State of the Bay 2024

Saldanha Bay and Langebaan Lagoon

Barry Clark

Barry Clark, Adam Rees, Kenneth Hutchings, Lily Bovim, Jessica Dawson, Amoré Malan, Kevin Schmidt, Emily Gammon, Robyn Payne, Yi-Ting Ho, Zachary Christensen, Aiden Biccard, Hrishabh Rajeev, Aqeela Parker, Julian Conrad, and Amy Wright

State of the Bay Reporting

Annual assessment of **anthropogenic impacts** to and **ecological health** of Saldanha Bay and Langebaan lagoon

- Anthropogenic impacts:
  - **Activities and discharges** affecting health of the Bay
- Physical Health:
  - **Water quality (temperature, salinity, oxygen, nutrients), currents & waves, groundwater inflow**
  - Concentrations of **contaminants** (e.g. trace metals, bacteria) in **sea water**, **sediments** and **living organisms in the bay**
- Ecological health:
  - **Changes in** abundance and **community structure** of living organisms (macrophytes, invertebrates, fish, birds, mammals)

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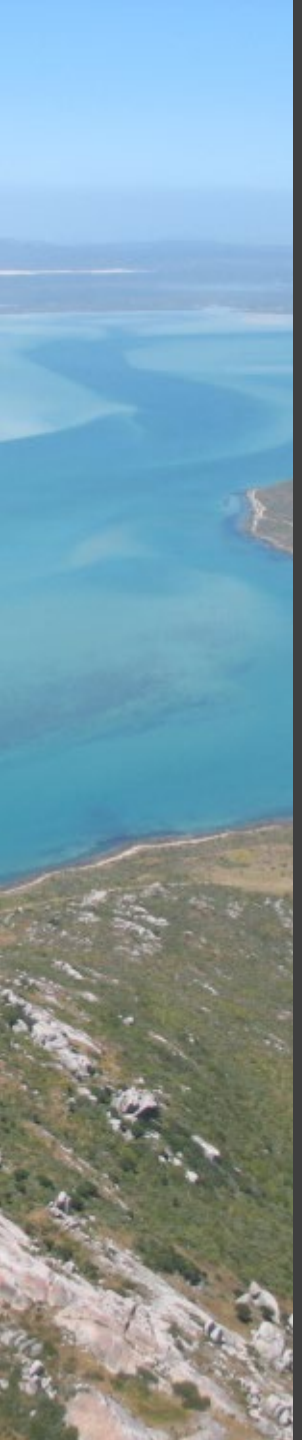
Indicator response times

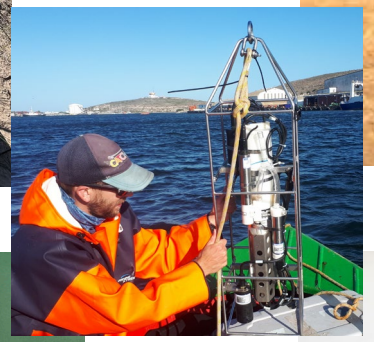


- Water… Hours/Days
- Sediments… Weeks/Months
- Living Organisms
  - Macrofauna… Weeks/Months/Years
  - Fish… Months/Years
  - Birds... Years/decades

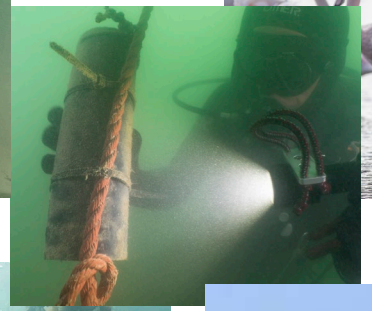
Components of the State of the Bay Monitoring Programme…

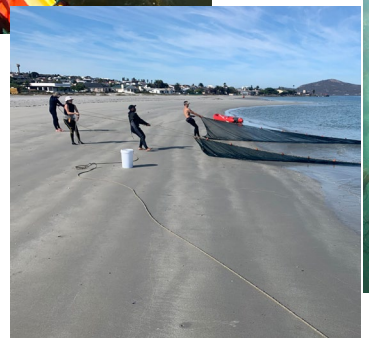
1. Summary of **activities and discharges** affecting health of the Bay
2. **Groundwater**
3. Marine **water quality**
4. **Sediment quality** (every two years)
5. **Coastal erosion**
6. **Aquatic macrophytes**
7. **Soft bottom benthic macrofauna**
8. **Rocky intertidal macrofauna** (every two years)
9. **Subtidal reef communities** (every two years)
10. **Fish**
11. **Birds and Mammals**
12. **Marine alien species**









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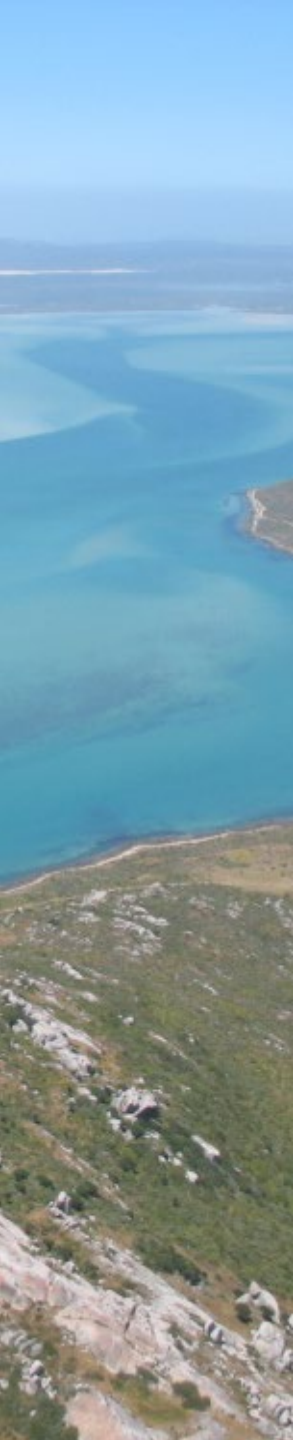

Health category	Ecological perspective	Management perspective
Natural 	**No or negligible modification** from the natural state	Relatively **little human impact**
Good 	**Some alteration** to the physical environment. Small to moderate loss of biodiversity and ecosystem integrity.	**Some human-related disturbance**, but ecosystems essentially in a good state,, continued regular monitoring is strongly recommended
Fair 	**Significant change** to the physical environment and associated biological communities; sensitive species may be lost, tolerant or opportunistic species beginning to dominate.	**Moderate human-related disturbance** with good ability to recover. **Management intervention required** to ensure no further deterioration takes place.
Poor 	Extensive change to the physical environment and biological communities, majority of sensitive species lost, tolerant or opportunistic species dominate.	**High levels of human related disturbance. Urgent management intervention is required** to avoid permanent damage to the environment or human health.

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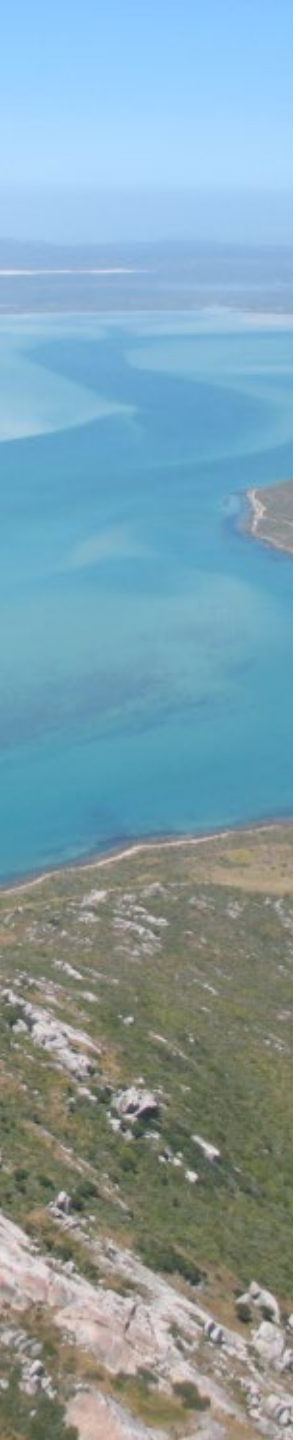

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national ports authority

vedanta
transforming elements

zinc international

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port terminals

Sea Harvest

SALDANHA BAAI BAY
MUNISIPALITEIT | MUNICIPALITY | uMASIPALA

KROPZ
ELANDSFONTEIN

AngloAmerican

Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Oiltankingmogs

TRONOX

AngloAmerican
KUMBA IRON ORE

SFF
A Subsidiary of CEF (SOC) Ltd

sunrise energy
Subsidiary of MOGS oil & gas

Premier Fishing
The First Choice

CLUB MYKONOS
LANGEBAAN

ArcelorMittal

Duferco
Duferco Steel Processing

METSEP
SALDANHA

South African
NATIONAL PARKS

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BLUE BAY
LODGE & RESORT
SALDANHA · WEST COAST · SOUTH AFRICA

BSASA
BIVALVE SHELLFISH FARMERS ASSOCIATION OF SOUTH AFRICA

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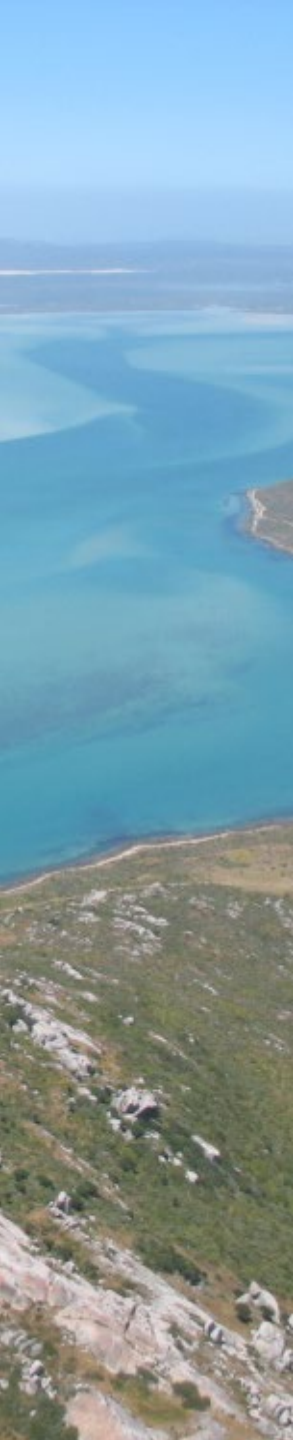

Thanks ….

CSIR
our future through science

ADU

South African Weather Service

South African National Parks

KROPZ ELANDSFONTEIN

BSASA
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Percy FitzPatrick Institute

the Marine lab

TRANSNET
national ports authority

Sea Harvest

forestry, fisheries & the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

water & sanitation
Department:
Water and Sanitation
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Theme.....
Coastal erosion
Langebaan Lagoon
1975 shoreline
Langebaan
Saldanha Bay

1. Activities & Discharges

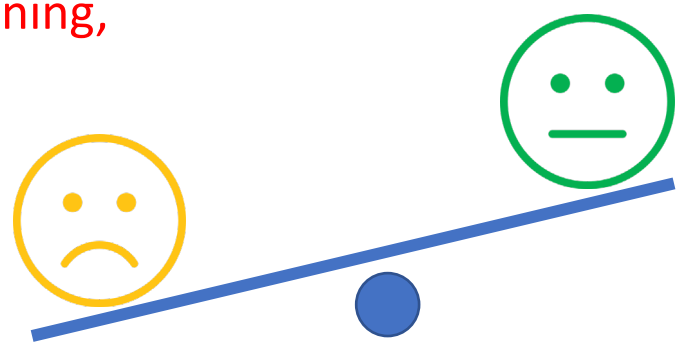
- Development pressure continues to ramp up in the Bay after having stalled for a short period (Global Financial Crisis, Covid)…

Up

- Population (6% p.a.)
- Visitor numbers
- Residential development, storm water runoff
- Ore exports (Manganese, Copper)
- Shipping traffic, Ballast water discharges
- New projects (~~Karpowership~~, Green hydrogen, RO Plants, LPG/LNG imports, ship repair, in-water hull cleaning, phosphate ore)

Down

- Effluent from WWTWs
- Ore exports (iron, Zinc, lead)
- Mariculture production (mussels & oysters)



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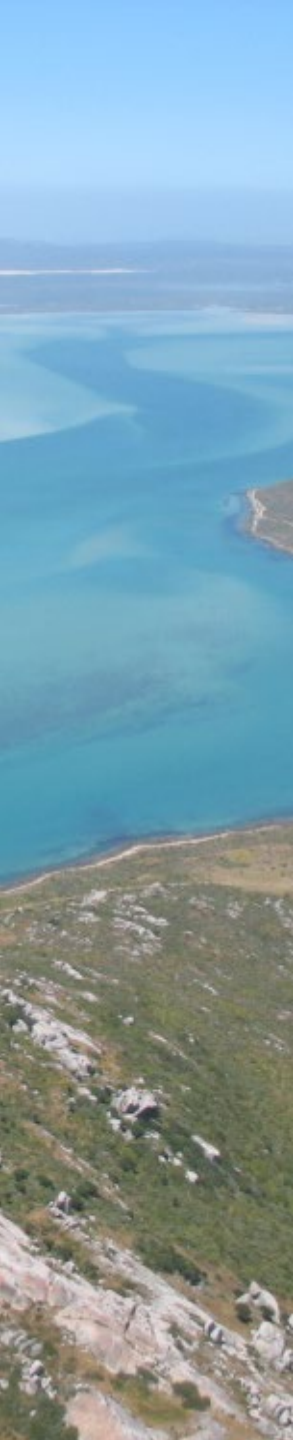
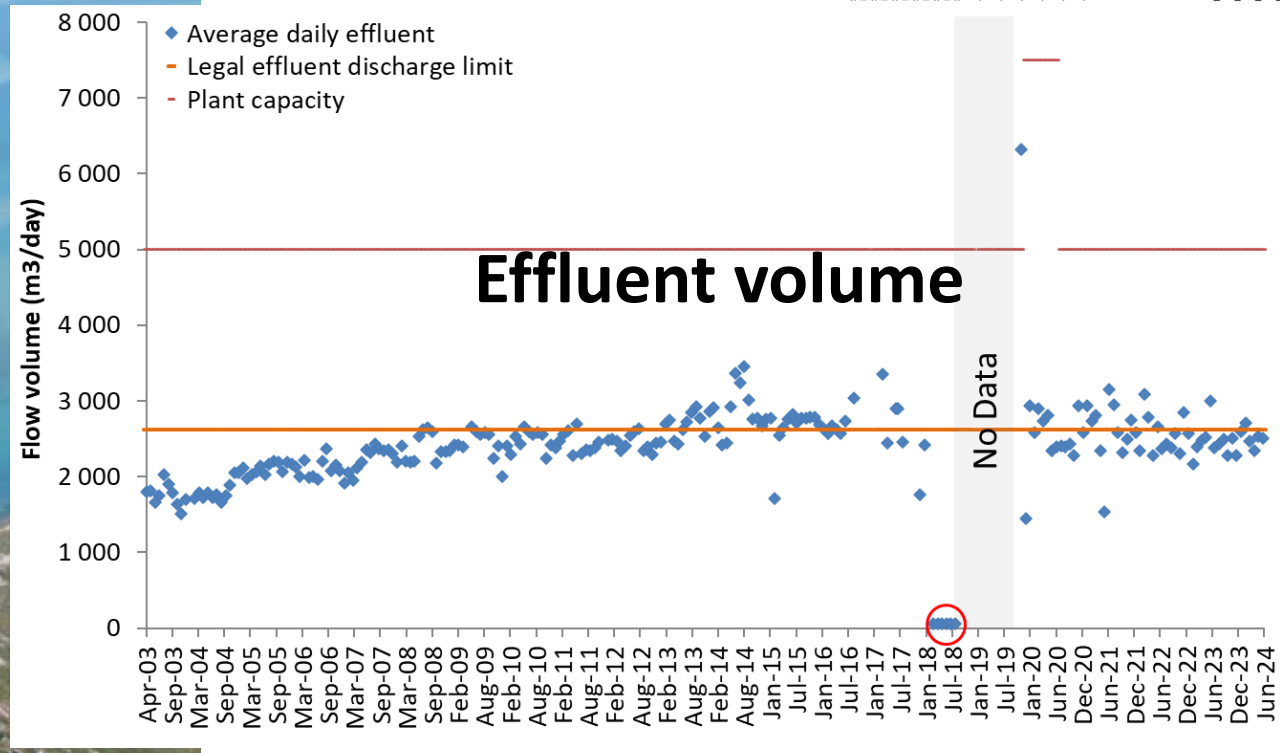
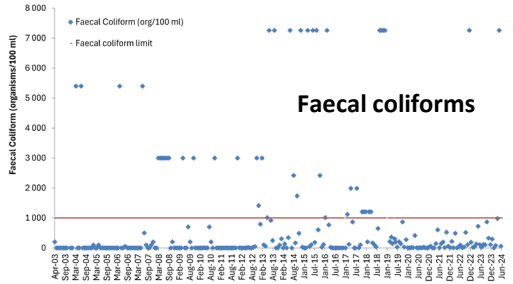
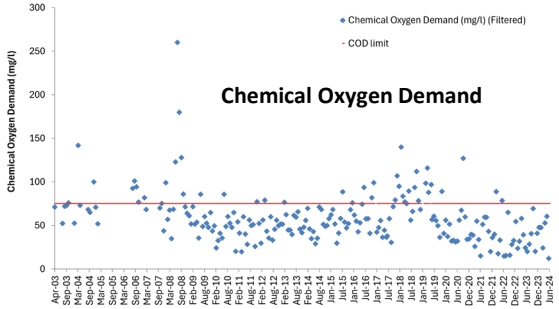


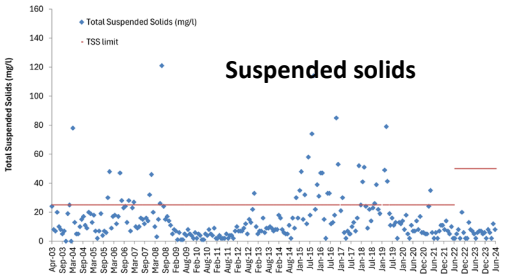

Saldanha
WWTW
Saldanha Animal Care
BLOUWATER BAY
Transnet Bayvue Centre
Roundabout
PARKERSDORP
Saldanha Bay View (Sea-side)
Dial Rock Cafe & Take-Aways
Image © 2024 Airbus
578 m
Google Earth

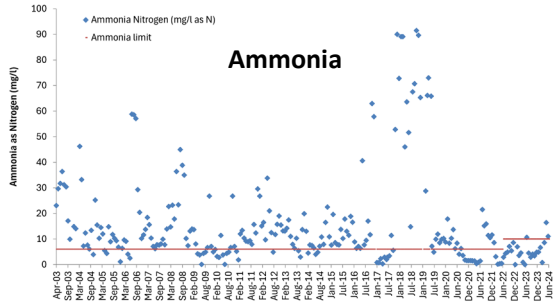
Saldanha Bay WWTW

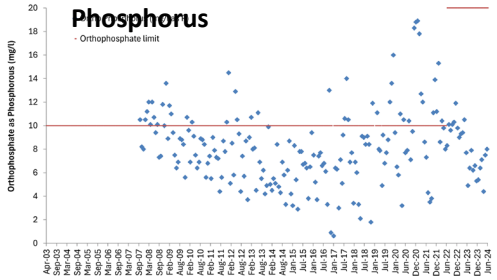


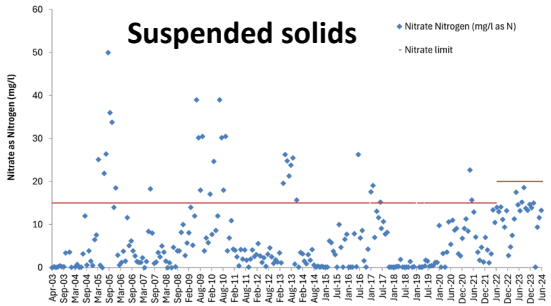


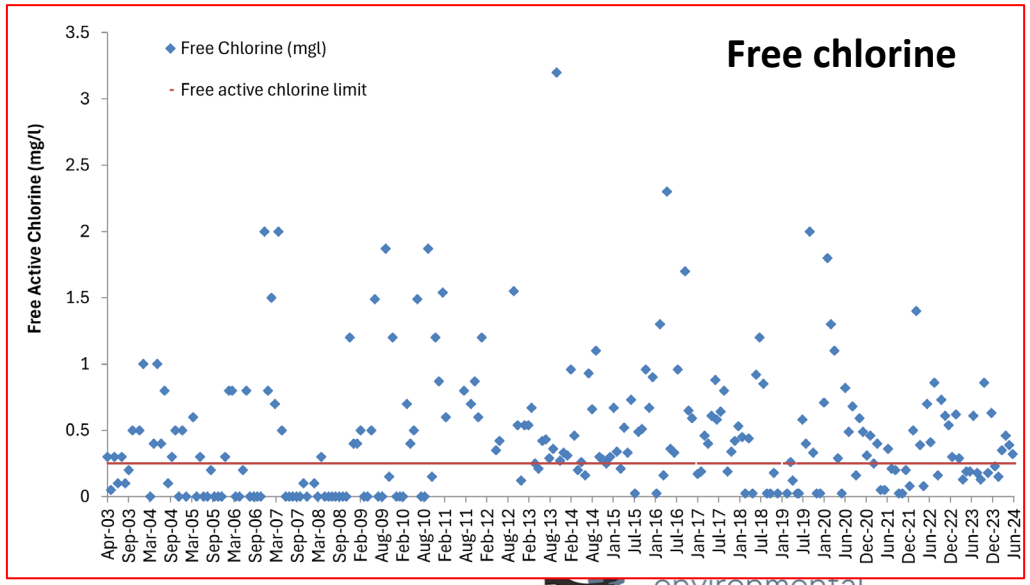












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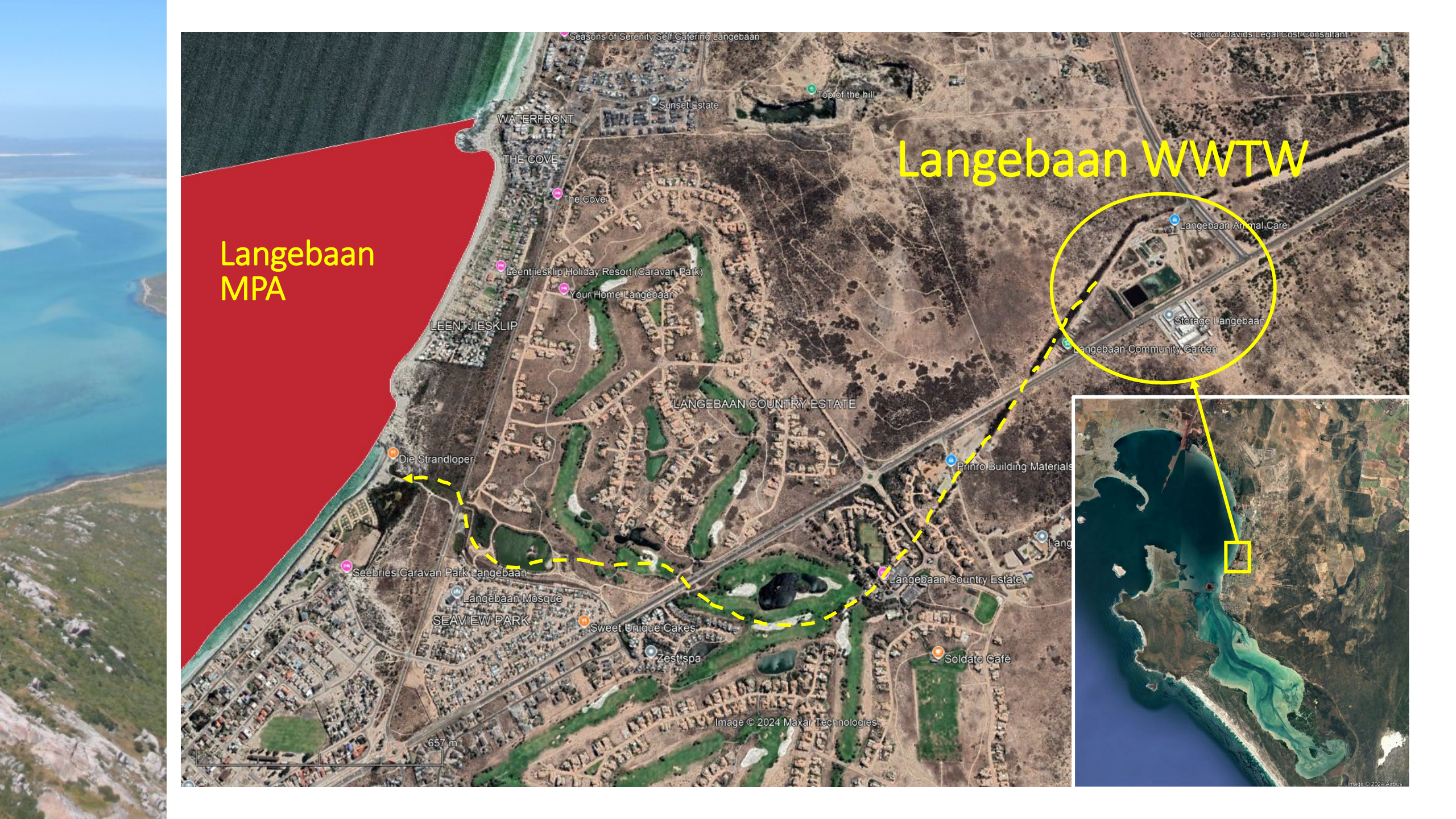
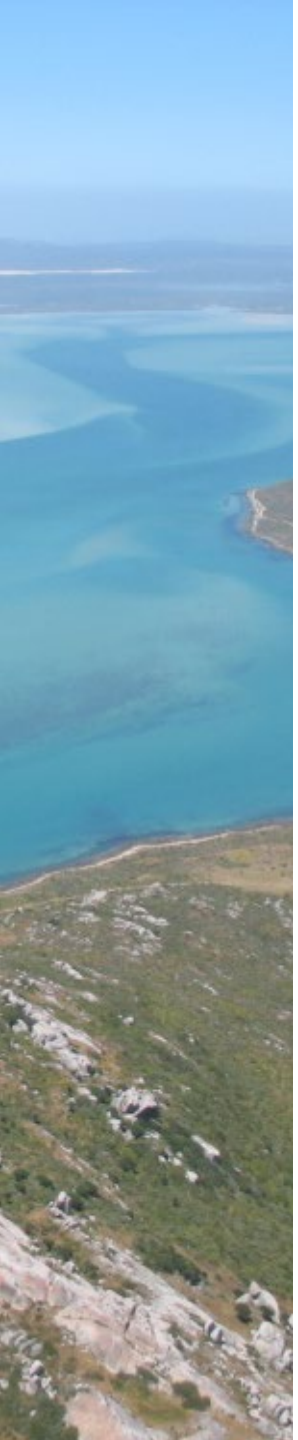
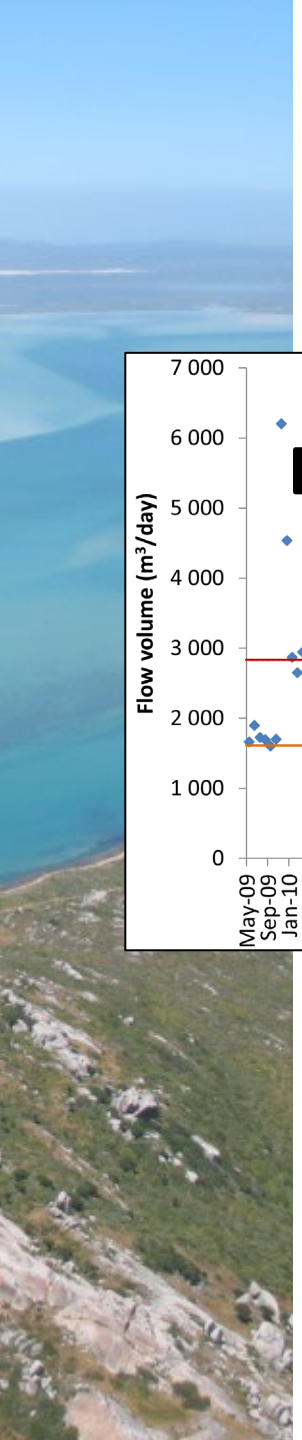
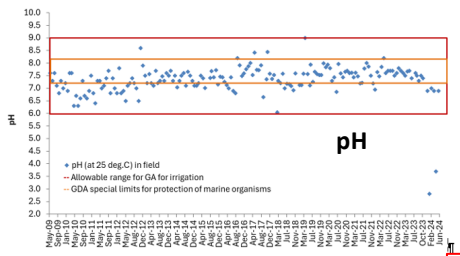

Langebaan MPA
Langebaan WWTW
Seasons of Serenity Self Catering Langebaan
Top of the hill
Sunset Estate
WATERFRONT
THE COVE
The Cove
Leentjiesklip Holiday Resort (Caravan Park)
Your Home Langebaan
LEENTJIESKLIP
LANGEBAAN COUNTRY ESTATE
Langebaan Animal Care
Storage Langebaan
Langebaan Community Garden
Die Strandloper
Prinro Building Materials
Seebries Caravan Park Langebaan
Langebaan Mosque
SEAVIEW PARK
Sweet Unique Cakes
Zest spa
Langebaan Country Estate
Soldato Café
Image © 2024 Maxar Technologies
657 m
Image © 2024 Airbus

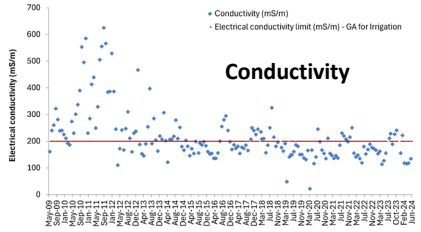


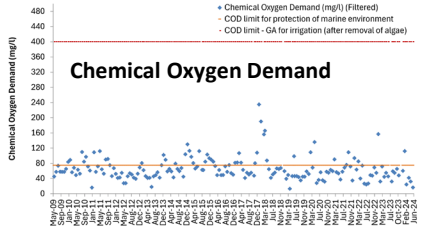

Langebaan
MPA
Die Strandloper
Ultra Solar and Electrical PTY
Image © 2024 Maxar Technologies
180 m
Google Earth

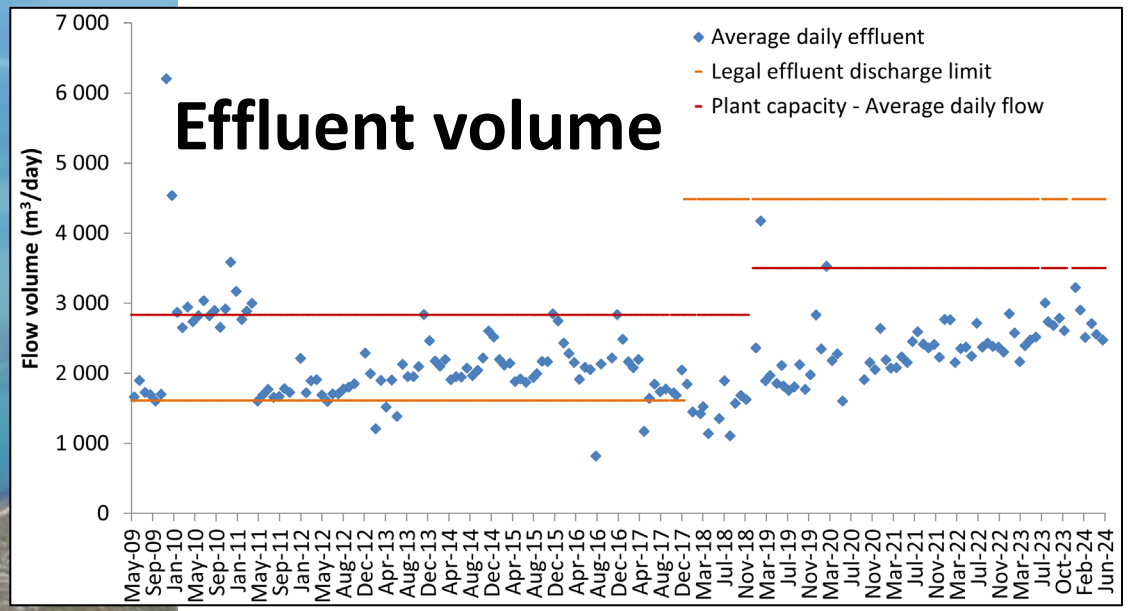
Langebaan WWTW

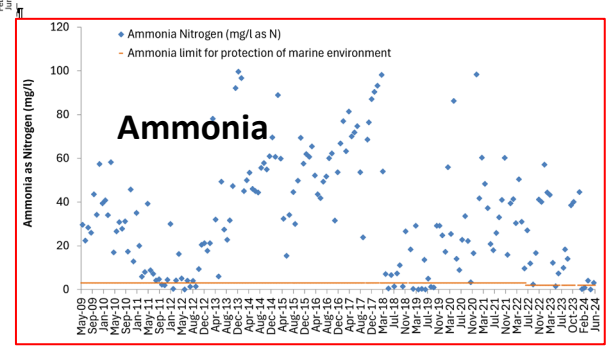


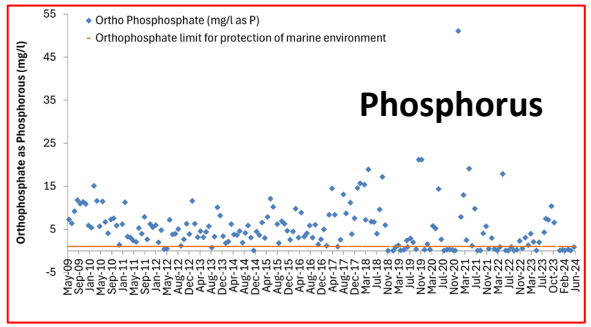


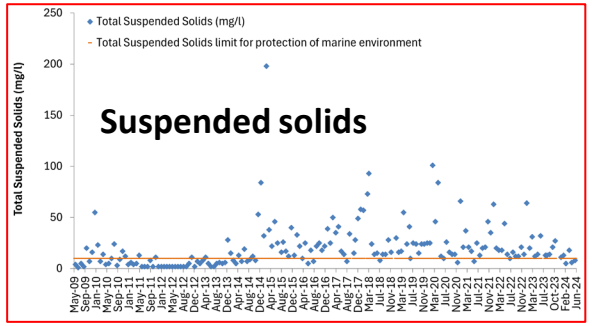


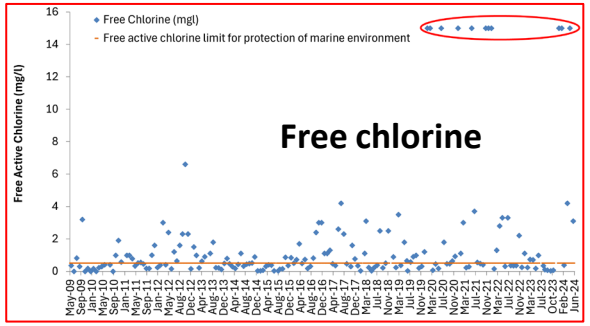


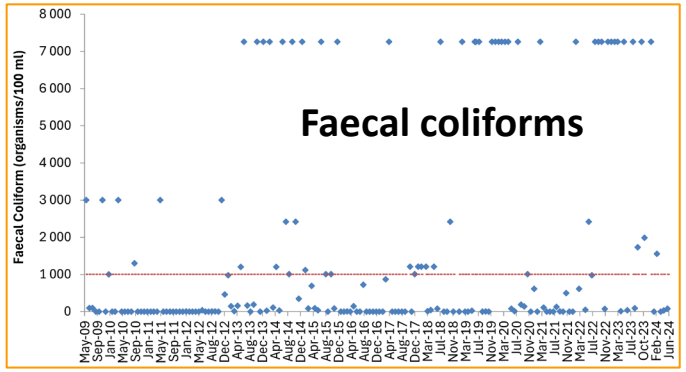


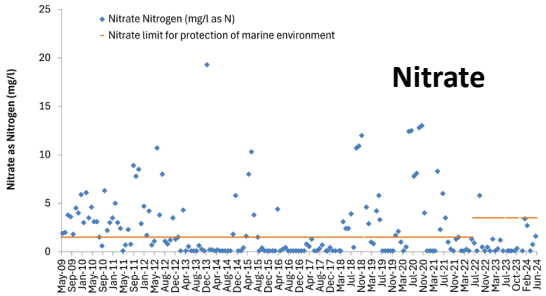












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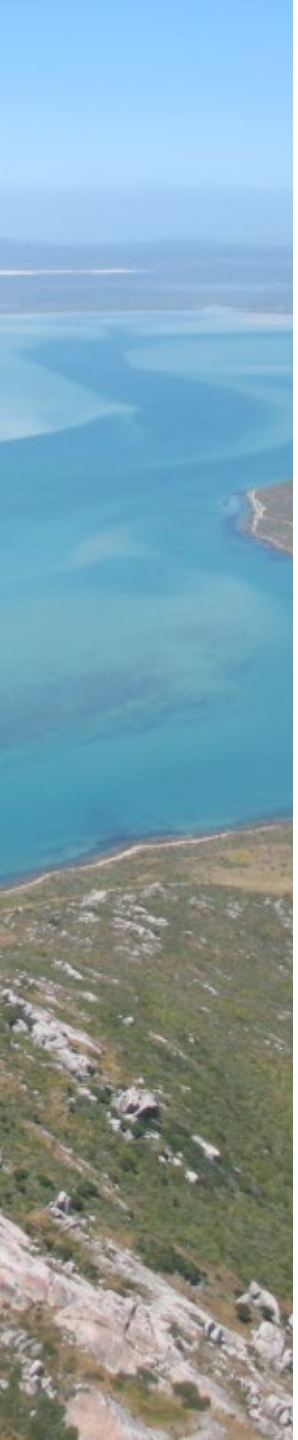
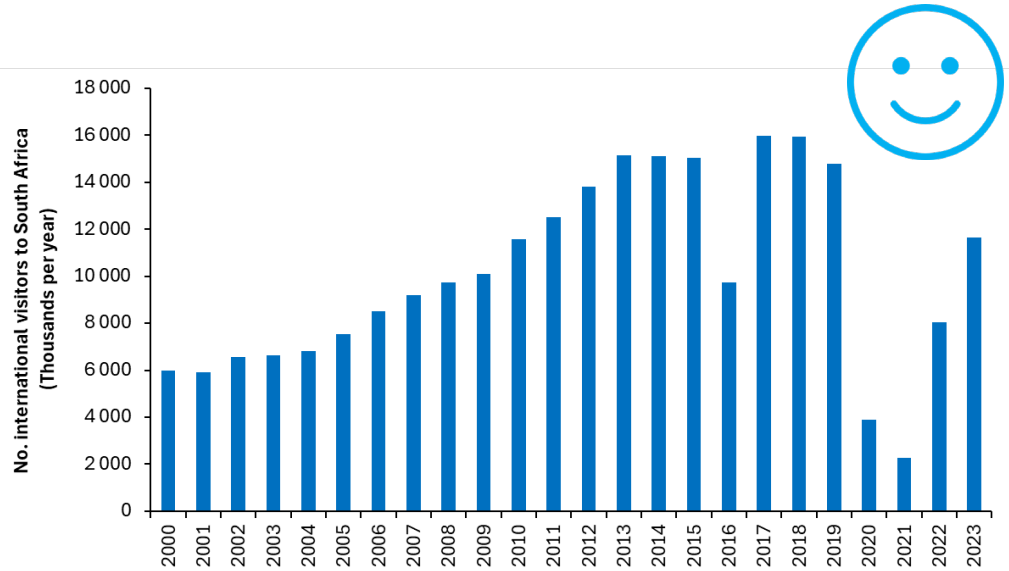


Visitor numbers (WCNP) ….

Long term trend over time….

West Coast National Park…



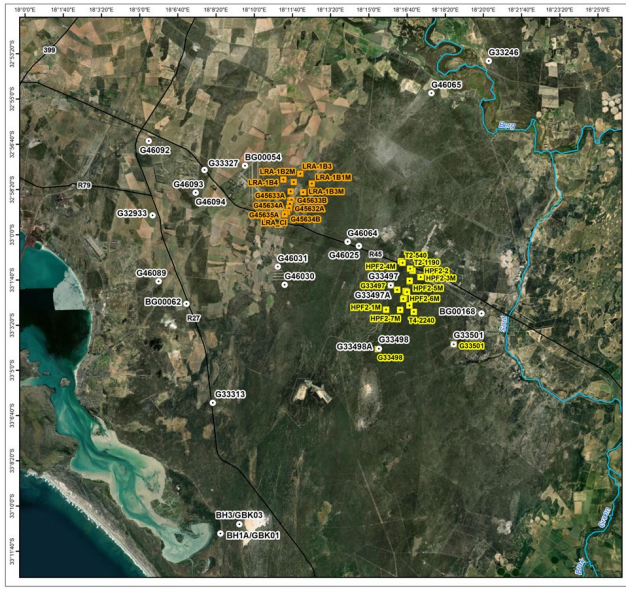
International visitors to South Africa…

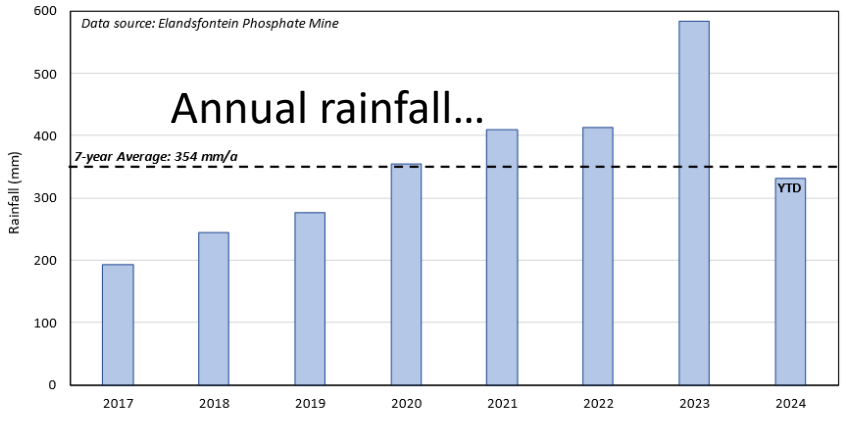
Tourism contributes 16-20% of the local GDP of Saldanha Bay

87% locals….

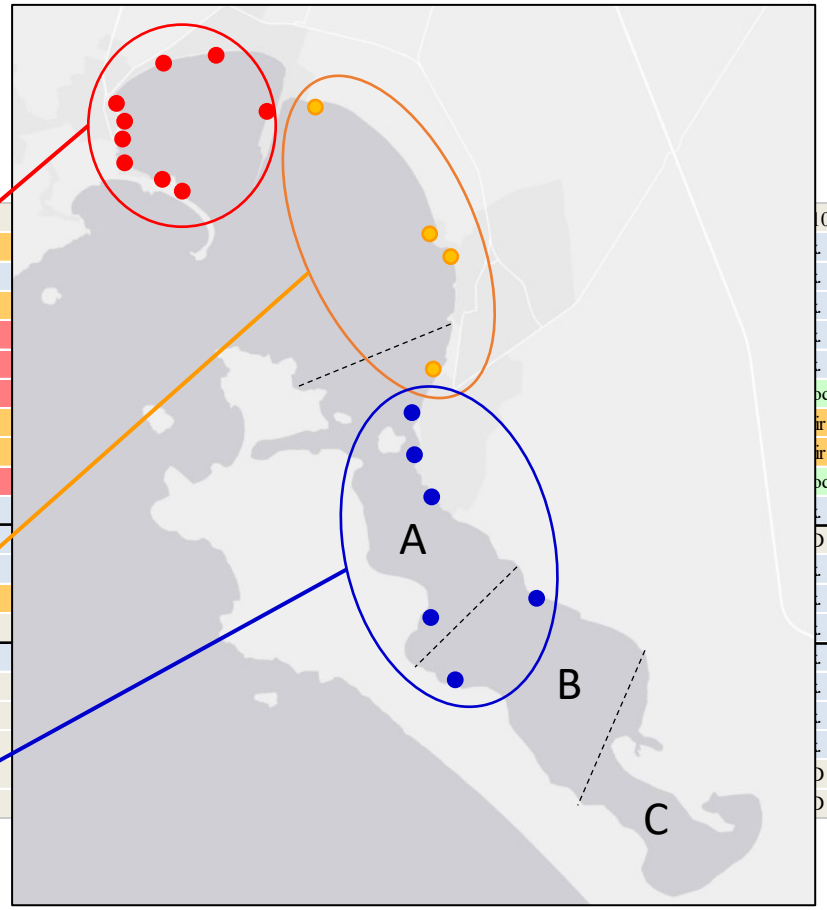
2. Groundwater

- Very important water resource in Saldanha Bay
- Historically – lots of uncertainly around GW dynamics
- Main uses:
  - Agricultural sector (1.5 Mm^3/a),
  - SBM - Langebaan Road Aquifer Wellfield (5.1 Mm^3/a) and Hopefield Wellfield (1.6 Mm^3/a),
  - Elandsfontein Mine (reinjection only)
- Total “sustainable” useable groundwater exploitation potential: 15.2 Mm^3/a and
- Groundwater levels are stable ….





Faecal coliforms (recreational limits)



	Site	10	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Small Bay	1. Beach at Mussel Rafts		Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	ND	Ex.	Ex.	Ex.
	2. Small Craft Harbour		Ex.	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	Ex.
	3. Sea Harvest - Small Quay		Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.
	4. Saldanha Yacht Club		Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	Ex.
	5. Pepper Bay - Big Quay		Ex.	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Poor	Good	Ex.	Ex.	Ex.
	6. Pepper Bay - Small Quay	od	Ex.	Good	Fair	Fair	Ex.	Ex.	Ex.	Ex.	ND	Ex.	Ex.	Ex.	Ex.	Ex.
	7. Hoedjies Bay Hotel - Beach	ir	Poor	Poor	Fair	Good	Fair	Good	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
	8. Beach at Caravan Park	ir	Fair	Poor	Good	Fair	Ex.	Fair	Fair	Fair	Fair	Fair	Ex.	Good	Fair	Ex.
	9. Bok River Mouth - Beach	od	Ex.	Poor	Fair	Good	Ex.	Poor	Poor	Fair	Fair	Good	Poor	Poor	Poor	Poor
	10. General Cargo Quay - TNPA		Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.
Big Bay	11. Seafarm - TNPA	D	ND	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Good	Ex.	Ex.
	12. Mykonos - Paradise Beach		Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	Good	Ex.
	13. Mykonos - Harbour		Fair	Ex.	Ex.	Good	Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.
	14. Leentjiesklip		Ex.	Fair	Ex.	Good	Ex.	Ex.	Ex.	ND	Ex.	Ex.	Ex.	Ex.	Fair	Ex.
Langebaan Lagoon	15. Langebaan North - Leentjiesklip		Ex.	Poor	Good	Ex.	Good	Ex.	Good	Ex.	Ex.	Fair	Ex.	Ex.	Fair	Ex.
	16. Langebaan - Main Beach		Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	ND	Ex.	Good	Ex.	Ex.	Fair	Ex.
	17. Langebaan Yacht Club		Ex.	Ex.	Good	Ex.	Ex.	Fair	Good	ND	Ex.	Ex.	Ex.	Ex.	Fair	Ex.
	18. Tooth Rock		Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	ND	Ex.	Ex.	Ex.	Ex.	Good	Ex.
	19. Kraalbaai North	D	ND	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	ND	Fair	Ex.	Ex.	Ex.	Ex.	Ex.
	20. Kraalbaai South	D	ND	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	ND	Ex.	Fair	Ex.	Ex.	Ex.	Ex.

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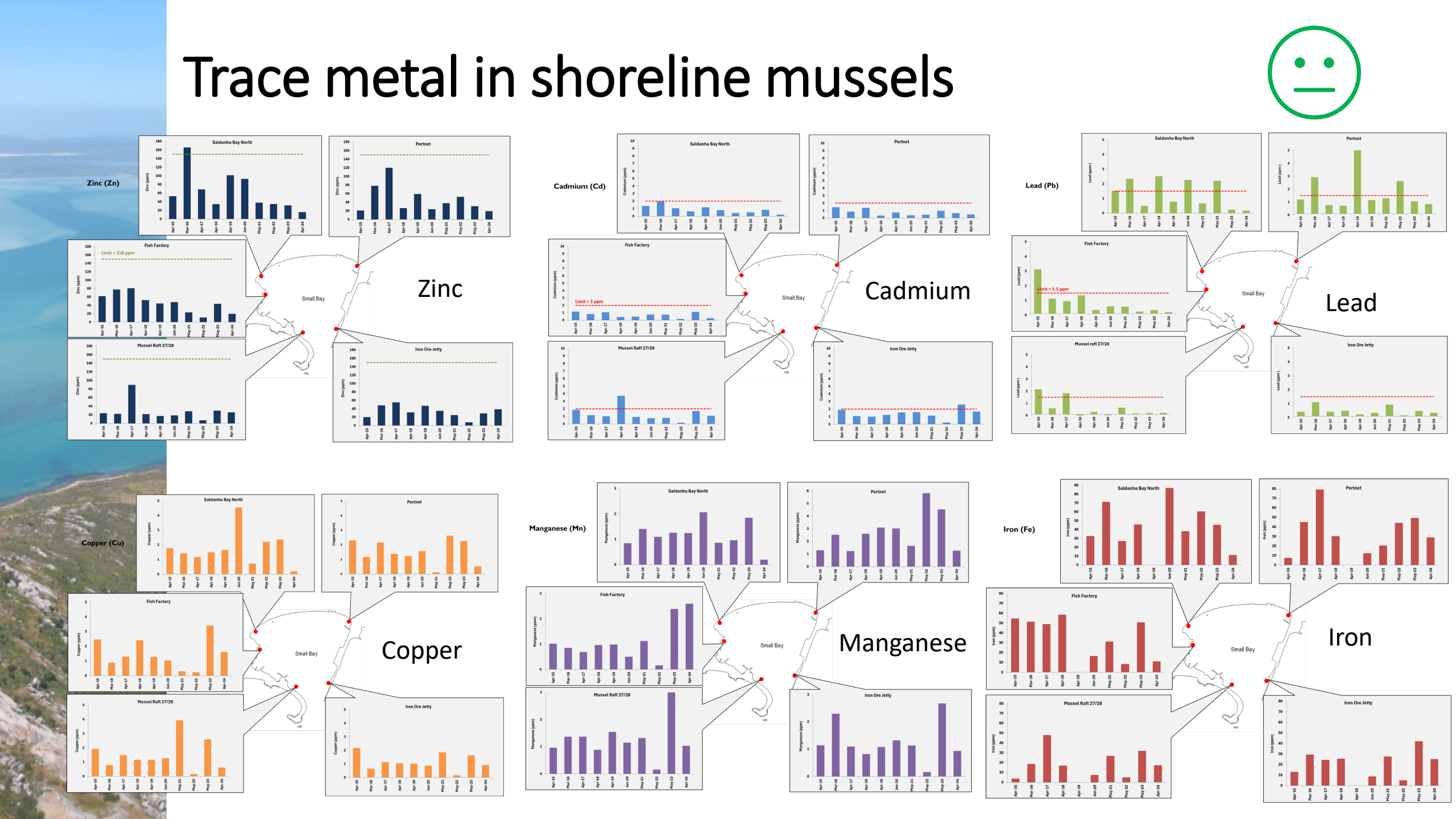
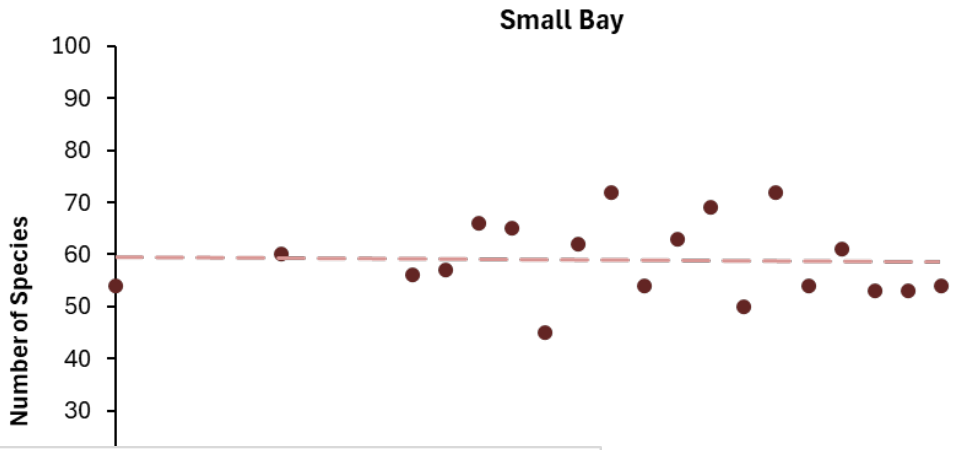
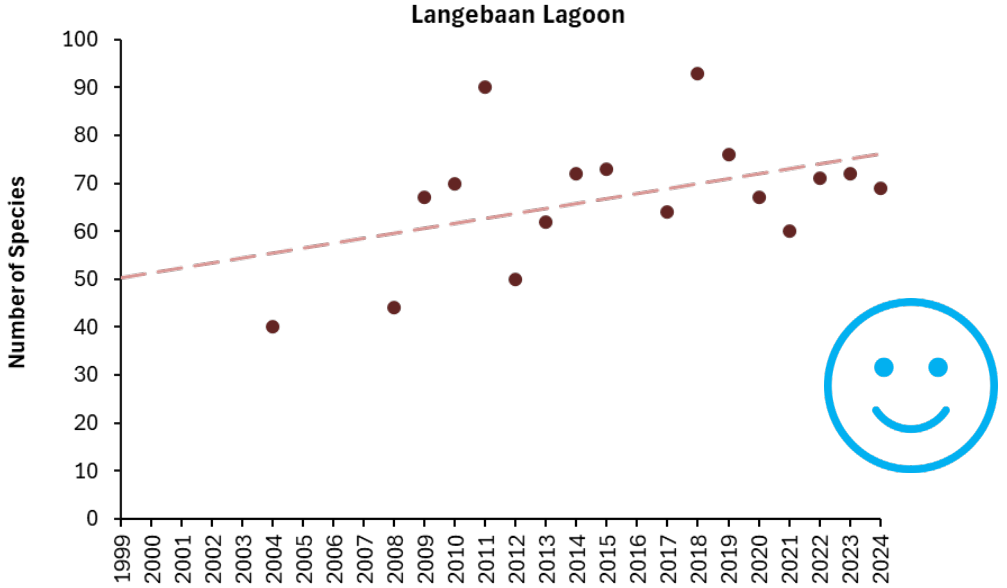
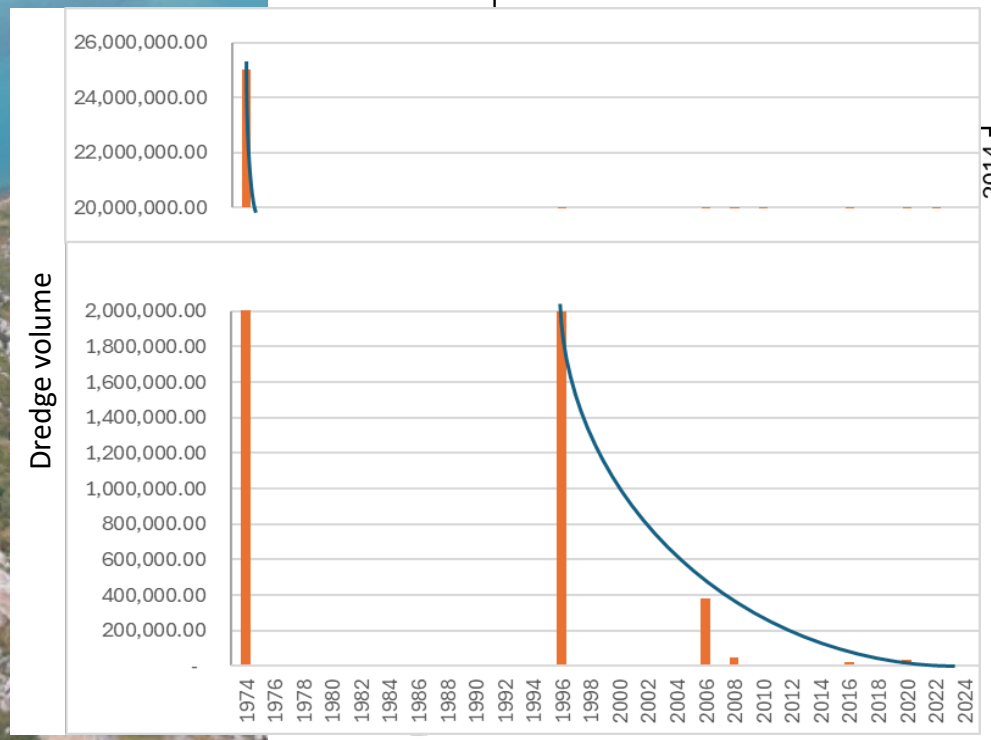
Trace metal in shoreline mussels

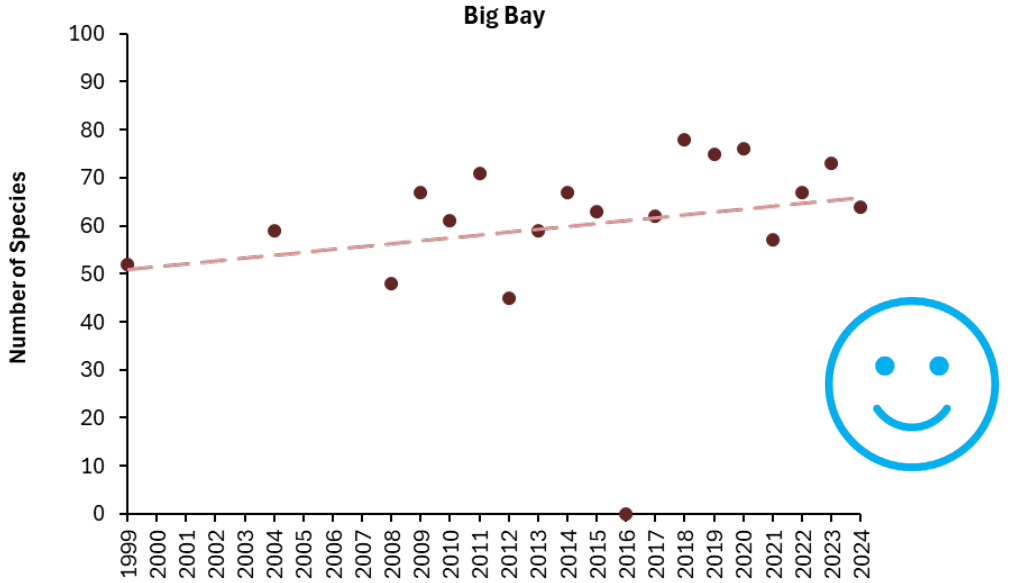


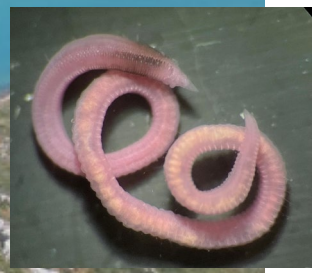
7. Soft bottom benthic macrofauna

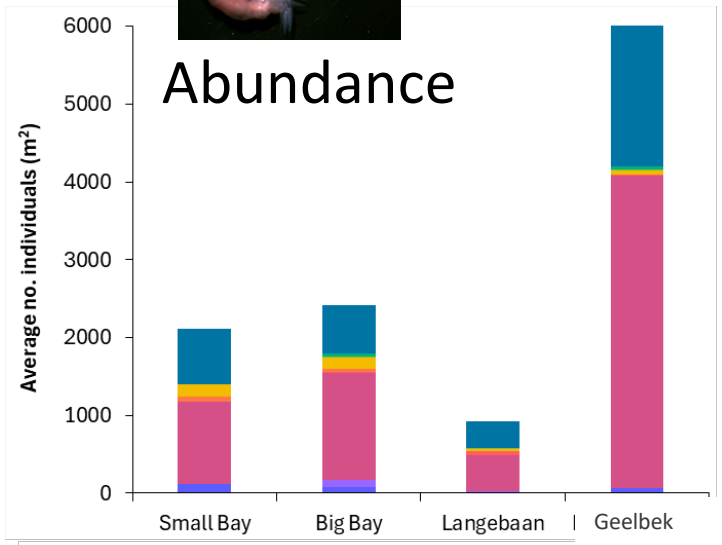


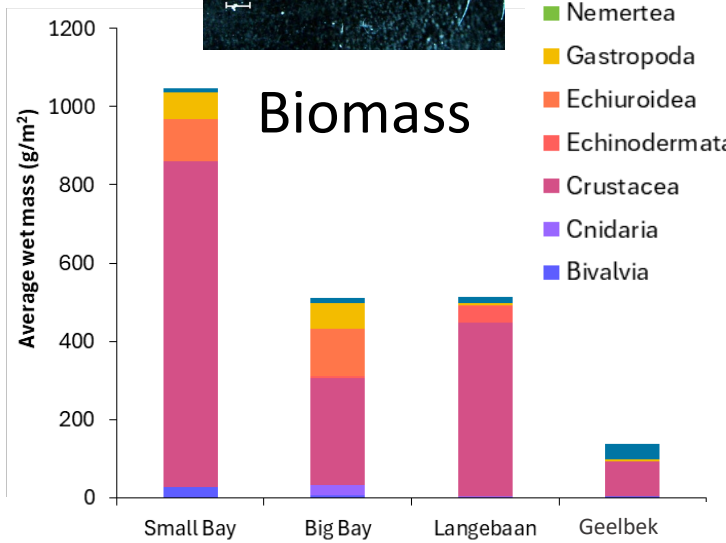


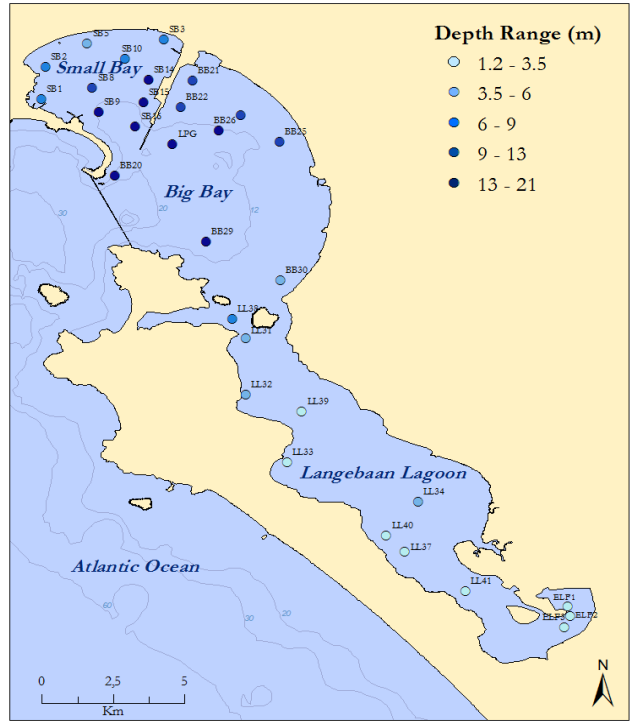


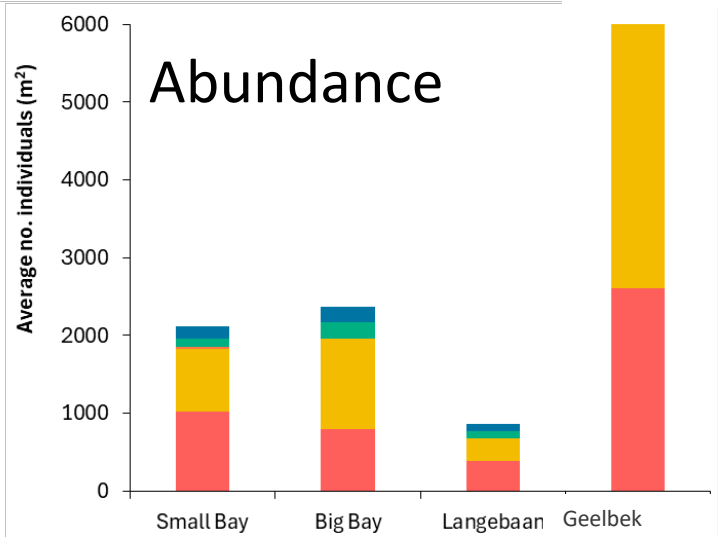


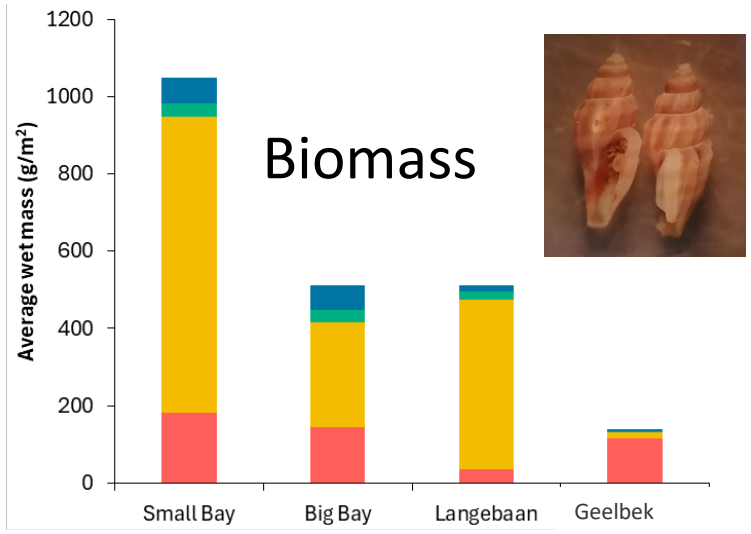


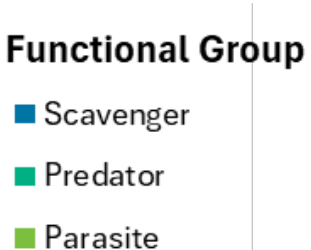












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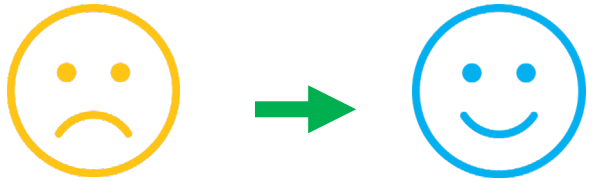
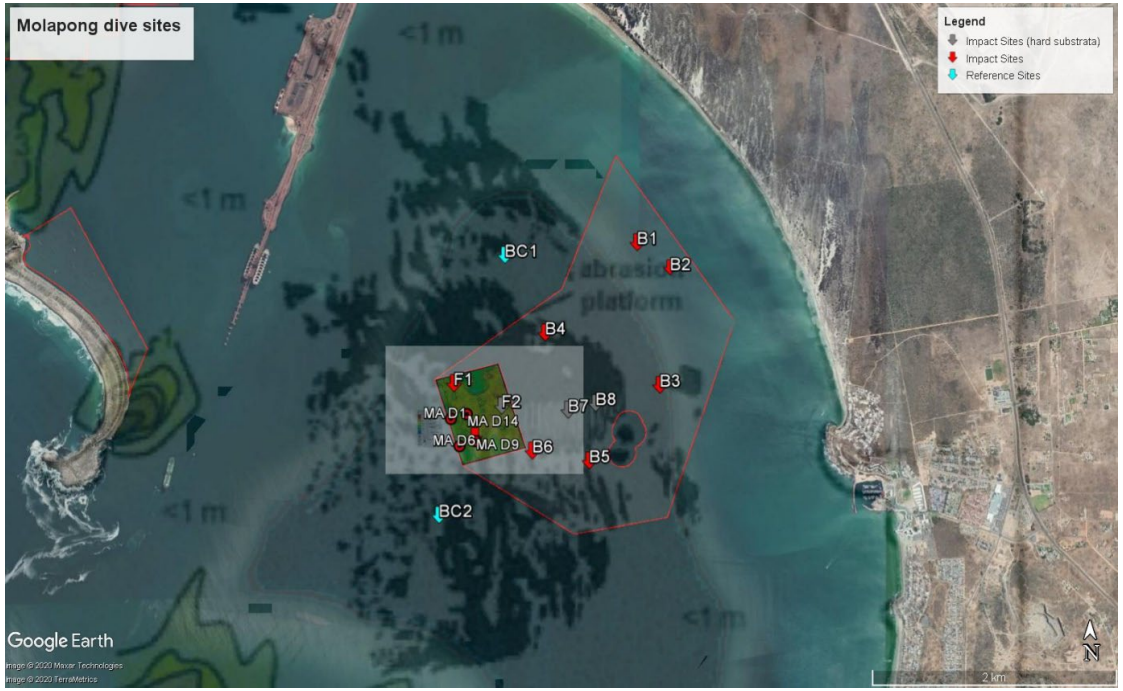
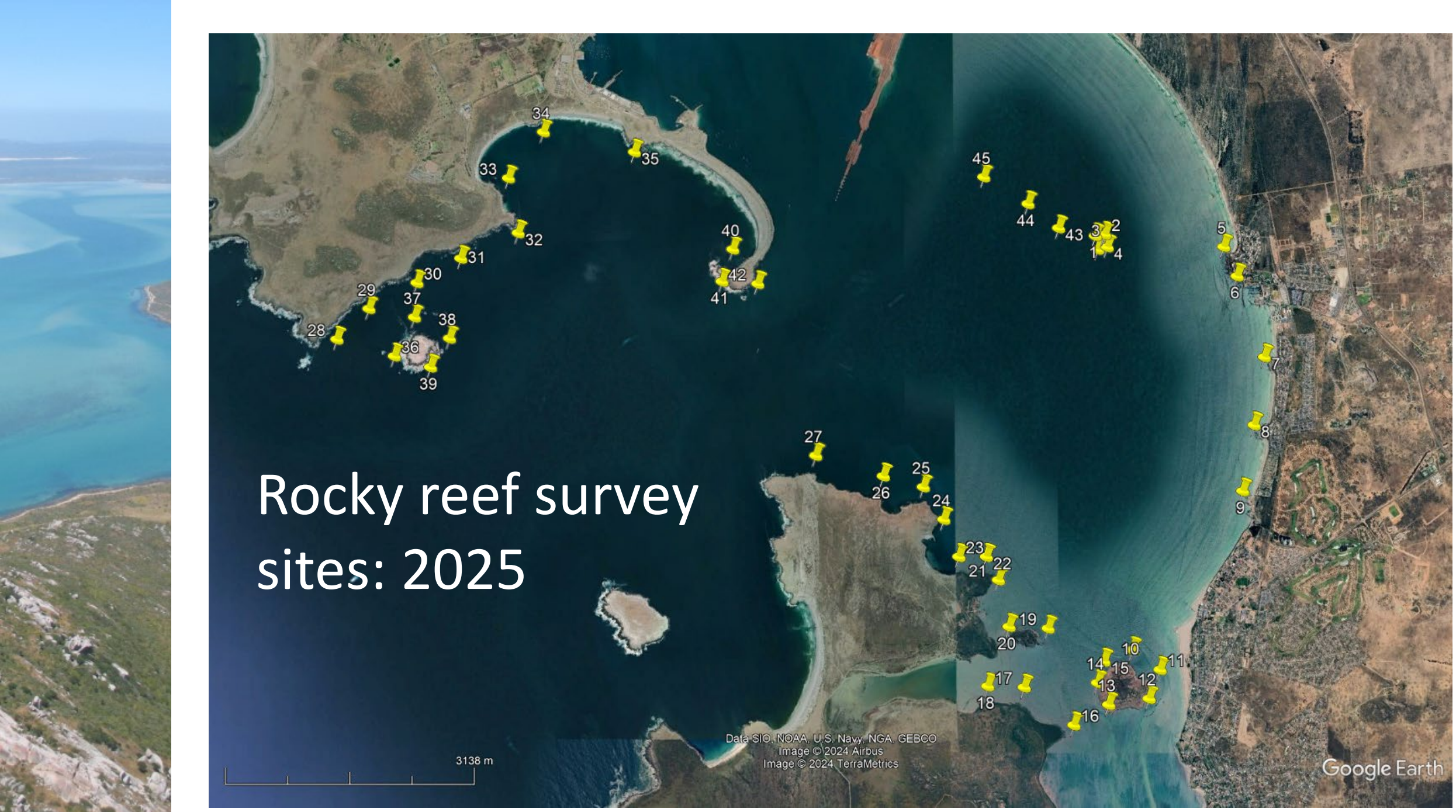
9. Hard bottom benthos



- Reef area in Big Bay is quite extensive (500 ha)
- Higher biodiversity and conservation importance than sediment but…
- ~50% of identified reef area falls within the (ADZ), LPG/LNG moorings area, proposed Karpowership site
- Soft sediment monitoring protocols (infauna, redox and H_2S) not really appropriate for this habitat type

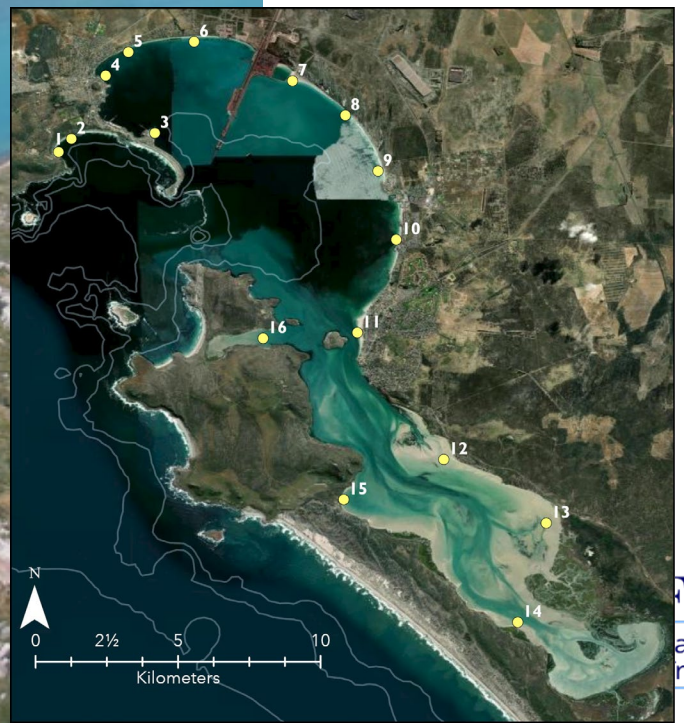
?
- Current extent of this reef is unknown
- Importance of this habitats to biota in the bay

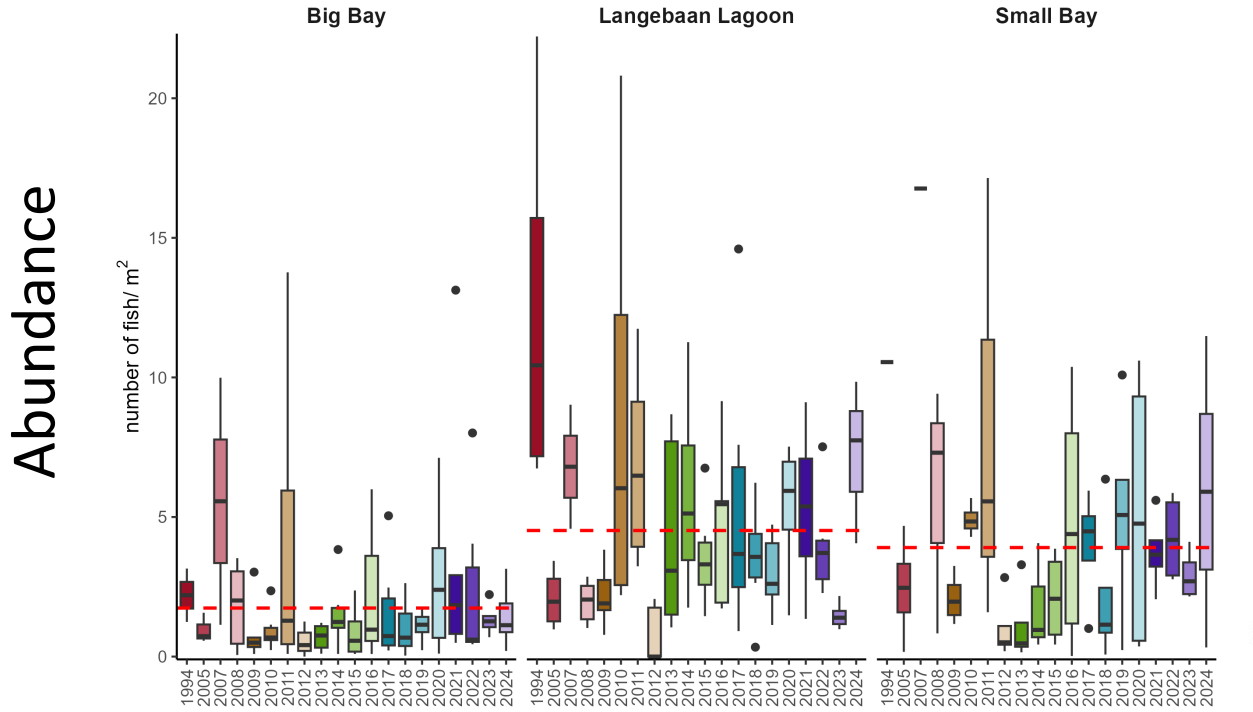



Rocky reef survey sites: 2025
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2024 Airbus
Image © 2024 TerraMetrics
3138 m
Google Earth

10. Fish

- Possible decline in numbers of species present in all areas of the Bay
- Overall abundance is very variable, but no clear change, except in Small Bay





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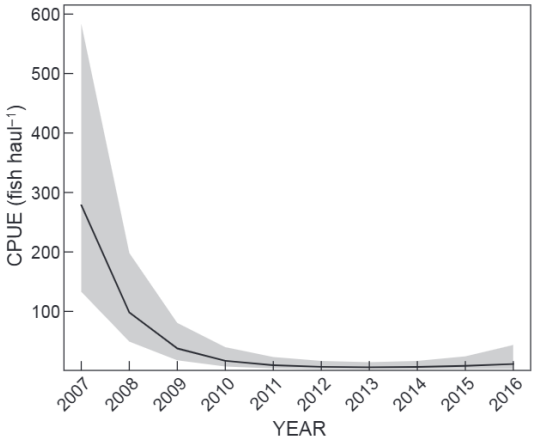
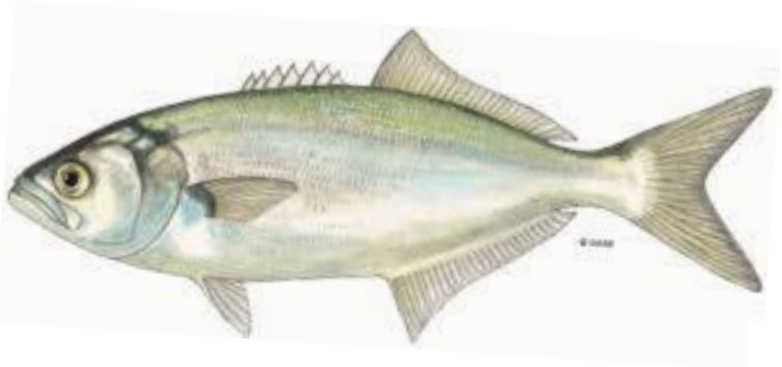
White stumpnose



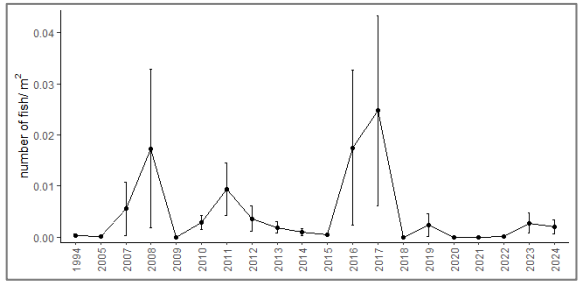
Recommendation…

Bag limit: 10/person/day ↓ 5

Size limit: 25 cm TL ↑ 30 cm



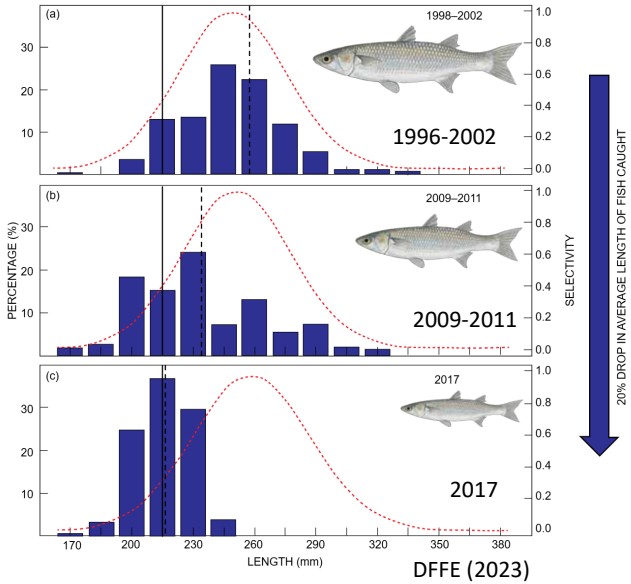
Elf



Bag limit: 4/person/day ✓

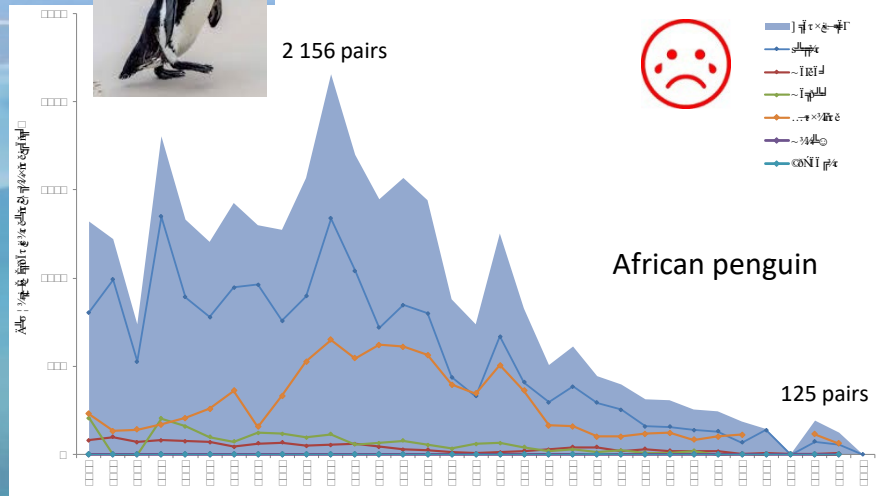
Size limit: 30 cm ✓

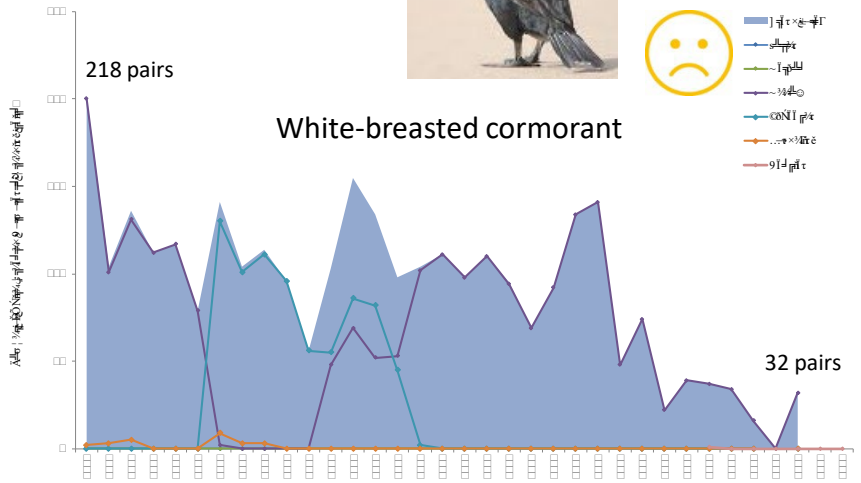
Harder (mullet)

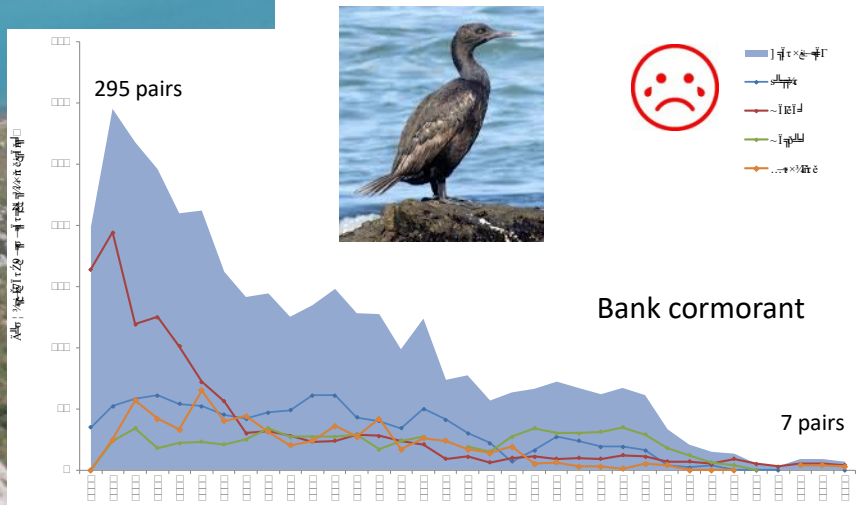


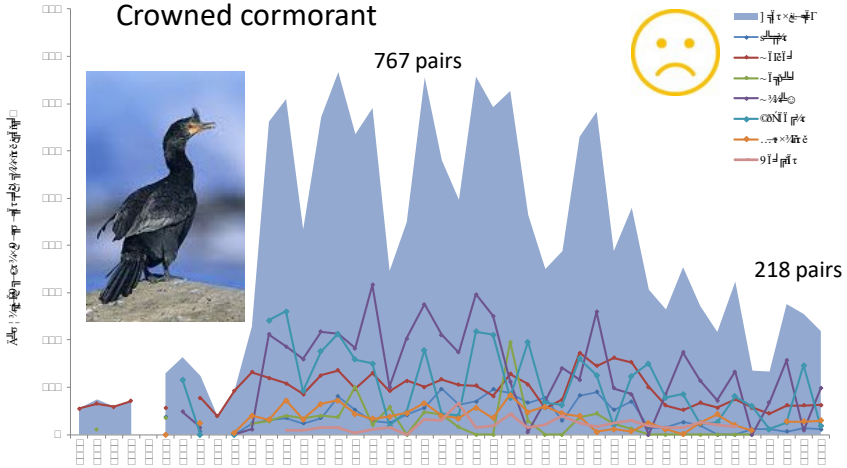
Resist pressure to allow gill net fishing in Zone B of the Langebaan MPA

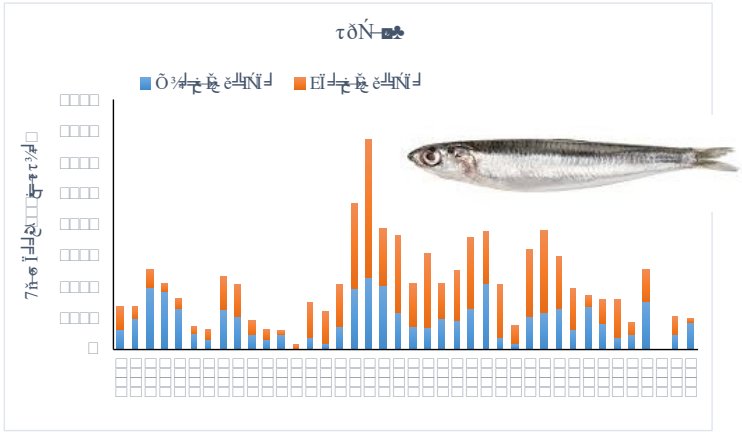
11a. Birds – Islands breeding

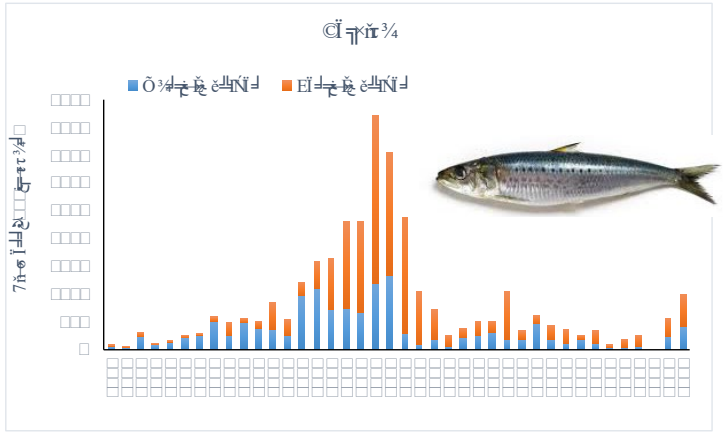












DFFE: Oceans and Coasts

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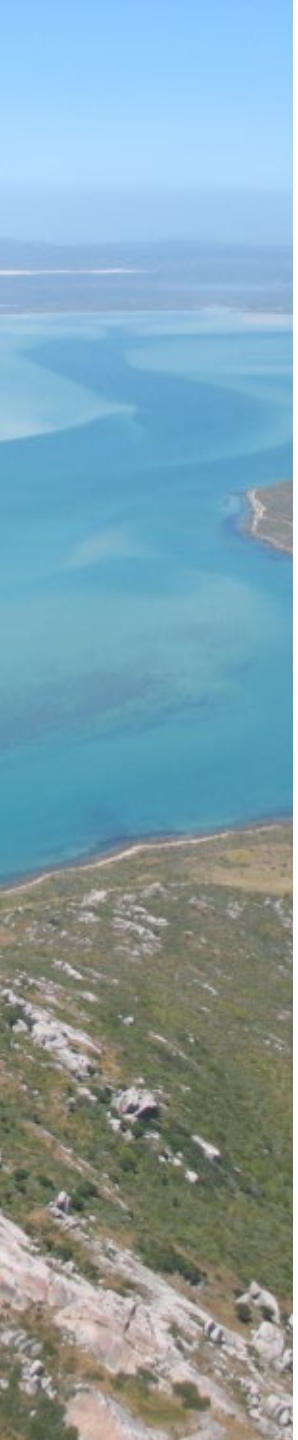
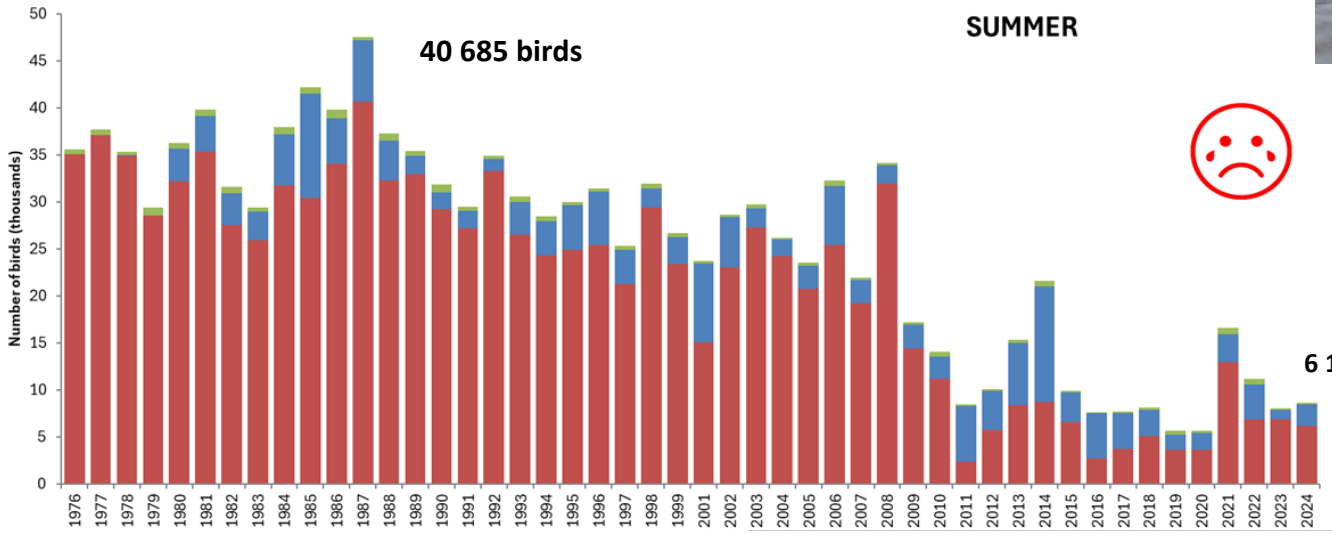
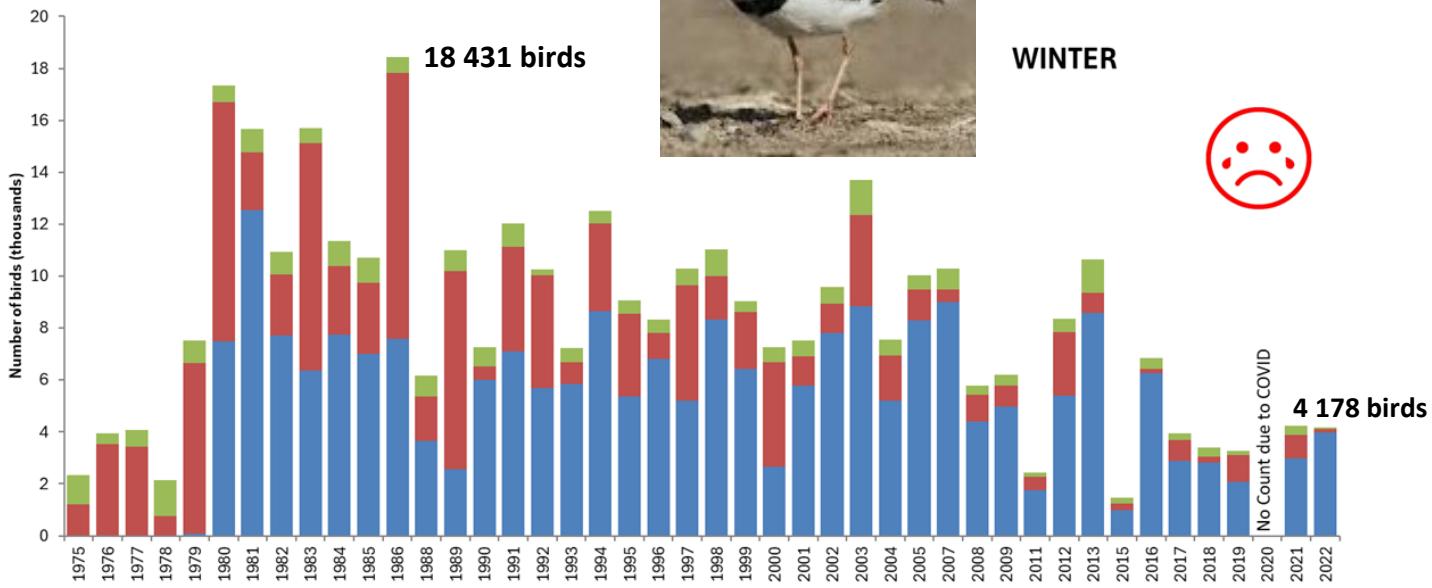
11b. Birds: Langebaan Lagoon







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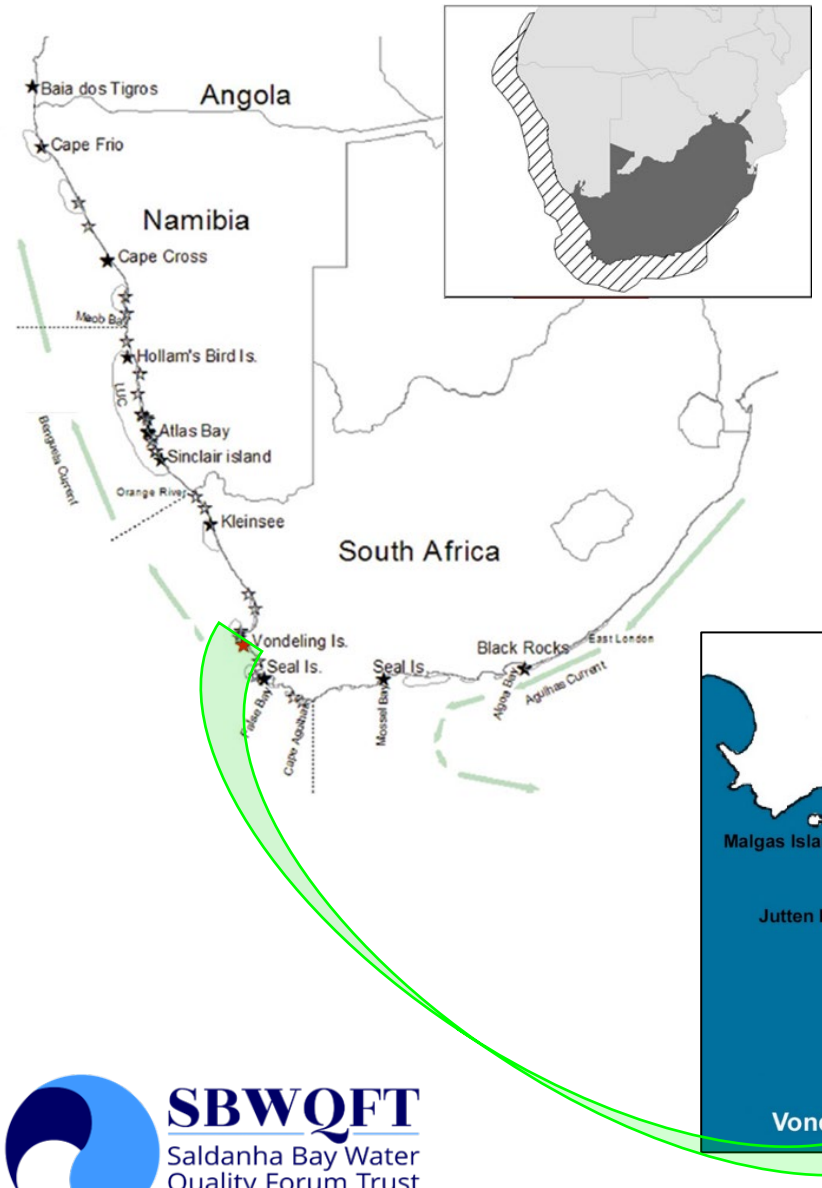
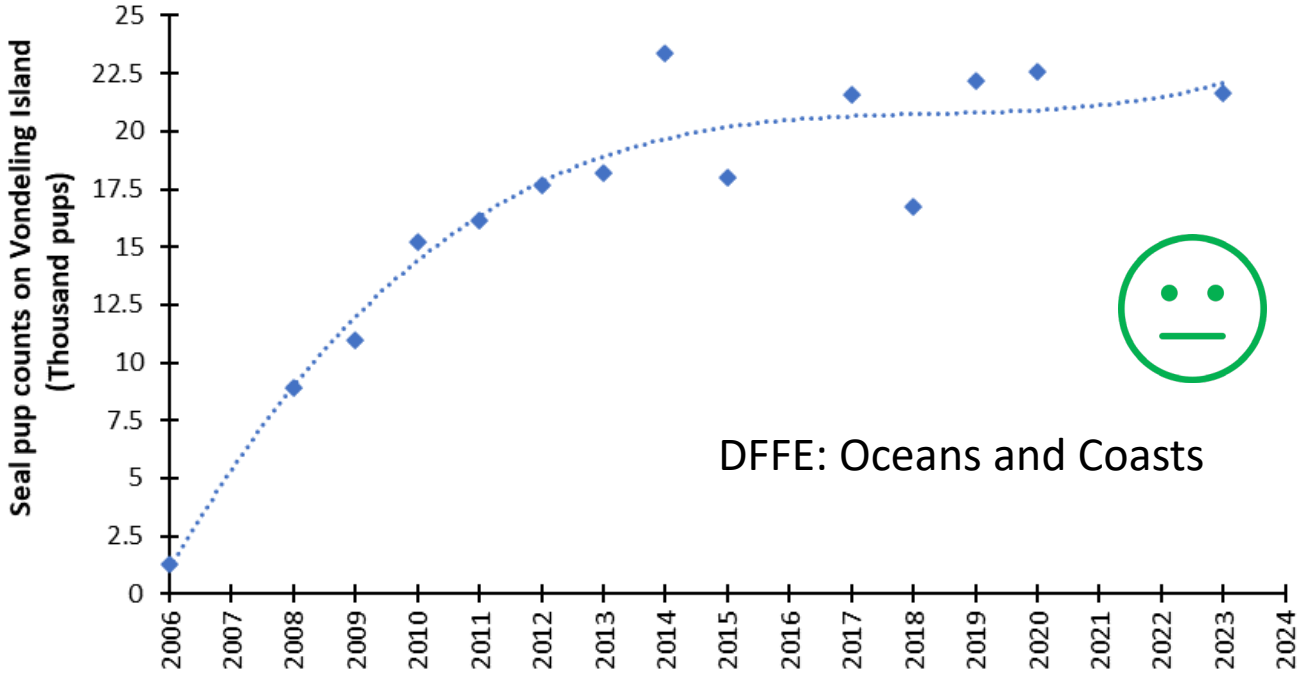
Animal Demography Unity (UCT)

12. Cape Fur seals





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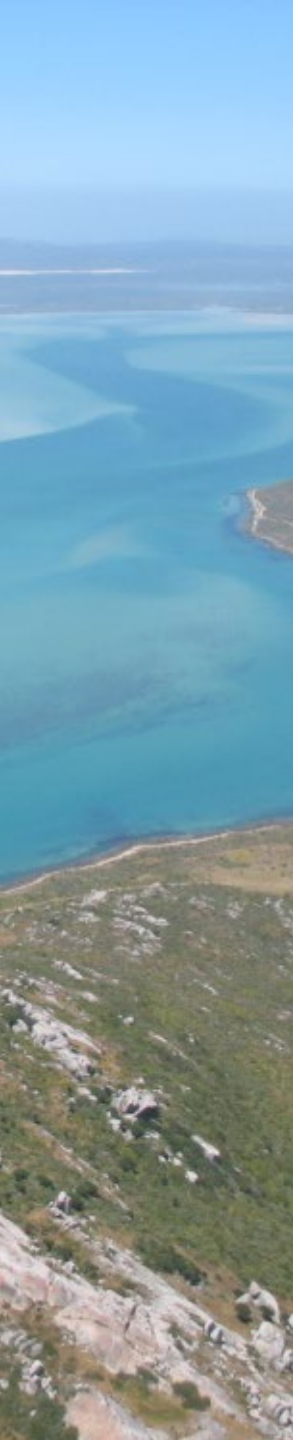
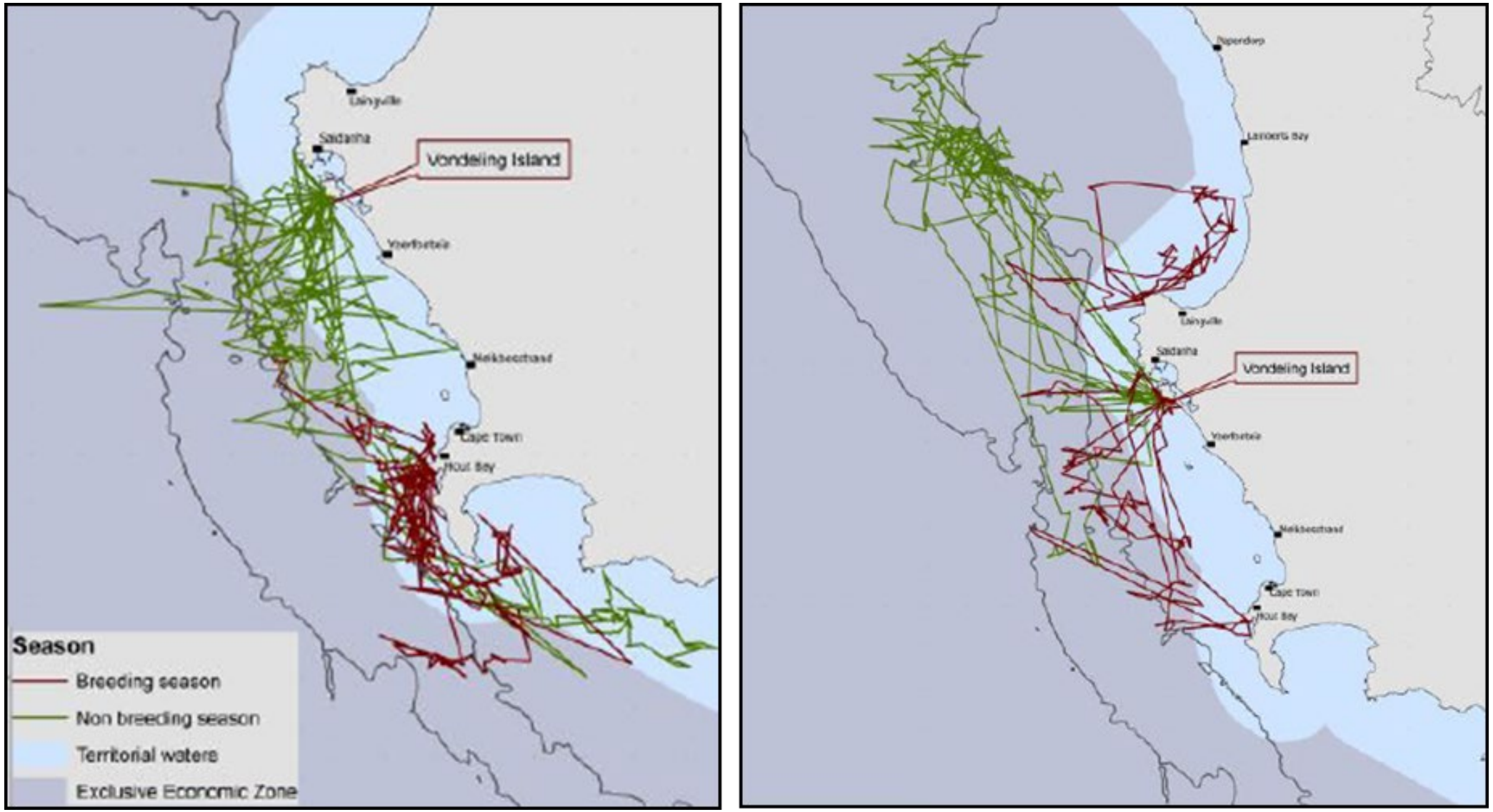
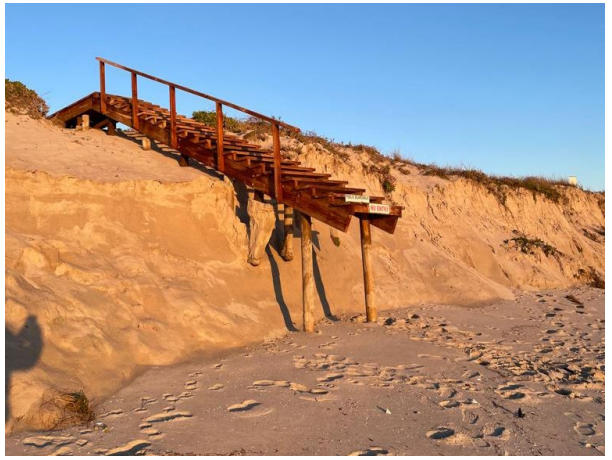




GPS tracks of female Cape fur seals tagged on Vondeling Island (Source: DFFE: Oceans and Coasts)

7. Coastal erosion

- One of the most significant threats to coastal populations and infrastruture around the world
- Approximately 3 billion people — about half of the world's population — live within 200 kilometers of a coastline
- Coastal erosion is a major problem in Saldanha Bay, particularly around the town of Langebaan but also in Big Bay between Spreeuwalle and the entrance to the Lagoon
- Losses of over 100 m of beach have occurred in some areas since 1960, up to 40 m of shoreline lost in just the last decade!
- Main drivers of coastal erosion include (1) climate variability (climate change), and (2) (inappropriate) development in the coastal zone (port development, dredging, piers and groynes, dredge spoil disposal)



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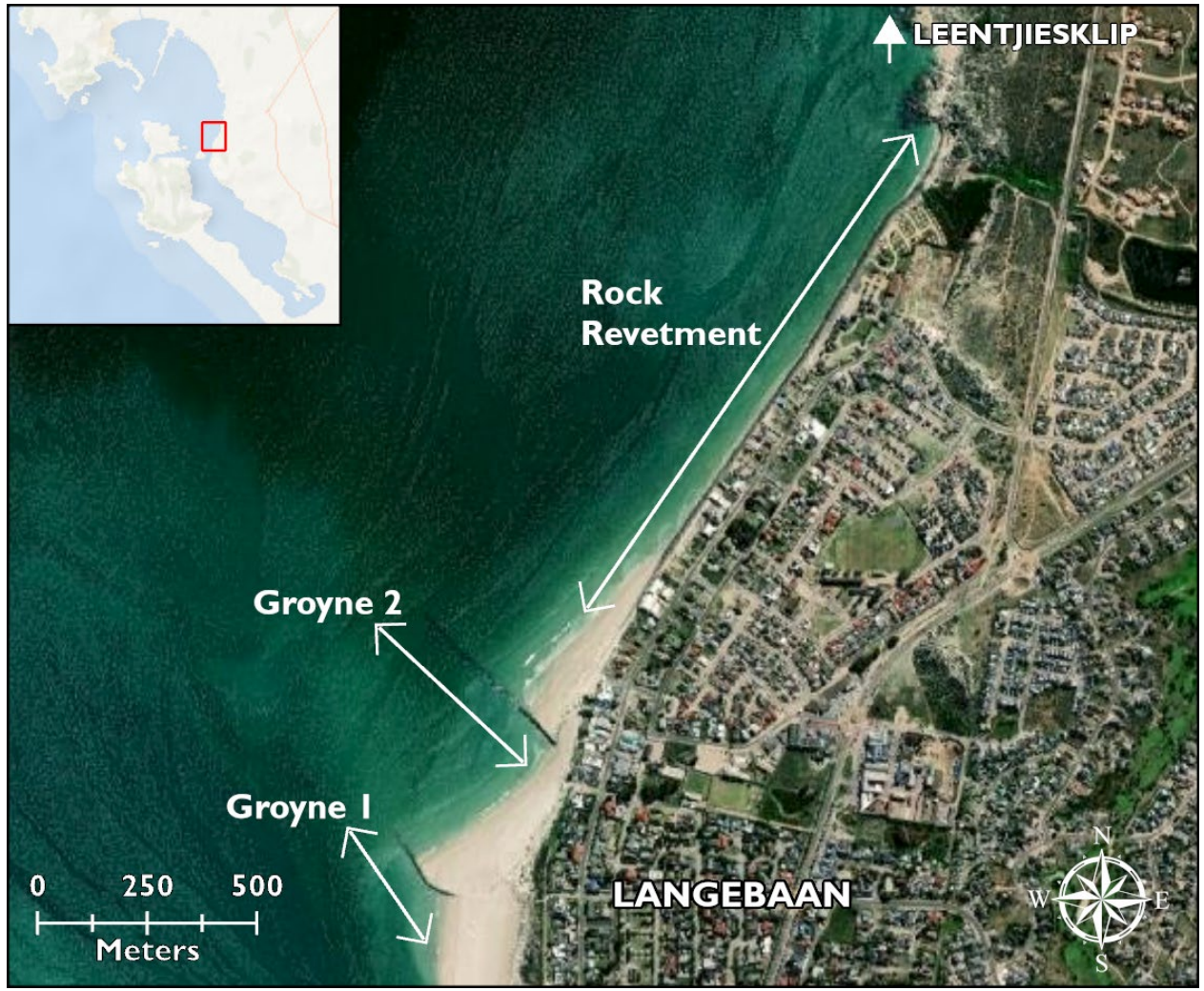
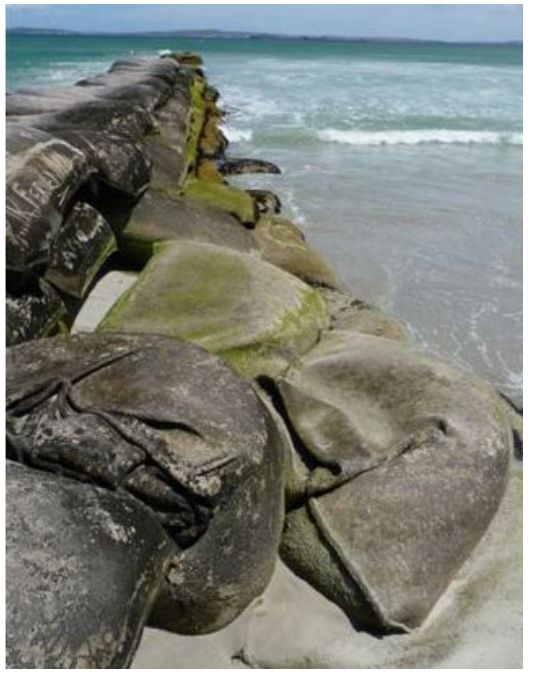
Shoreline erosion control in Saldanha Bay





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1997-2007

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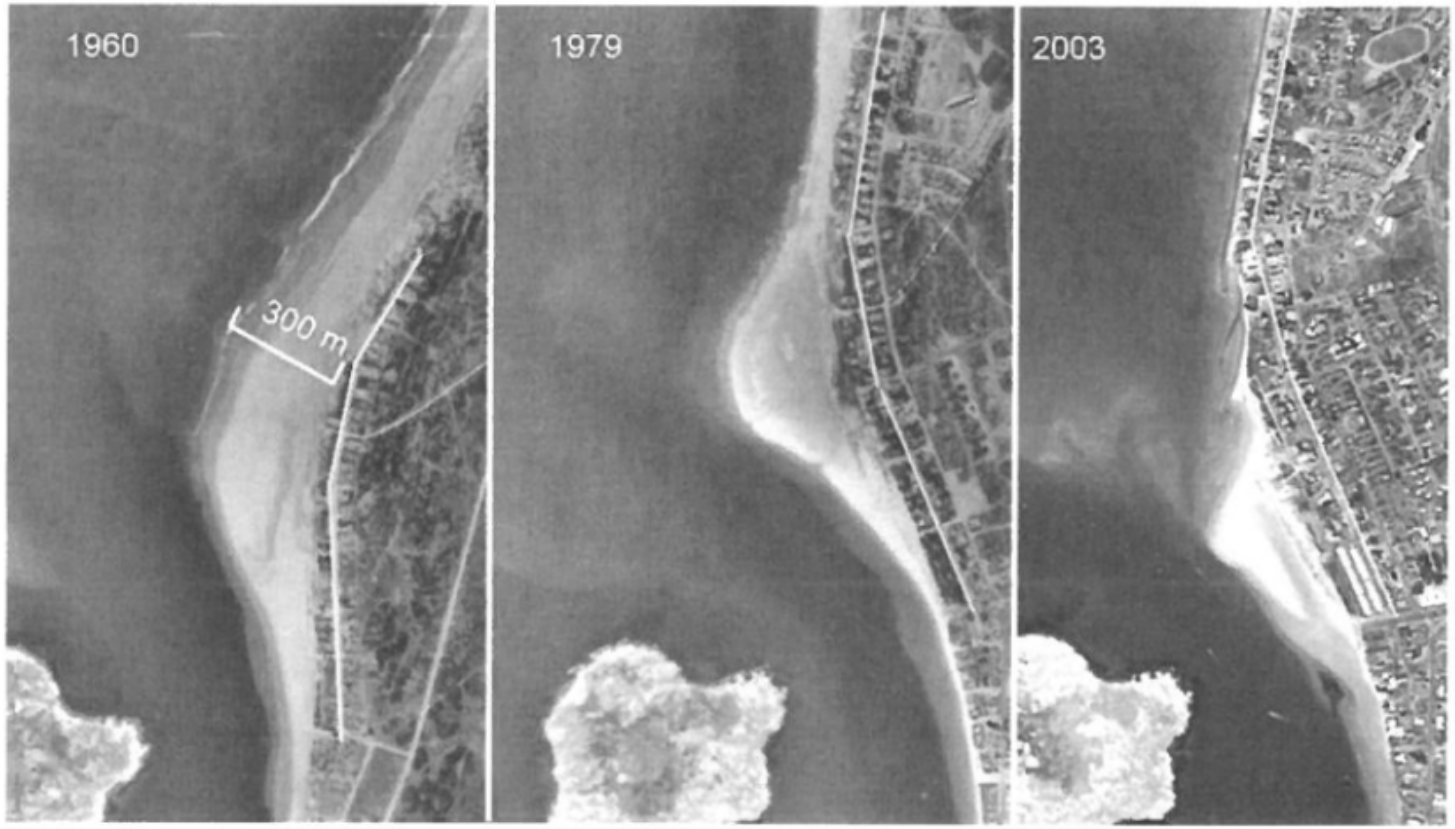
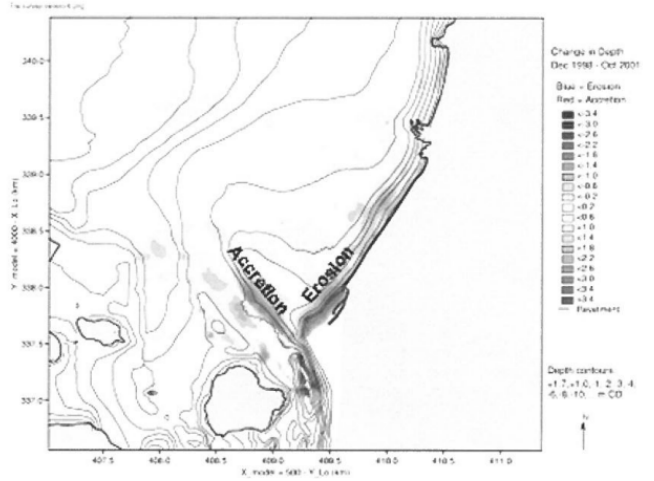
Paradise Beach, Club Mykonos

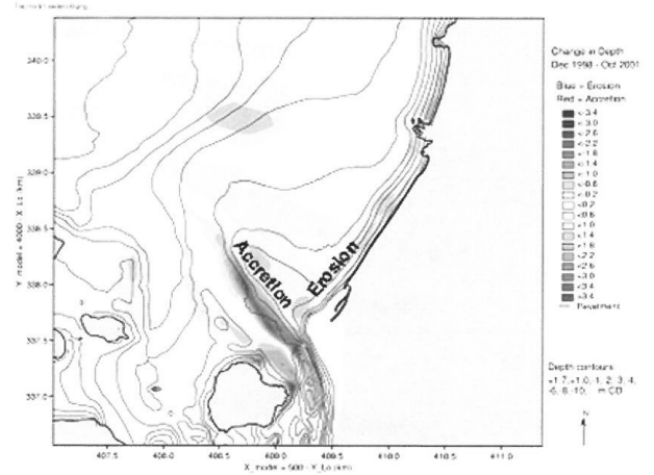
Historical efforts to document and understand coastal erosion in Saldanha Bay



Stephen Luger et al (2007) Morphological design for a beach restoration project. ***Coastal Engineering, 30th International Conference***



Measured erosion accretion 1998-2001



Modelled erosion accretion 1998-2001

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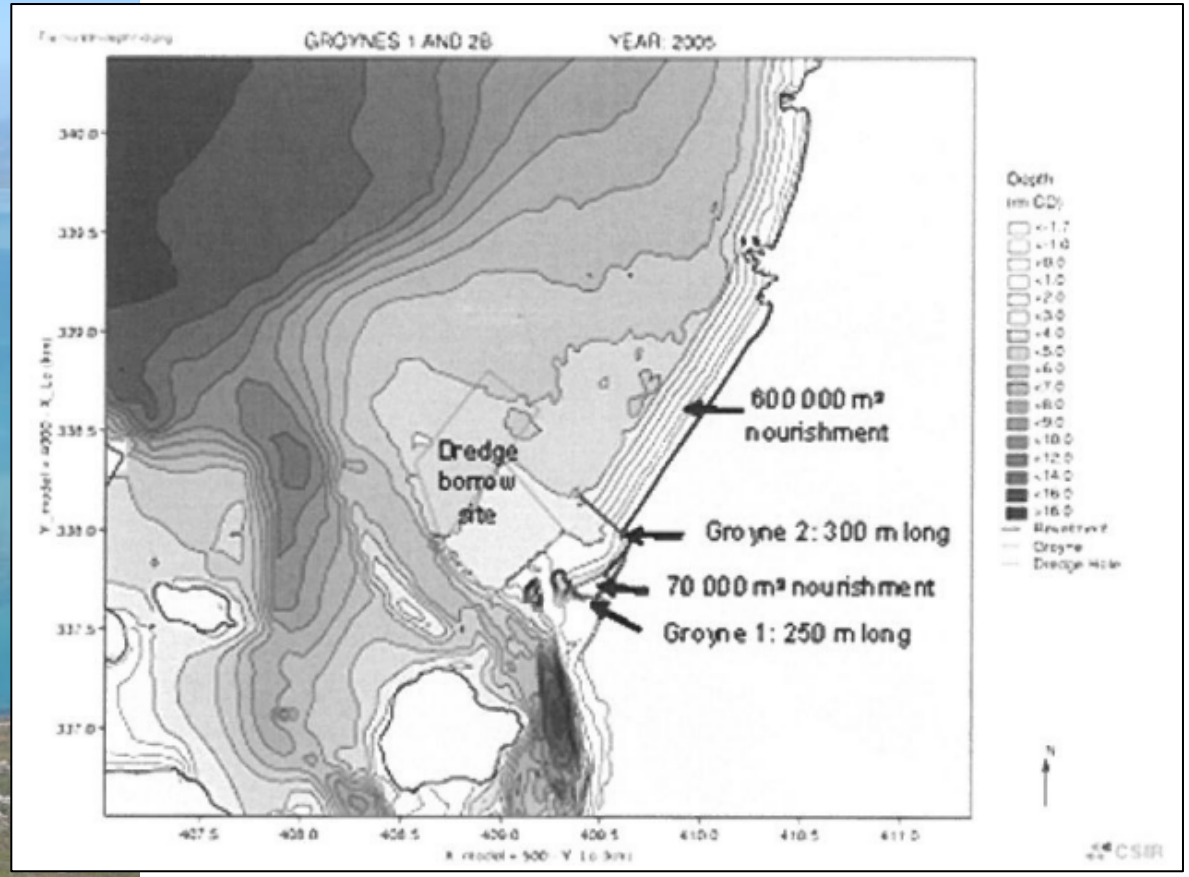
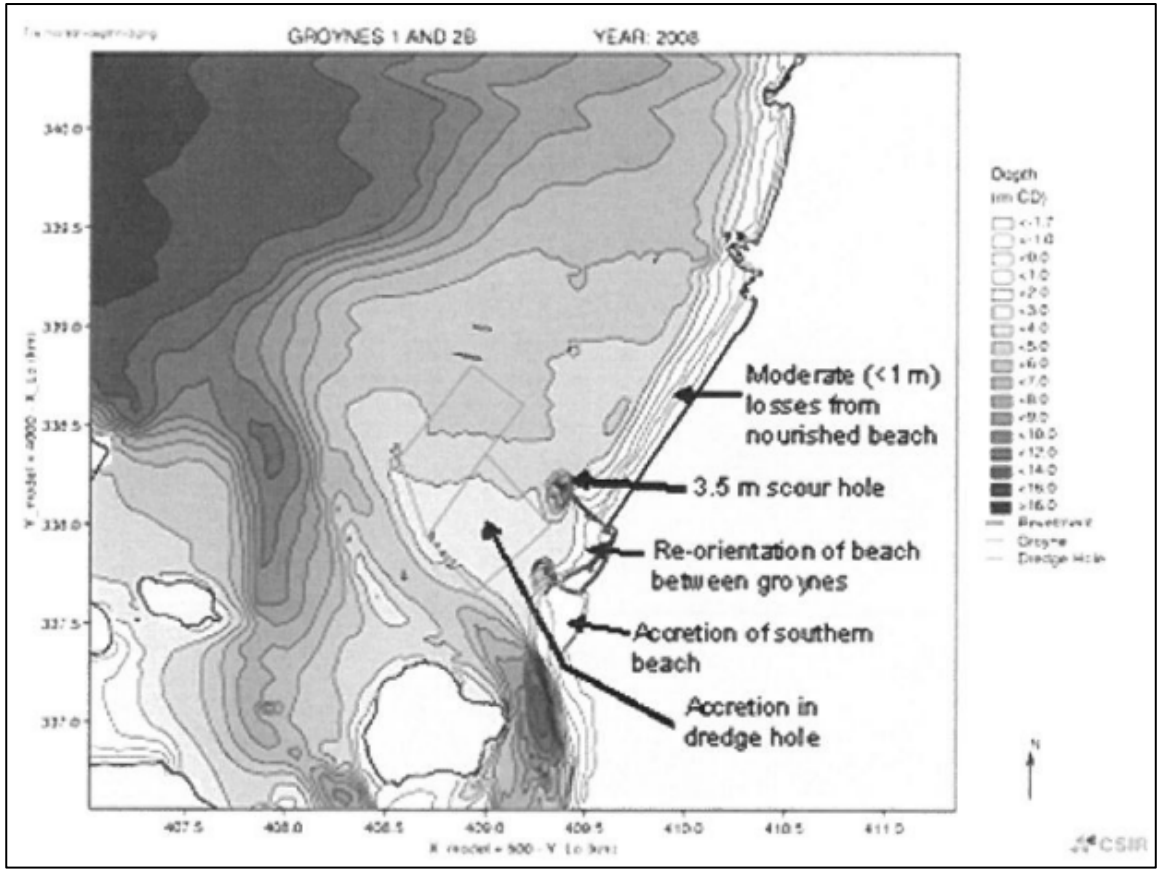


Modelled bathymetry at the start of the simulation period



Modelled bathymetry after 3 years with groynes in place

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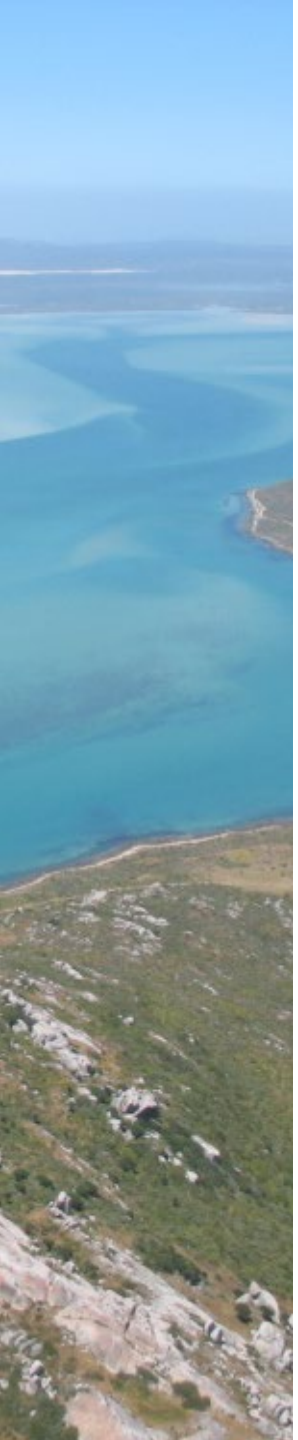

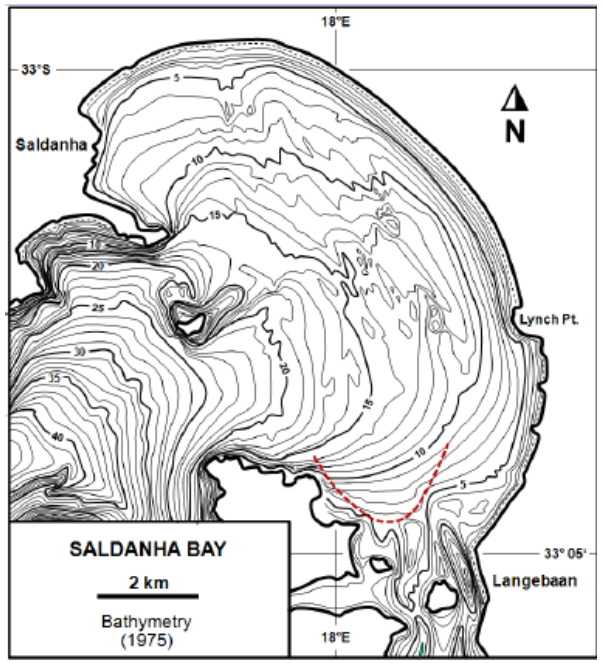

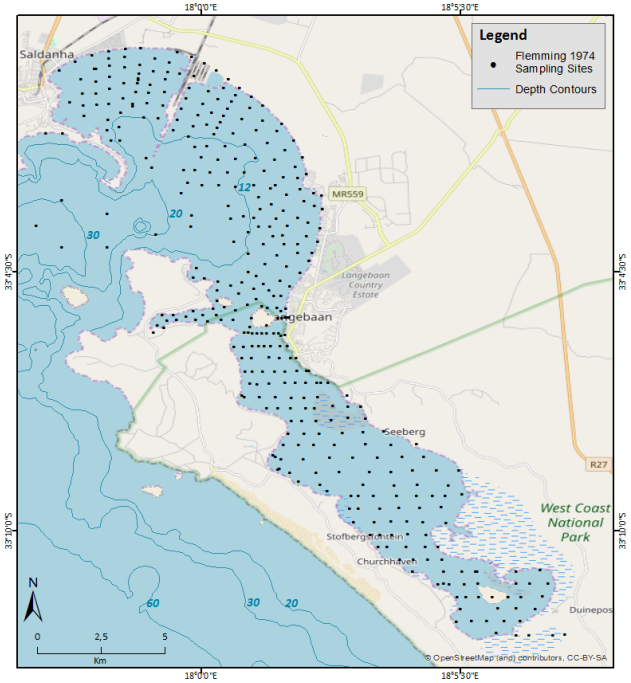

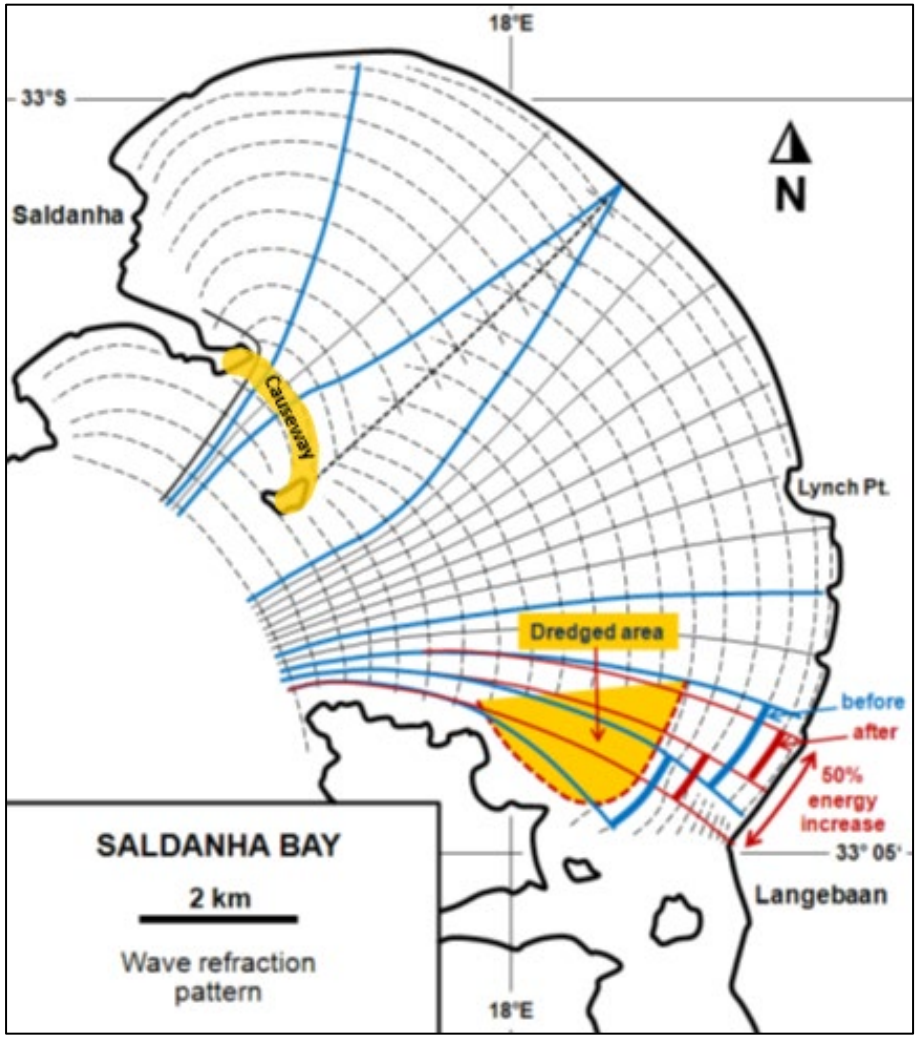

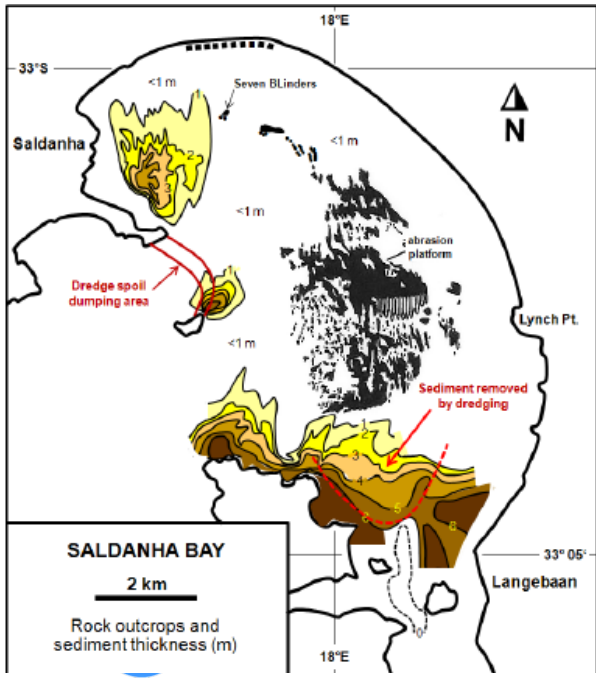

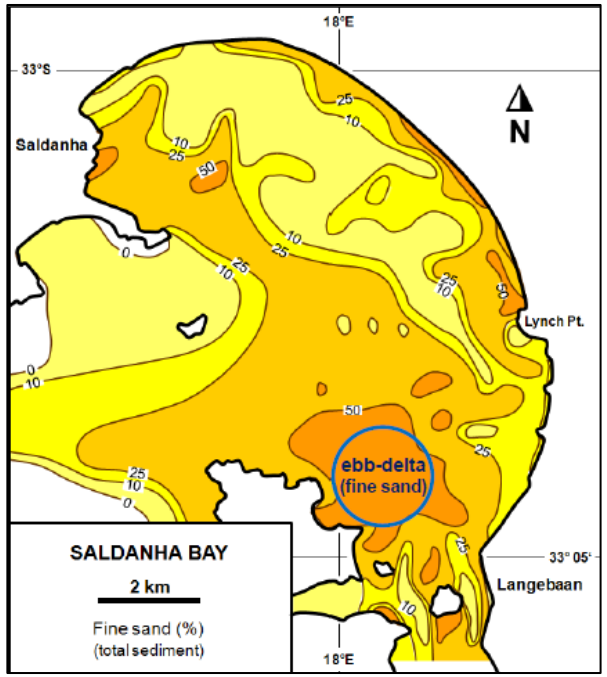

Burghart Flemming (1974, 1975, 1977, 2016)

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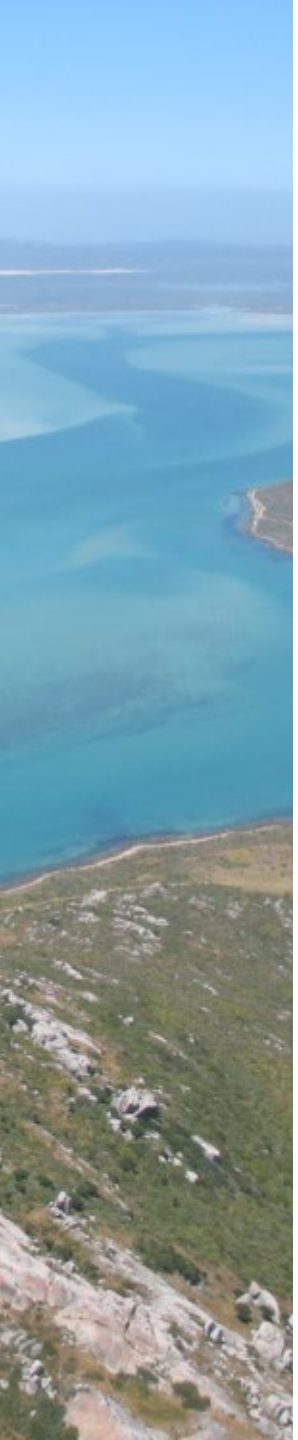
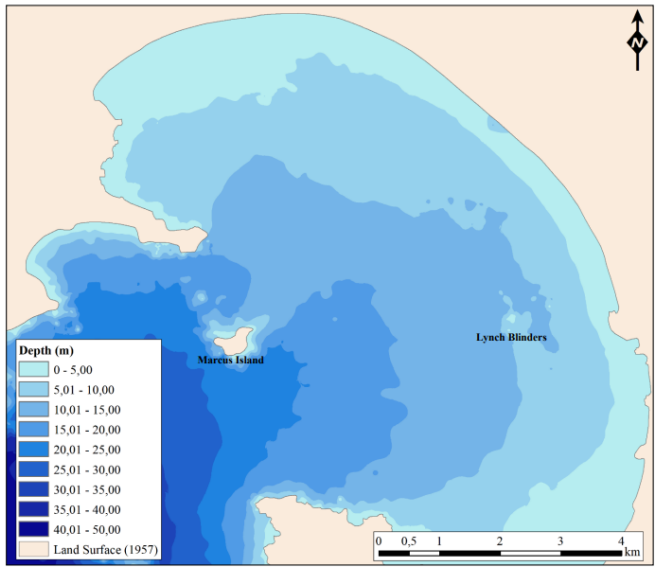
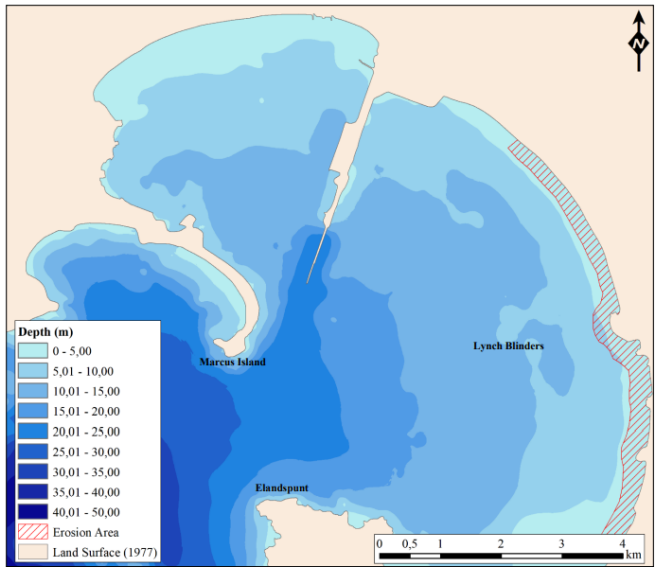
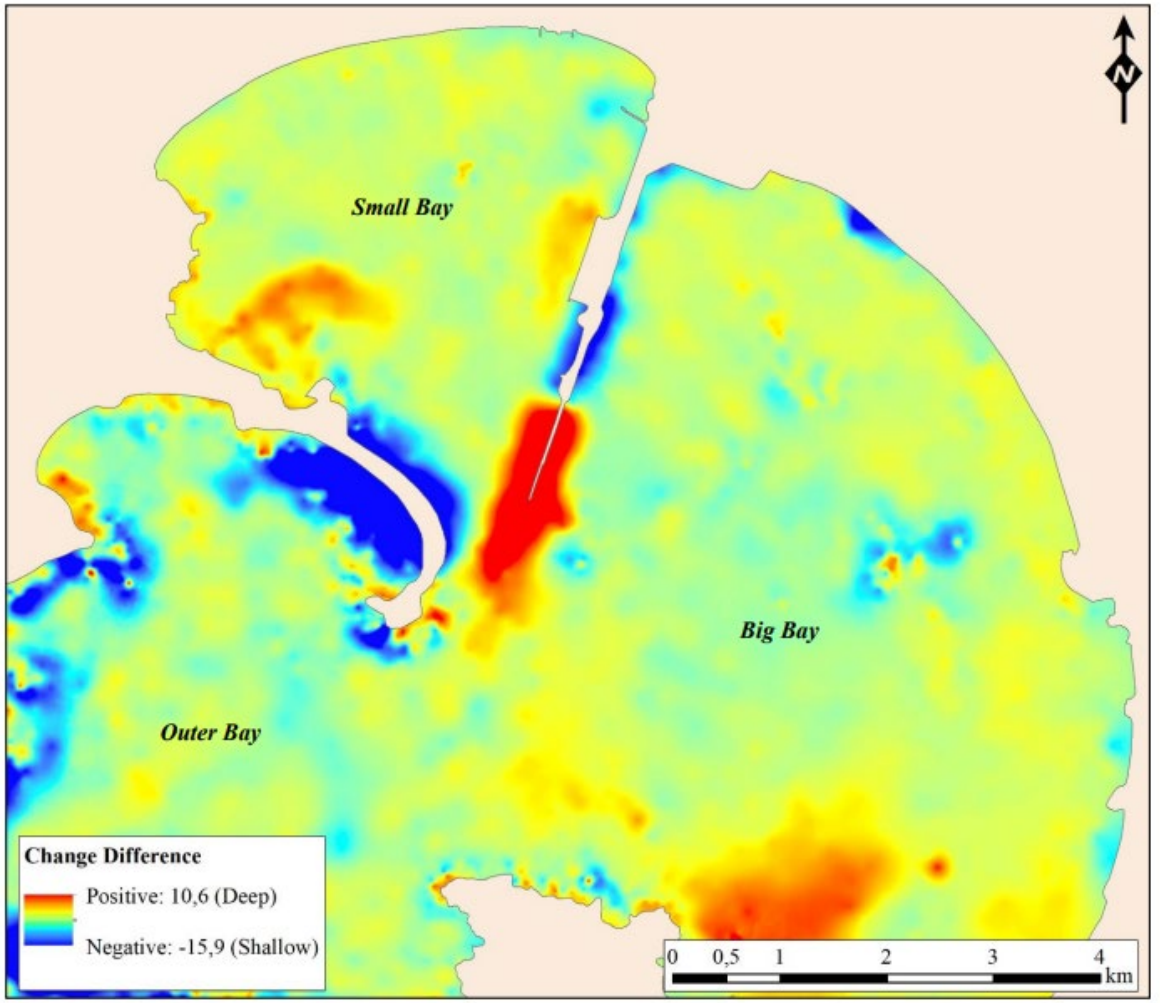


Ivan Henrico & Jacques Bezuidenhout (2020). Determining the change in the bathymetry of Saldanha Bay due to the harbour construction in the seventies. South African J Geomatics 9:236–249.

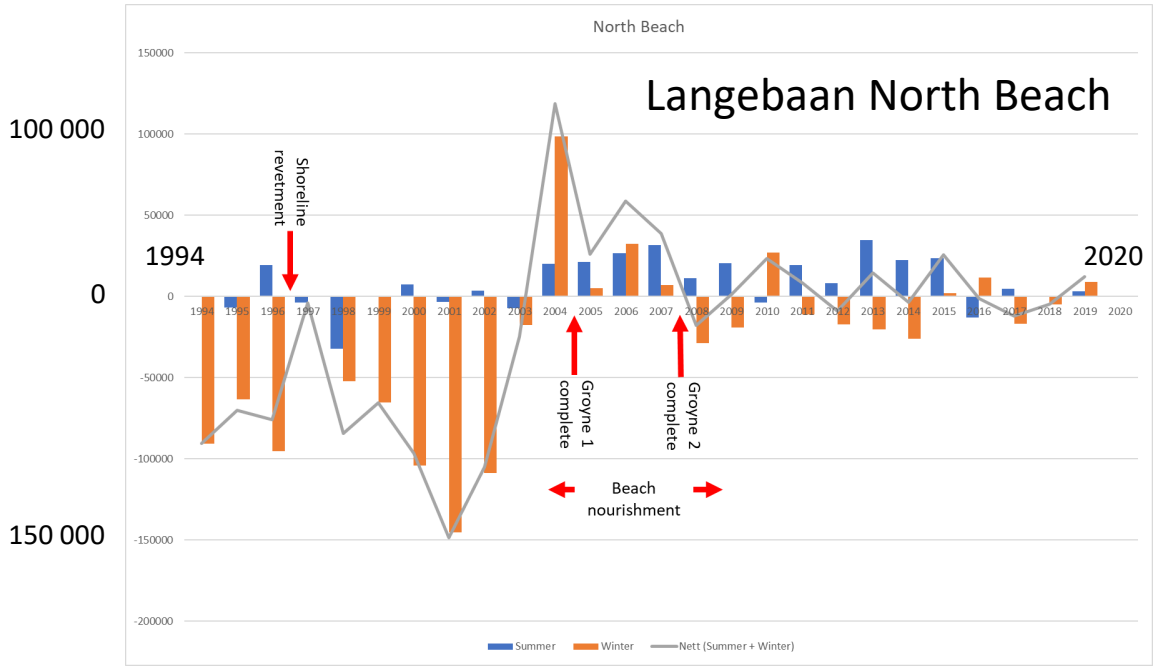


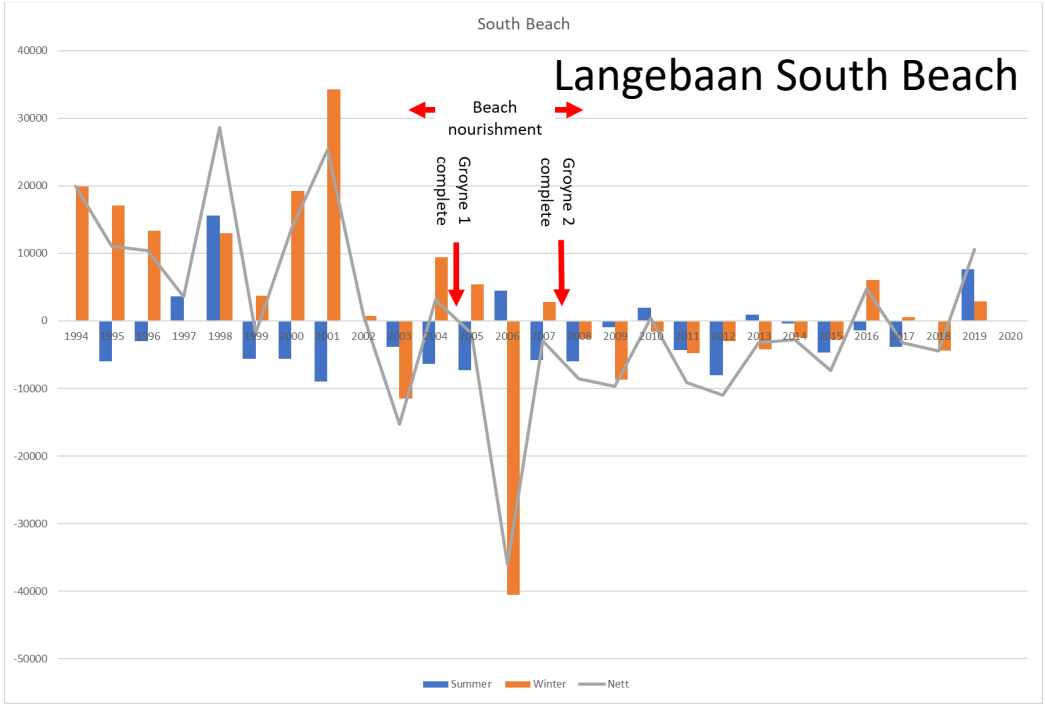


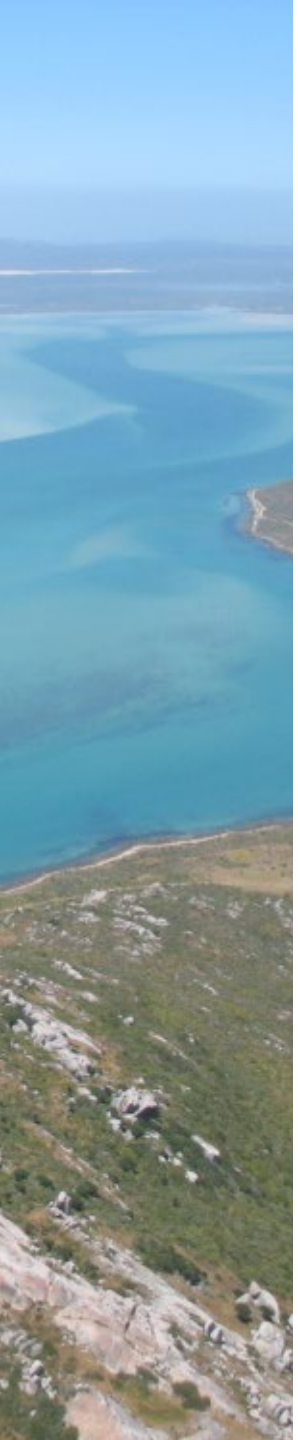


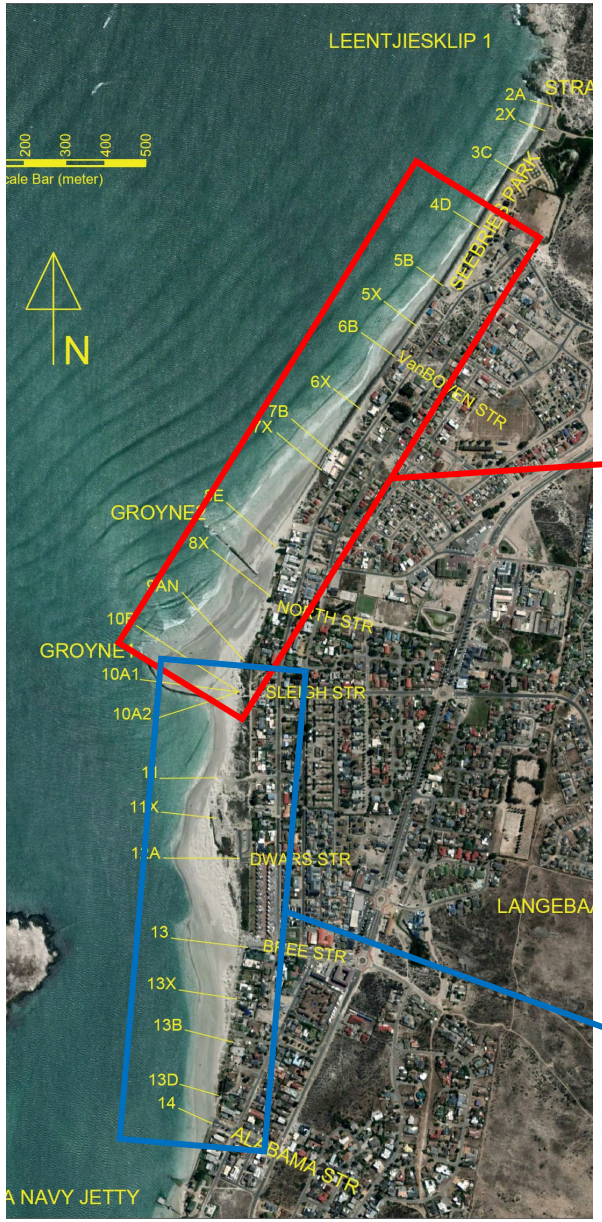
Change in bathymetry between 1957 and 1977….

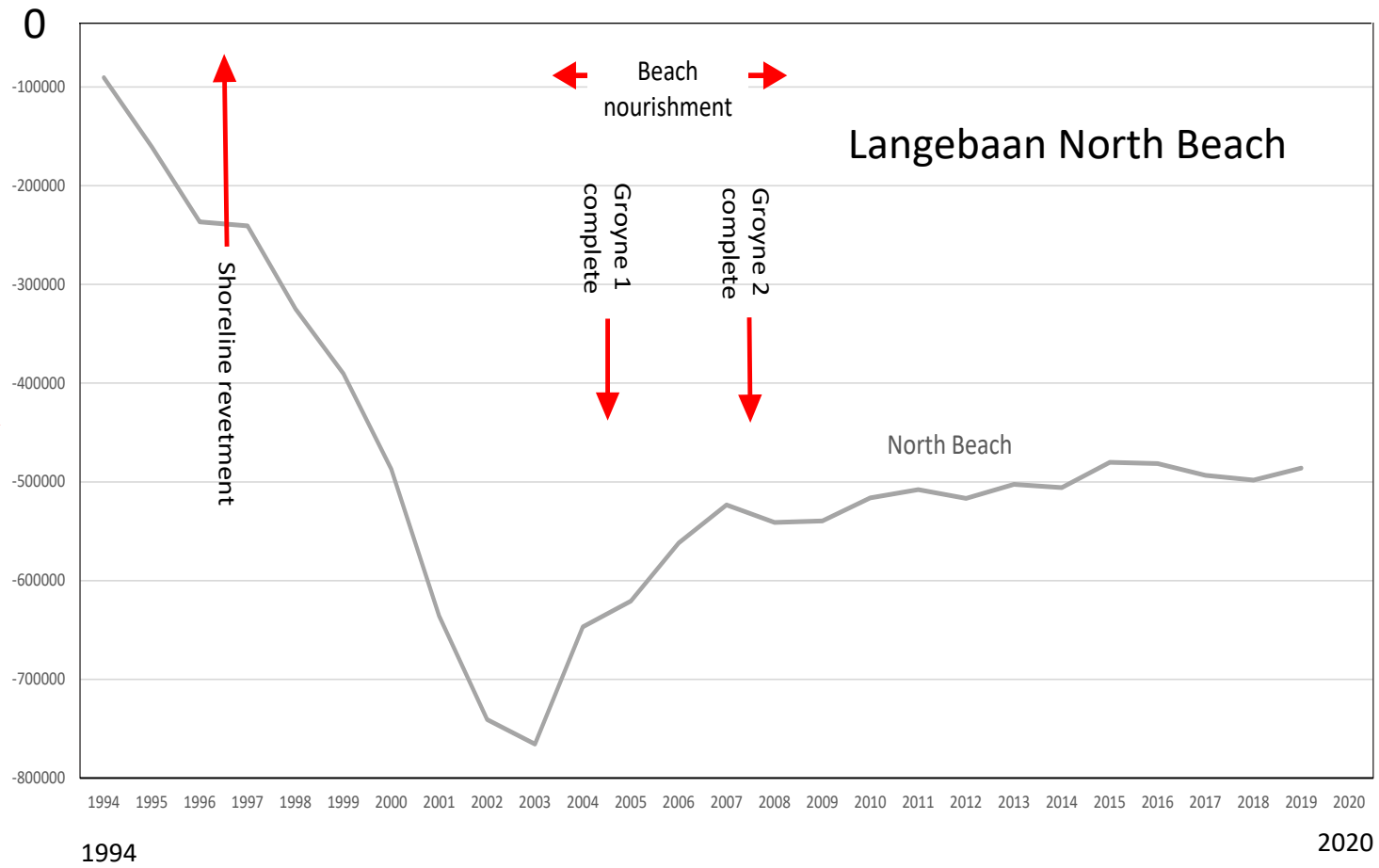
State of the Bay (2020)

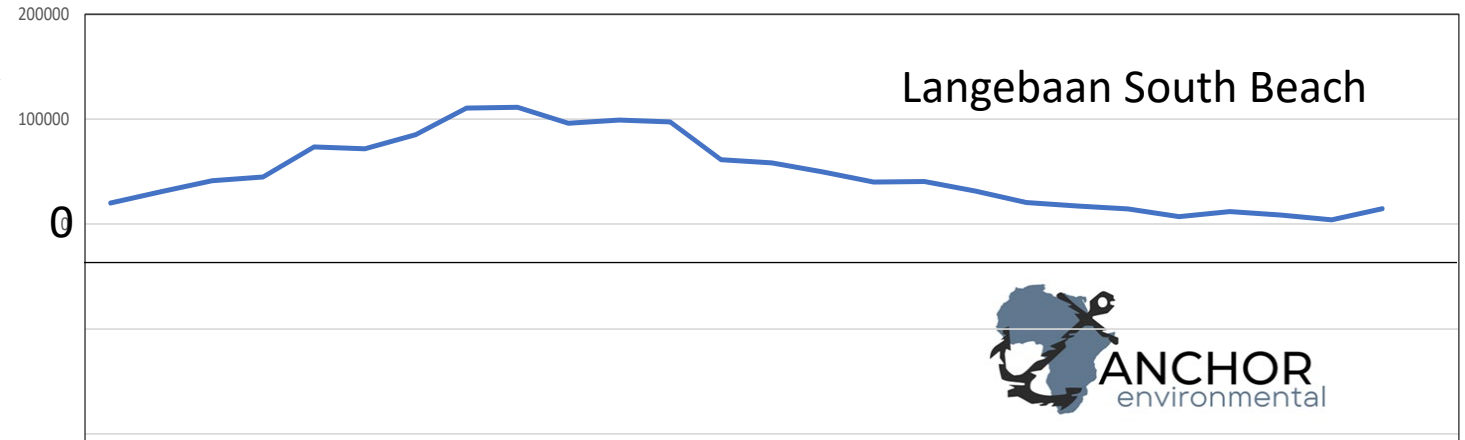












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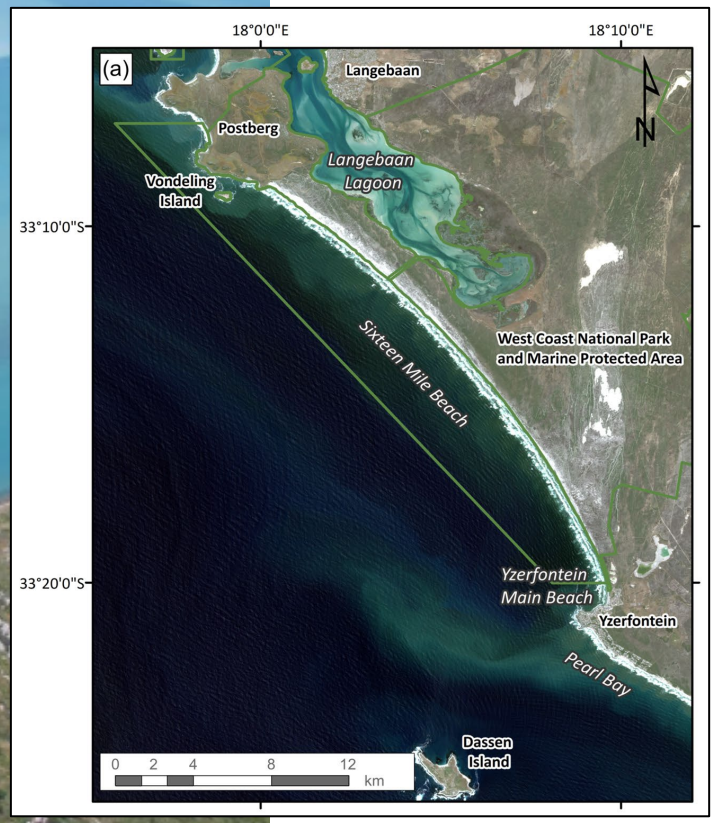
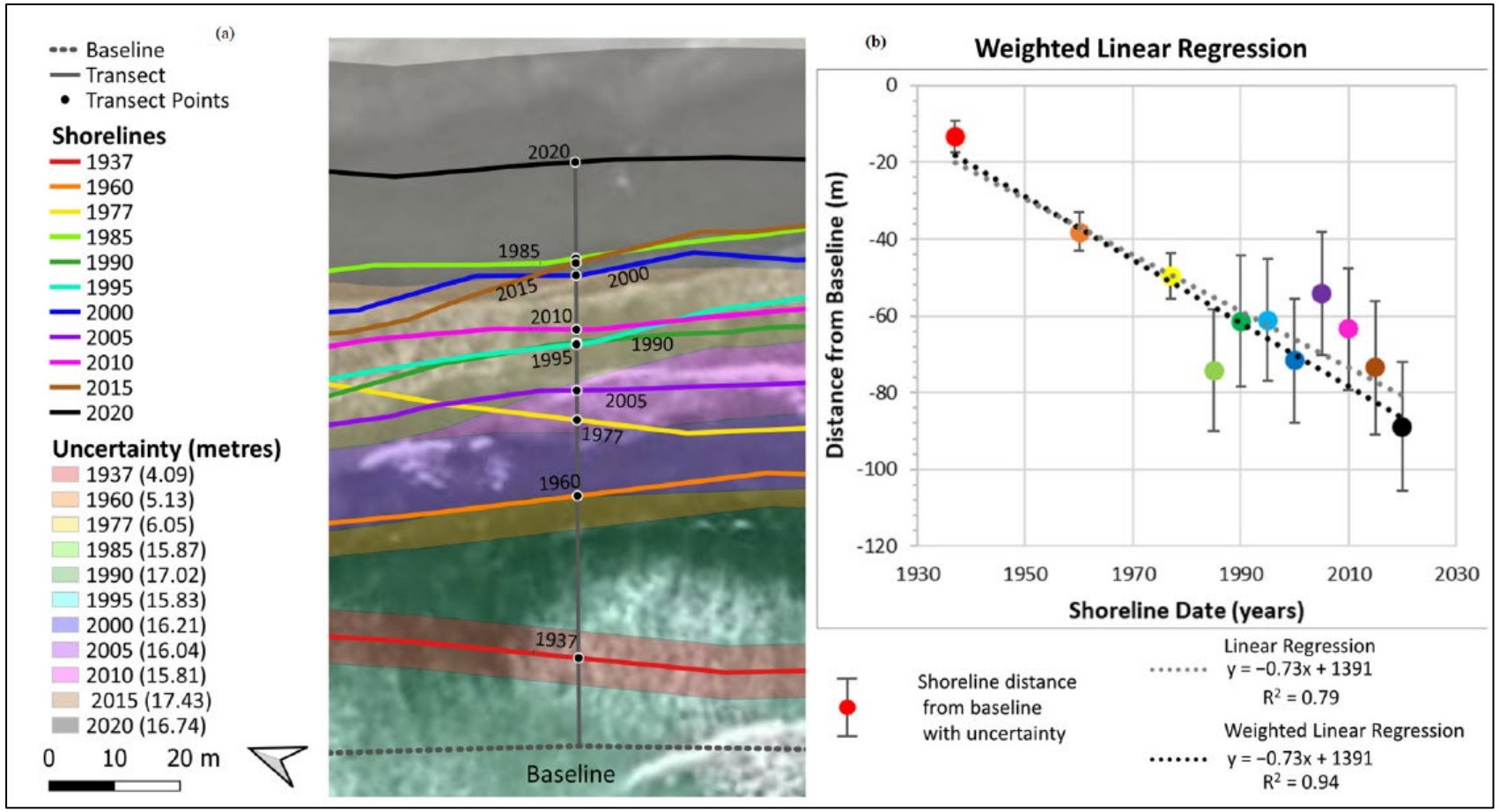
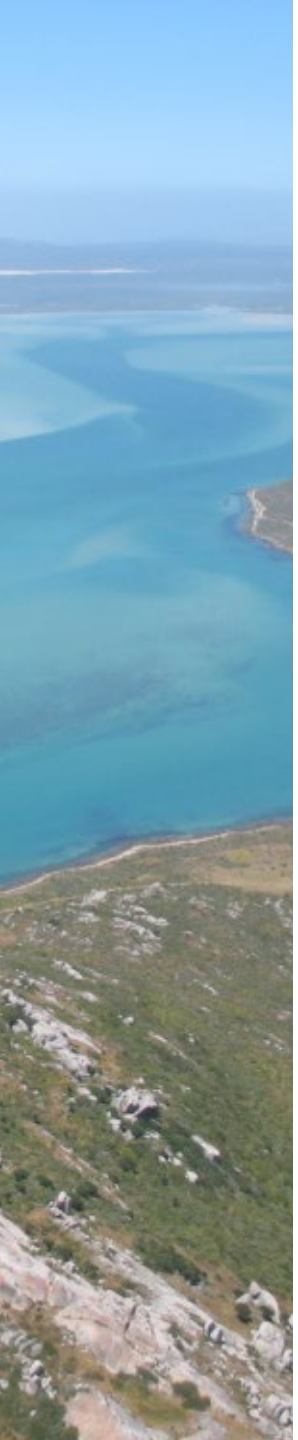
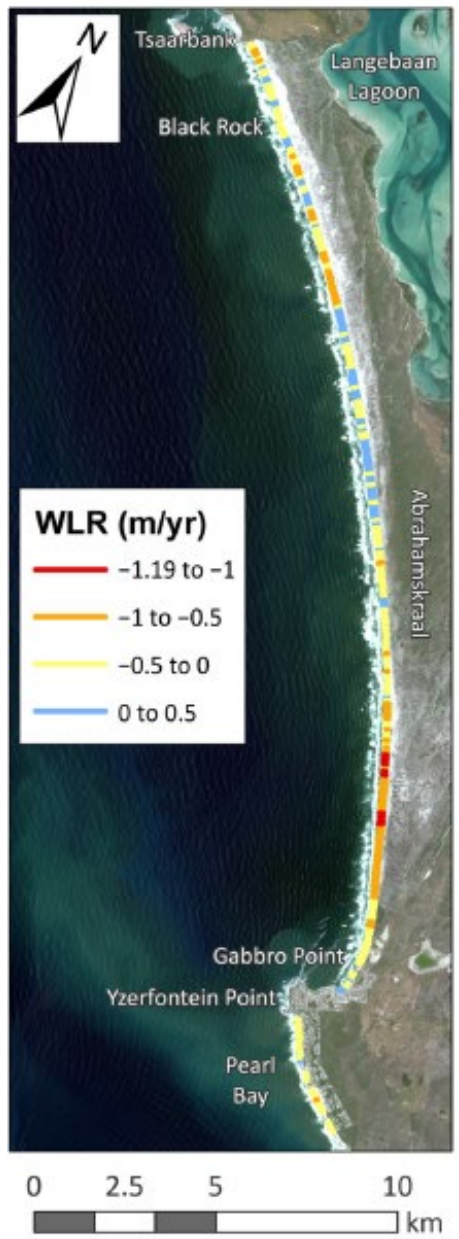
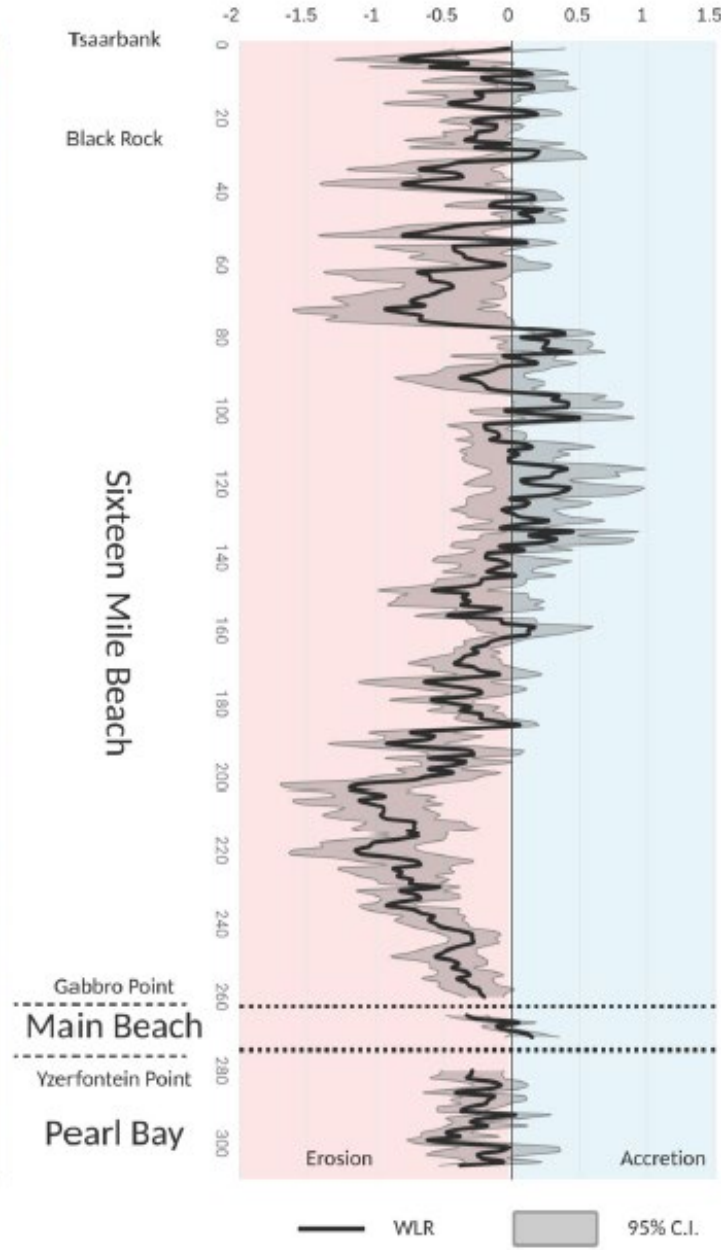
Jennifer Murray et al. 2023. Monitoring shoreline changes along the southwestern coast of South Africa from 1937 to 2020 using varied remote sensing data and approaches. Remote Sensing 15: 317-336

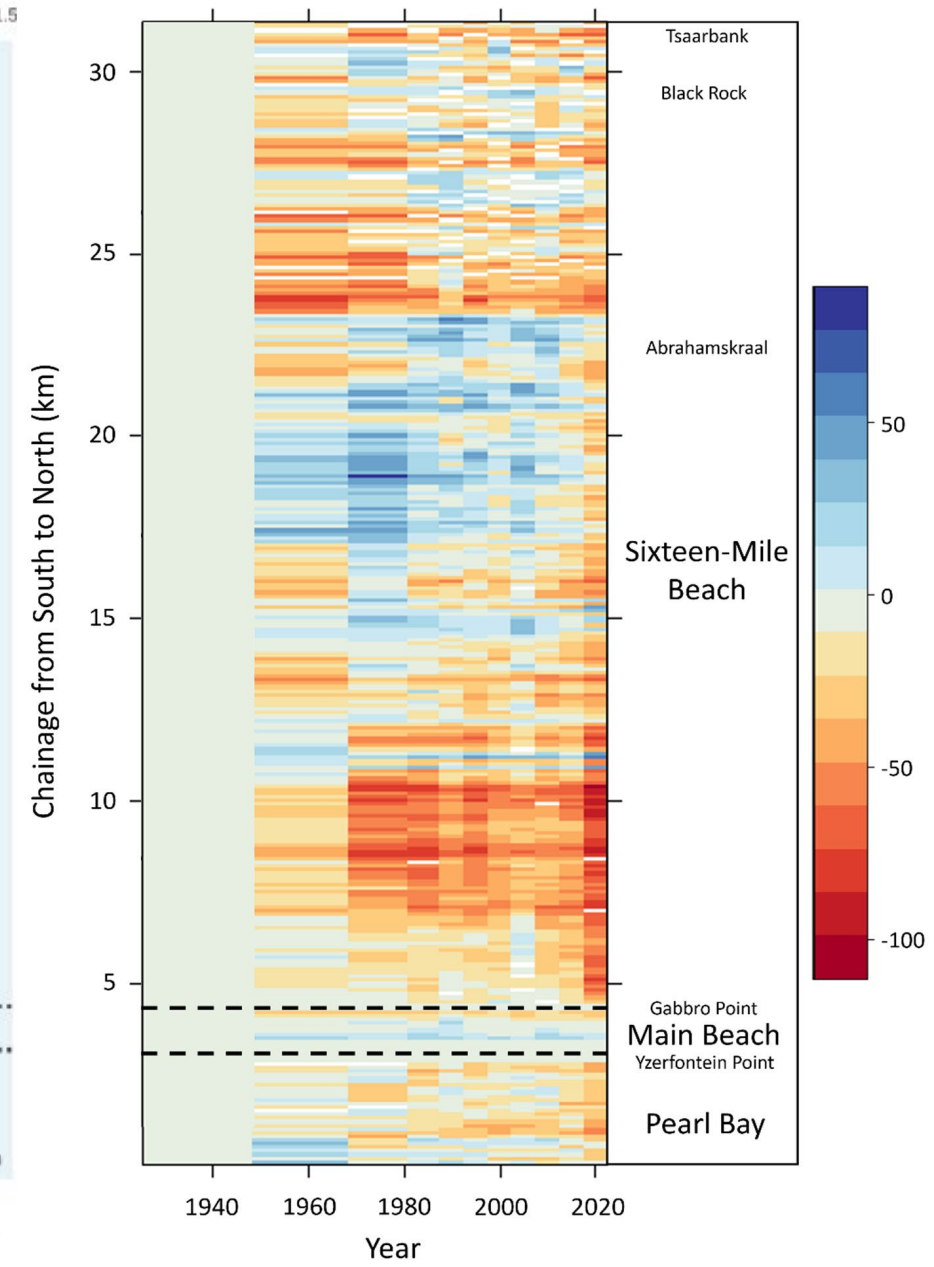







Tsaarbank
Langebaan Lagoon
Black Rock
Abrahamskraal
WLR (m/yr)
−1.19 to −1
−1 to −0.5
−0.5 to 0
0 to 0.5
Gabbro Point
Yzerfontein Point
Pearl Bay
0 2.5 5 10
km


-2 -1.5 -1 -0.5 0 0.5 1 1.5
Tsaarbank
Black Rock
Sixteen Mile Beach
Gabbro Point
Main Beach
Yzerfontein Point
Pearl Bay
Erosion
Accretion
WLR
95% C.I.


Chainage from South to North (km)
30
25
20
15
10
5
Tsaarbank
Black Rock
Abrahamskraal
Sixteen-Mile Beach
Gabbro Point
Main Beach
Yzerfontein Point
Pearl Bay
1940 1960 1980 2000 2020
Year
50
0
-50
-100
Seaward movement of shoreline w.r.t. 1937
Shoreline Change (m)
Landward movement of shoreline w.r.t. 1937

Time to set up a coastal erosion monitoring component as part of the SOB monitoring programme….

- Remote sensing techniques using available satellite imagery is the obvious solution…..

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Landsat 1	80m Resolution																										
Landsat 2				80m Resolution																							
Landsat 3							80m Resolution																				
Landsat 4											30m Resolution																
Landsat 5													30m Resolution														
Landsat 6																						*Did not achieve orbit					

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Landsat 5	30m Resolution																										
Landsat 6	*Did not achieve orbit																										
Landsat 7	30m Resolution																										
Landsat 8															30m Resolution												?
Landsat 9																							30m Resolution				
Sentinel 1																10m Resolution											
Sentinel 2																	10m Resolution										

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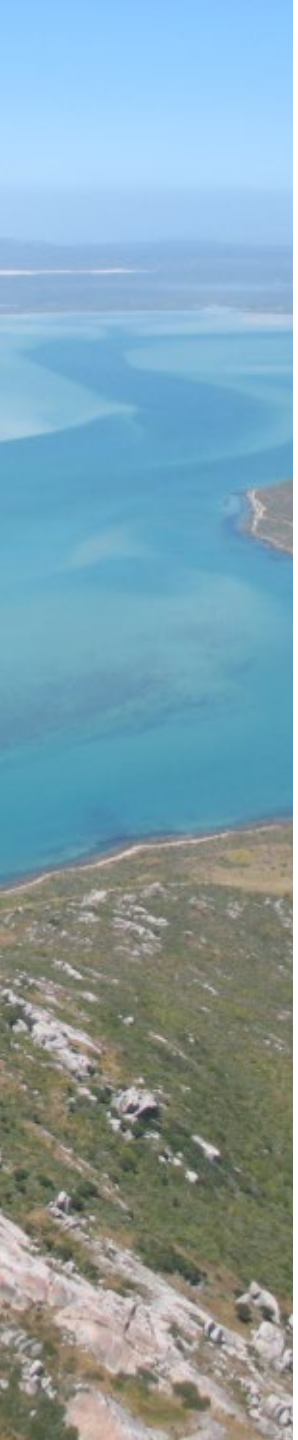
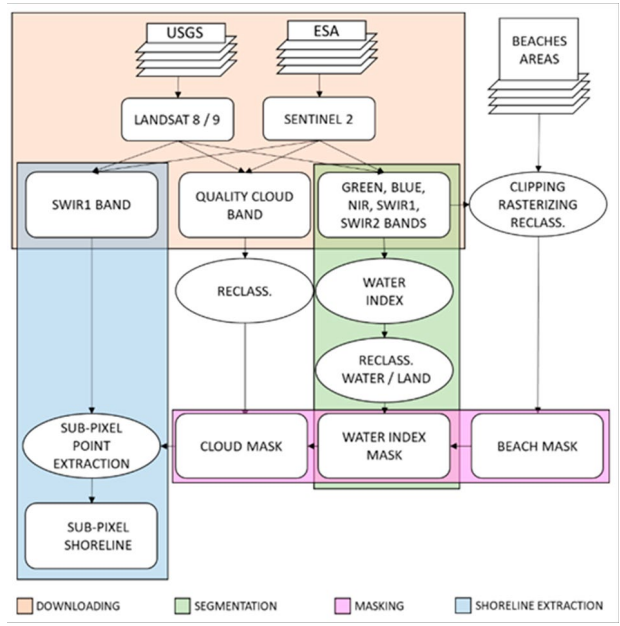


- Shoreline Analysis and Extraction Tool (SAET) - a new tool for analysis of shoreline change based off satellite imagery (Palomar-Vázquez et al. 2023)
- Automatically extract shoreline position from satellite imagery, use it as input for coastal erosion forecasting, management, and recovery analysis
- Satellite imagery is available as far back as 1972 but resolution prior to 1985 is not good enough(80 m resolution) for use in shoreline analysis



- Low revisit frequency also a problem:
  - only one usable image per year from 1985-2000: looked at change in 5-year increments (1985,1990, 1995 and 2000)
  - Slightly greater from 2000-2015 = annual intervals
  - Very much greater from 2015-2024 = bi-annually intervals (twice per year).

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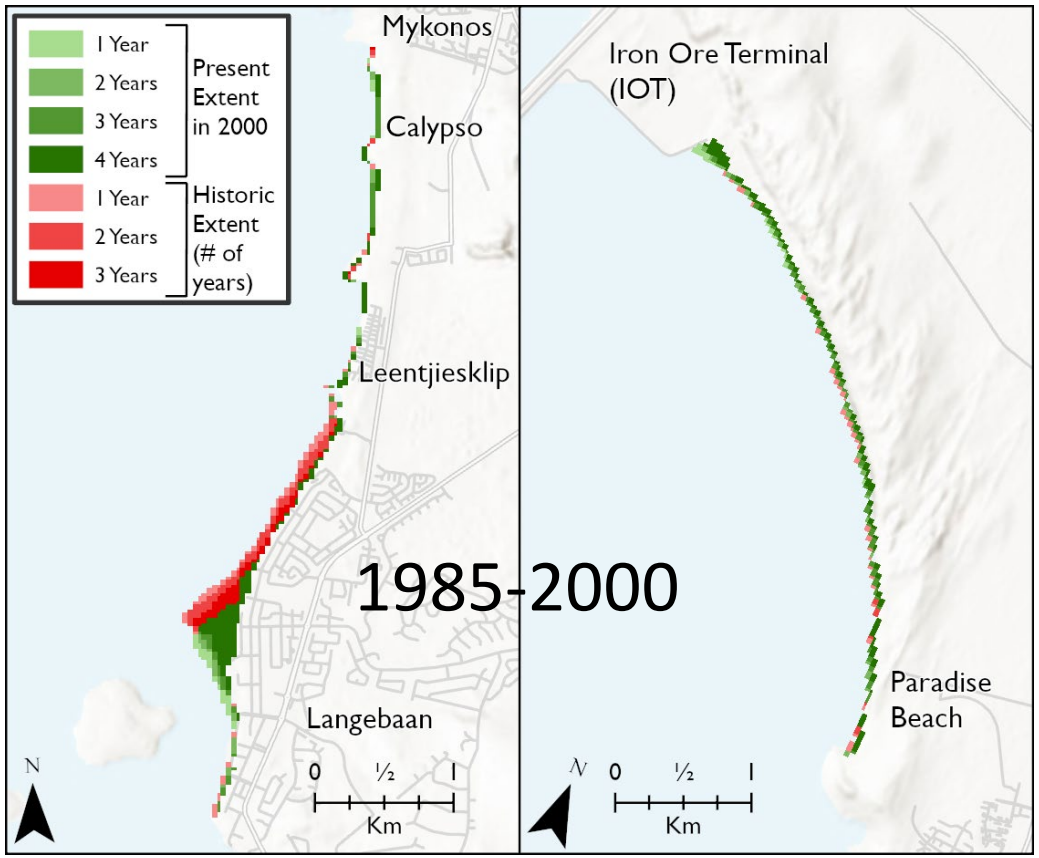

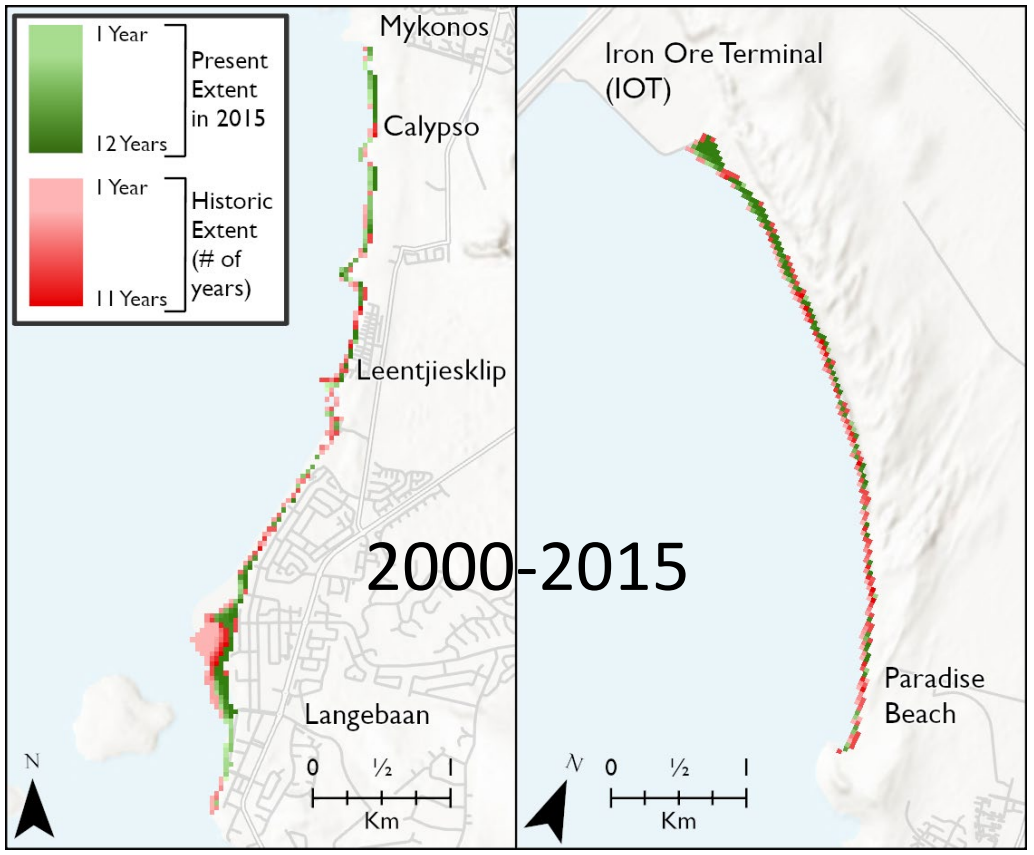

Green = accretion

Red = erosion

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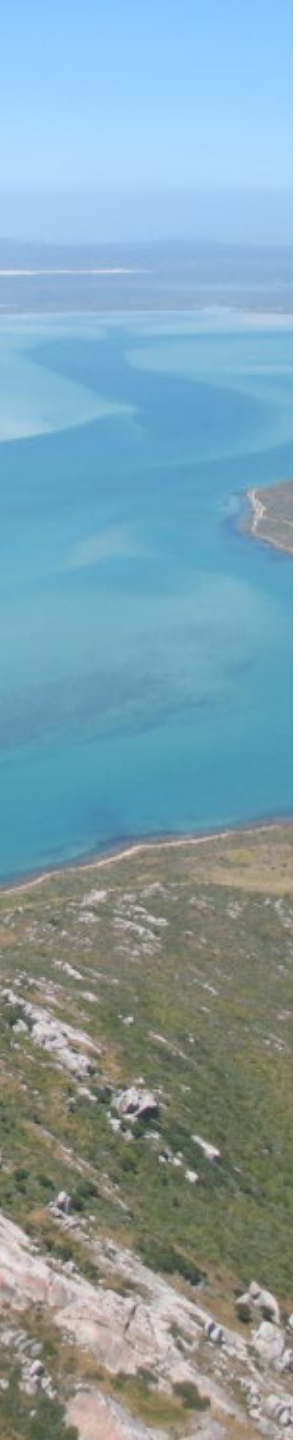

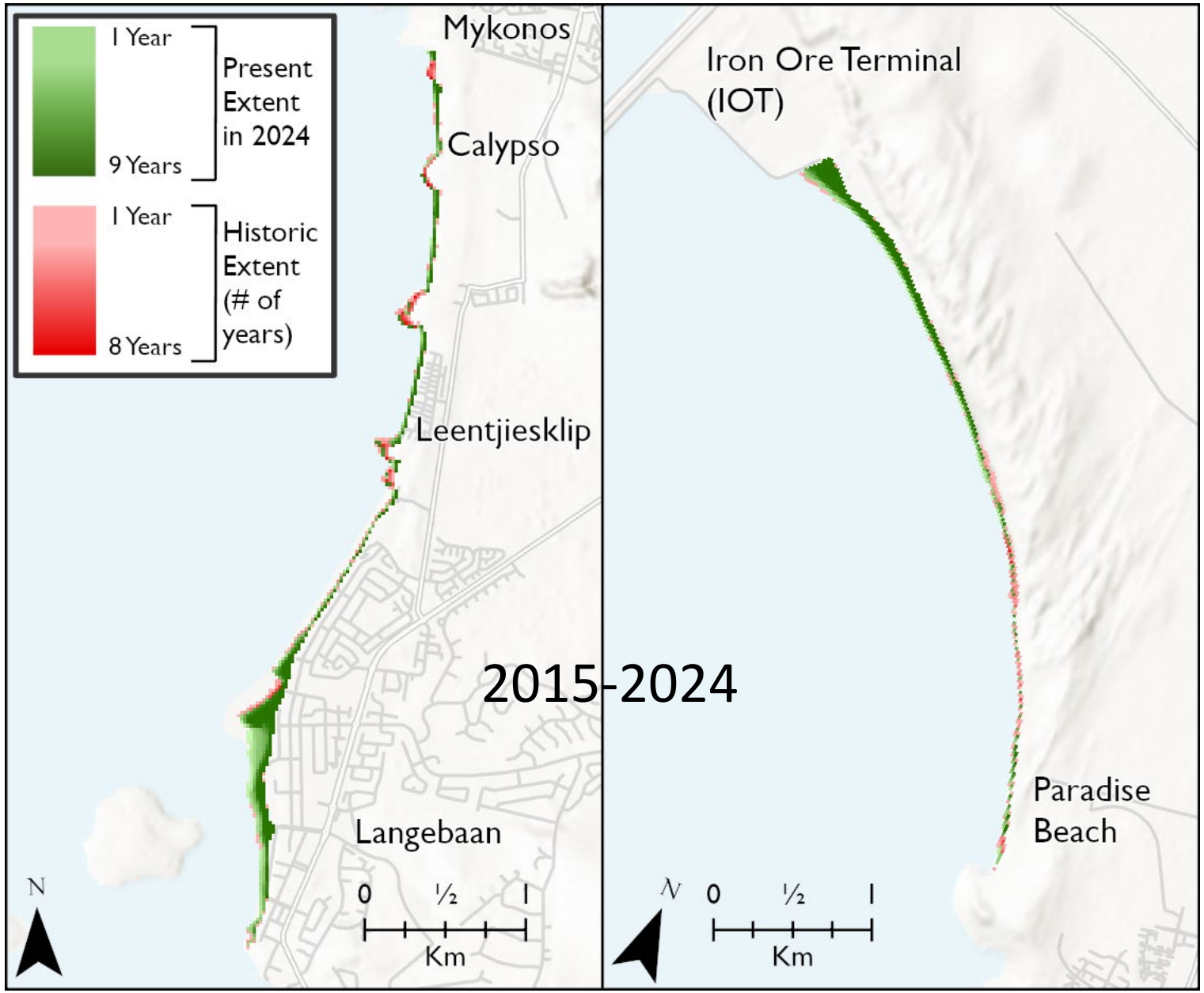

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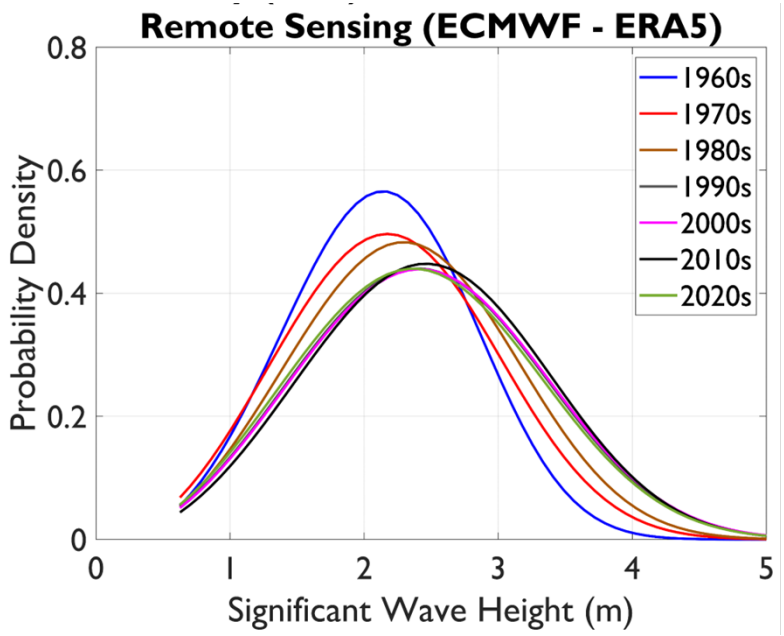
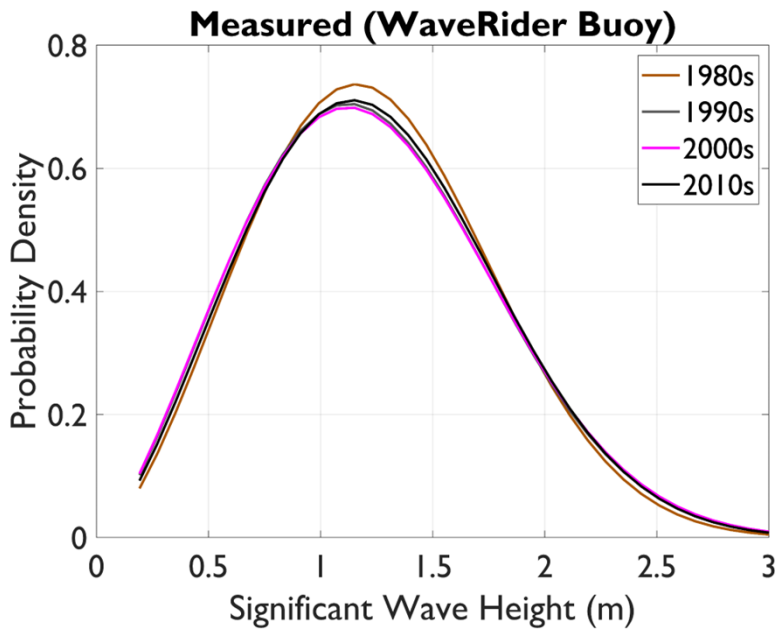
What is causing shoreline erosion in Saldanha Bay?

- Port development (breakwater construction and dredging) and climate variability (climate change change)





Decade	Maximum SWH & (Extreme Wave Height): CSIR WaveRider	Maximum SWH: ECMWF-ERA5
1960s		4.18
1970s		5.02
1980s	5.26 (9.34)	5.96
1990s	5.36 (15.54)	5.43
2000s	6.15 (9.99)	5.85
2010s	8.03 (11.55)	6.10
2020 – 2022		6.24

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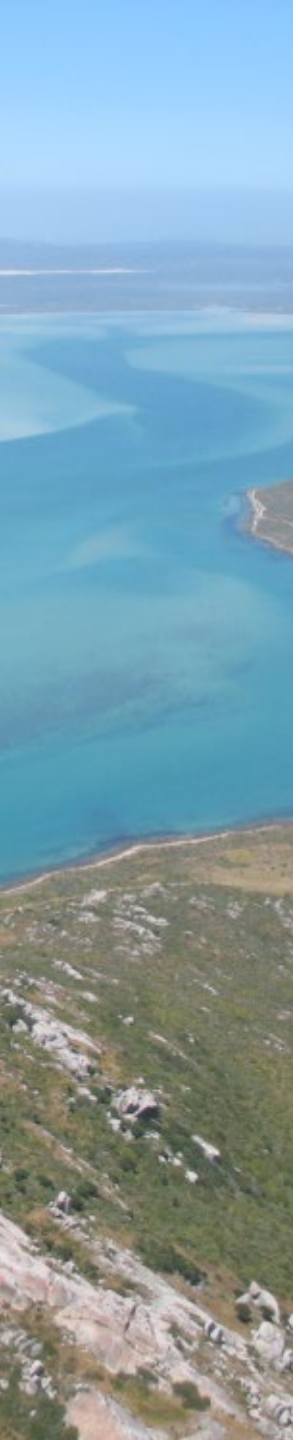

Summary

- Development pressure continues to ramp up in the Bay after having stalled for a short period (Global Financial Crisis, Covid), international tourists have returned but local visitors are lagging…
- Groundwater reserves are stable and may even have increased in the last 12 month due to above average rainfall
- Water quality (faecal coliforms levels) are at their best (lowest) levels on record
- Sediment quality (mud fraction) has improved dramatically in the last two decades
- Coastal erosion is a big problem and likely to get worse as wave energy intensity is increasing!
- Benthic macrofauna populations in soft sediments in Langebaan Lagoon and Big Bay have responded positively to improvements in sediment quality but not so much in Small Bay...
- Fish populations overall are highly variable , declines in some species, management action is required!…
- Birds breeding on the islands in the Bay and those in the Lagoon continue to decline
- Marine aliens are increasing and we are getting better at finding them…

Overall: We are doing well but don't we don't want to take our eyes off the road…

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Thank You

Photo: Steve Benjamin