State of the Bay 2020

Saldanha Bay and Langebaan Lagoon

Barry Clark

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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 community structure** and abundance of living organisms (macrophytes, invertebrates, fish, birds)

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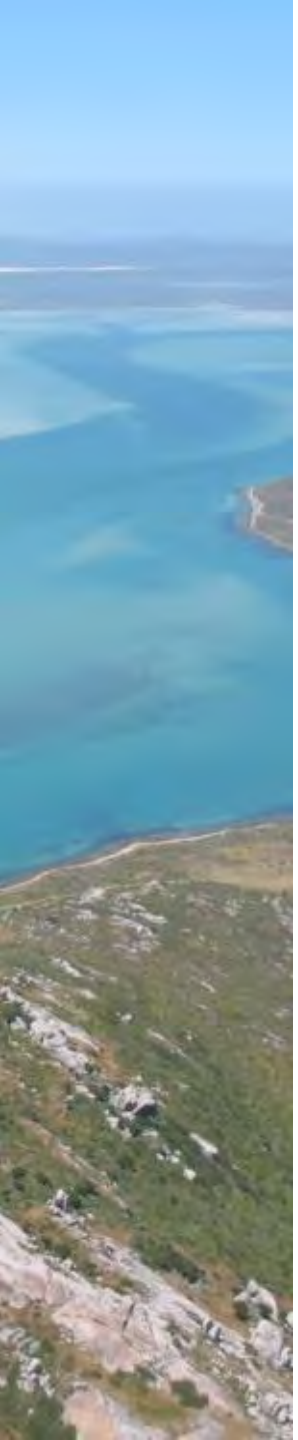
Indicator response times

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



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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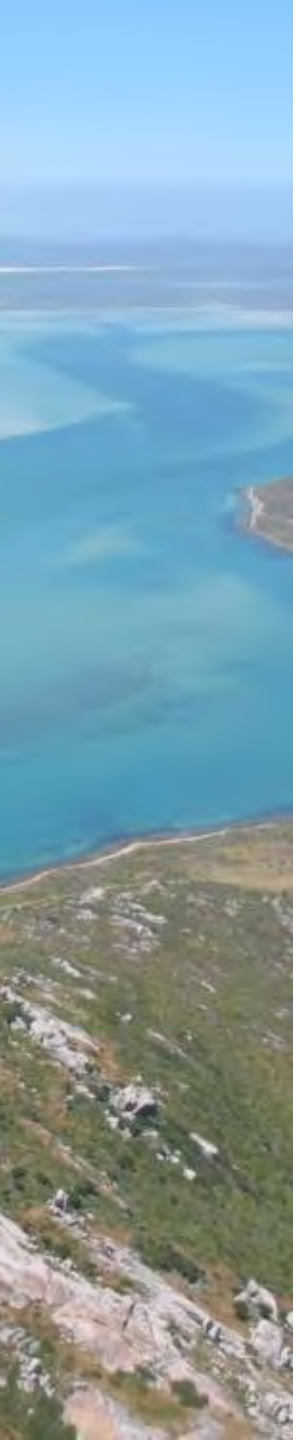

sunrise energy

Oiltankingmogs

TRANSNET national ports authority

TRANSNET port terminals

KROPZ FEED YOUR WORLD

Black Mountain

SALDANHA BAAI BAY

METSEP SALDANHA

ImproChem Water, Energy & Air Solutions

Sea Harvest

Premier Fishing The First Choice

LANGEBAAN COUNTRY ESTATE GOLF & LEISURE

CLUB MYKONOS LANGEBAAN

SFF

Duferco Duferco Steel Processing

Bivalve Shellfish Farmers' Association Saldanha

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TRONOX Namakwa Sands

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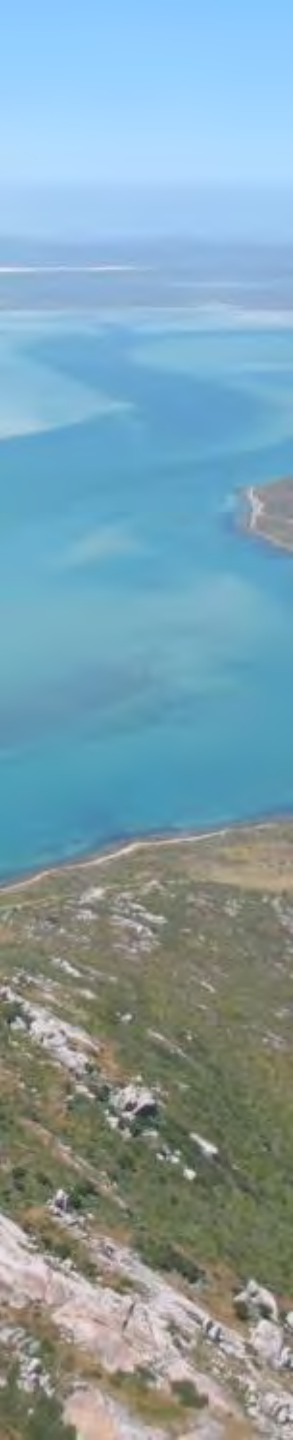

Thanks ….

CSIR
our future through science

ADU

South African Weather Service

South African National Parks

Percy FitzPatrick Institute

Bivalve Shellfish Farmers' Association Saldanha

WESTCOAST-ON-WEST COAST

TRANSNET
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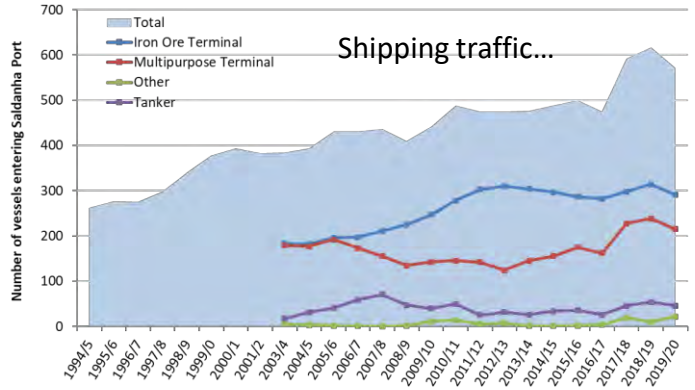
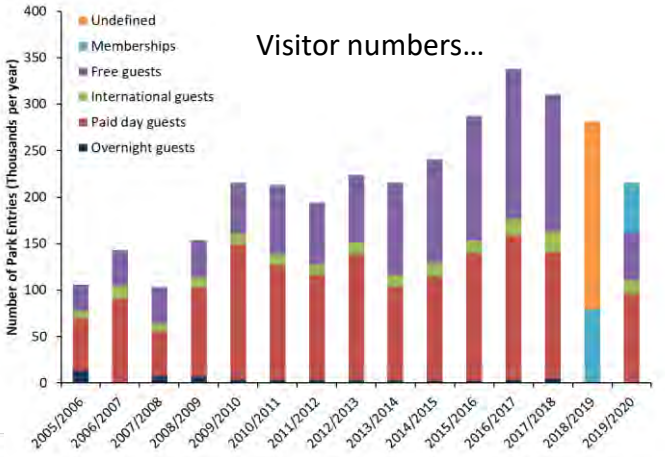
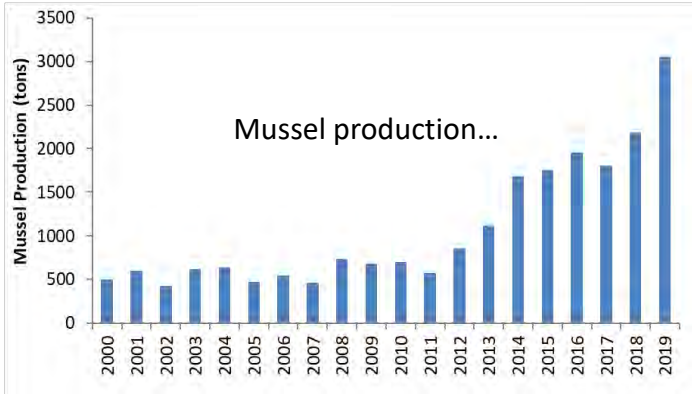
1. Activities & Discharges

- Little progress has been made of many of the larger developments that were proposed (IDZ, LPG/LNG imports, export of iron and manages ore, phosphate mining, fish processing, desalination), although there are some exceptions (ADZ, Powership);
- Some industries have closed down (Arcelor Mittal);
- Shipping traffic and ballast water discharges are both down;
- Numbers of tourists visiting the WCNP are down
- Saldanha WWTW being an exception – Waste Water discharge to the bay is up again
- Aquaculture is also an exception, mostly due to the government sponsored ADZ







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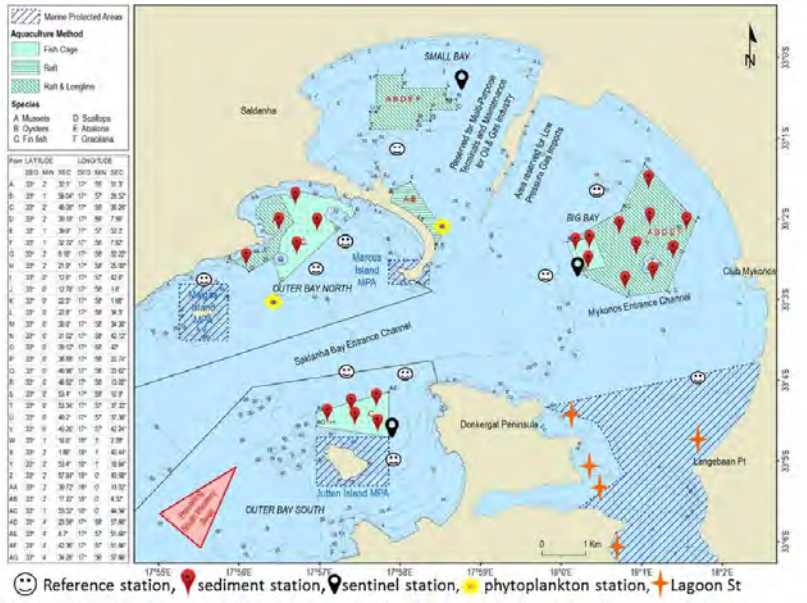
1.1 Aquaculture Development Zone

- Increase aquaculture footprint from 464 to 884 ha
- EA has some strict conditions including EMP, CF and AMC, programme to monitor environmental impacts, provision for adaptive management
- Independent monitoring of water quality (T, O_2, NO_3, Chla), sediment quality (redox, PSD, TOC, TON, trace metals) and macrofauna
- On farm monitoring (interactions with megafauna, disease, pathogens, escape)
- Sediment surveys have “identified” areas of reef in Big Bay that were not picked up in the EIA



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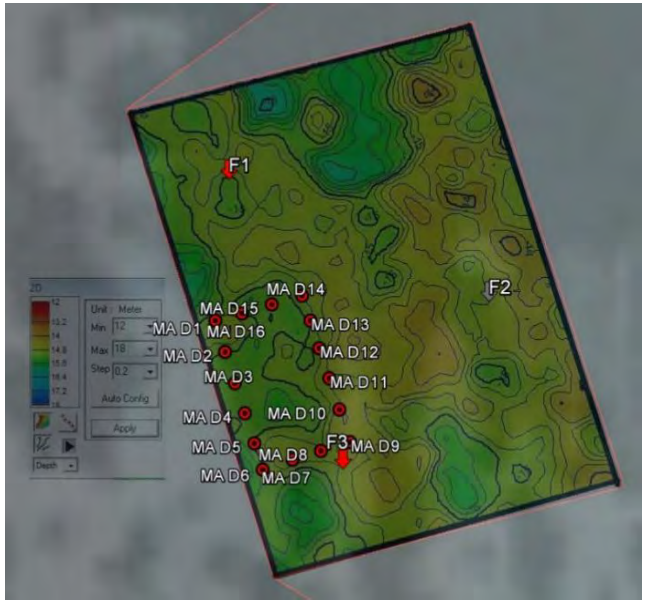
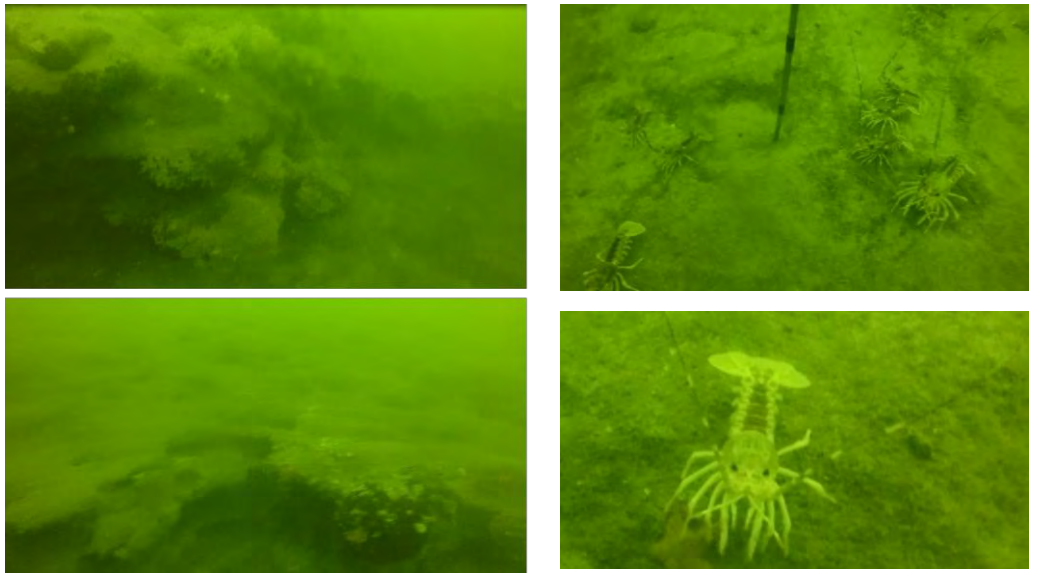
Reef area in Big Bay

- Reef area in Big Bay is quite extensive and knowledge of this has been in place since the 1970s (Flemming 1977) but not “fully” acknowledged in the EIA
- Highlighted in a recent bathymetry survey and through underwater photography collected by Molapong
- Concerns:
  - Higher biodiversity and conservation importance than sediment
  - Monitoring of redox and H_2S not really appropriate
- DEFF is taking action to address these concerns





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2.1 Groundwater

GROUNDWATER AND EARTH SCIENCES
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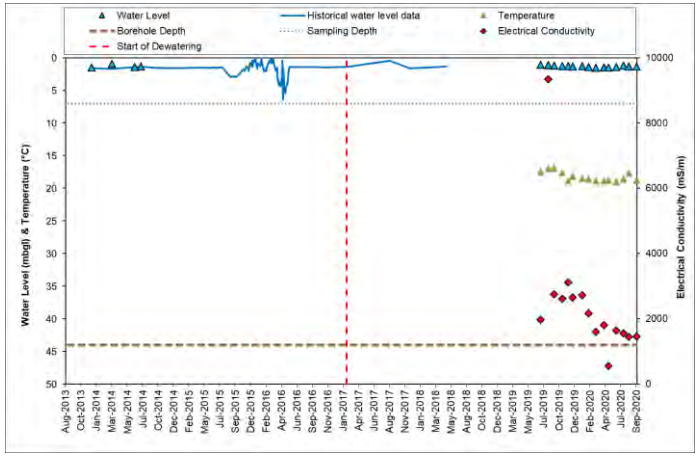
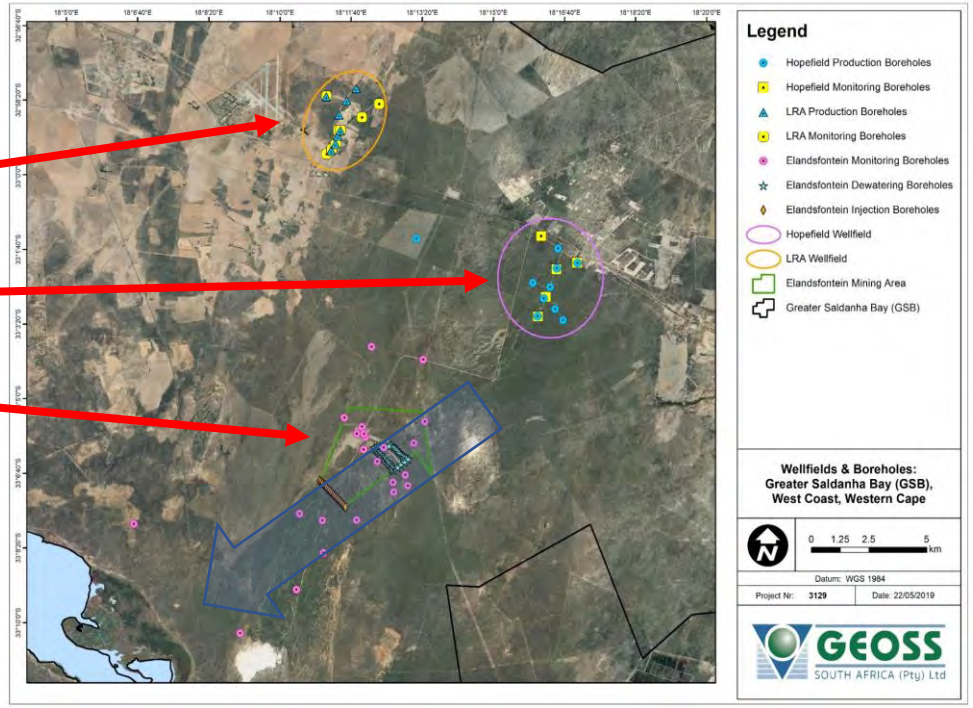


- New “partner” on board - GEOSS
- Groundwater is very important (GW control area)
- Total useable groundwater exploitation potential: 15.2 Mm^3/a
- Registered/allowable use of groundwater:
  - Agriculture: 1.6 Mm^3/a
  - Langebaan Road Aquifer: 5.1 Mm^3/a
  - Hopefield Wellfield: 1.8 Mm^3/a
  - Elandsfontein (reinjection only)
- Wellfields should only be used in times of severe drought, should be kept as “full” as possible in non-drought times so as not to compromise future utility or outflow to Langebaan Lagoon
- Comprehensive monitoring is essential…



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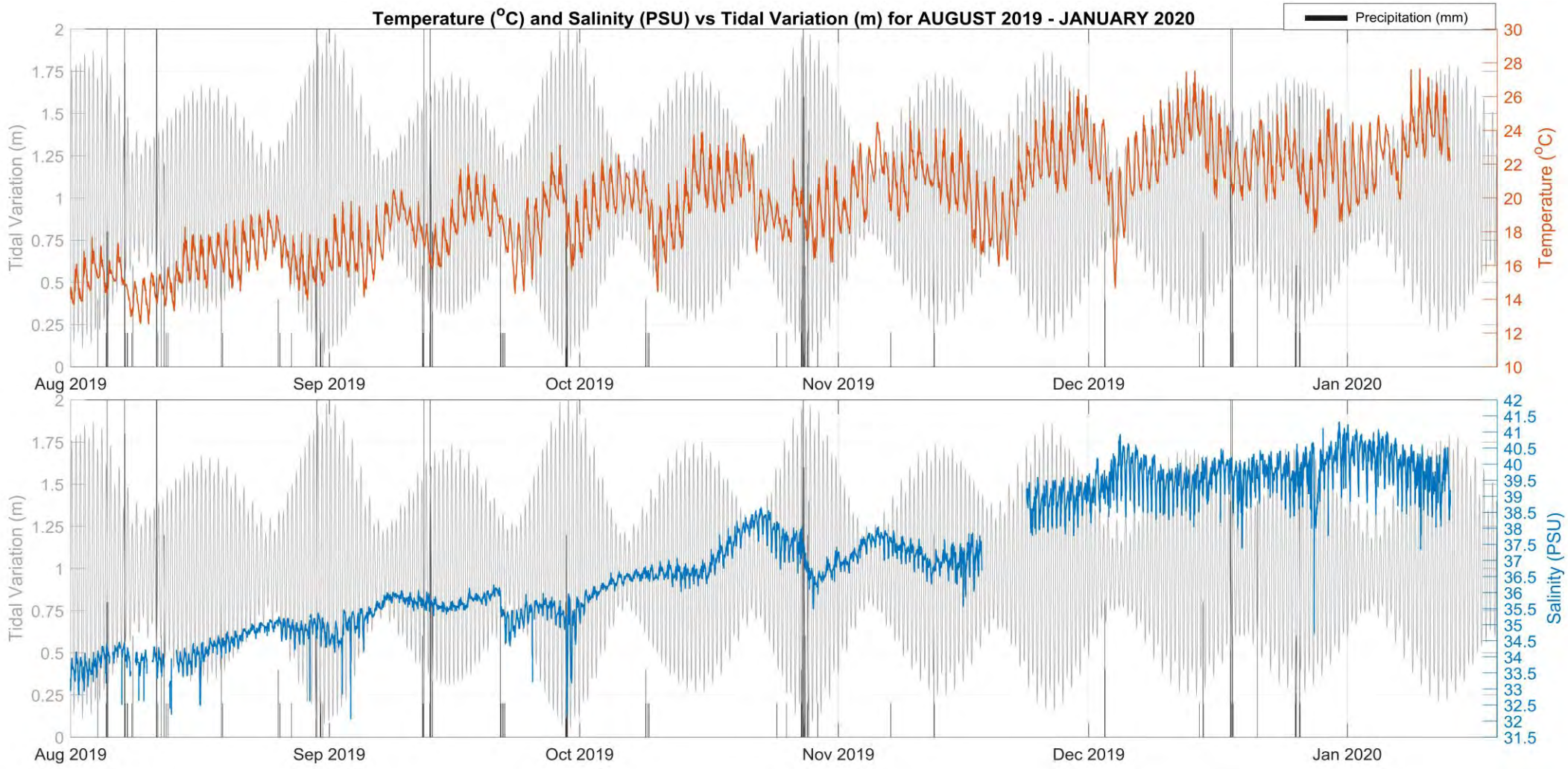
Seasonal patterns in temperature and salinity in Langebaan Lagoon



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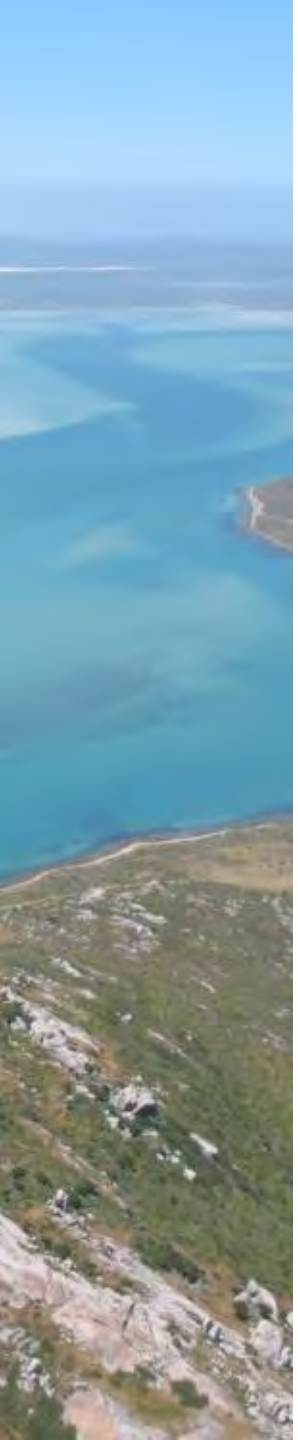
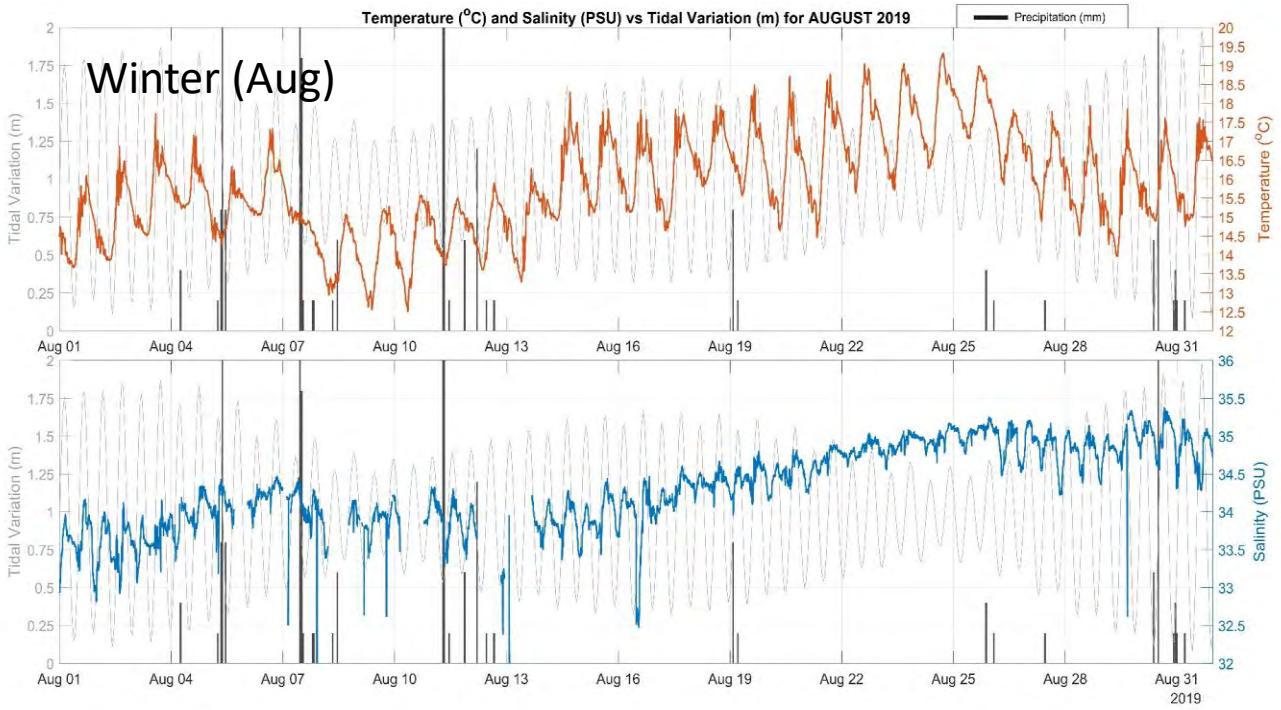
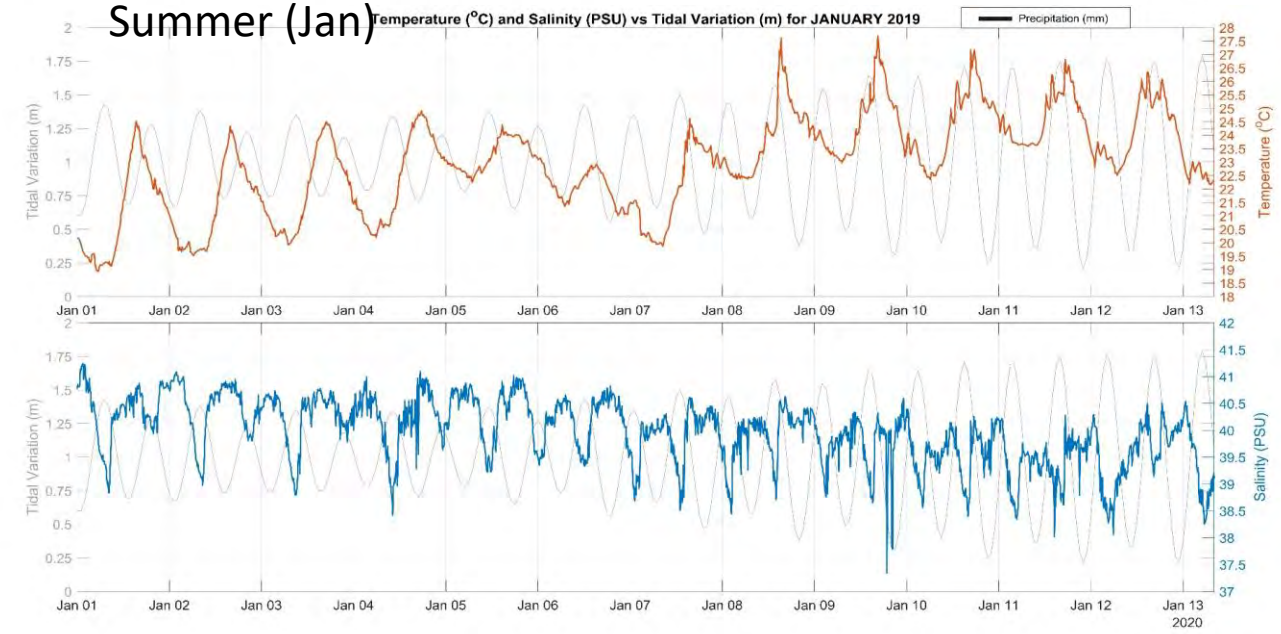


- In winter, temperature typically increases during the course of day, peaking in mid-afternoon, and drops again at night. Salinity also fluctuates daily, dropping from that of normal seawater (35.0 PSU) at high tide to around 32.0-34.0 PSU as the tide drops due to freshwater outflow from the aquifer
- In summer, similar pattern but due to increased evaporation, at high tide salinity is equivalent to normal seawater (35.0 PSU) but as the tide drops, salinity rises dues to outflow of hyper-saline water (39 – 40 PSU) from the marshes at the head of the lagoon
- Patterns are completely independent of rainfall





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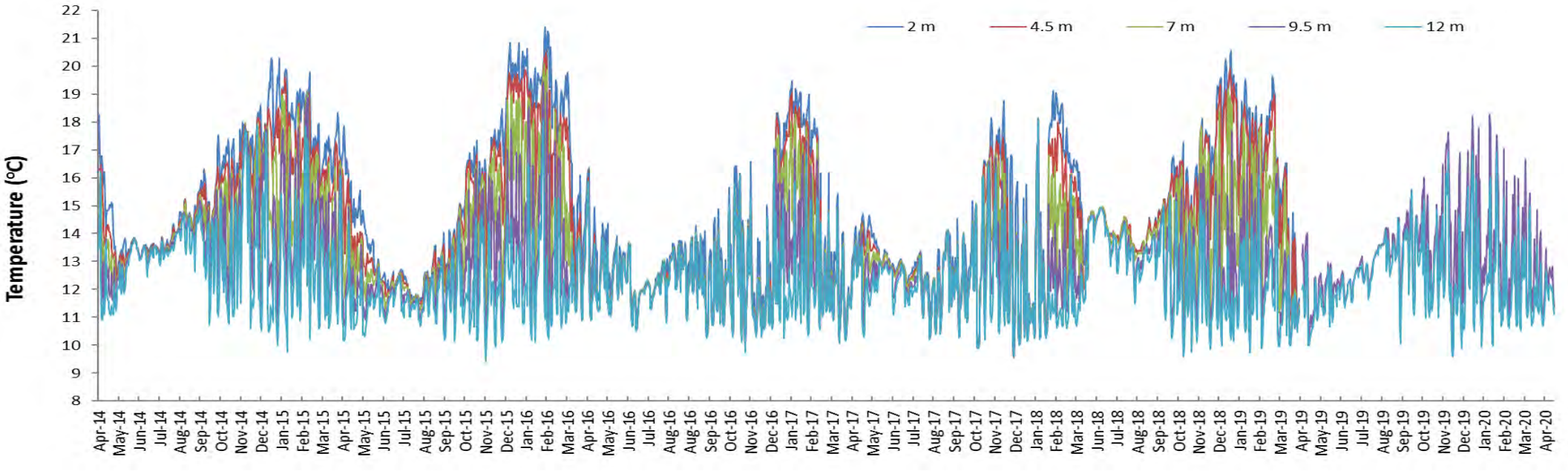
2.2 Water Quality - Temperature

- Patterns observed in 2019/2020 are similar to those recorded in the past, aside from 2016/2017 which were “influenced” by the drought
- Sensors have started to reach the end of their useful life and need to be replaced



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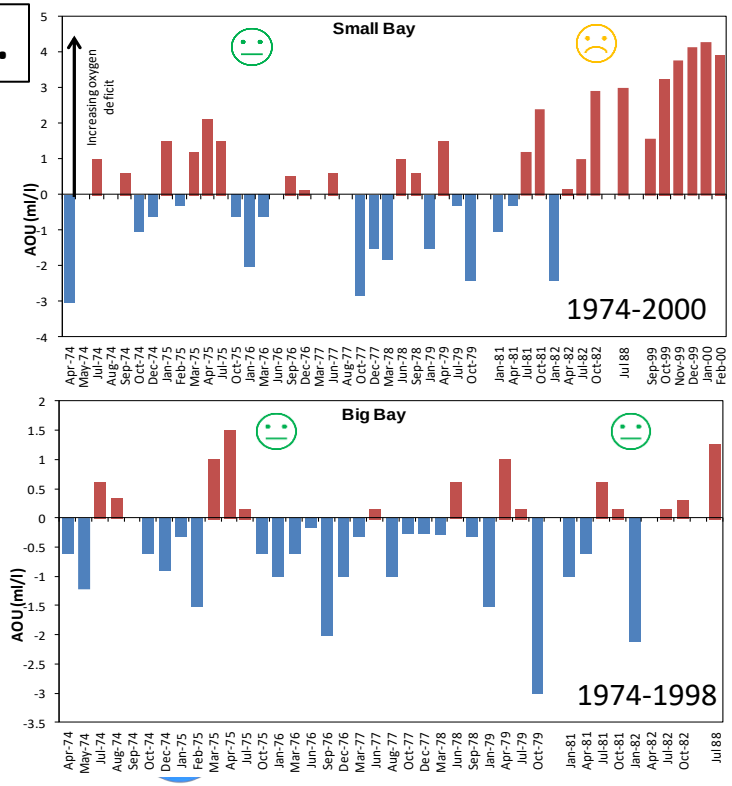
2.3 Dissolved oxygen

1. Historic (SFRI) monitoring data (1974-2000)
2. Historic data: Small Bay Sep 1999-Feb 2000
3. Recent data: Small Bay & Big Bay May –Jul 2020

1.



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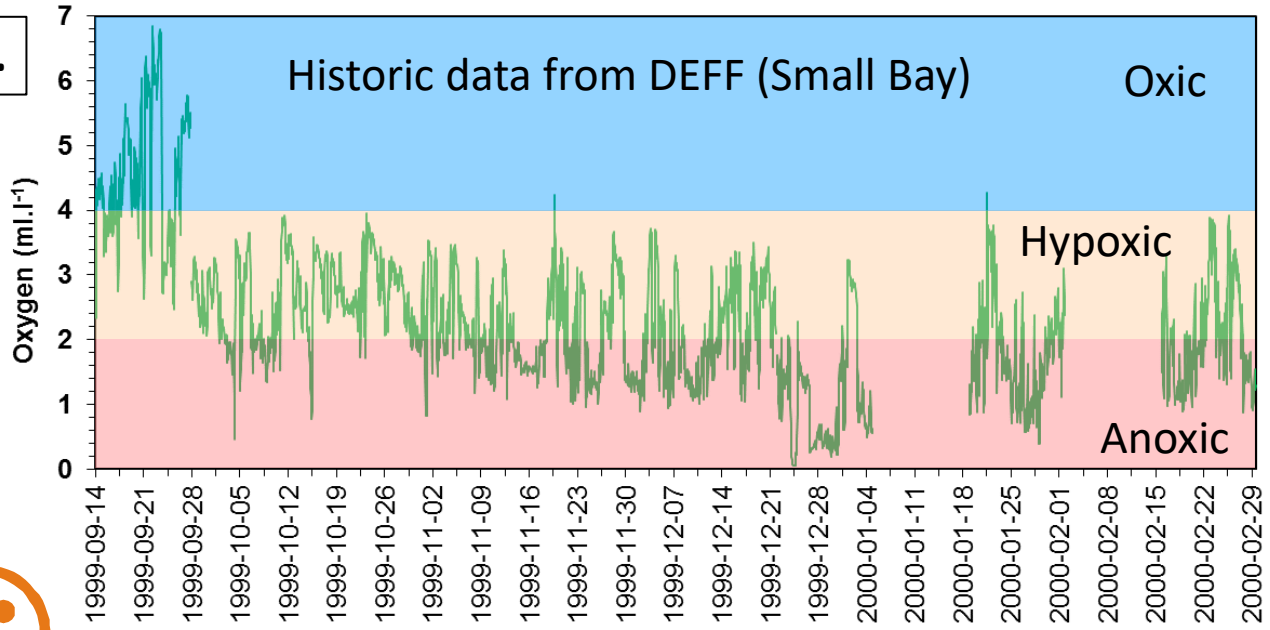

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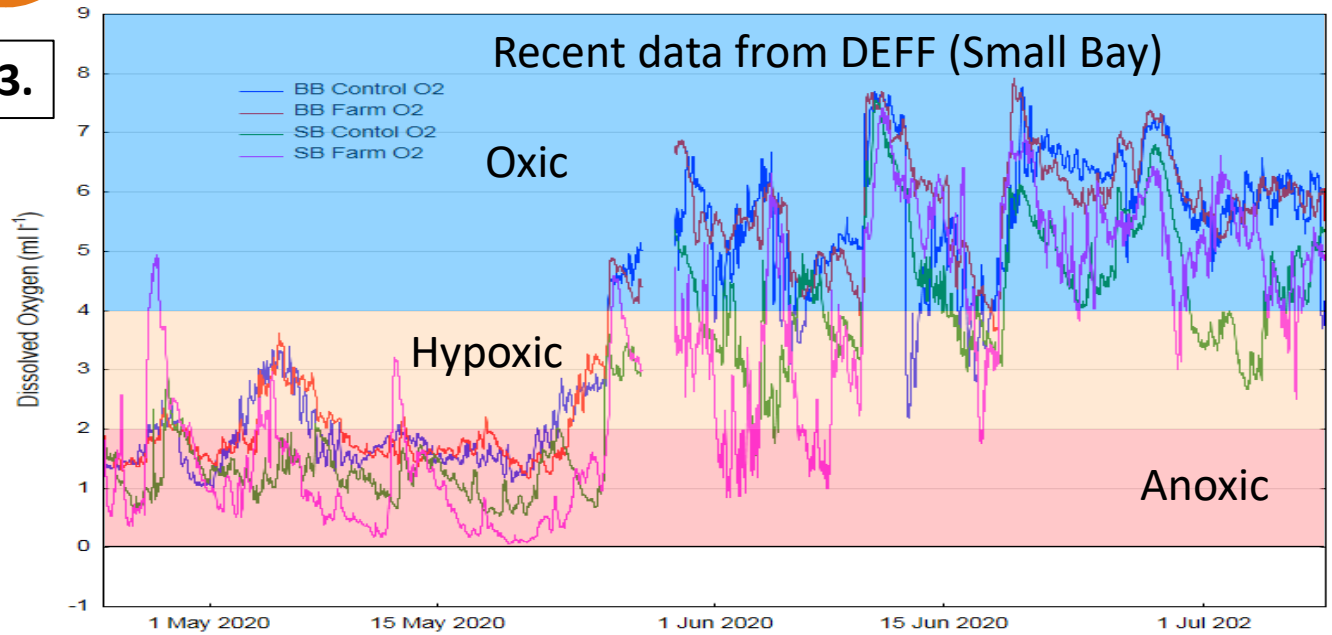

2.4 Microbial data – recreational limits

- 2020 similar to 2016-2019, maybe a little worse (2 sites poor, 5 sites fair, 2 sites good, 11 excellent)

	Site	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Small Bay	1. Beach at Mussel Rafts	Fair	Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair
	2. Small Craft Harbour	Ex.	Fair	Good	Ex.	Ex.	Ex.	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.
	3. Sea Harvest - Small Quay	Fair	Fair	Ex.	Ex.	Fair	Ex.	Fair	Ex.	Ex.	Ex.	Good	Ex.	Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	Ex.
	4. Saldanha Yacht Club	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.
	5. Pepper Bay - Big Quay	Poor	Fair	Poor	Fair	Fair	Fair	Fair	Poor	Ex.	Ex.	Fair	Ex.	Ex.	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Poor
	6. Pepper Bay - Small Quay	Poor	Fair	Fair	Good	Ex.	Good	Ex.	Ex.	Good	Ex.	Good	Good	Ex.	Good	Fair	Fair	Ex.	Ex.	Ex.	Ex.	ND	Ex.
	7. Hoedjies Bay Hotel - Beach	Fair	Fair	Poor	Fair	Good	Poor	Poor	Good	Fair	Ex.	Fair	Fair	Poor	Poor	Fair	Good	Fair	Good	Fair	Poor	Poor	Poor
	8. Beach at Caravan Park	Fair	Fair	Fair	Poor	Ex.	Fair	Poor	Ex.	Good	Poor	Fair	Fair	Fair	Poor	Good	Fair	Ex.	Fair	Fair	Fair	Fair	Fair
	9. Bok River Mouth - Beach	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Ex.	Fair	Poor	Poor	Good	Ex.	Poor	Fair	Good	Ex.	Poor	Poor	Fair	Fair	Good
	10. General Cargo Quay - TNPA	Ex.	Fair	Ex.	Ex.	Ex.	Ex.	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.
Big Bay	11. Seafarm - TNPA	Ex.	Fair	Ex.	Ex.	ND	ND	Ex.	Ex.	Ex.	ND	Ex.	ND	ND	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.
	12. Mykonos - Paradise Beach	Ex.	Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair
	13. Mykonos - Harbour	Fair	Fair	Ex.	Ex.	Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	Good	Fair	Ex.	Ex.	Ex.	Ex.	Ex.
	14. Leentjiesklip	ND	ND	Good	Fair	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Good	Ex.	Ex.	Ex.	ND	Ex.	Ex.
Langebaan La	15. Langebaan North - Leentjiesklip	Ex.	Fair	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Poor	Good	Ex.	Good	Ex.	Good	Ex.	Ex.	Fair
	16. Langebaan - Main Beach	ND	ND	Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Good	Ex.	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	ND	Ex.	Good
	17. Langebaan Yacht Club	ND	ND	ND	ND	ND	Poor	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Good	Ex.	Ex.	Fair	Good	ND	Ex.	Ex.
	18. Tooth Rock	ND	ND	ND	ND	ND	Fair	Ex.	Ex.	Ex.	Ex.	Fair	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	ND	Ex.	Ex.
	19. Kraalbaai North	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	ND	Fair	Ex.
	20. Kraalbaai South	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	Ex.	Ex.	Ex.	Ex.	Ex.	Ex.	ND	Ex.	Fair

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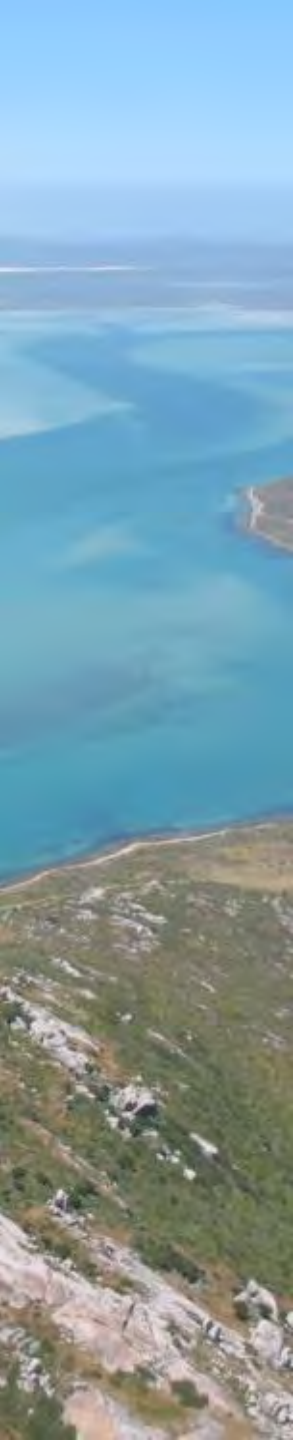
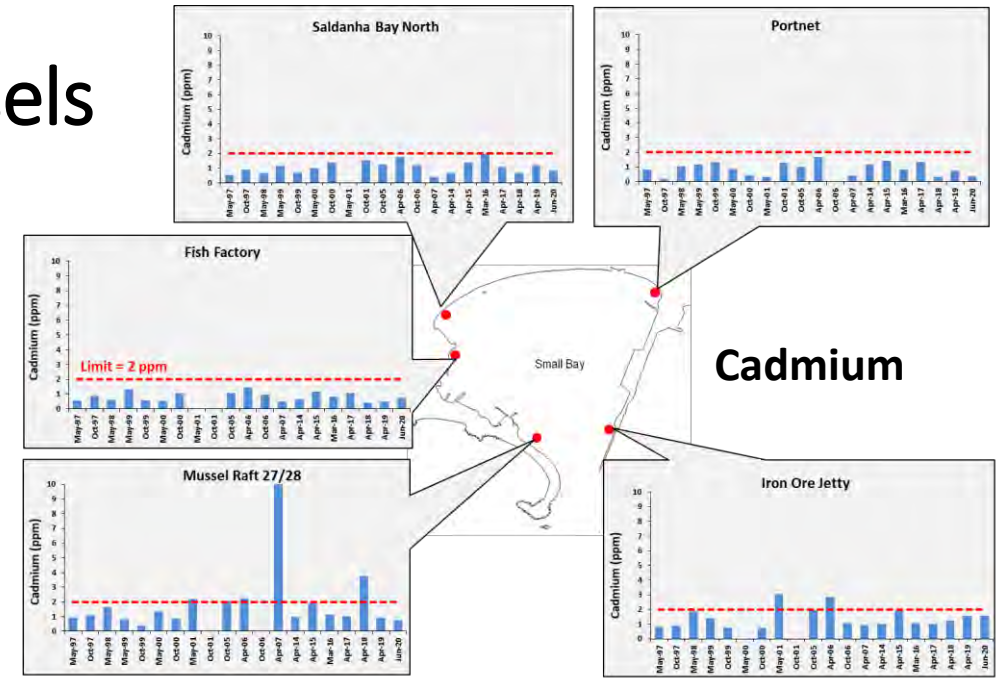
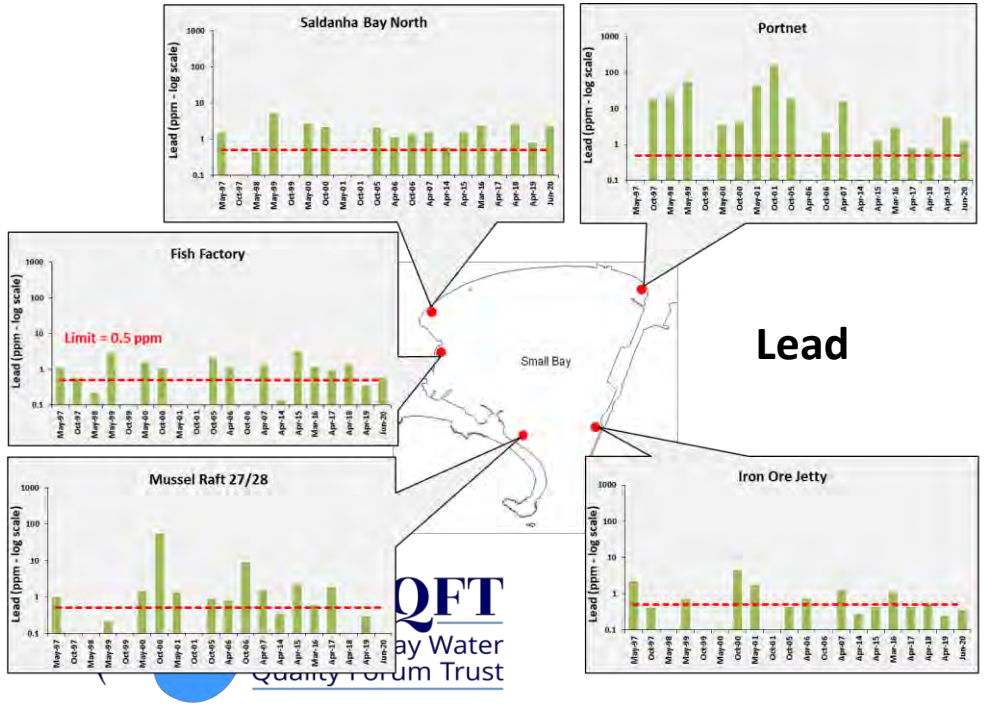
2.5 Trace metals in shoreline mussels

- Little change evident in the “usual suspects (Pb, Cd, Cu, Zn)
- Manganese clearly increasing in recent years in concert with ore exports

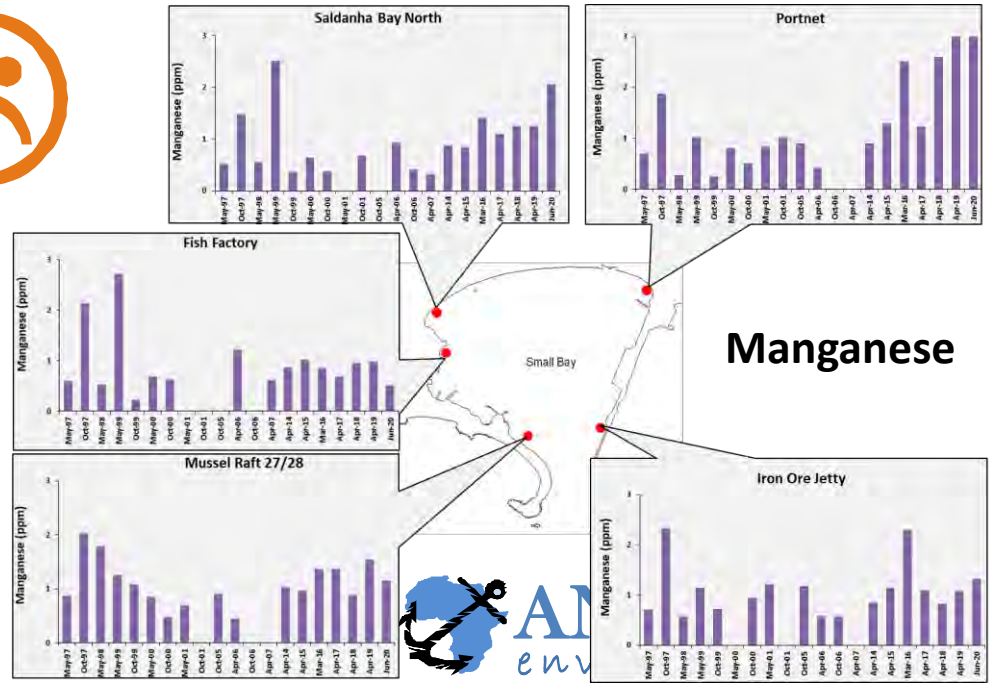




Cadmium



Lead

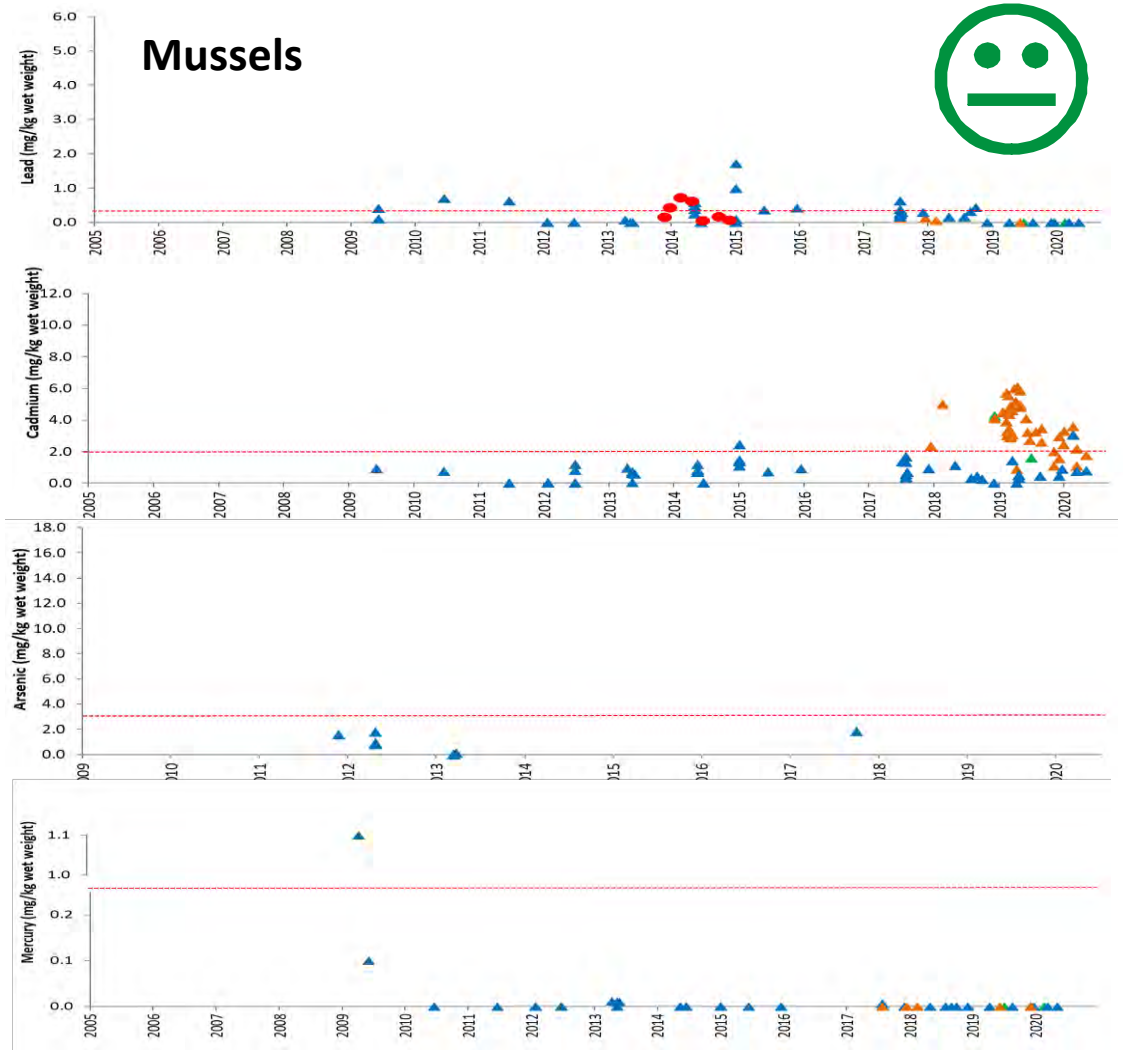


Manganese

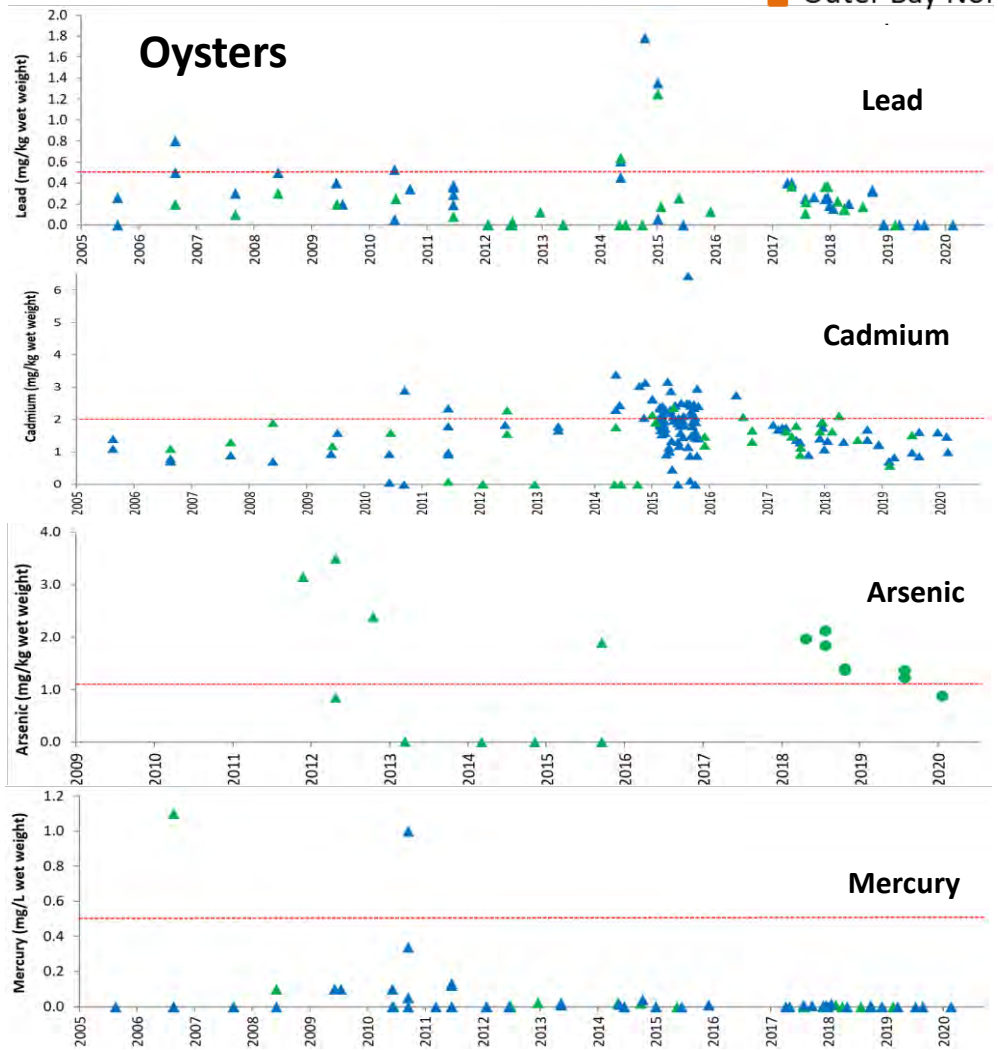
Trace metals in farmed mussels & oysters

Small Bay
Big Bay
Outer Bay North

Mussels



Oysters



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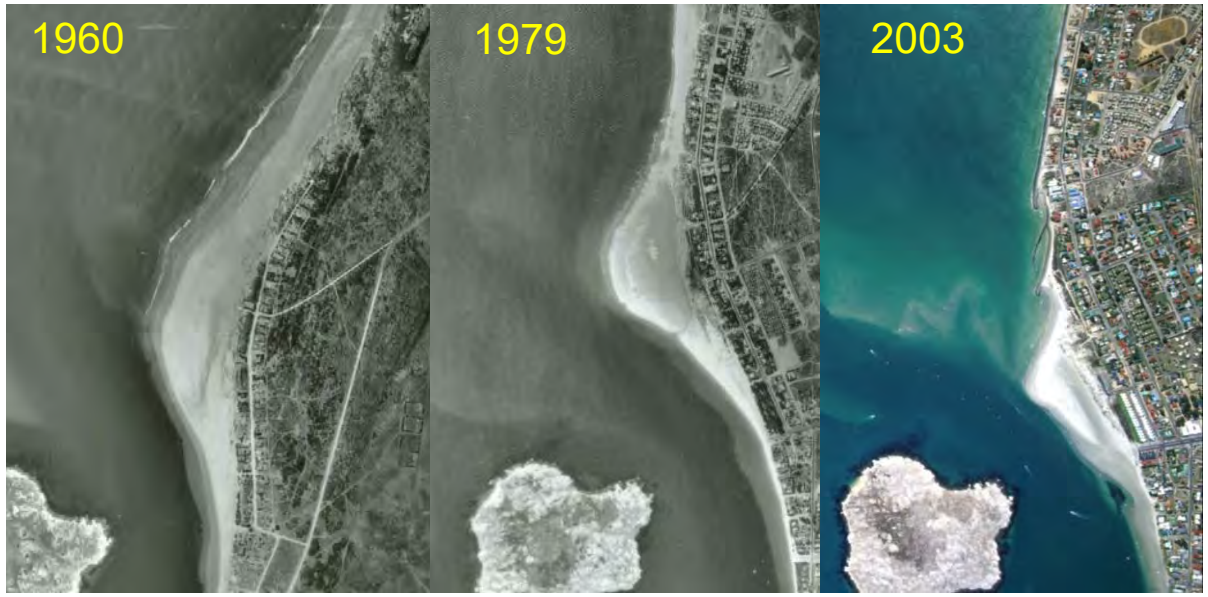
2.6 Sediments – Shoreline erosion



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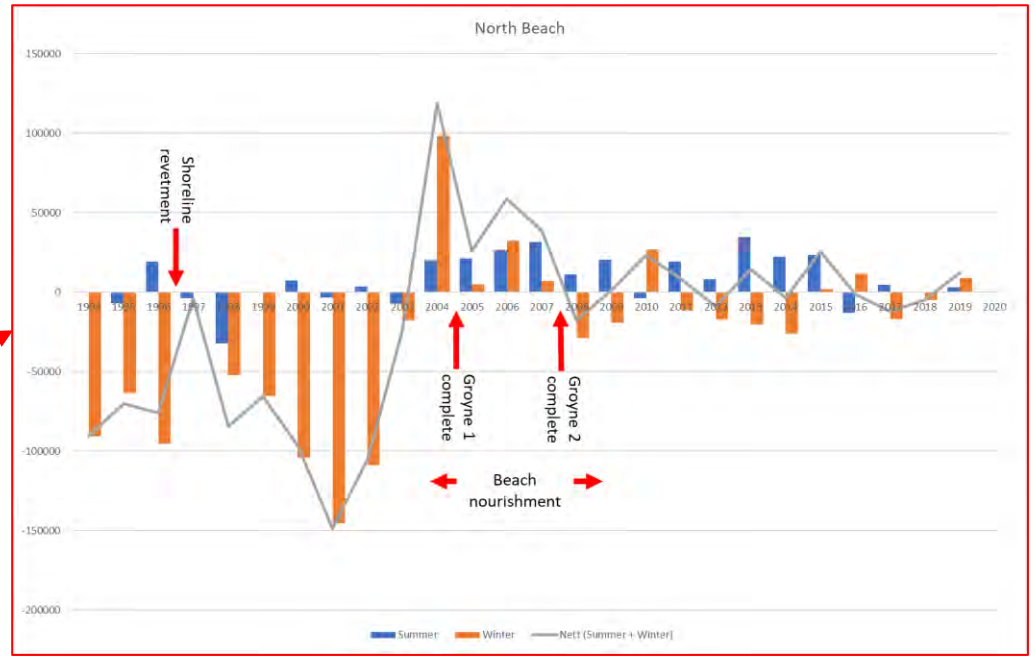
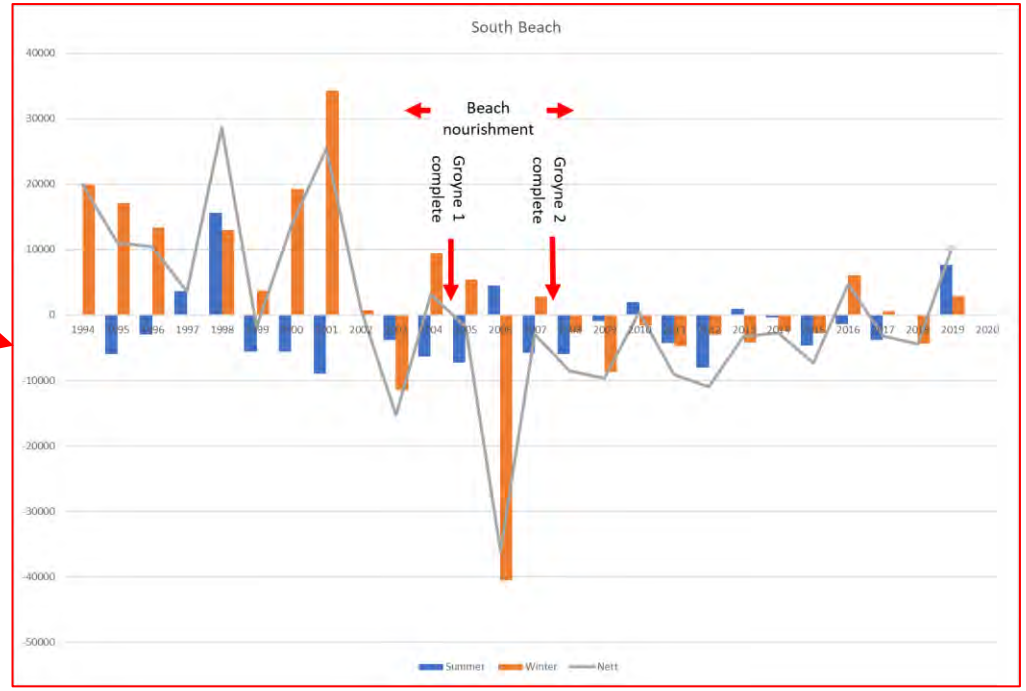
Shoreline stability

- Monitoring of beach profiles along a series of transects 1994-2020, twice per annum (Oct/Nov – winter, Mar/Apr – post-summer)
- Calculate amount of sediment that has been gained (accretion) or lost (erosion)





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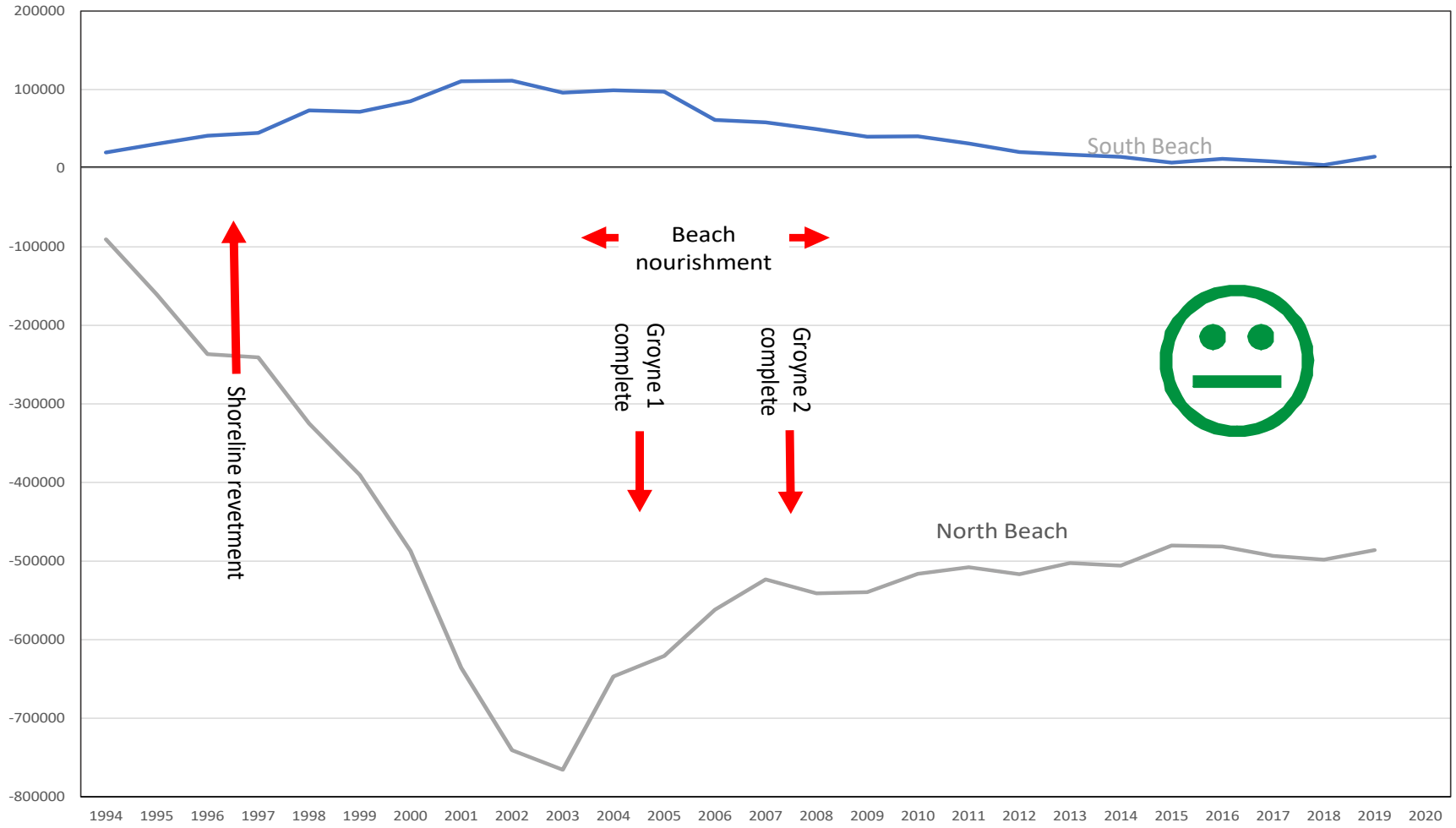
Shoreline stability



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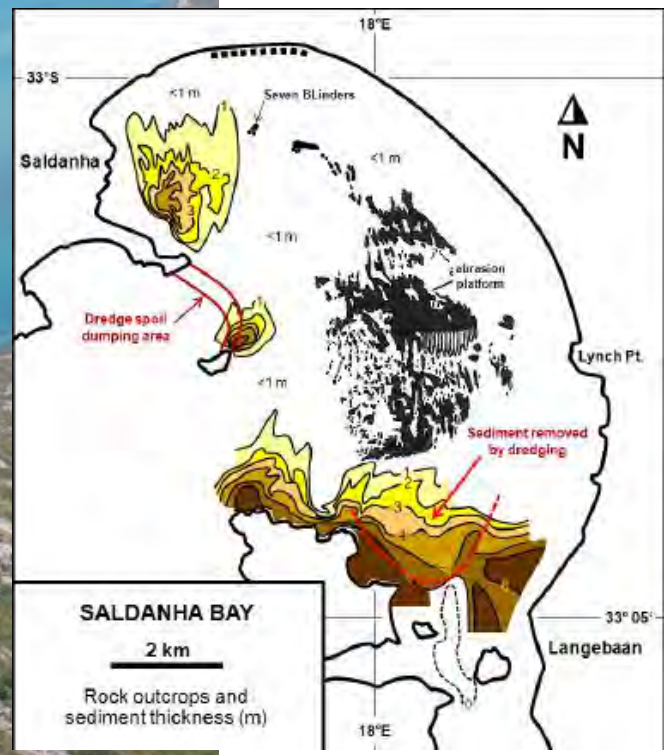
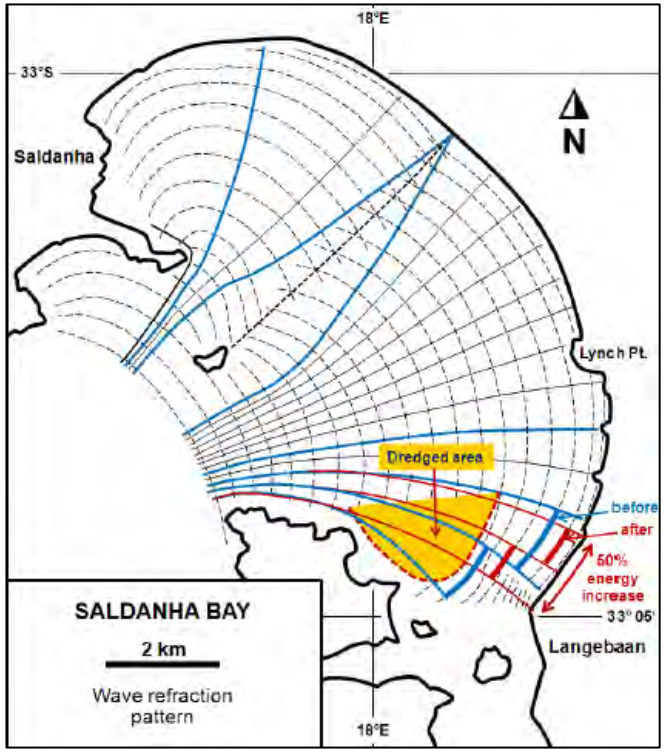
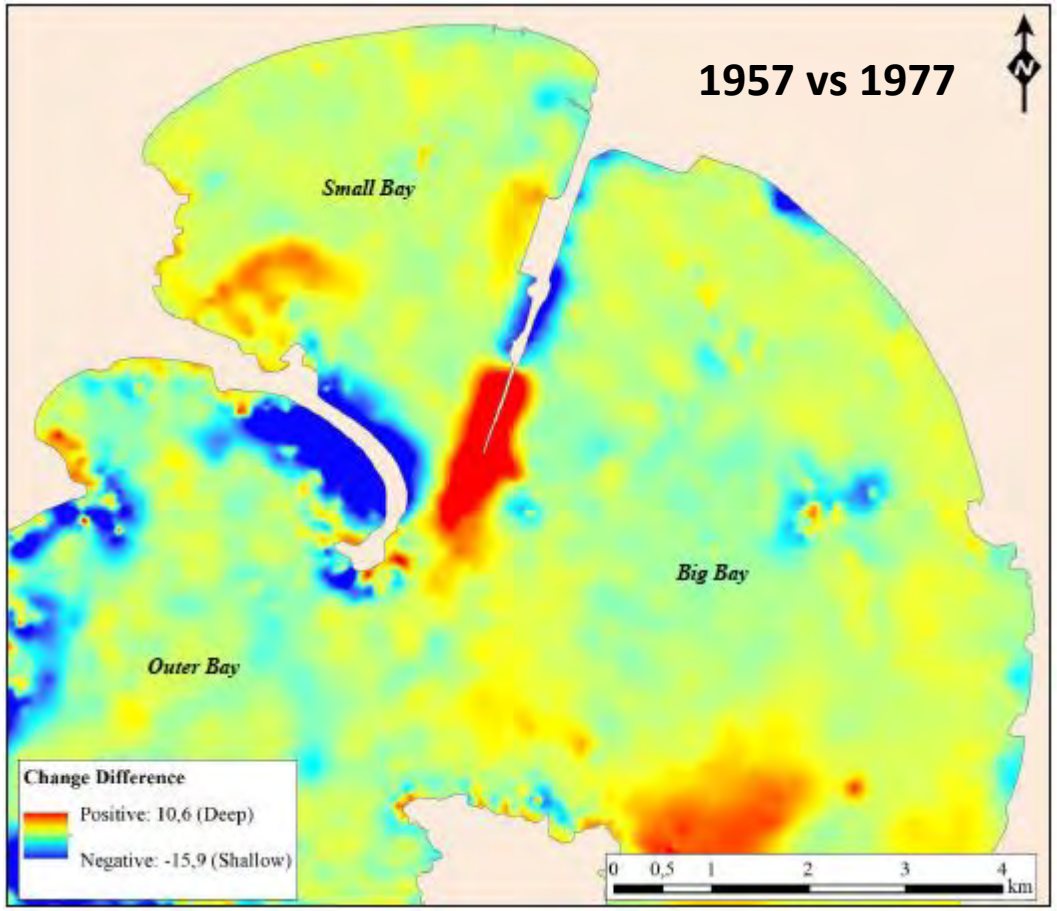
Shoreline erosion: What is the cause?

- Flemming (2016) attributed erosion at Langebaan beach to dredging activities during the development of the Port of Saldanha (Marcus Island causeway) and the impact the had on wave refraction in this area
- Others disagreed – primarily natural process , might have been exacerbated by port development





Flemming (2016)



Henrico & Bezuidenhout (2020)

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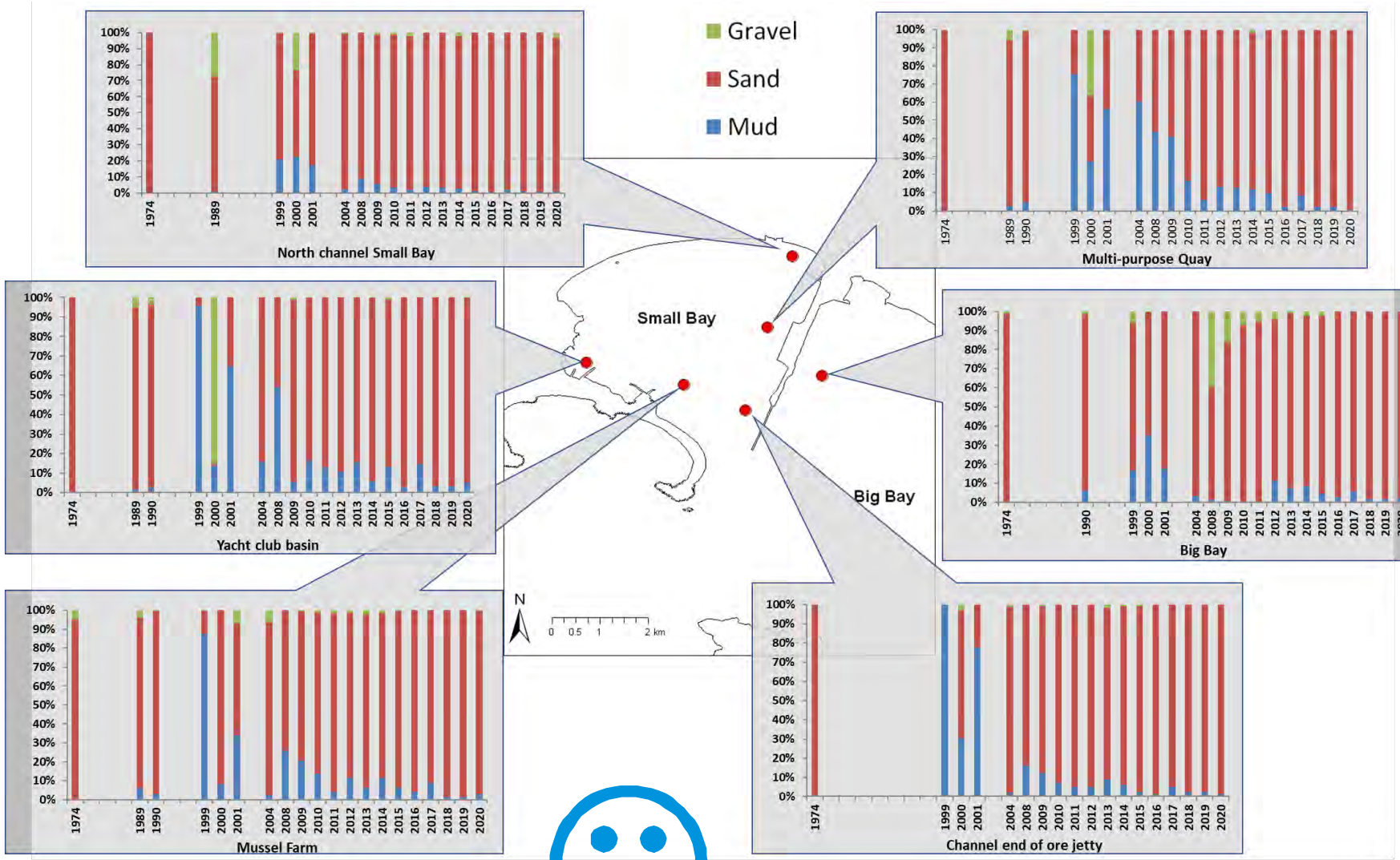
2.8 Sediment quality - particle size

- Amount of fine material (mud) peaked in 1990a and has decreased progressively since then



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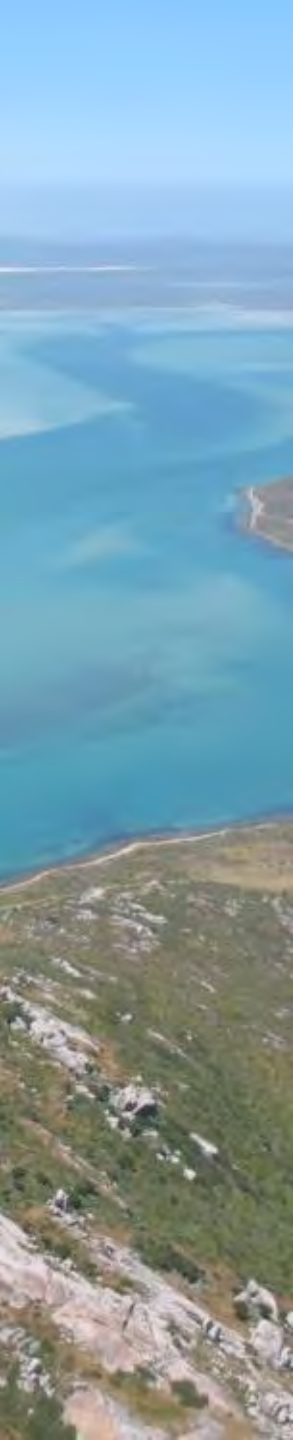
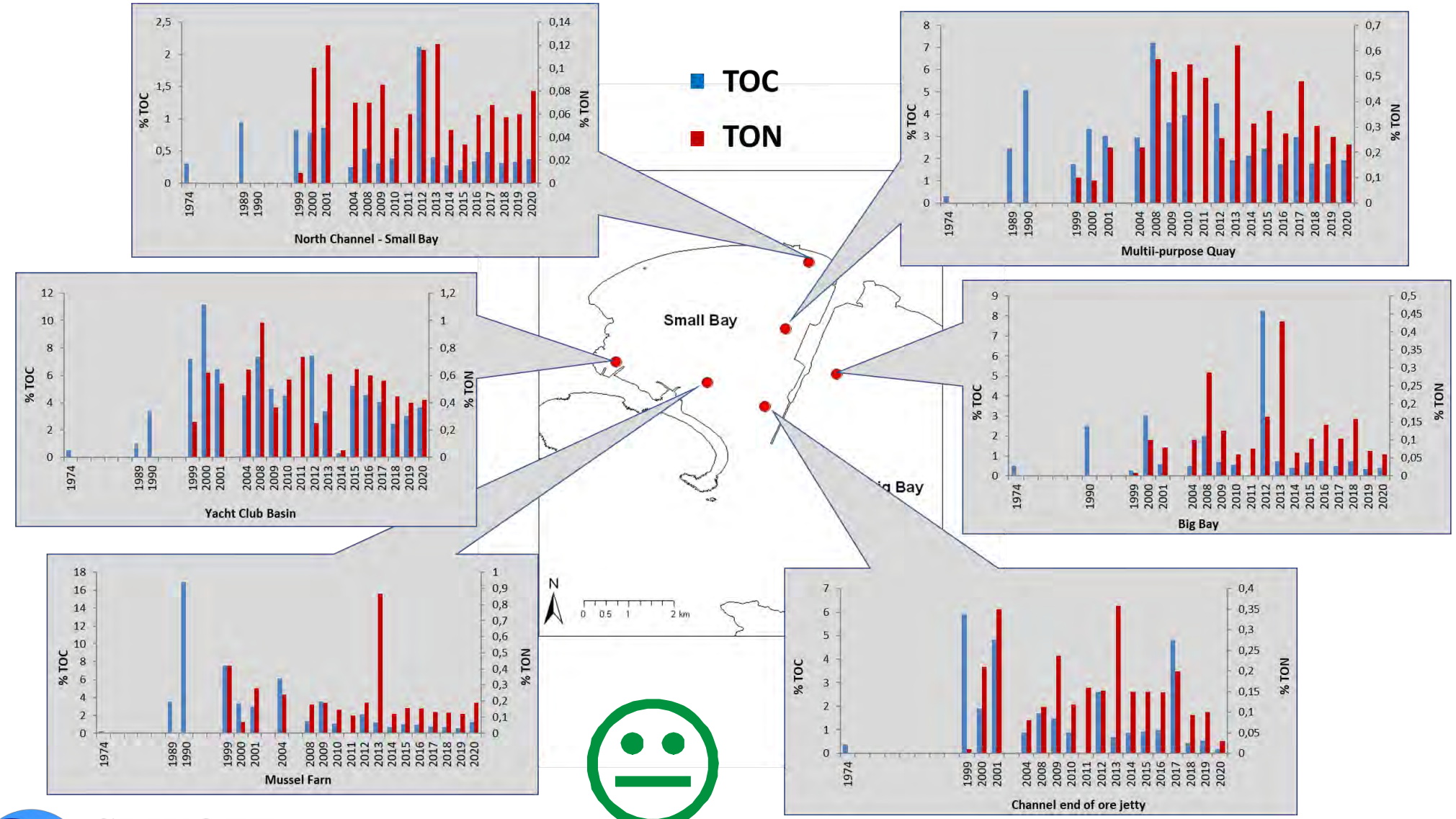
2.9 Organic Carbon & Nitrogen





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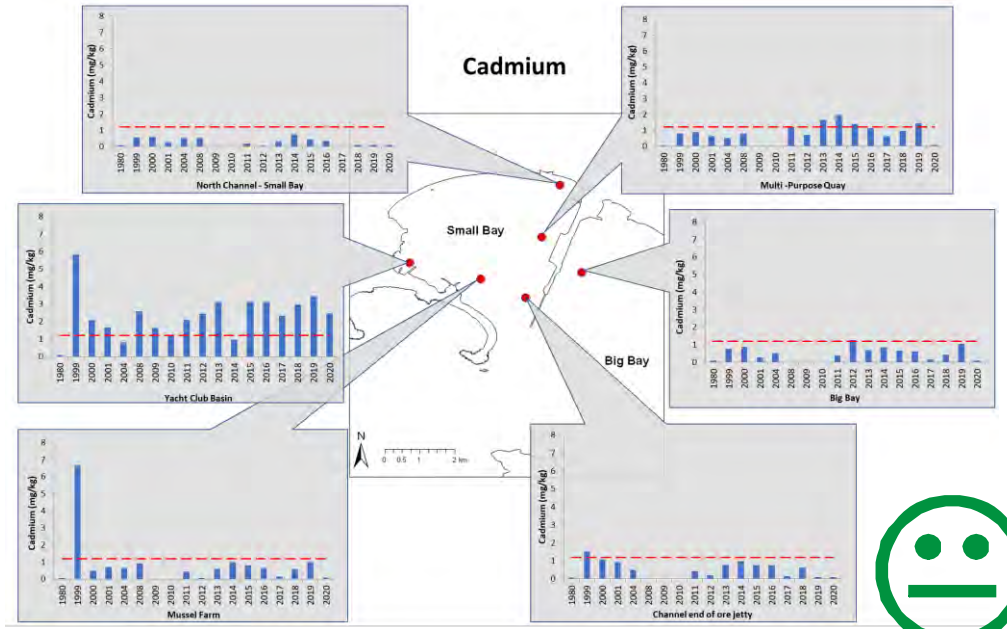
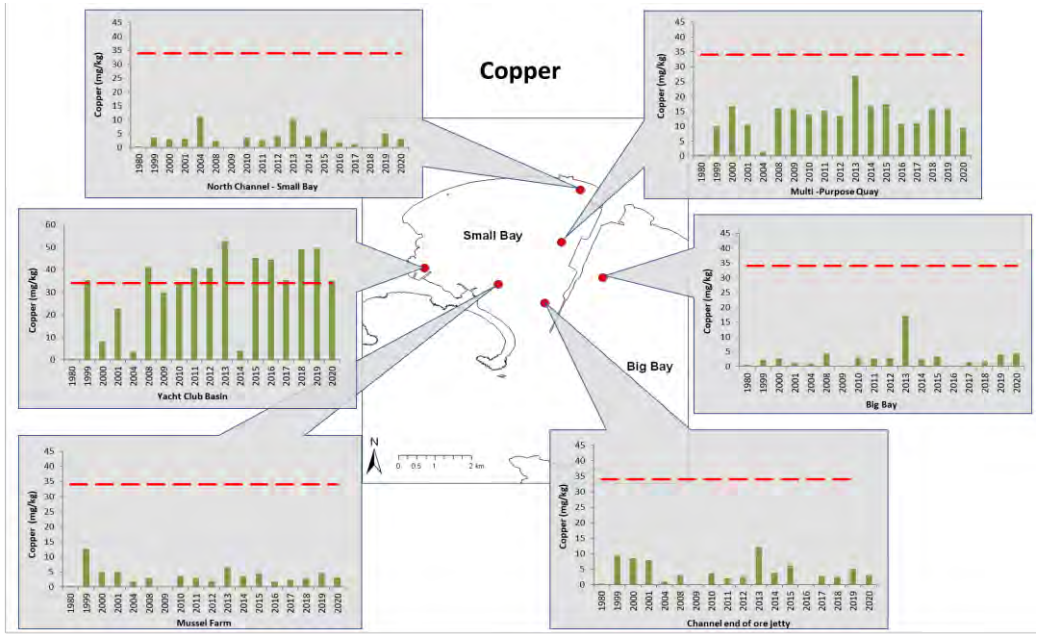
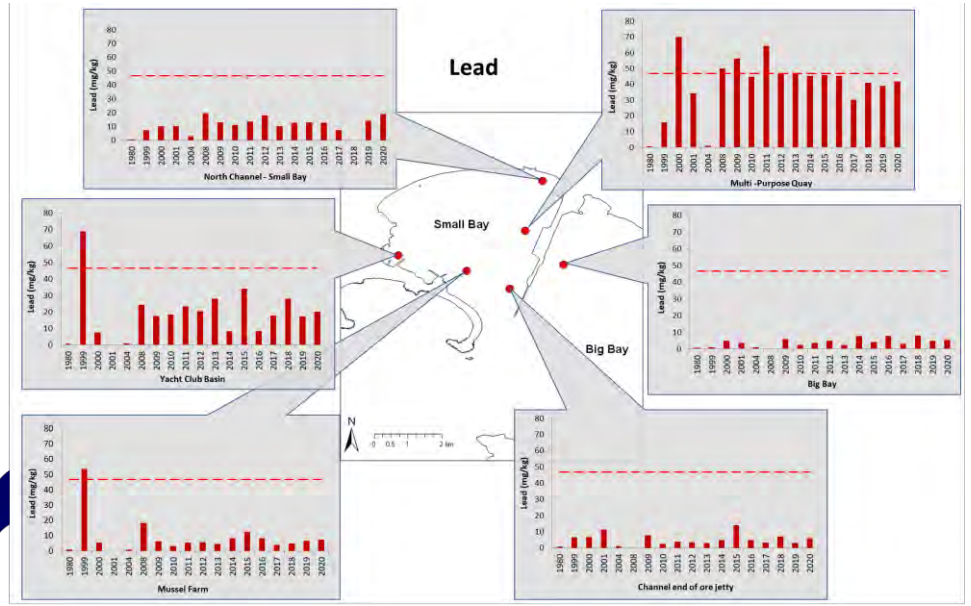
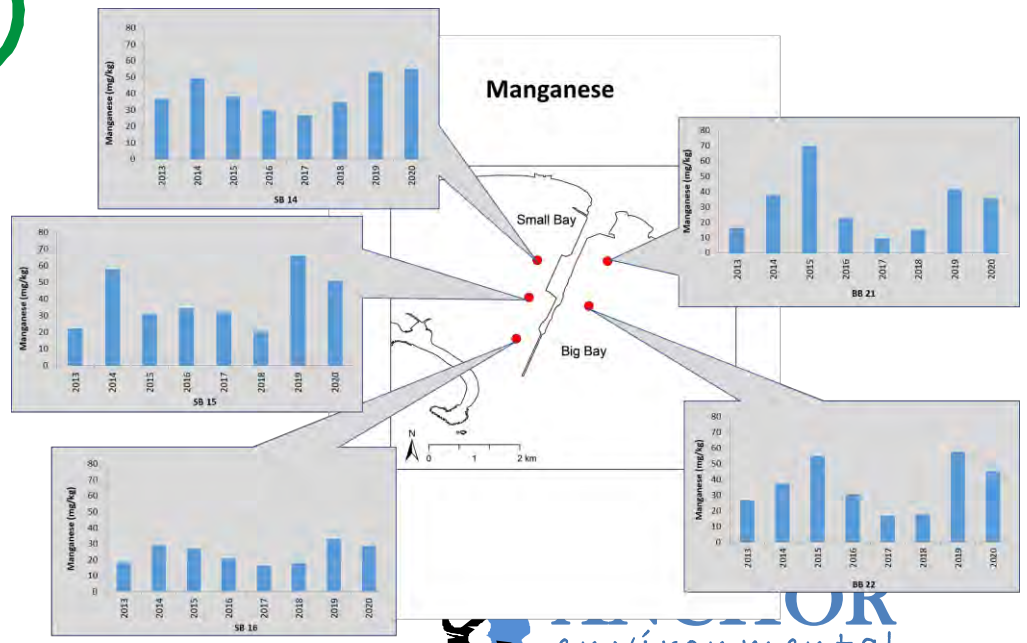
2.10 Trace metals



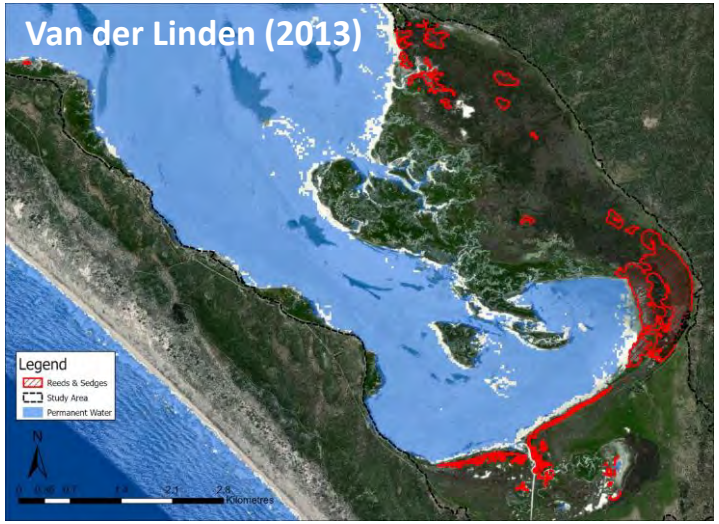


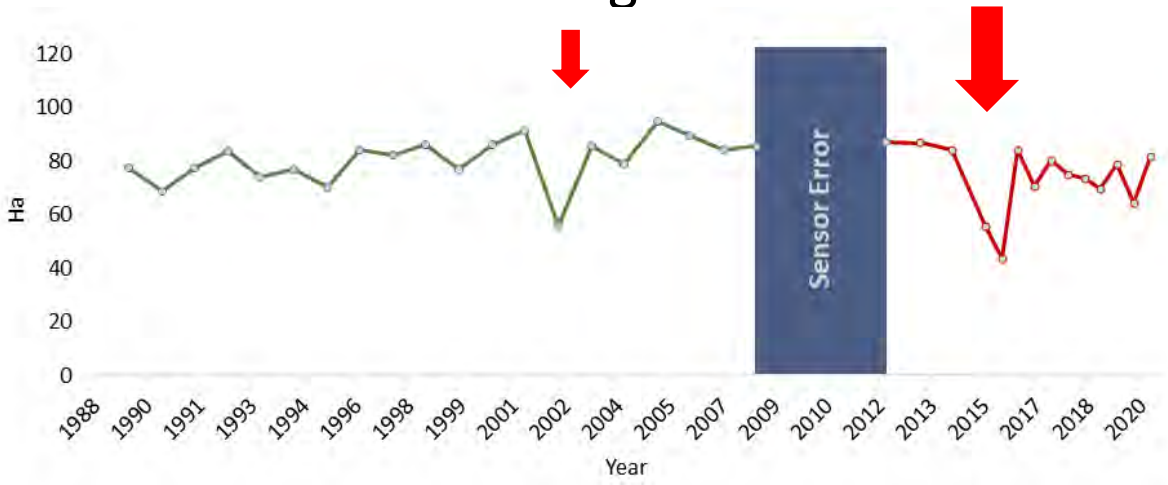


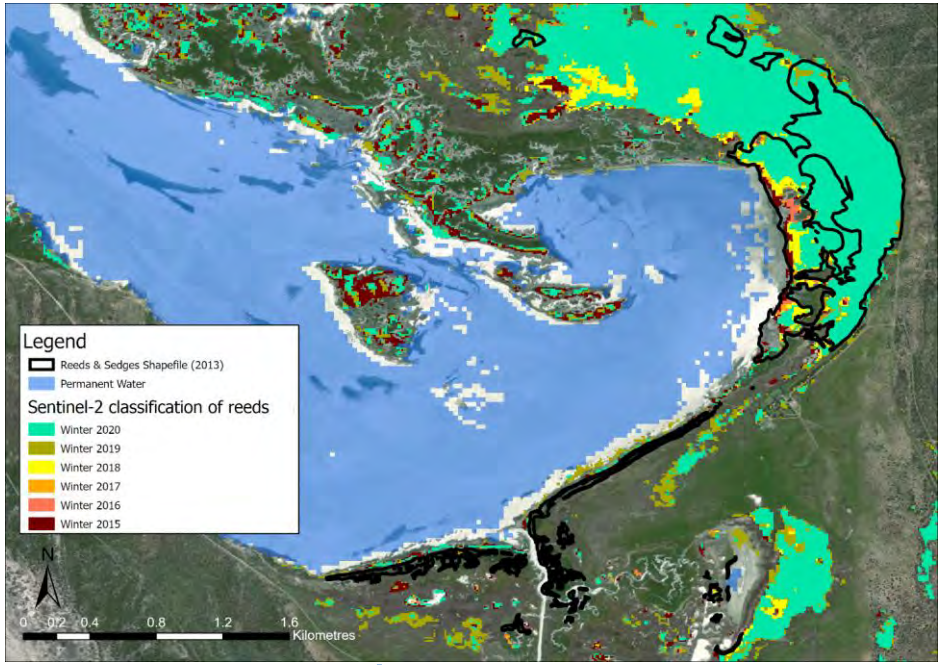


3.1 Aquatic macrophytes

- Mapping of vegetation using “unsupervised” classification of satellite data with Google Earth Engine
- Developed and trained algorithm on existing mapping done by van der Linden (2013) based on aerial photography
- Results are still to be ground truthed…







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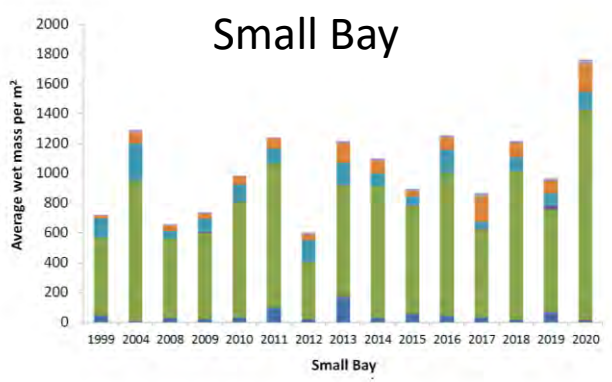
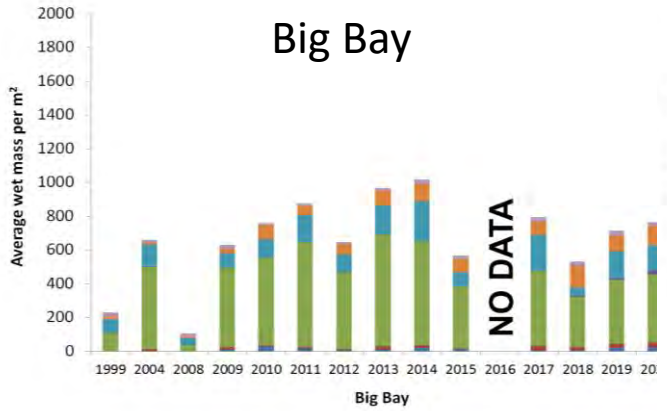
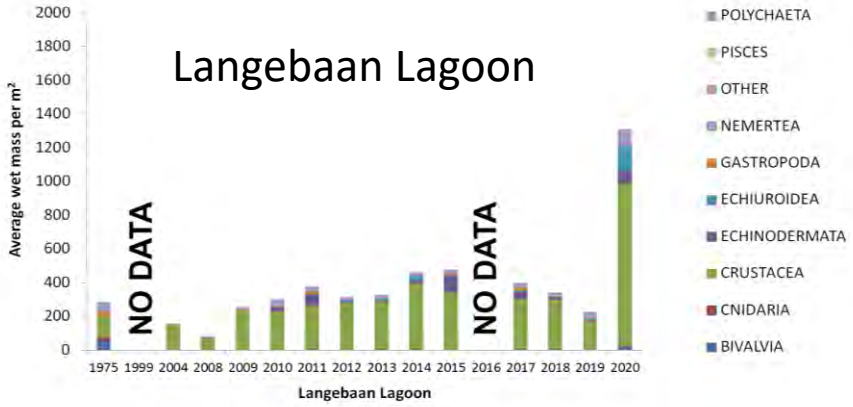
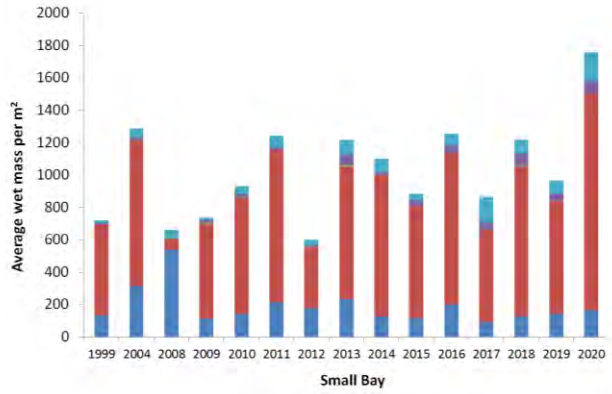
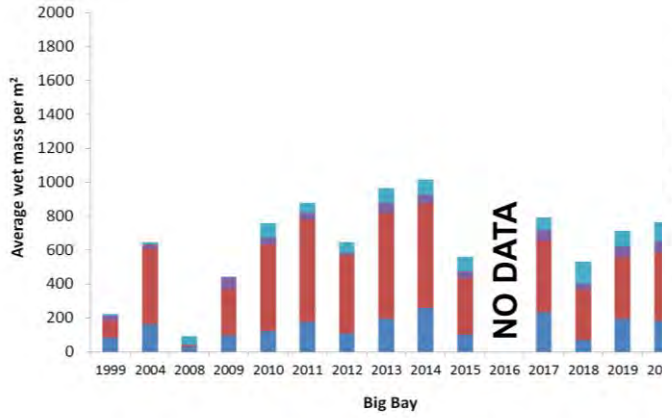
3.2 Soft bottom benthic macrofauna

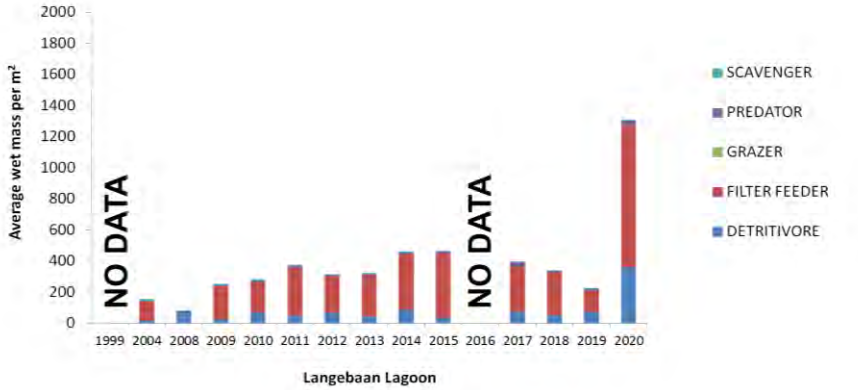












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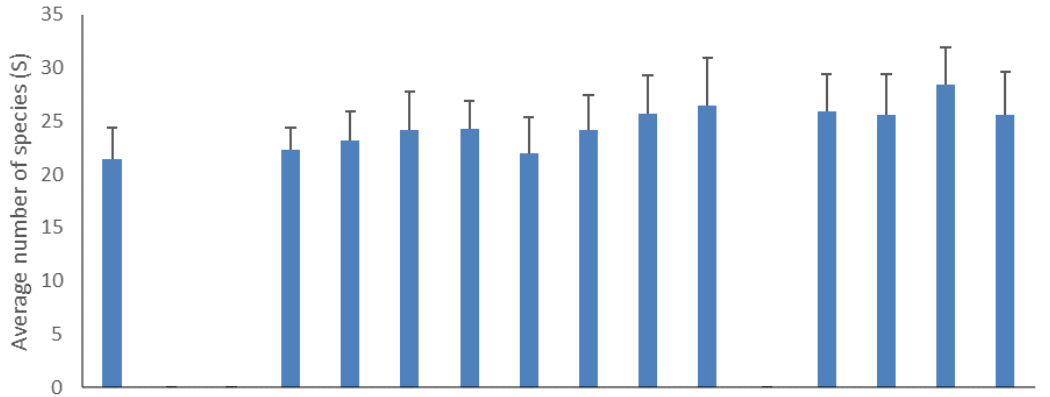
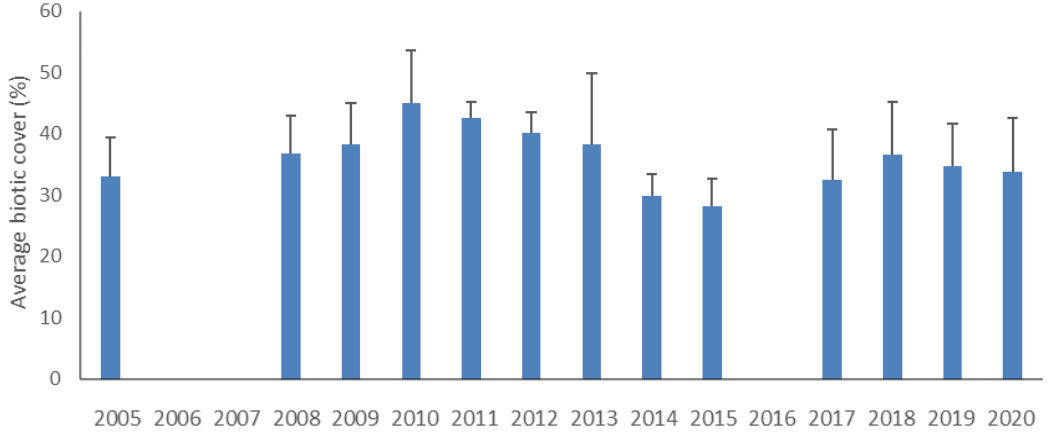
3.3 Rocky intertidal communities

- Numbers of species recorded appears to have been increasing over time
- Probably not real – our identification skills have been improving, some new alien species
- All sites are still overwhelmingly dominated by alien species (mussel, barnacles) but their abundance is declining





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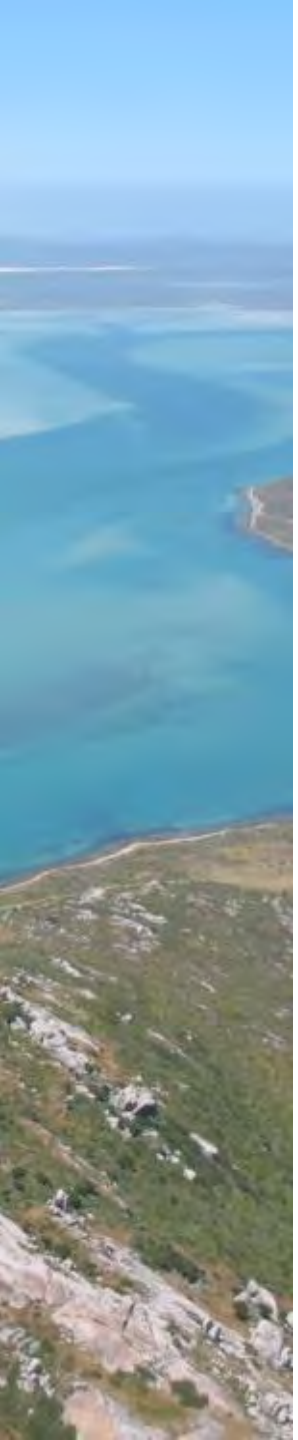
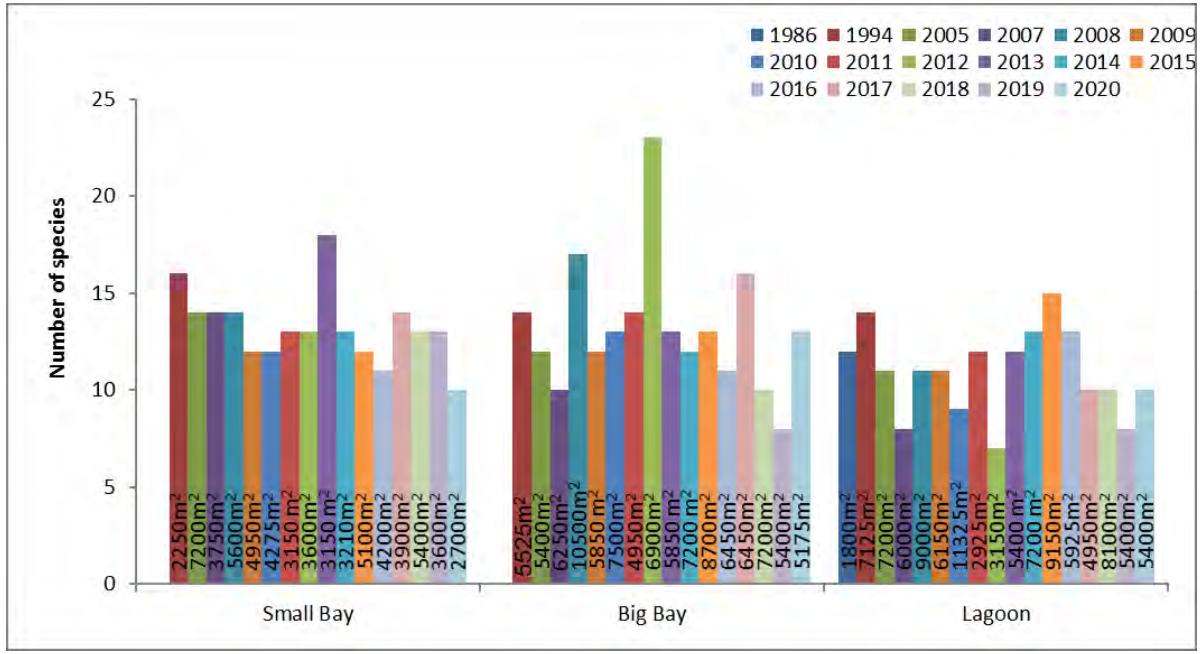
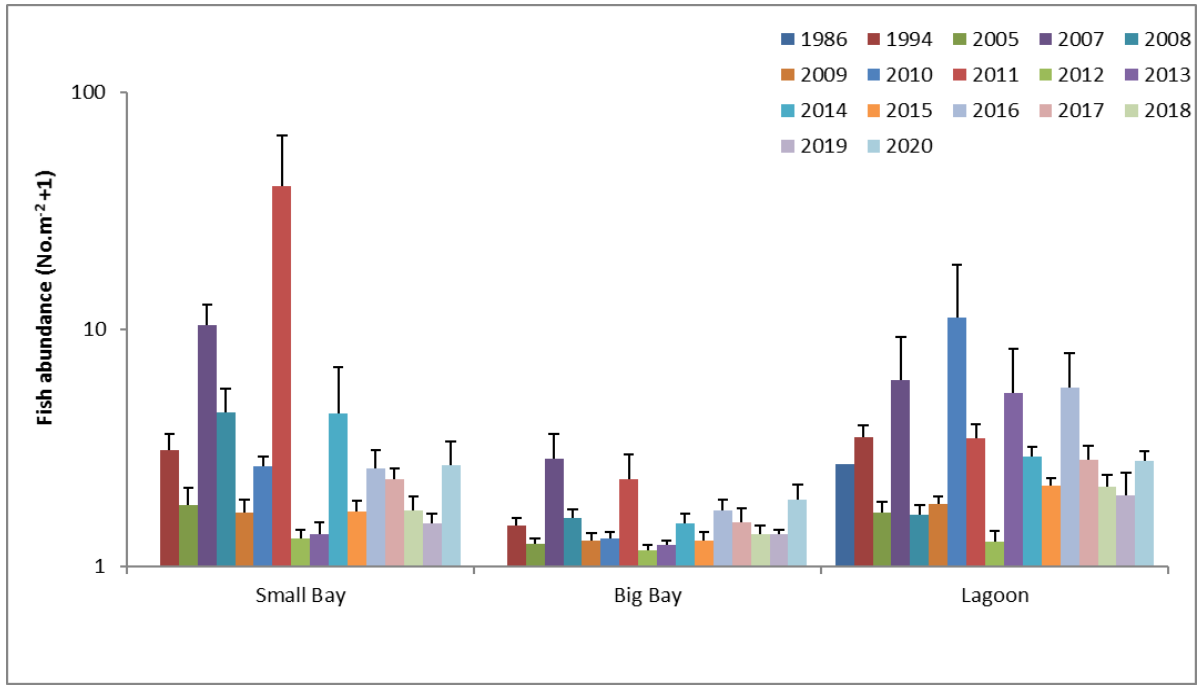


3.4 Fish

- Number of species has dropped over time
- Overall abundance is very variable, but no clear change
- Abundance of white stumpnose remains very low after stocks collapsed in 2010
- No juvenile elf have been caught in the last 3 years
- Harders have been severely overfished, average size of the fish and abundance in gill net catches is declining precipitously





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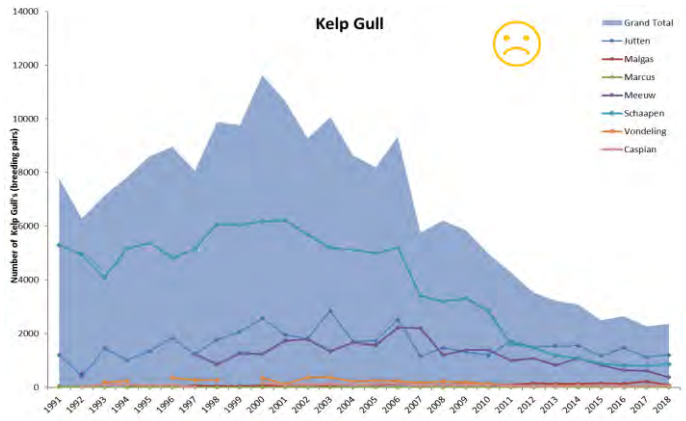
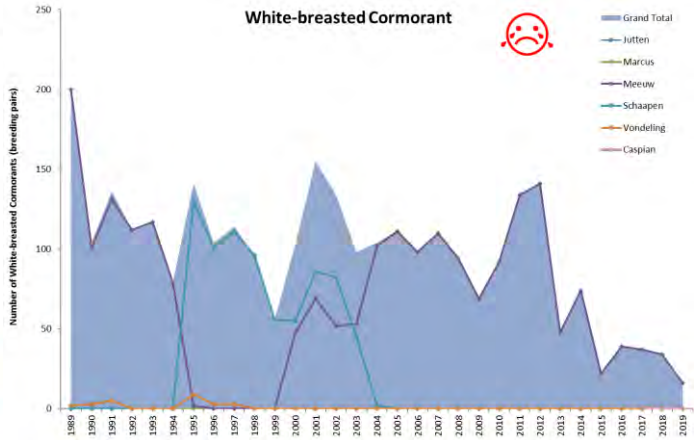
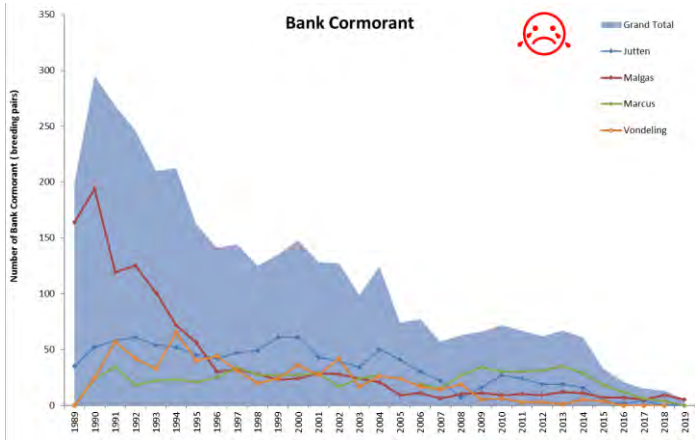
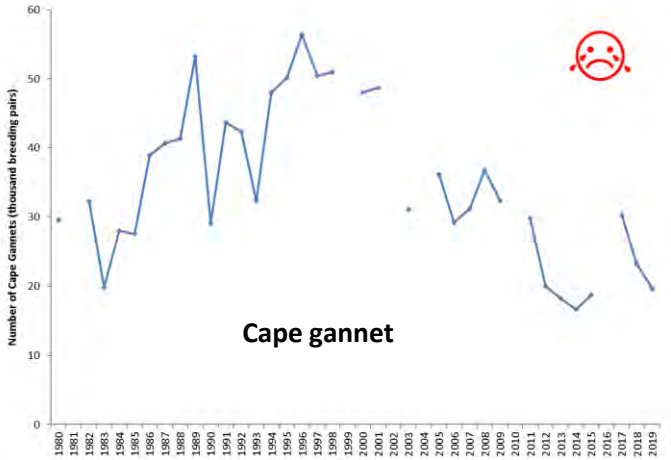
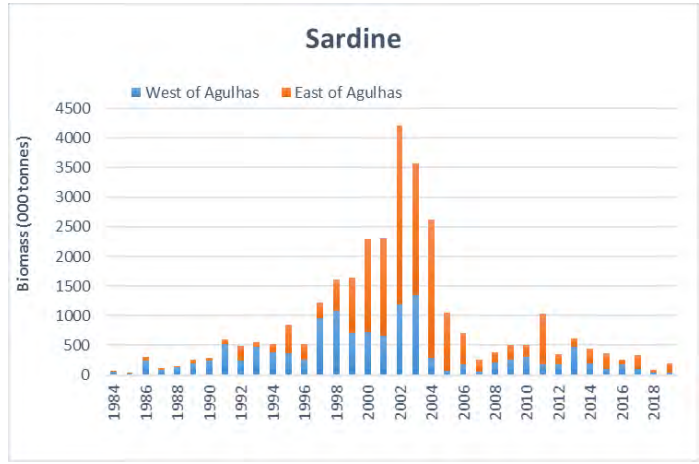
3.5 Birds – Islands breeding

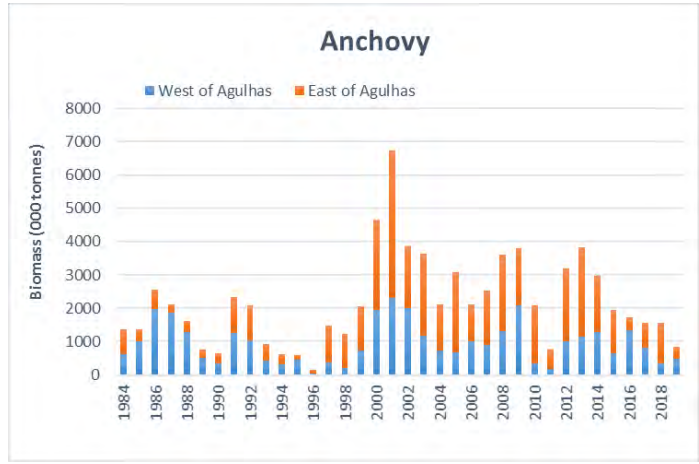












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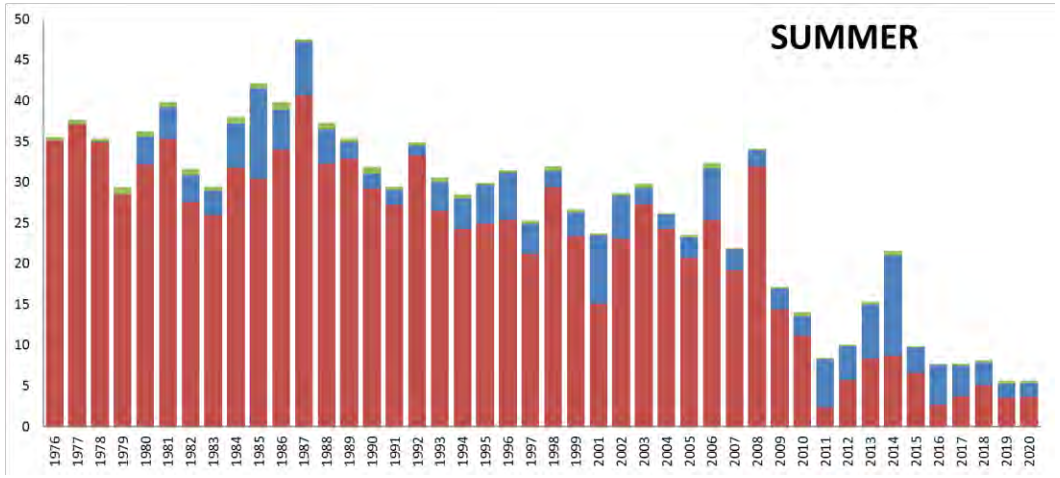
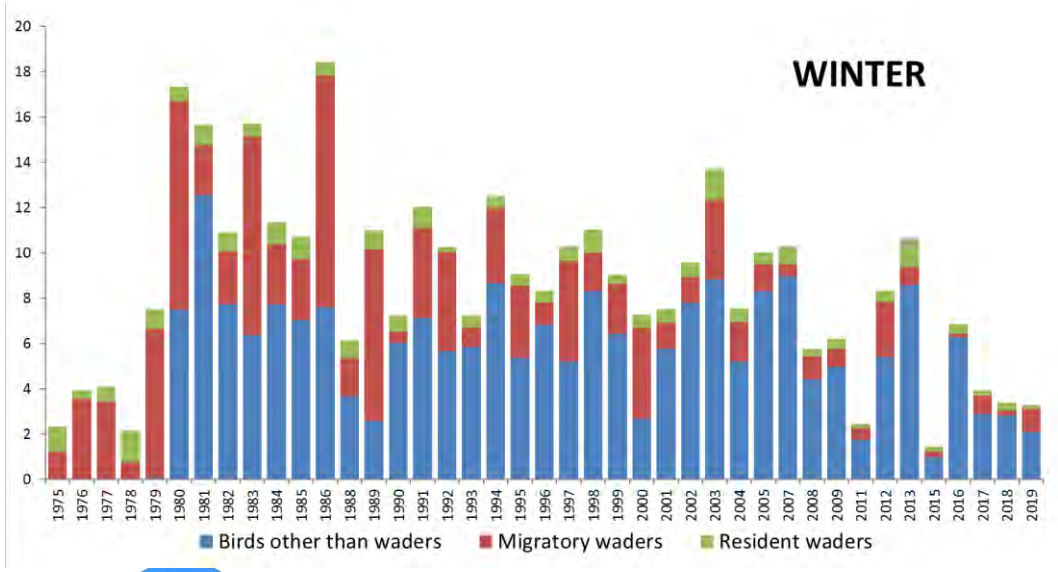
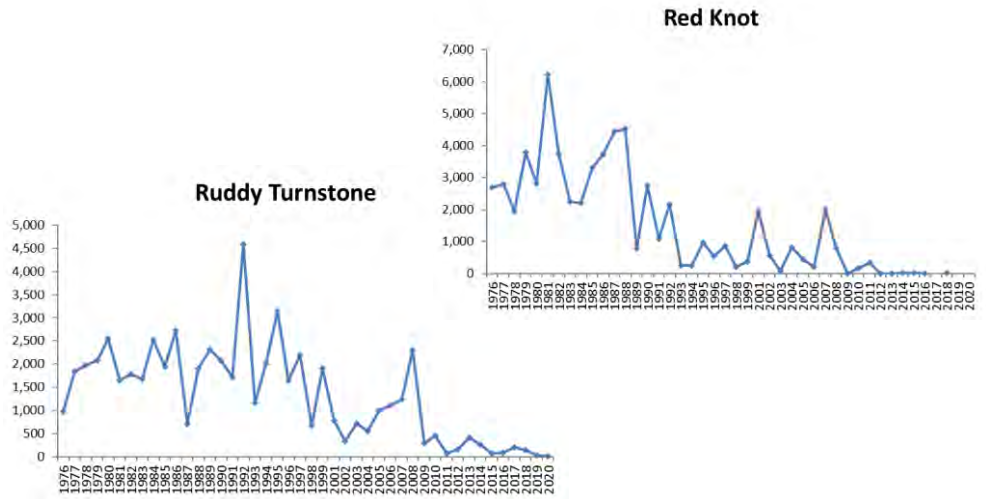
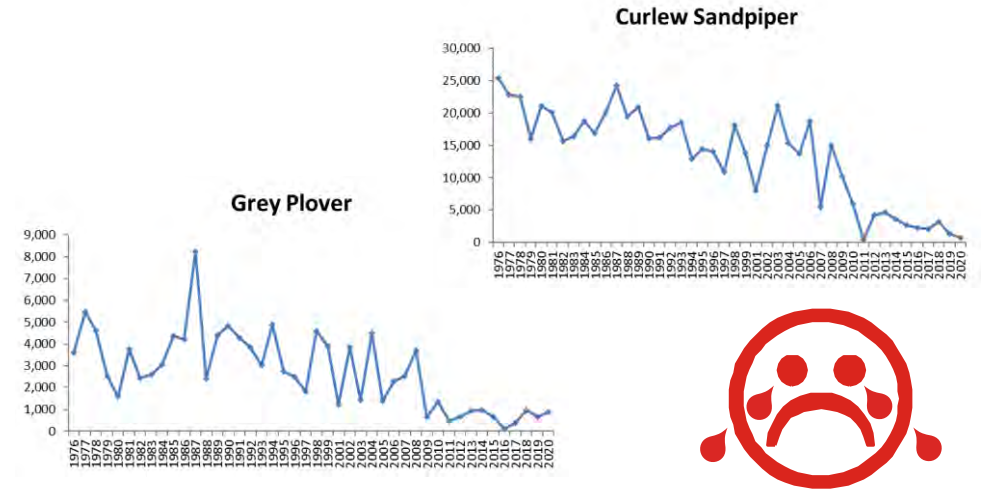
3.6 Birds: Langebaan Lagoon









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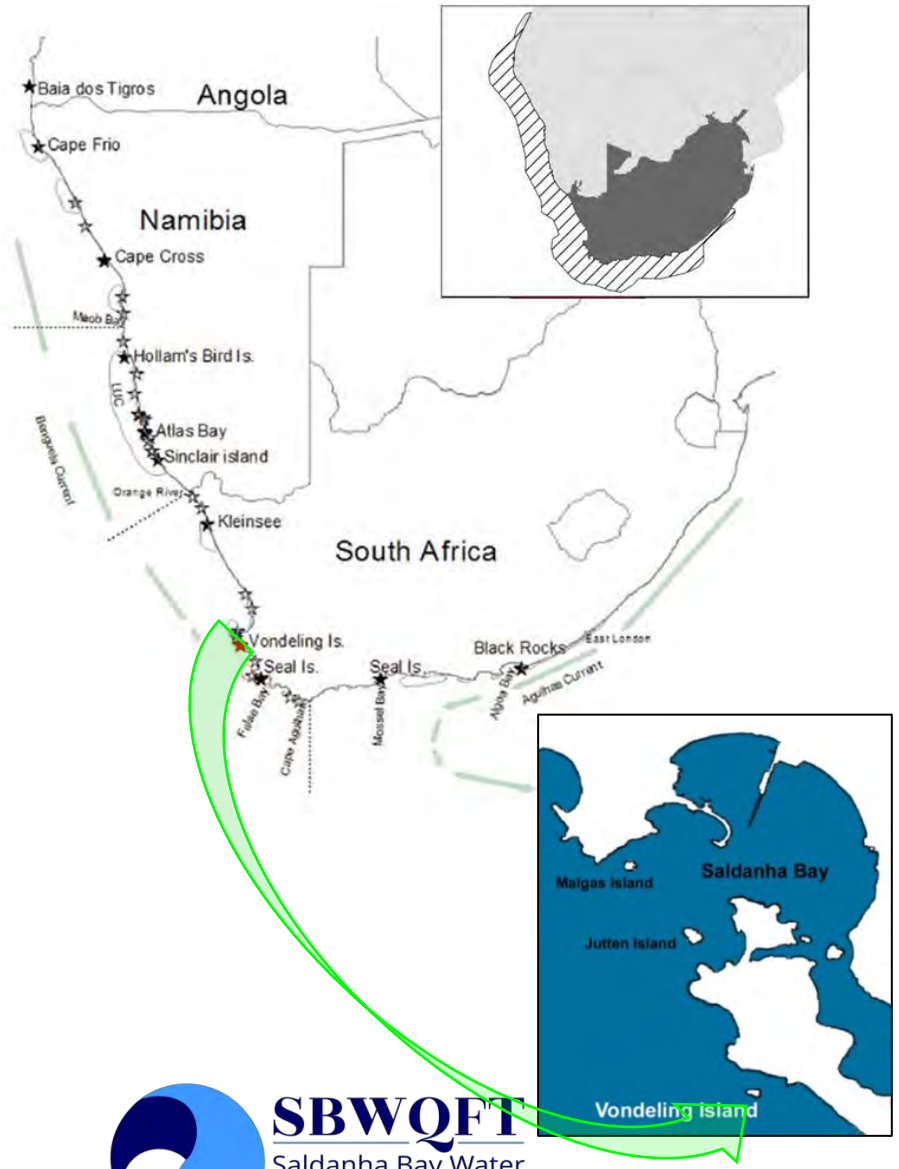
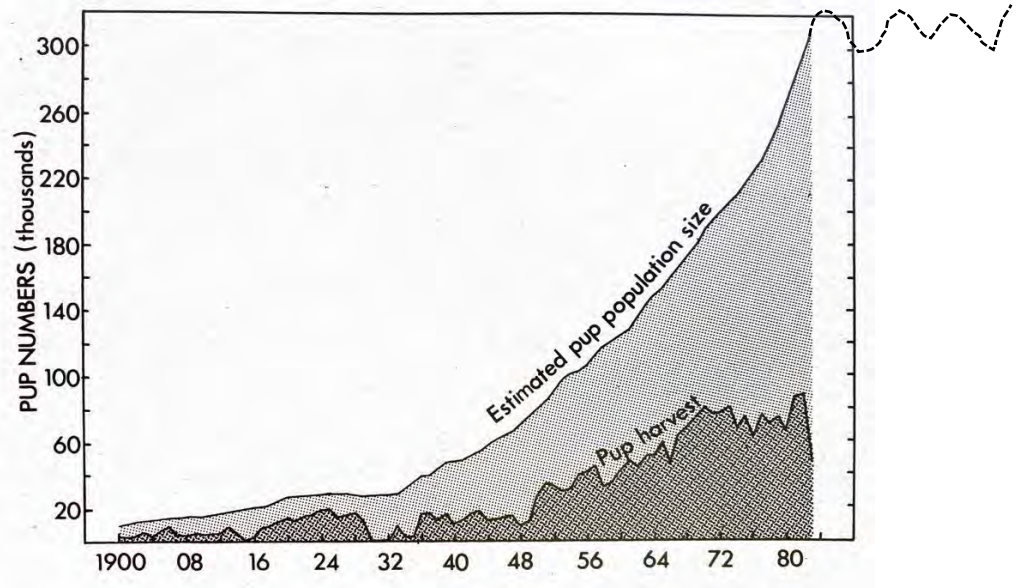
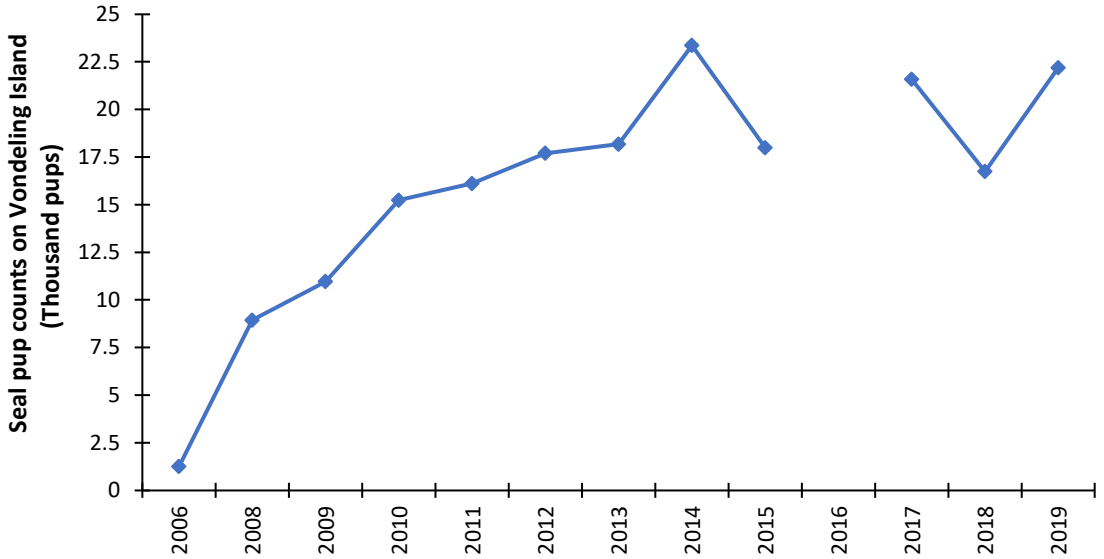
3.6 Cape Fur seals







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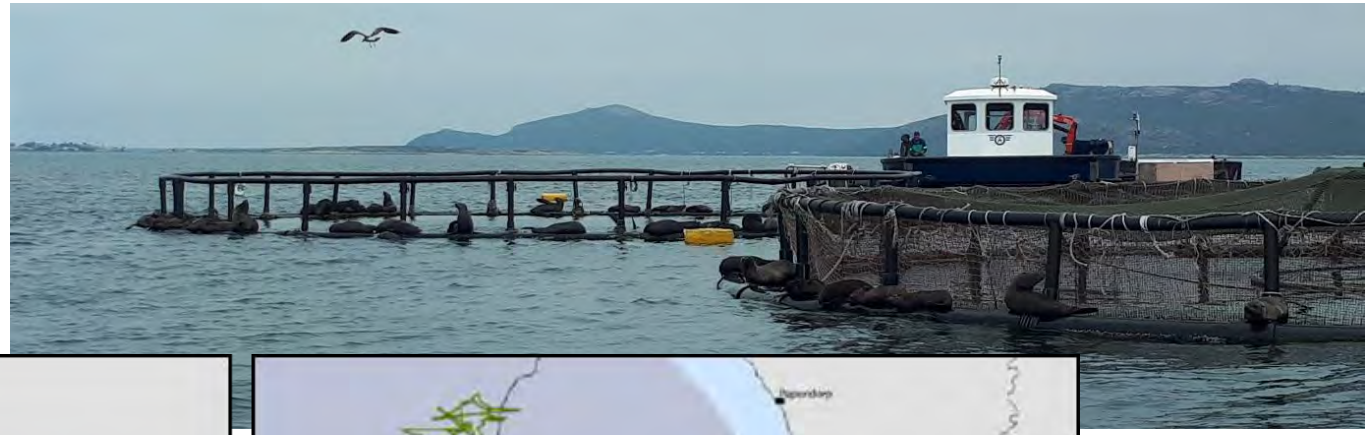
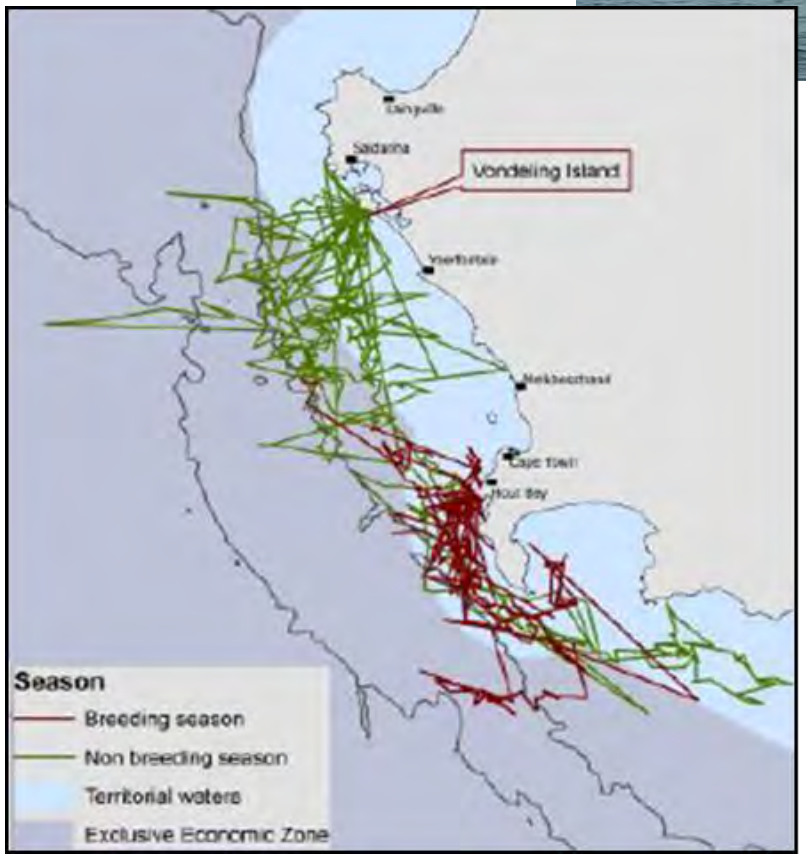
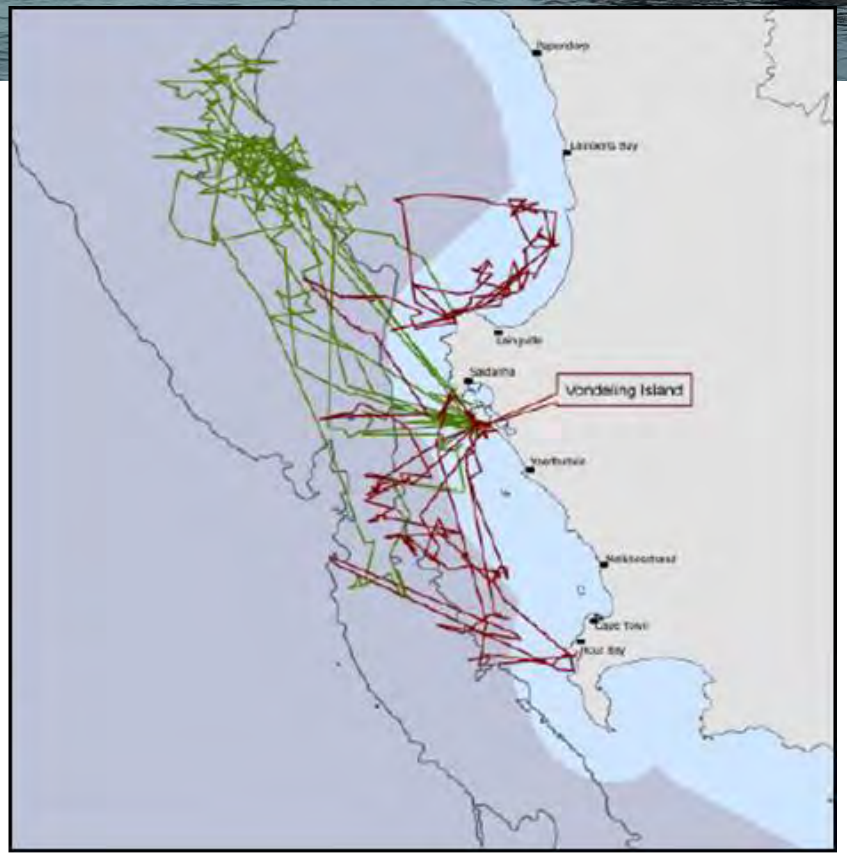
Seals – foraging







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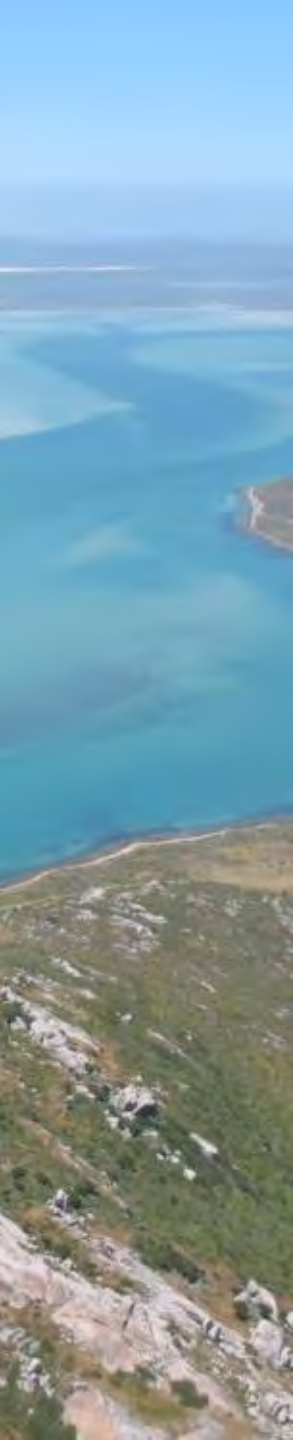

Summary

- Development, shipping traffic, waste water discharge, visitor numbers have slowed in 2020, but mariculture is increasing …
- Water and sediment quality are improving or at least stable
- Biota:
  - benthic macrofauna abundance and biomass both increasing,
  - Fish populations are decreasing…
  - Birds (both on the islands and in Langebaan Lagoon) continue to decline…
- Marine aliens are increasing…rapidly

- Overall:……?

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Thank You
Photo: Steve Benjamin