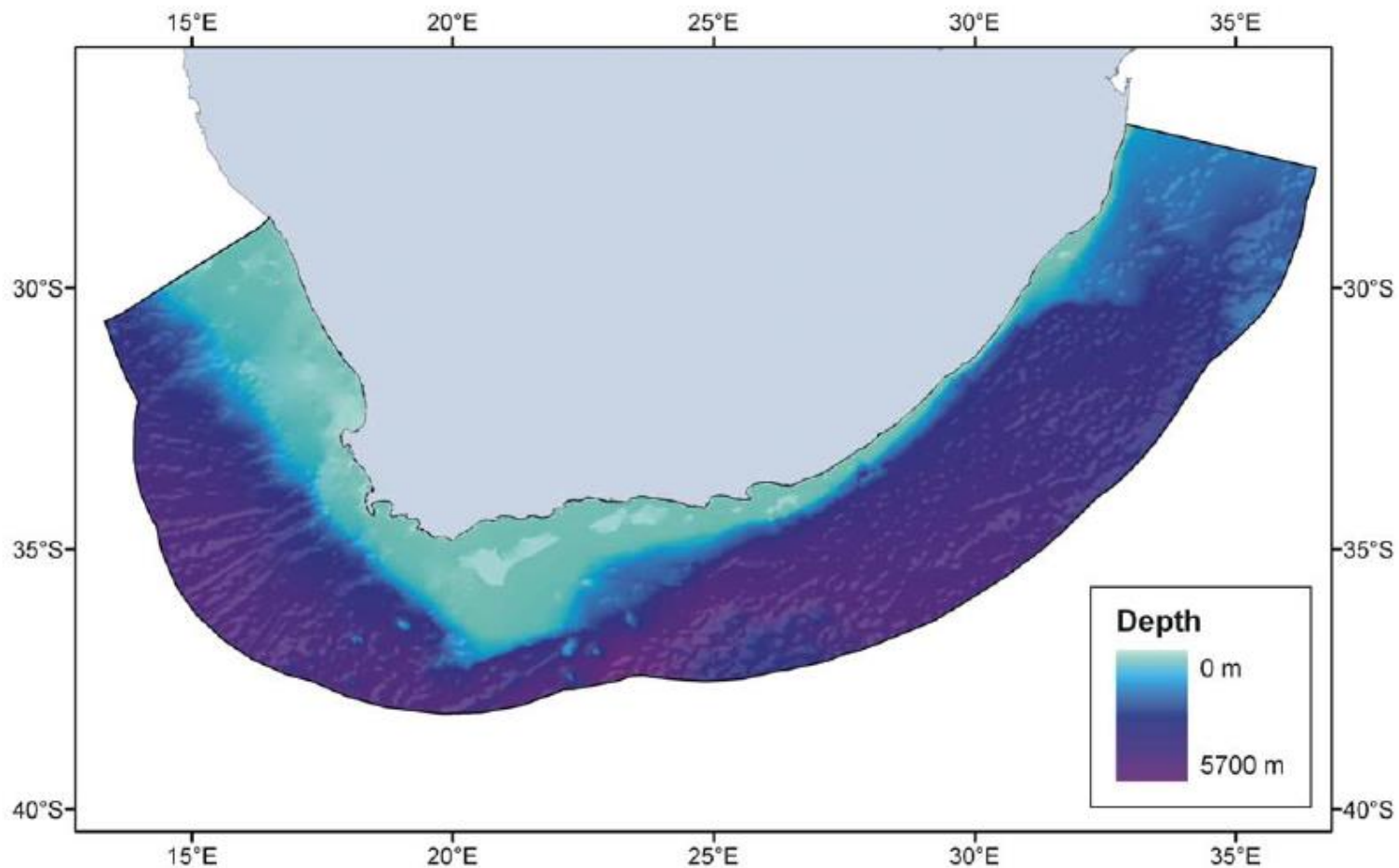


Figure 2. Map showing seafloor depths and the boundaries of South Africa's continental Exclusive Economic Zone (EEZ).
doi:10.1371/journal.pone.0012008.g002

Review

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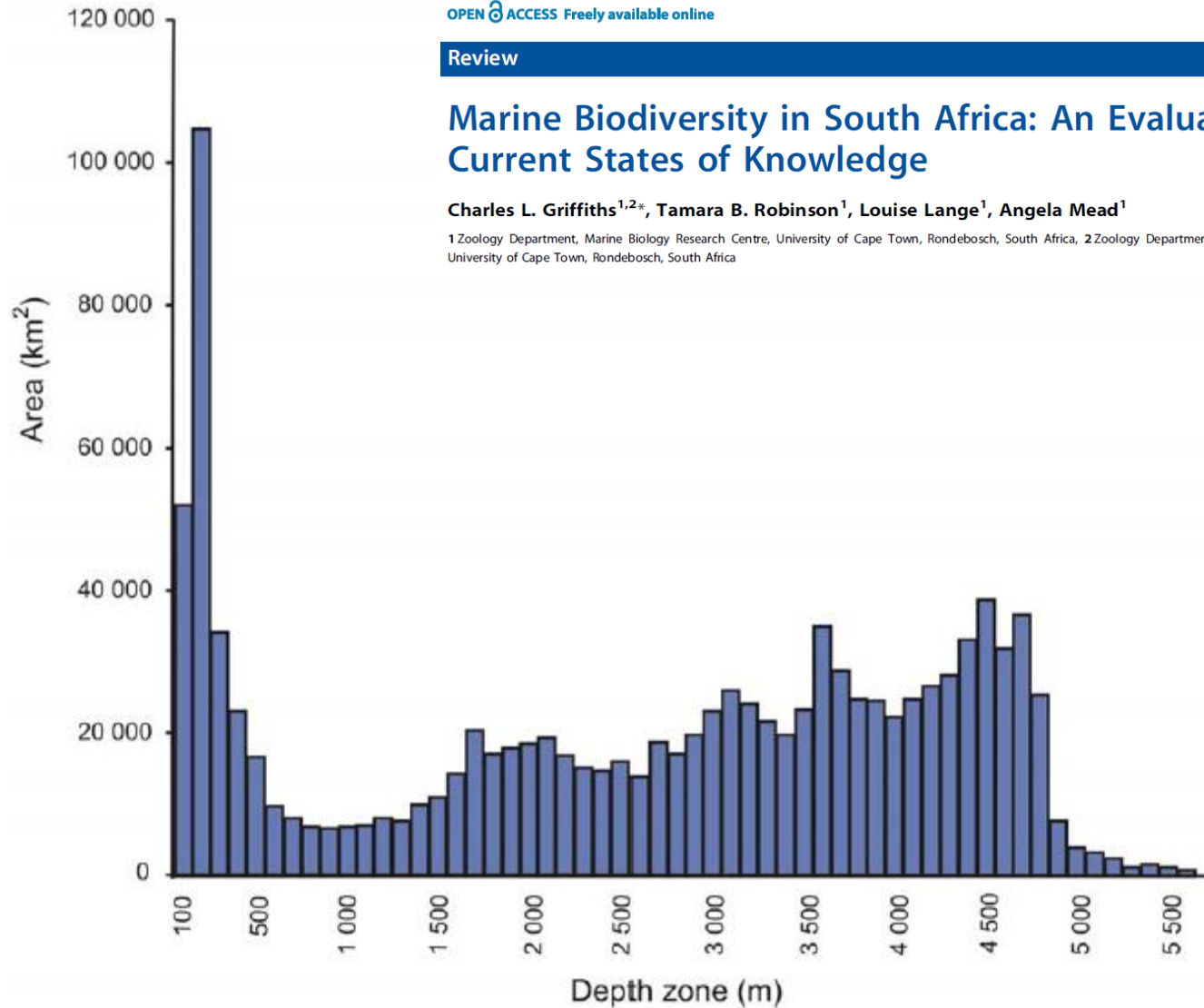


Figure 3. Area occupied by each 100 m depth zone within the South African continental EEZ.
doi:10.1371/journal.pone.0012008.g003

Review

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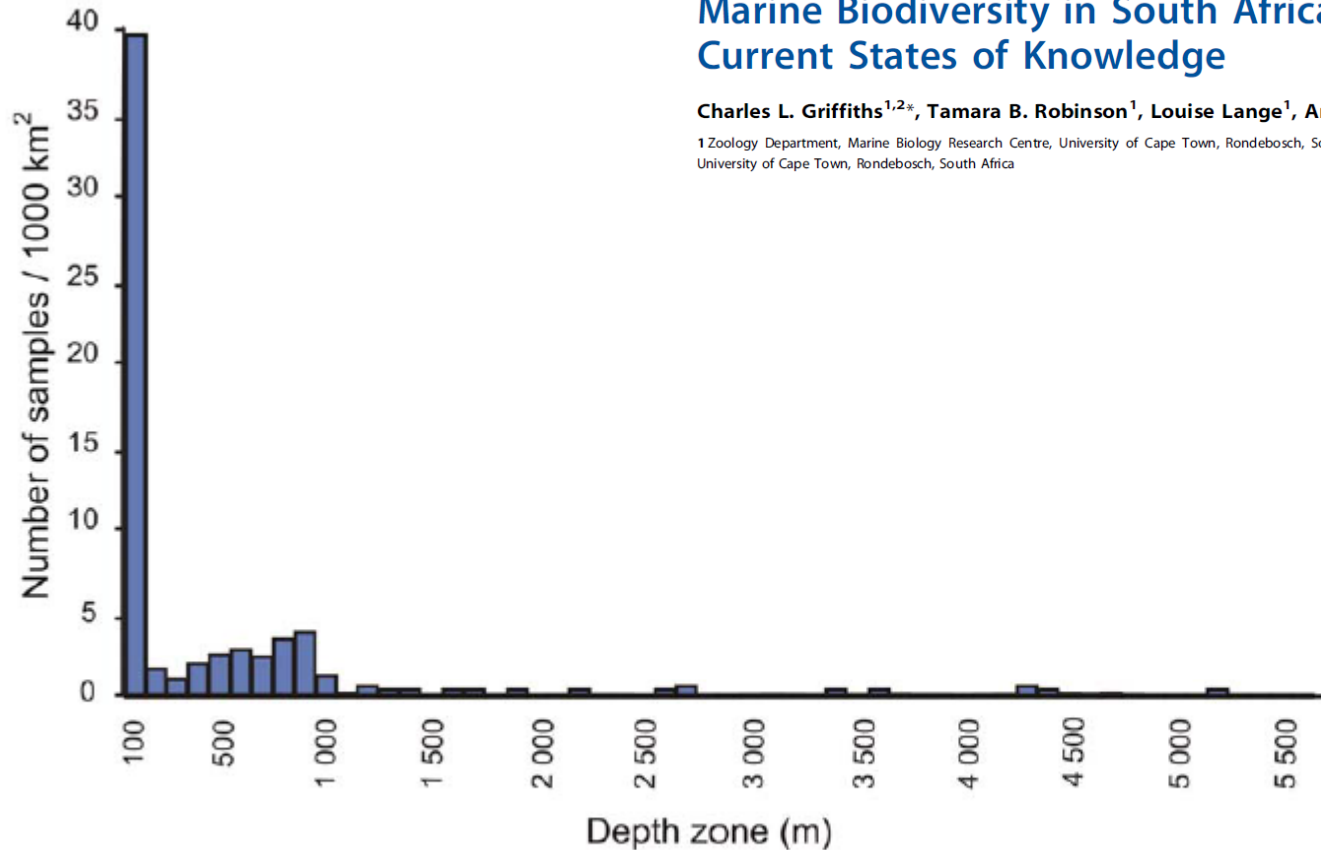


Figure 8. Number of benthic samples taken per 1,000 km² in each 100 m depth zone within the South African EEZ.
doi:10.1371/journal.pone.0012008.g008

Do we expect seaweeds and echinoderms to have similar biogeographic patterns

- **No!**
- Seaweeds only grow down to 10s of metres (light)
- Highest echinoderm taxonomic diversity at bathyal depths (1500m+): much colder, more stable, dark. Species diversity highest in shallow water? (Samyn et al. pers. comm.)

Inshore/Offshore: different ecosystems (and biologists?)

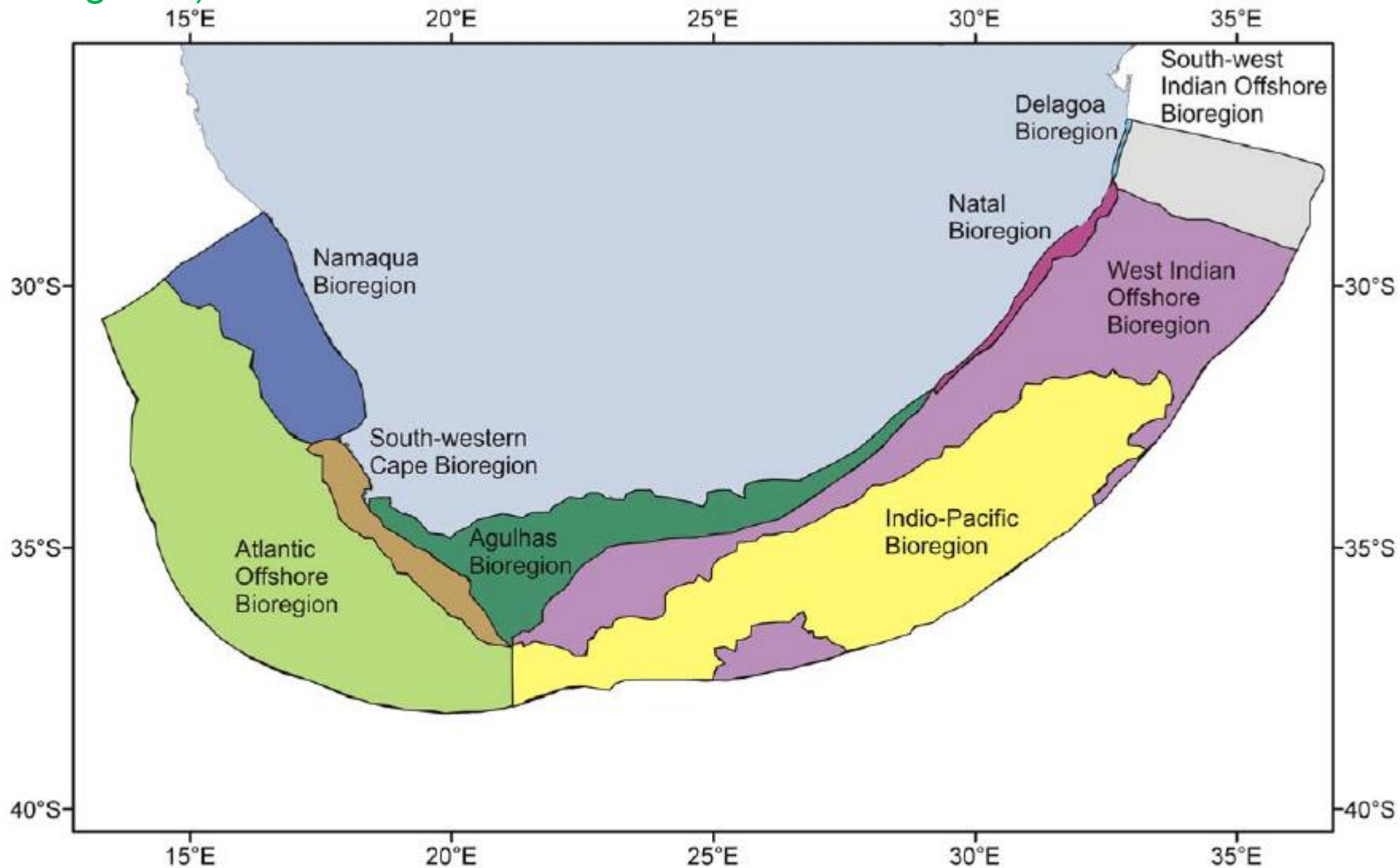
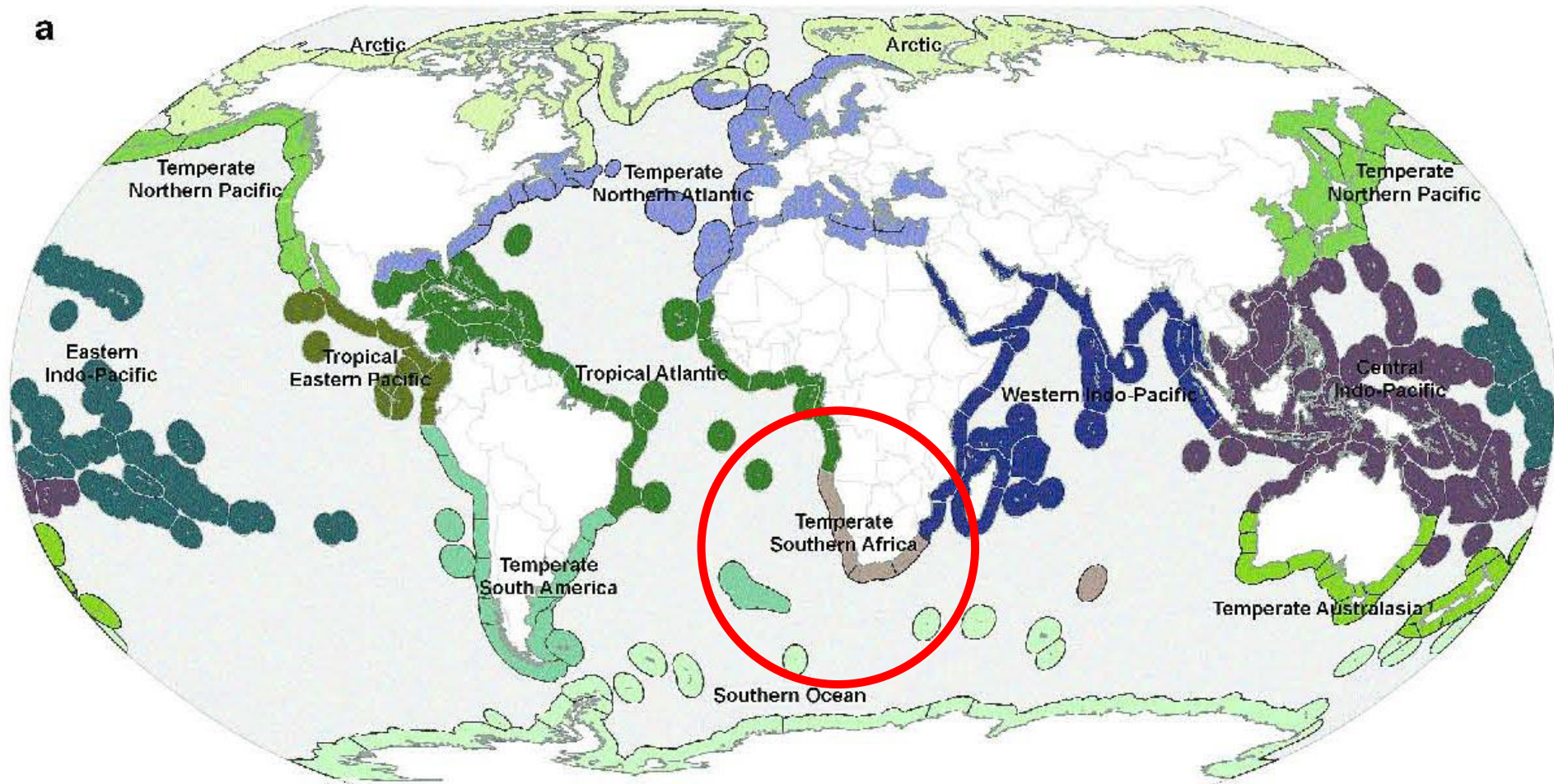


Figure 4. South Africa's nine marine bioregions, as defined by Lombard [14].

doi:10.1371/journal.pone.0012008.g004

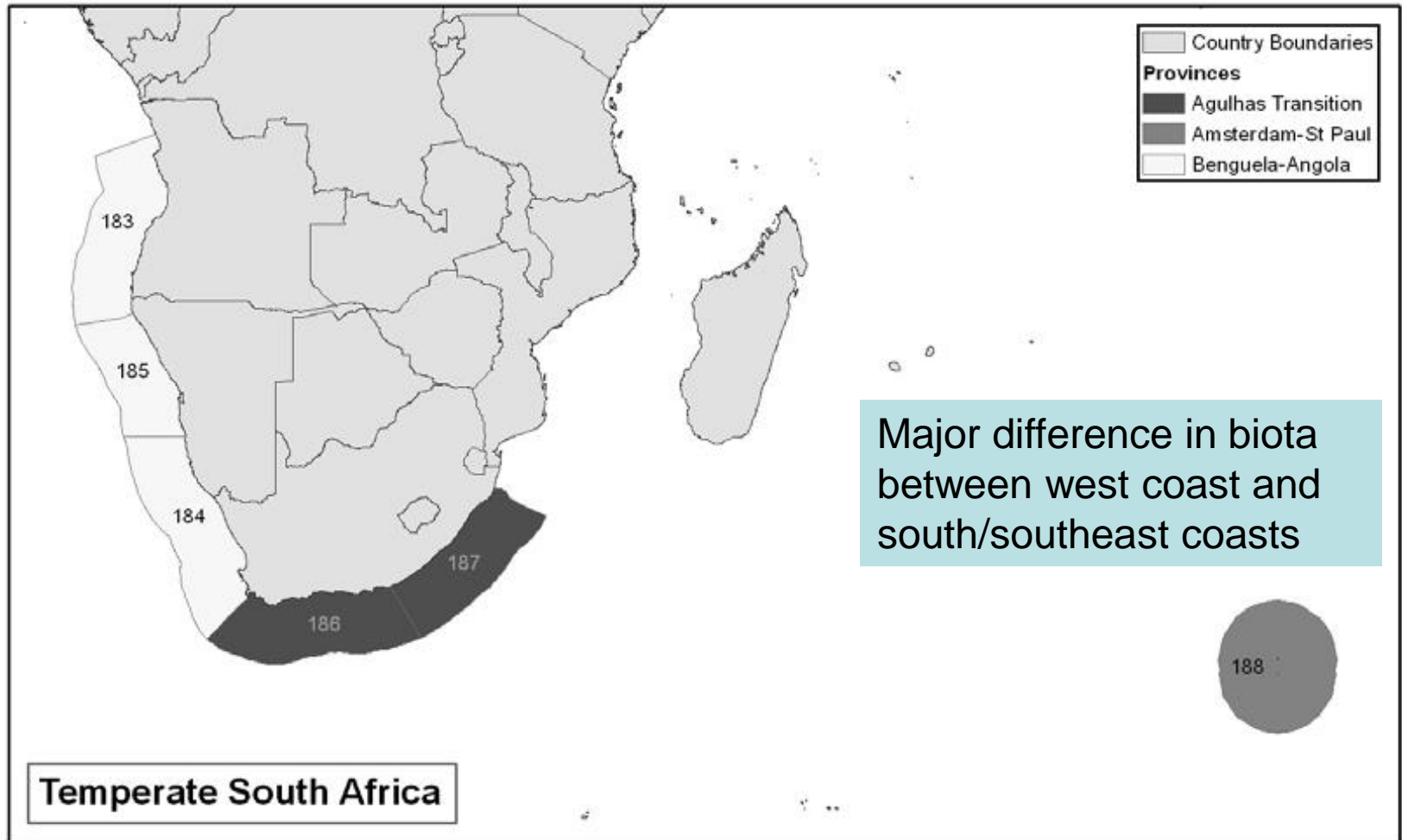
‘Marine Biogeographic Realms’: determined by distributions of organisms
(Spalding et al. 2007)
Hierarchy with 11 ‘realms’ as the largest unit



Spalding et al. (2007) hierarchy

- Marine Realms
- Marine Provinces
- Marine Bioregions

Temperate Southern Africa: Marine bioregions (Spalding et al. 2007)



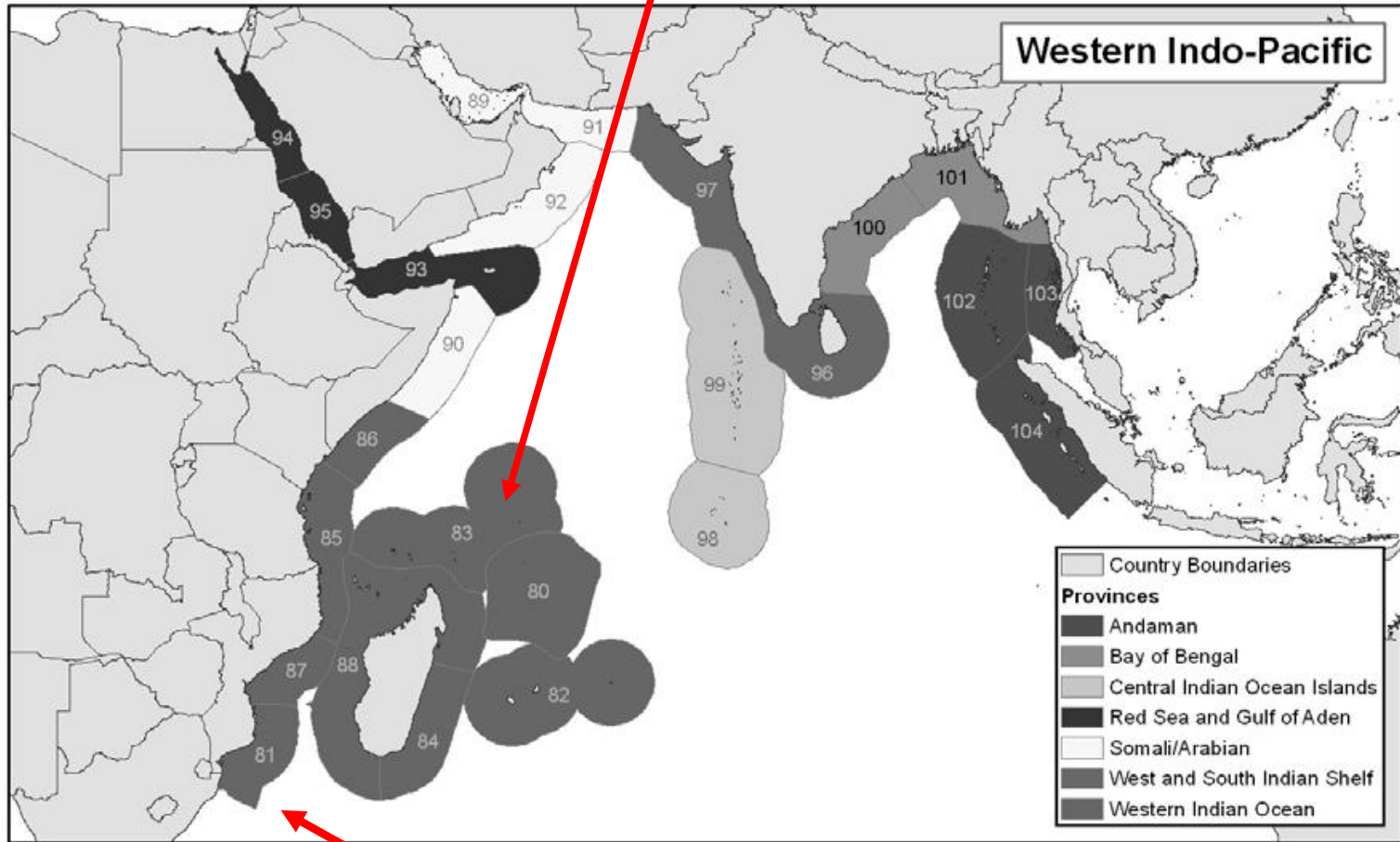
Benguela-Angola

- 183 Angolan
- 184 Namaqua
- 185 Namib

Agulhas Transition

- 186 Agulhas
- 187 Natal

Tropical Western Indian Ocean



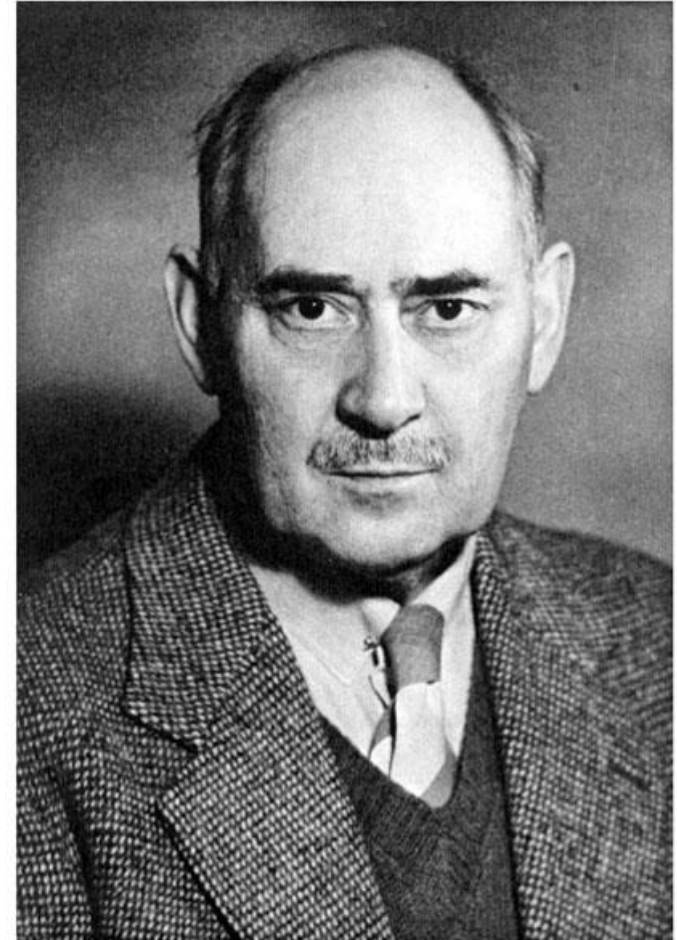
Boundary inside northern South Africa

What determines the boundaries of these units

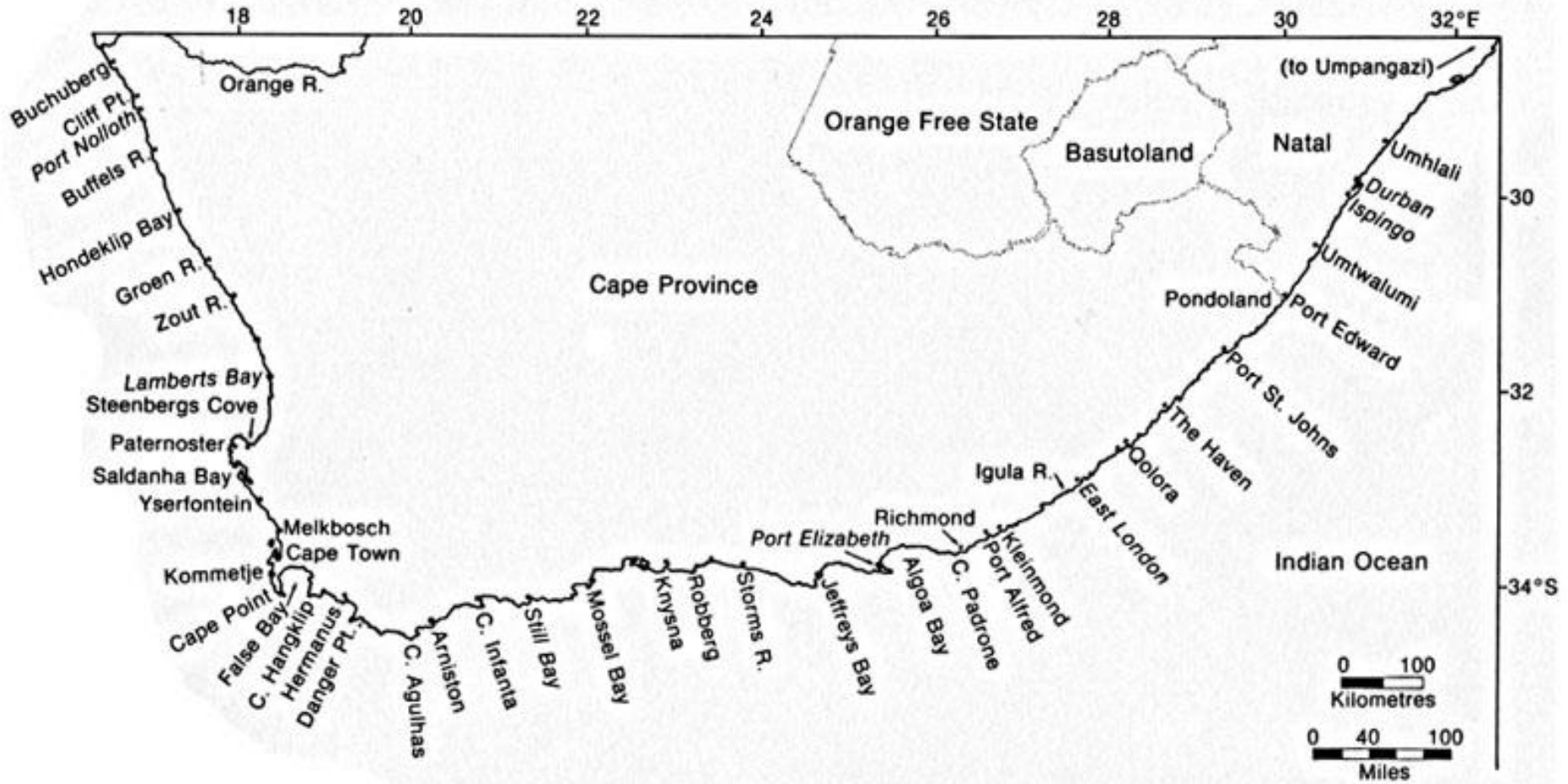
- Species distribution?
- Endemism?
- Communities (ecosystems)?
- Different authors use different criteria and often come to slightly different conclusions
- Briggs (book on Marine Zoogeography 1974): marine provinces separated from other marine provinces by species discontinuities, but also a marine province must have >10% endemism.

(Coastal) Marine Biogeographic Regions in South Africa

- Traditionally follow T. A. Stephenson
- “..for descriptive purposes, we have subdivided the coast ... into five sections, in order that the regions where each population is most fully developed may be distinguished..



Intertidal sites for Ecological Survey (1931-40)



Marine 'populations' of Stephenson

East coast (or Natal) population

(Umpangazi to Port Edward)

Eastern Overlap (Port Edward to Port Elizabeth)

South-coast population

(Port Elizabeth to Cape Agulhas).

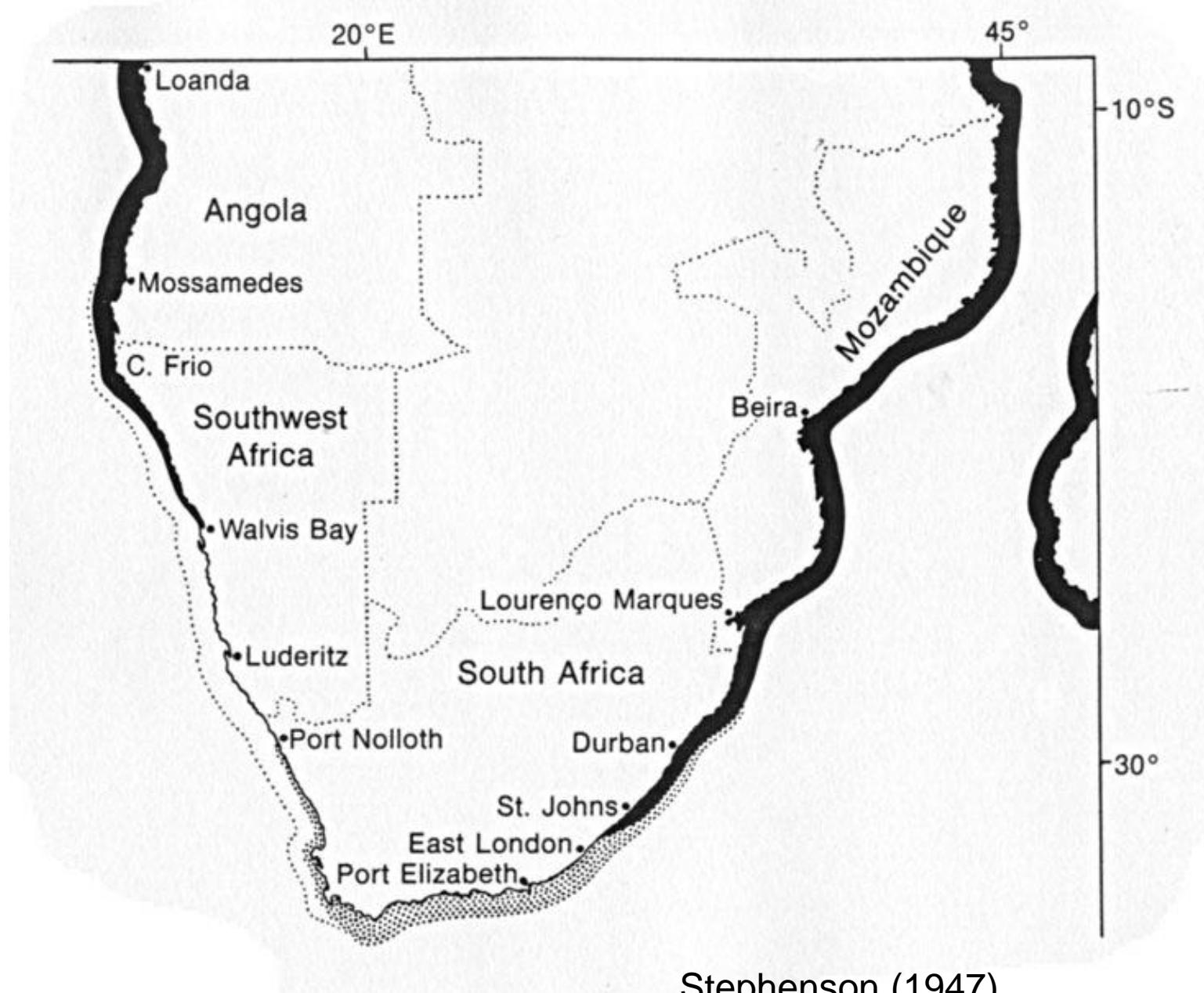
Western Overlap (Cape Agulhas to Kommetjie)

West coast population

(Port Nolloth to Kommetjie)

-

Major faunas around the South African coastline



Stephenson (1947)

What Stephenson Didn't Do

1. Only intertidal
2. Only in south Africa – limited knowledge of Namibia and Mozambique
3. Little knowledge of northern KZN
4. Common, larger organisms:
(Seaweeds – around a quarter of species)

Not all species have clearly separated west coast and south coast populations: especially those that grow commonly in deeper, cooler water

e.g.

Polychaetes:

0-200m depth (Day 1967)

Echinoderms (Thandar)

58 x 50km COASTAL SECTIONS

NAMIBIA

MOZ.

SOUTH AFRICA

0

58

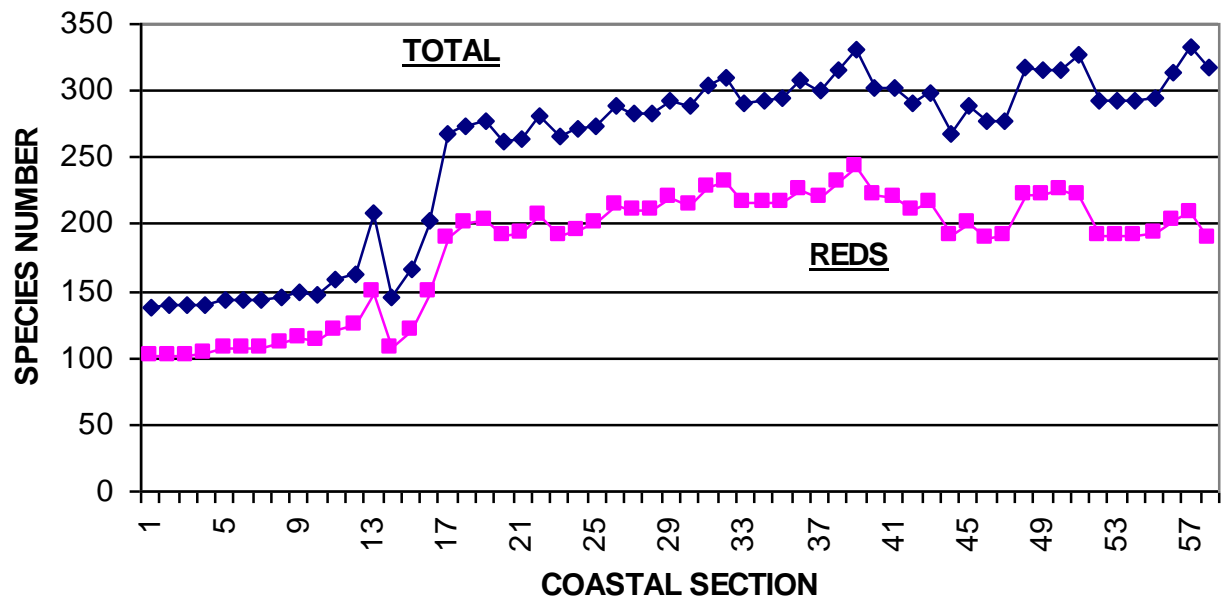
10

50

20

40

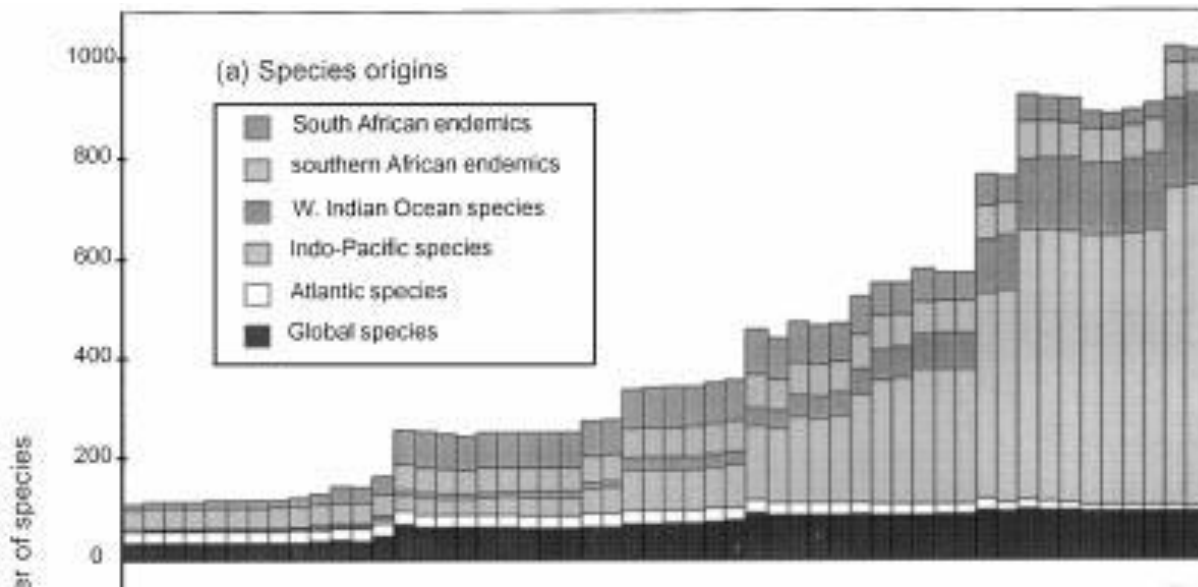
30



SEAWEEEDS

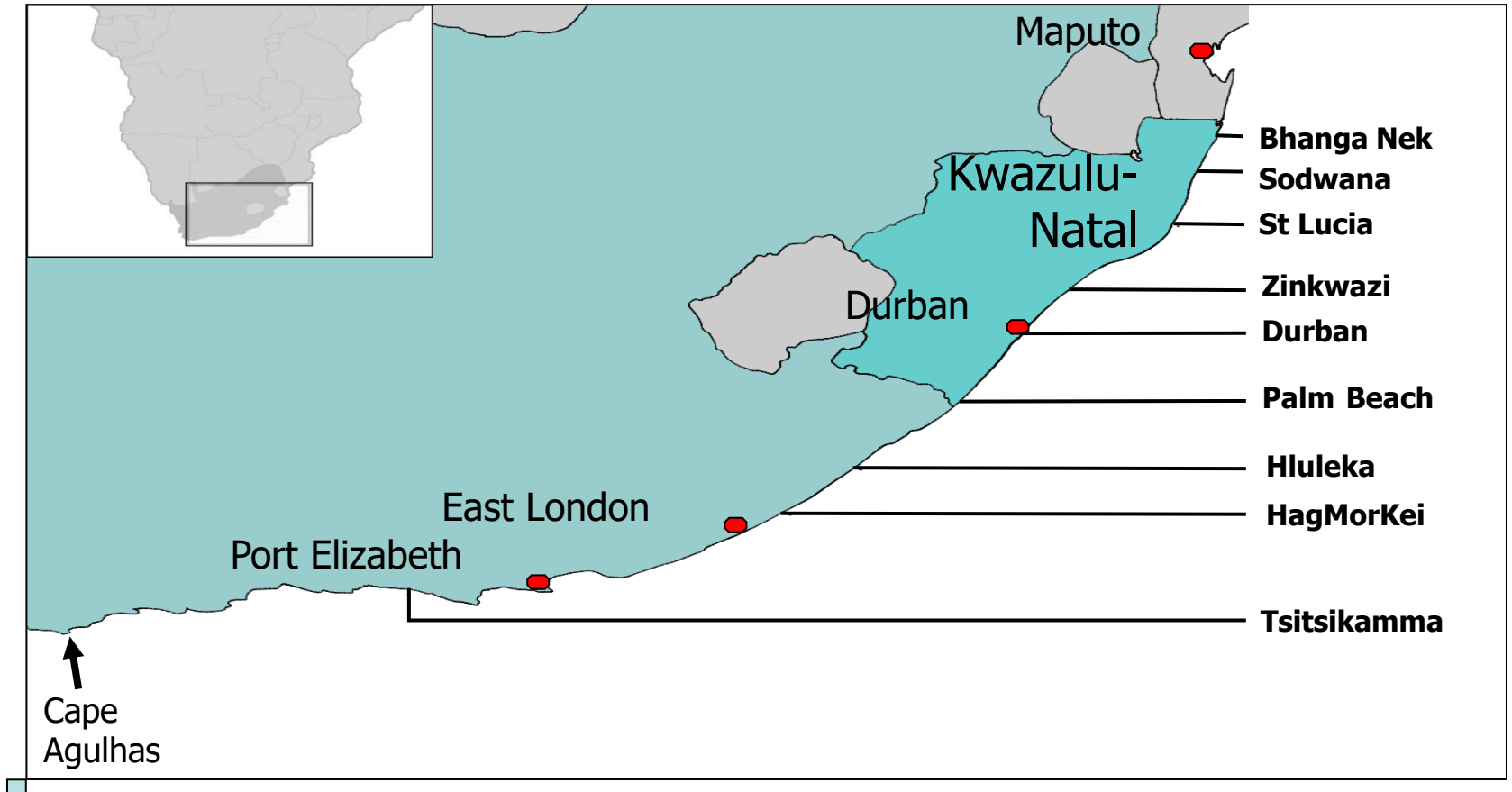
Bolton & Anderson
(unpubl.)

Species richness along the South African coastline



FISH

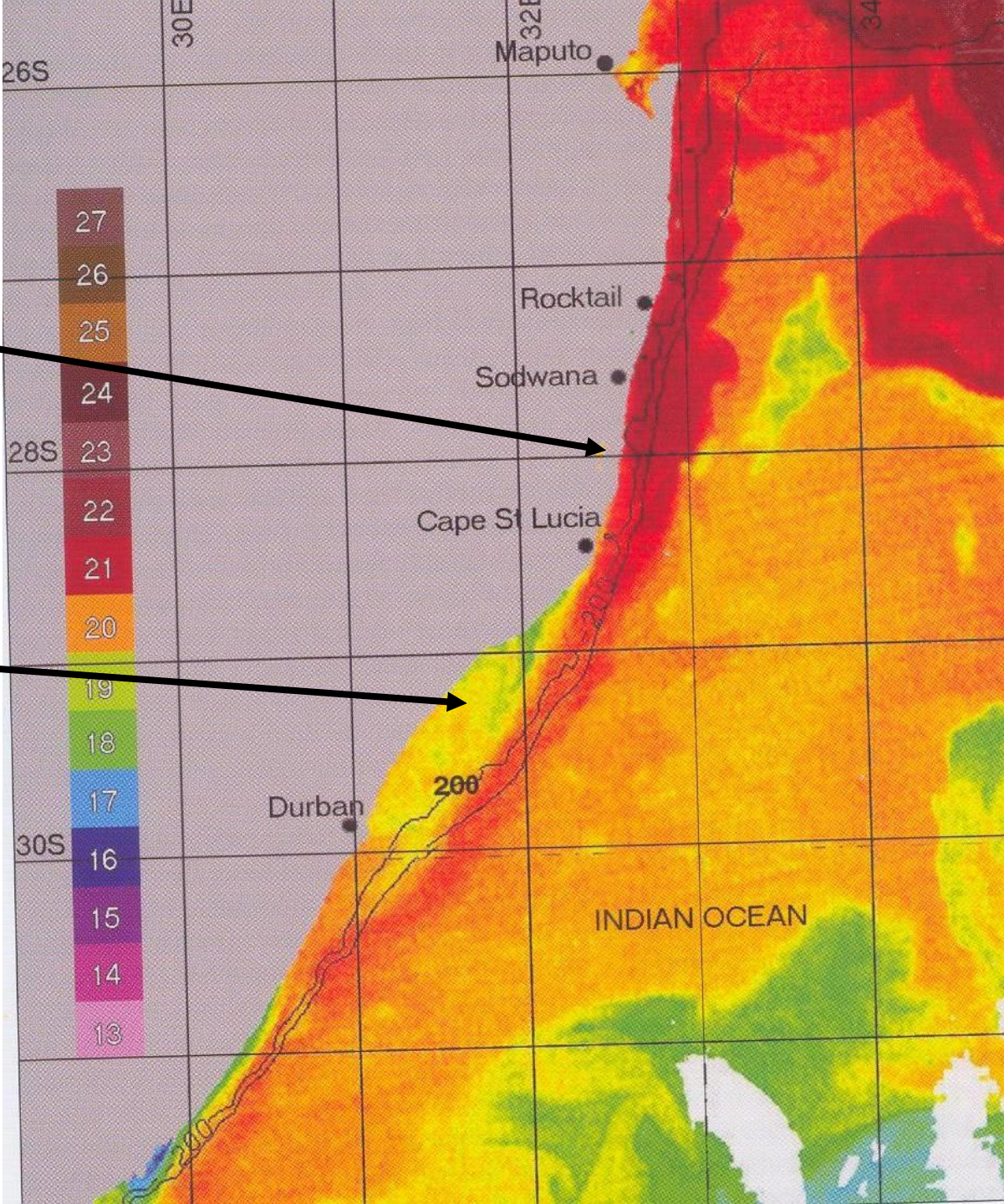
Turpie et al. 2000



Indo-Pacific/Temperate southern African boundary –where is it?

Detailed seaweed collections on South African east coast

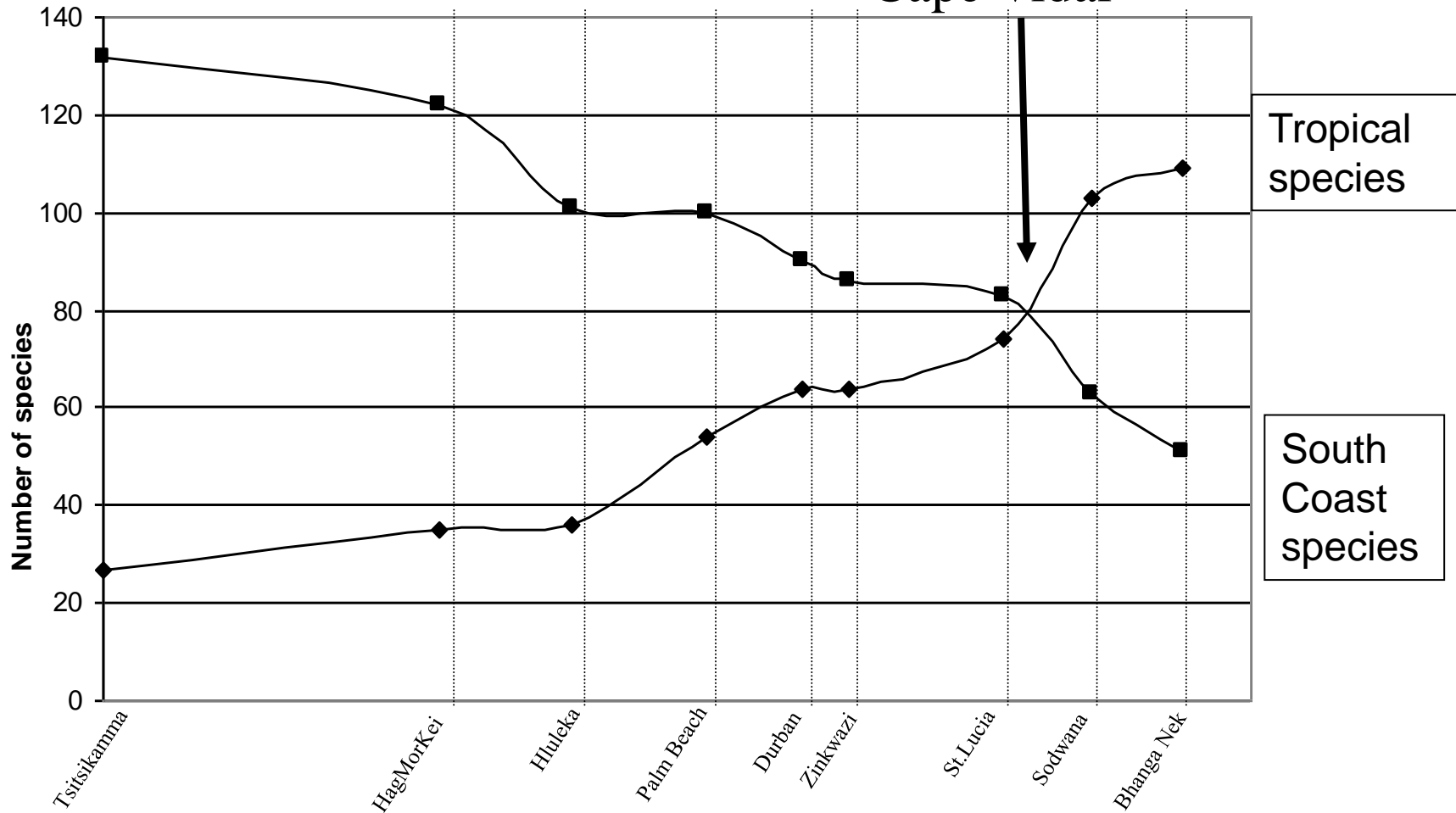
- **Warm Agulhas current** moving down KZN coast moves offshore near Cape St. Lucia
- **Natal Bight is cooler**
- (satellite data)



South Coast

East Coast

Cape Vidal



Number of SA south coast and Tropical East African (Tanzania) species in selected seaweed floras: Bolton et al. Marine Biology (2004)

- Intertidal communities (Sink et al. 2005)

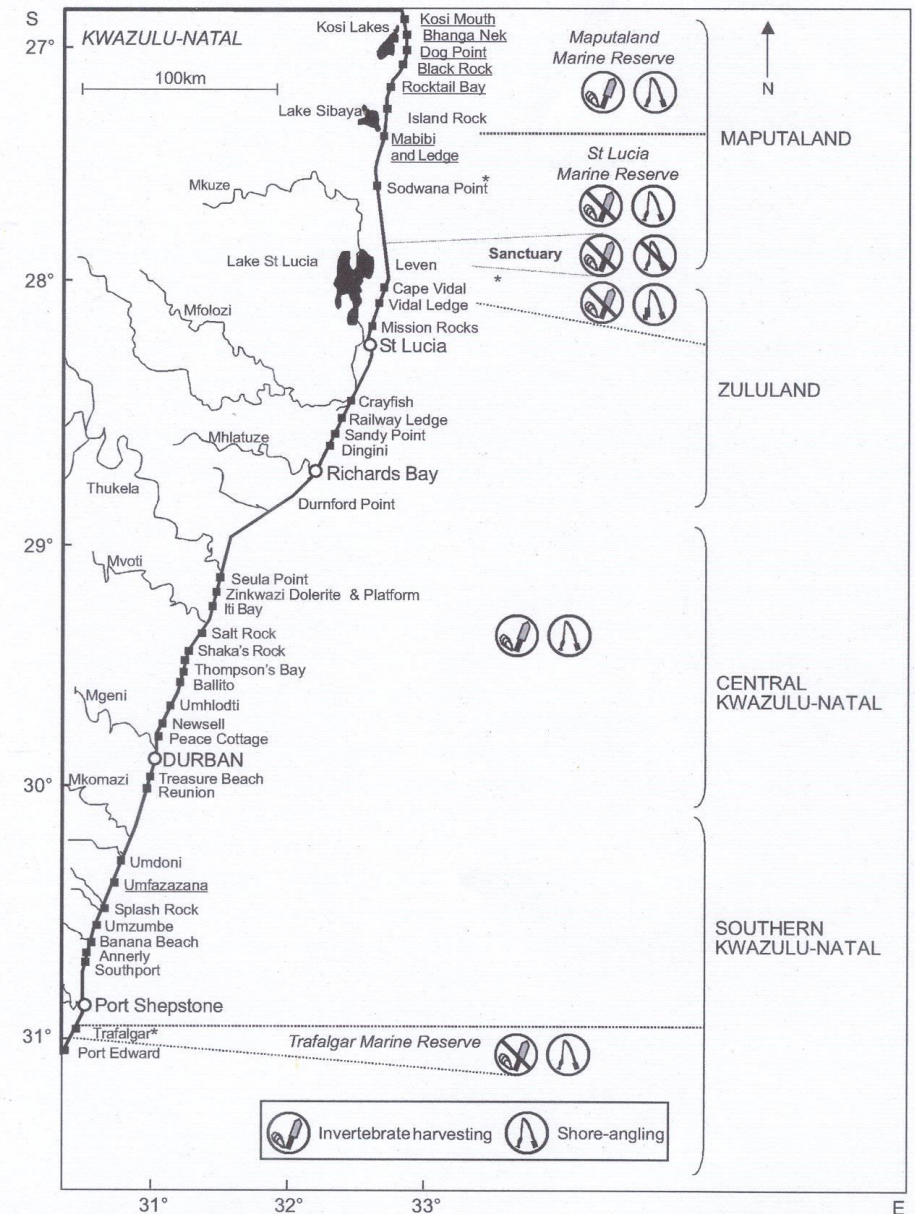


Figure 2: Map of the KwaZulu-Natal coast showing all rocky shore sites (closed squares) surveyed during the biogeographic study and the pre-defined regions that were tested for significant differences in community structure. All sites are recreationally exploited except for those that are fully protected (*), inaccessible (Island Rock) or subject to subsistence harvesting (underlined). The positions of current marine protected areas and the types of harvesting occurring in different areas are shown

Intertidal communities (Sink et al. 2005)

- A clear biogeographic break between these two provinces was identified at Cape Vidal Point, with >65% Bray Curtis dissimilarity in community structure between Maputaland and (KwaZulu-)Natal.

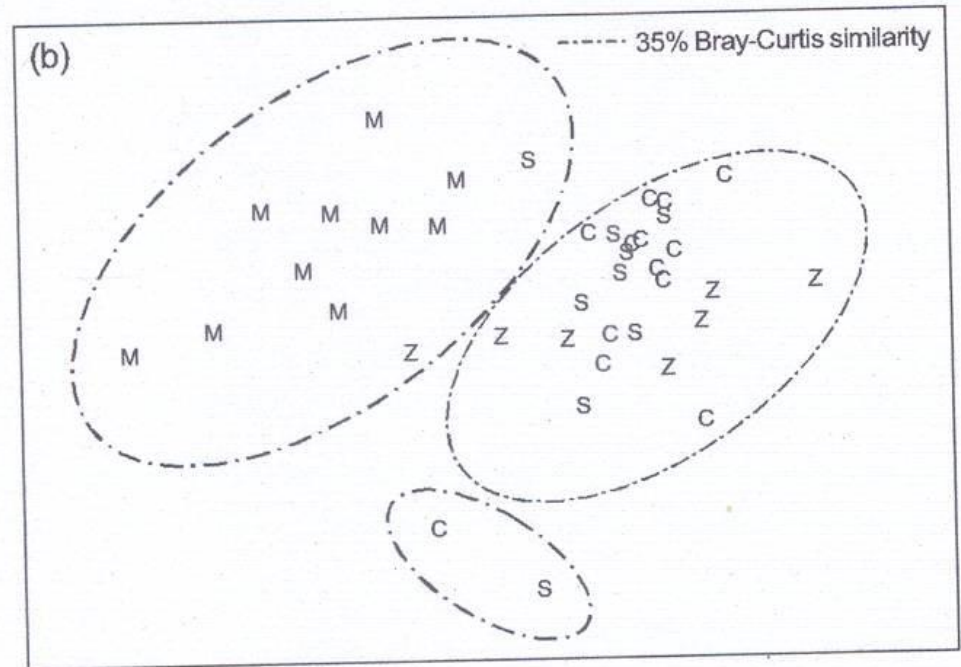


Figure 3: (a) Dendrogram of the hierarchical cluster analysis and (b) MDS plot (stress = 0.14) for the low shores of 39 sites within four pre-defined regions: M = Maputaland, Z = Zululand, C = Central KwaZulu-Natal, S = Southern KwaZulu-Natal

Maputaland is part of Tropical Indian Ocean

- Intertidal communities and seaweed species: **major break - Cape Vidal**
- Seaweed relationships and coral communities: **Maputaland part of Spalding's Tropical Western Indian Ocean**
- BUT: Delagoa region somewhat different communities from further north (**McLanahan corals/Porter subtidal communities**)



Hierarchy of regions!