

NATIONAL ESTUARIES MONITORING PROGRAMME: MONITORING OF THE MDLOTANE ESTUARY AND THE ANALYSIS OF PRELIMINARY WATER QUALITY RESULTS

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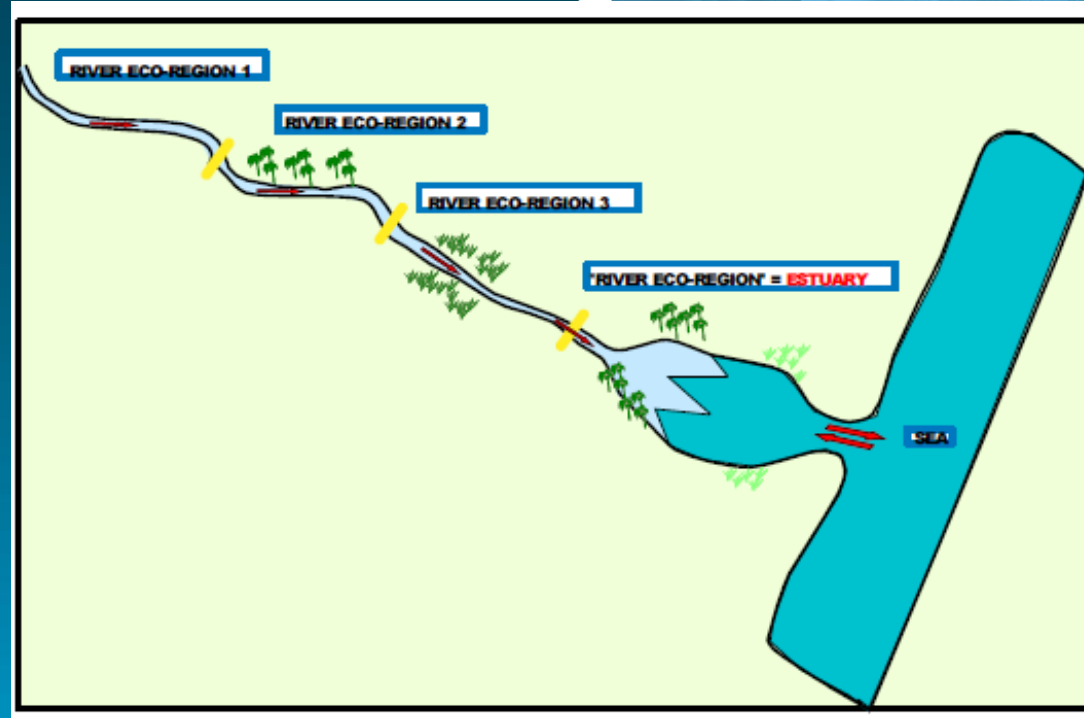
INTRODUCTION

- Complex systems
 - Interplay of freshwater and marine water
 - Different drivers and response indicators
 - Different types and functionality



DEFINITION OF ESTUARIES?

- According to the National Water Act (No. 36 of 1998) an estuary is defined as a partially or fully enclosed water body—
 - that is open to the sea permanently or periodically, and
 - within which the seawater can be diluted, to an extent that is measurable, with freshwater drained from land.



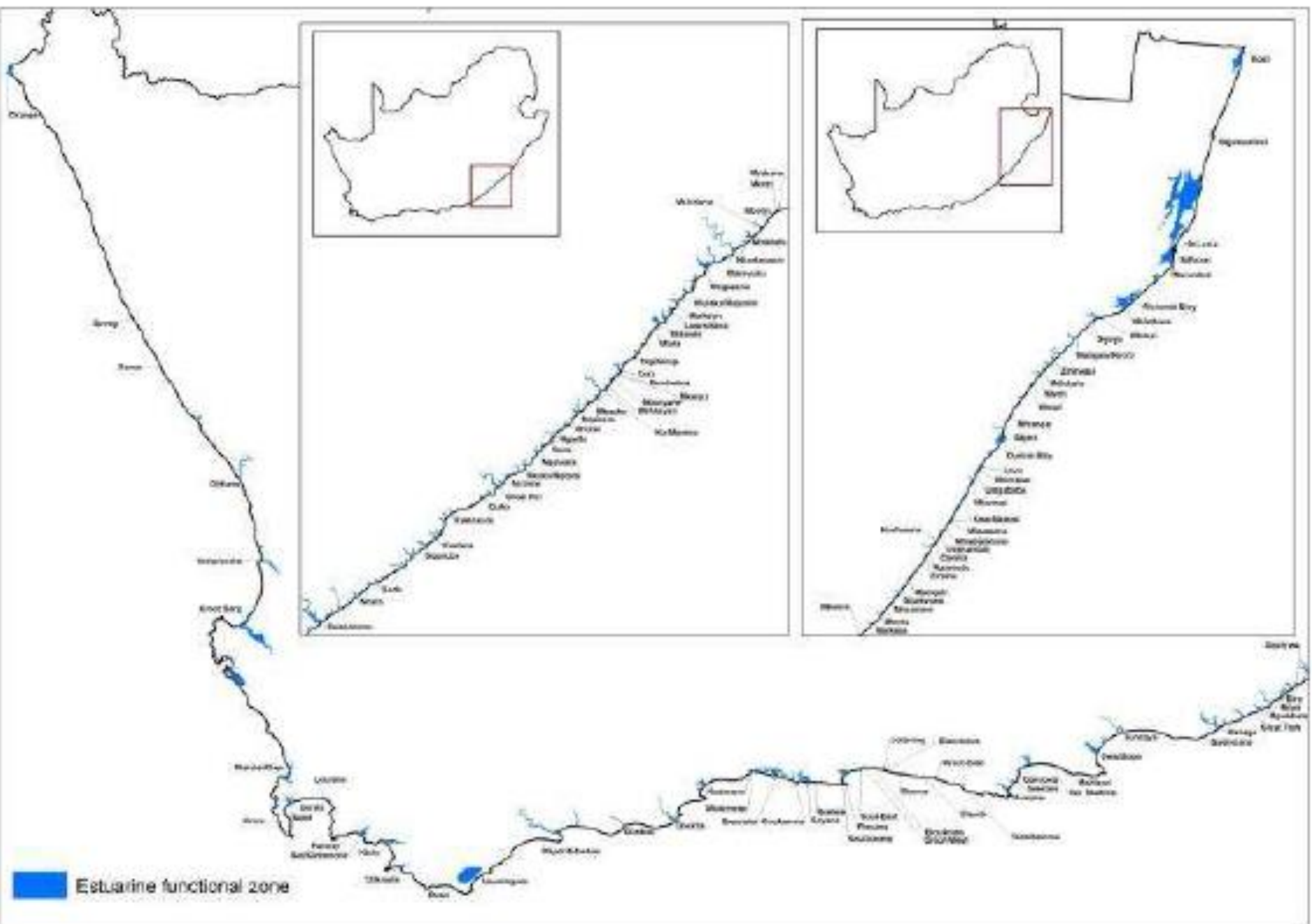
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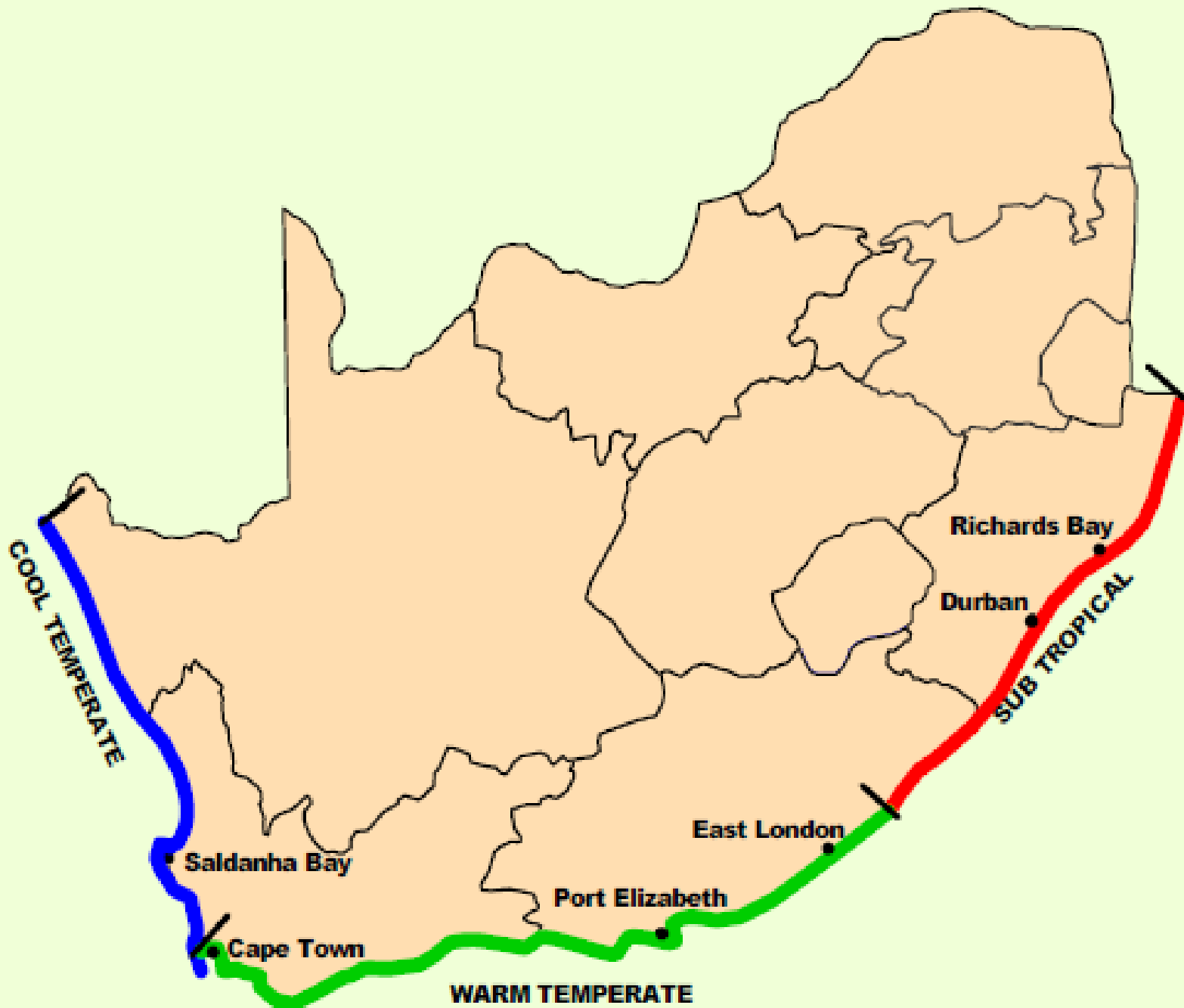
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S.A. ESTUARIES?

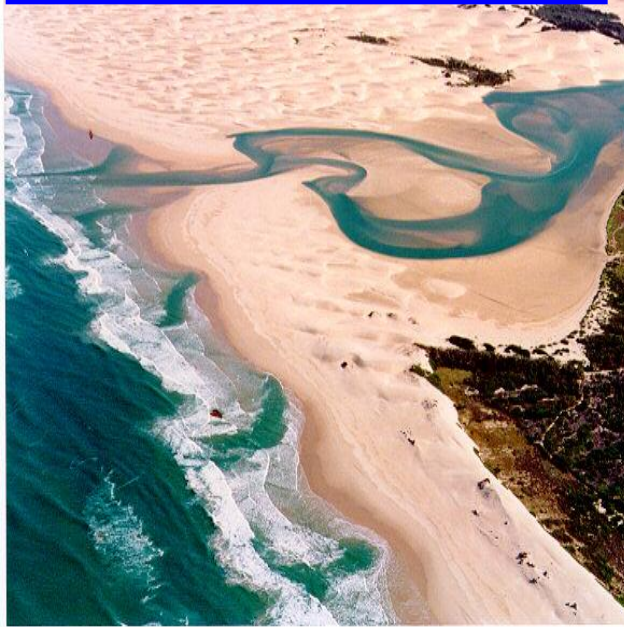
- Approx 250 functional estuaries – (Whitfield, 2000)
- Now nearly 300 (NBA, 2011)
- 3 Biogeographical zones: Subtropical, warm-temperate, cool-temperate
- Approx 171 000ha of estuarine functional zone, 60% in Subtropical
- 5 types: Permanently Open, Temporarily Open-Closed, Estuarine Lake, Estuarine Bay, River Mouth
- 75% TOCEs, vulnerable to change







Sundays: Permanently Open



Thukela: River mouth



Knysna: Estuarine Bay



Swartvlei: Estuarine Lake



Mtati: temporarily open / closed

WHY SO IMPORTANT

- Estuaries are recognised as being among the most productive types of ecosystems worldwide. They are focal points for community and business activities along the coast, as they provide a wide range of opportunities and benefits. Thus, substantial pressure.



KEY ECOSYSTEM SERVICES

Ecosystem services		Description	Importance in estuaries
Provisioning services (goods)	Water	Provision of water for subsistence and agricultural use (only applicable in fresher upper reaches)	Low
	Food, medicines	Production of fish and food plants; medicinal plants	High
	Raw materials	Production of craftwork materials, construction materials, fodder and biofuel (especially important in rural and arid areas)	Medium to high
Regulating services	Climate regulation	Carbon sequestration, oxygen and ozone production, urban heat amelioration	High
	Disturbance regulation	Flood control, drought recovery, refuges from pollution events	High
	Water regulation	Provision of dry season flows for agricultural, industrial and household use (only applicable in fresher upper reaches)	Low
	Erosion control and sediment retention	Prevention of soil loss by vegetation cover and capture of soil, e.g. reeds and sedges preventing bank erosion	High
	Ecological regulation	Regulation of malaria, bilharzia, liver fluke, black fly, invasive plants as salinity assist with pest control.	High
Supporting services	Waste treatment	High retention makes is effective in breaking down waste and detoxifying pollution. Tidal and fluvial flushing assist with dilution and transport of pollutants	Medium to high
	Refugia/ Nursery areas	Critical habitat for migratory fish and birds, important habitats or nursery areas for species	High
	Export of materials and nutrients	Export of nutrients and sediments to marine ecosystems	High
	Genetic resources	Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species	Low
Cultural services (attribute)	Structure and composition of biological communities	The characteristics, including rarity and beauty, that lend an area its aesthetic qualities or make it attractive for recreational, religious or cultural activities	High



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KEY PRESSURES

- Flow reduction
- Pollution
- Exploitation of living resources
- Land-use and development
- Estuary mouth manipulation



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MANAGEMENT OF ESTUARIES

- The South African Constitution (Act 108 of 1996);
- Environment Conservation Act, 1989 (Act 73 of 1989);
- National Environmental Management Act, 1998 (Act 107 of 1998);
- **National Water Act, 1998 (Act 36 of 1998);**
- Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002);
- Biodiversity Act, 1998 (Act 36 of 1998);
- Marine Living Resources Act, 1998 (Act 18 of 1998); and
- **Integrated Coastal Management Act (Act No 24 of 2008)**



MONITORING BY DWS

- The Department's role in monitoring SA water resources
- Chapter 3 of the National Water Act
 - Protection of water resources
 - Determination of Reserves, Classification System
 - Implementation thereof
- Chapter 14 of the National Water Act
 - Establishment of national monitoring and information systems
 - Mechanisms to co-ordinate monitoring of water resources
 - Provision of and Access to information
 - Regulations for monitoring, assessment and information



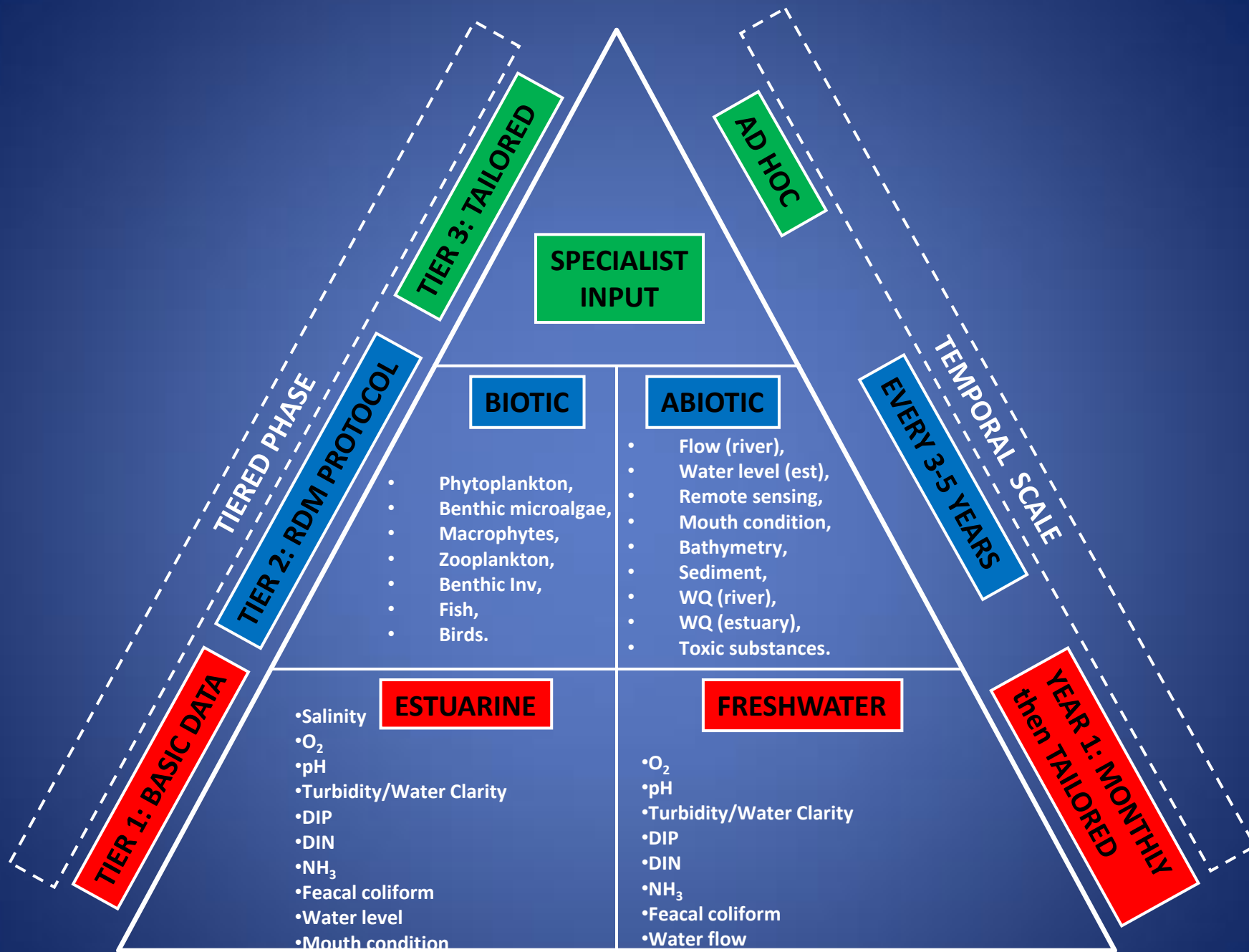
NATIONAL ESTUARIES MONITORING PROGRAMME

- A long-term, nationally coordinated monitoring program for estuaries
- NAEHMP
- To monitor different types, functionality, and various levels of baseline info
- Mostly prioritising building up data in under-studied systems
- Systems chosen also depend on collaborating organisations



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KwaZulu-Natal

St Lucia Mfolozi

Mlalazi

Zinkwazi Mdlotane Nonoti

Pietermaritzburg

Umhlanga

Umngeni

Tugela Canyon

NESMP in KwaZulu Natal

Mpenjati Mtamvuna

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Data SIO, NOAA, U.S. Navy, NGA, GEBCO

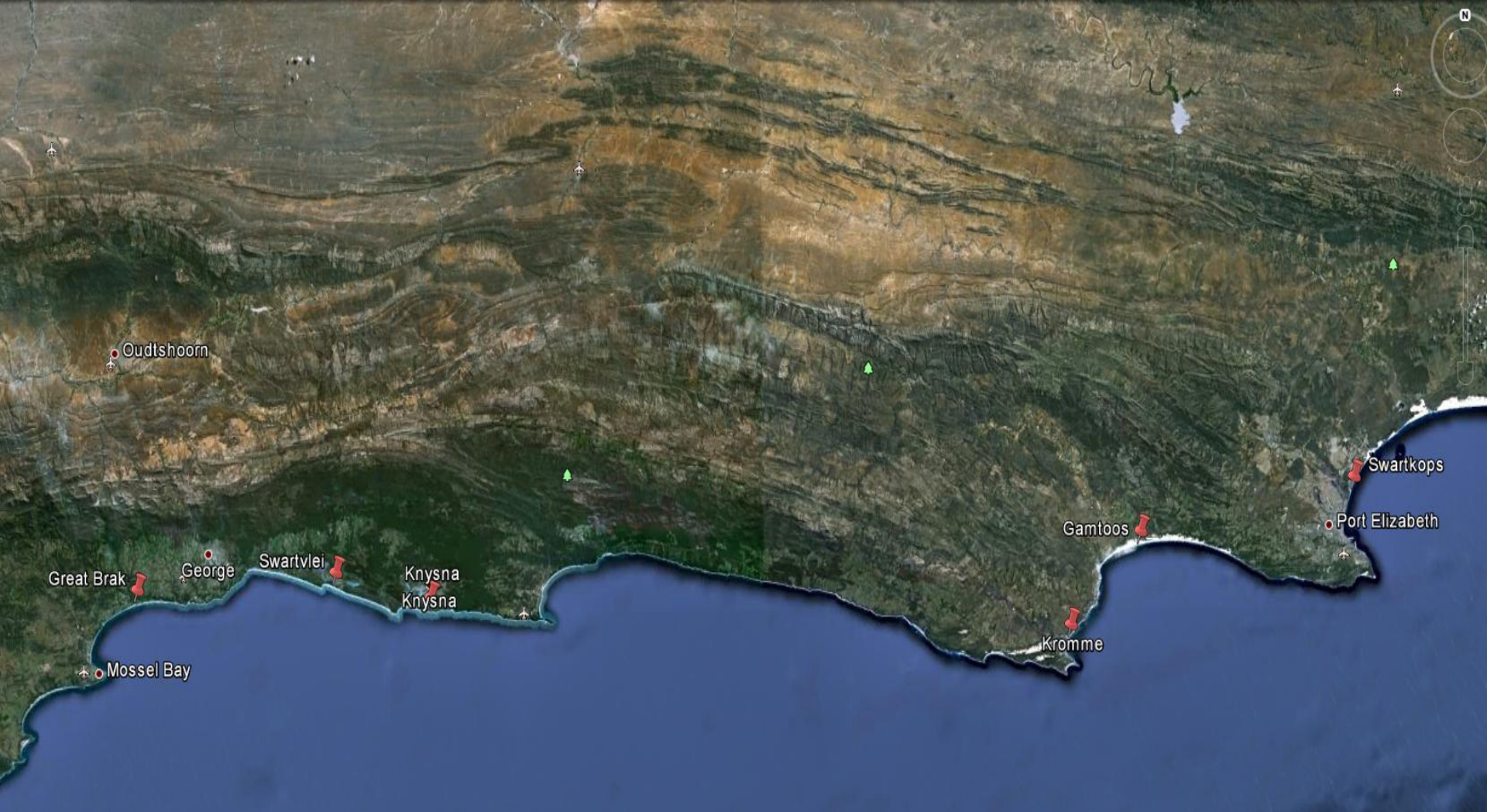
Natal Valley Google earth

Imagery Date: 4/10/2013

29°47'27.56" S 31°46'05.22" E elev -682 m

Eye alt 369.93 km

NESMP in East-Southern Cape



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Olifants

Verloenvlei

Berg

Western Cape

Western Cape

Cape Town

George

Klein Bot

Breede

Image Landsat
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Google earth

MDLOTANE ESTUARY MONITORING

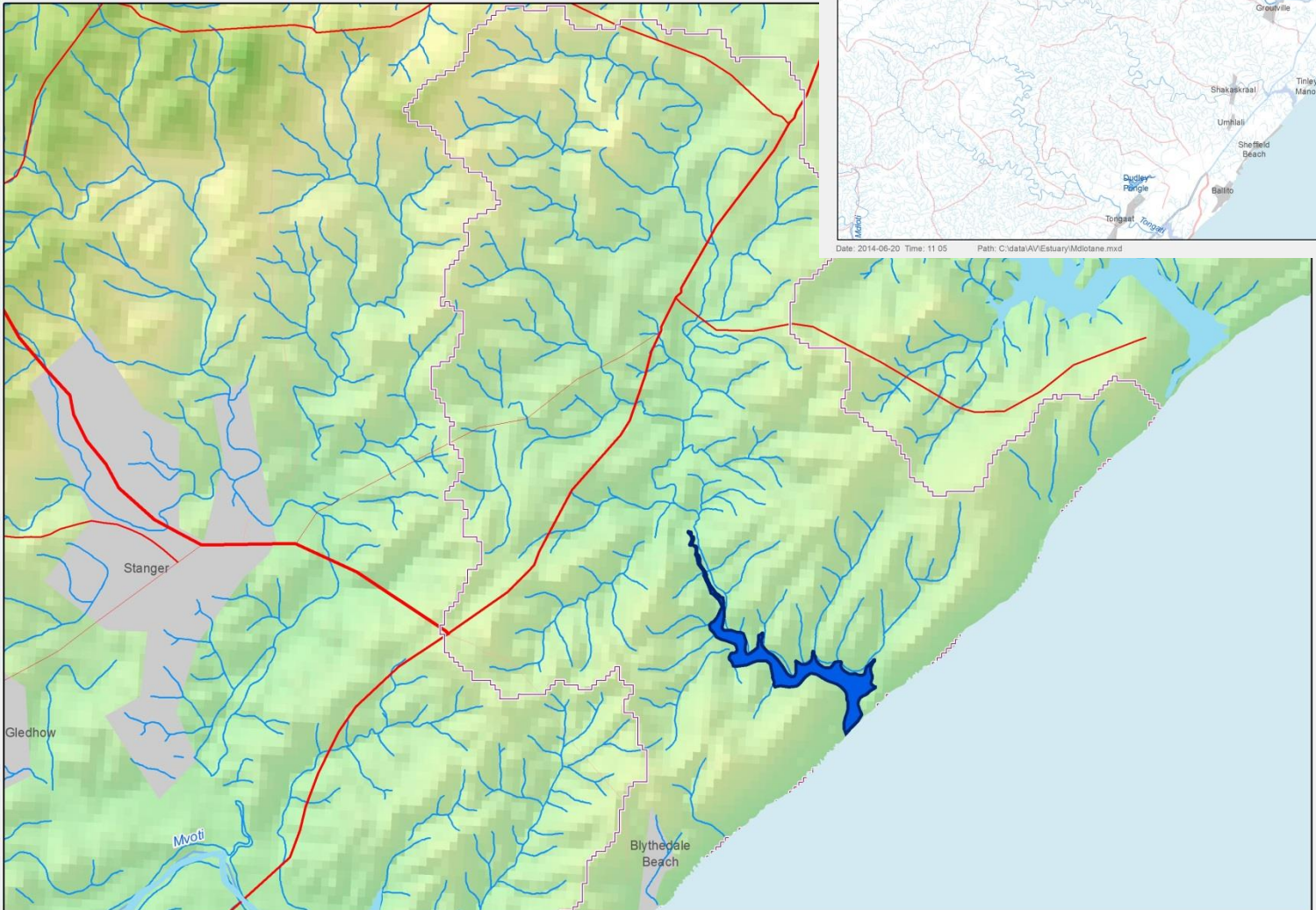
- Two known fish kills occurred in 2013
- Limited information
- NESMP initiated in August 2013
- Collaboration: Department and ZBC, Ezemvelo (events)
- Aim: Monitor the water quality of the Mdlotane Estuary, build a long-term record, build on the baseline, for future robust studies
- Thus, Tier 1 monitoring



MDLOTANE CATCHMENT

- Small catchment
 - (33.6 – 52km²),
 - River length estimated at 10 – 16km
 - Estuary approx. 3.7 km, not navigable from \pm 2km
 - Requires full protection (NBA, 2011)
 - Considered PES = B, Recommended = A (NBA, 2011)
- Various Land Uses/Activities:
 - Waste Dump Site
 - Sugar Cane
 - Eucalyptus plantation
 - Golf Course
 - Settlements and Holiday Resort (Possible septic tanks)
 - Water Treatment (Prince's Grant)





Date: 2014-06-20 Time: 11 22 Path: C:\data\AV\Estuary\Mdotlone.mxd



Date: 2014-06-20 Time: 11 05 Path: C:\data\AV\Estuary\Mdotlone.mxd



SITES



Prince's Grant Golf Estate

MD-4

MD-3

MD-2

MD-1

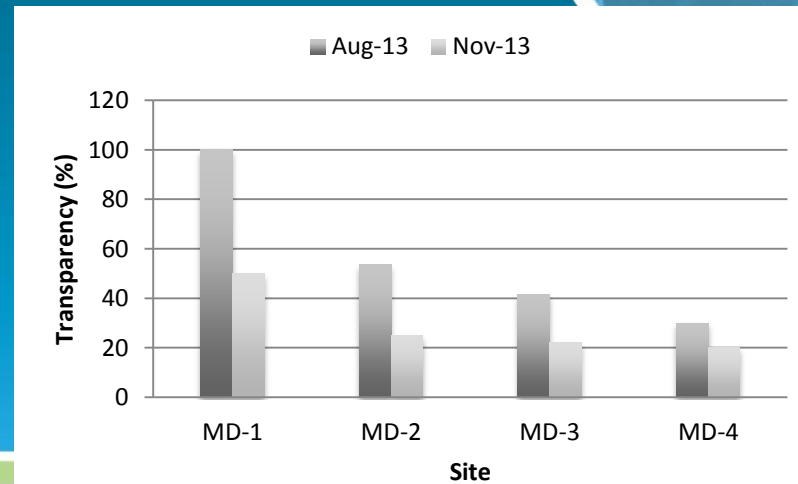
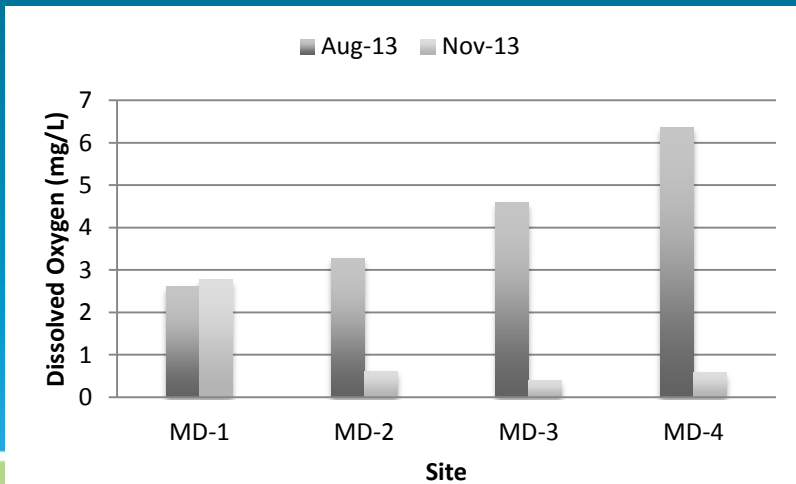
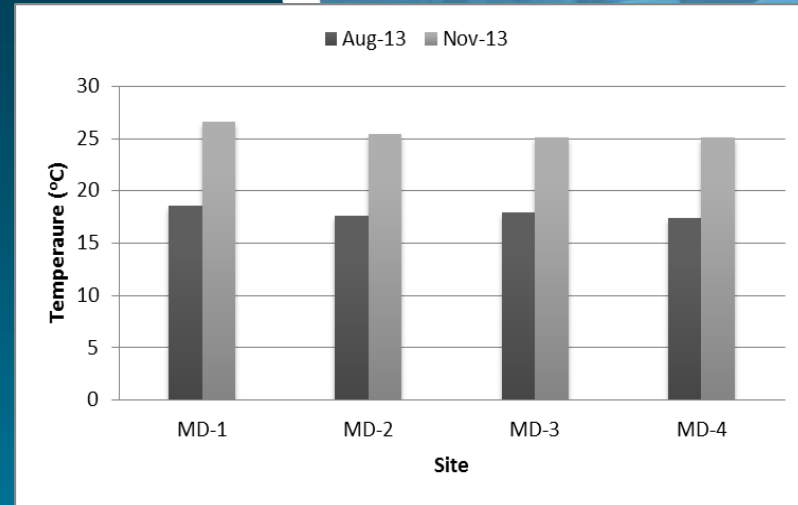
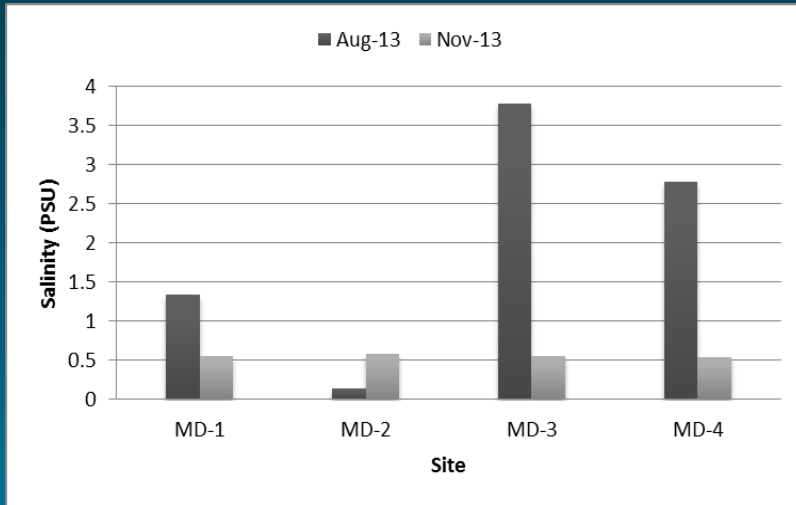
Mdlotane

SAMPLING

- Four sites selected for NESMP but 3 sites' analysed
- August and November nutrient samples reported
- Analysis for:
 - Nutrients (Orthophosphate, Nitrate and Nitrite and Ammonia) - surface
 - Phytoplankton biomass (chlorophyll-a) - surface
 - System variables (pH, temperature, dissolved oxygen, salinity) – 0.2m intervals
 - Secchi depth - transparency



System Variables

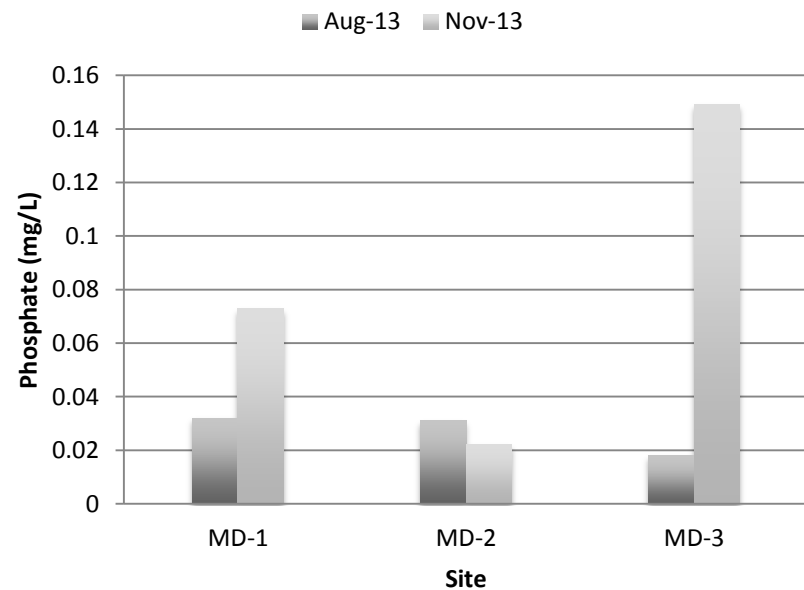
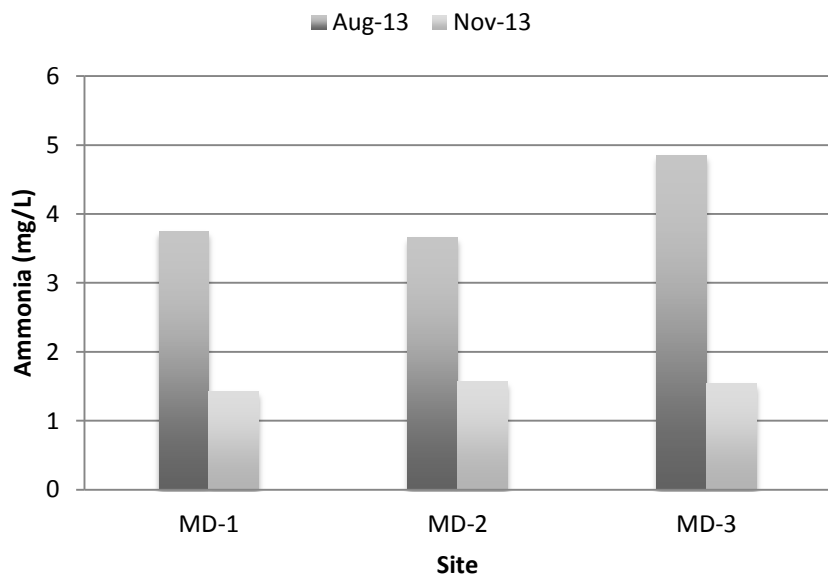
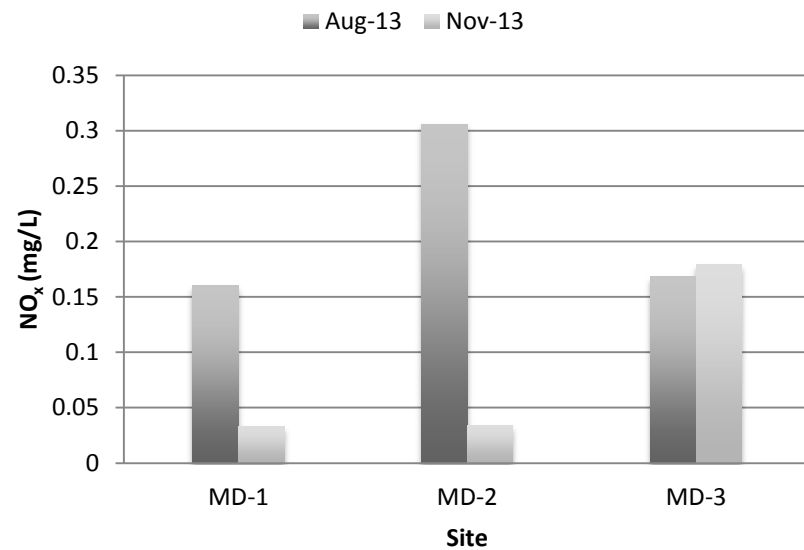
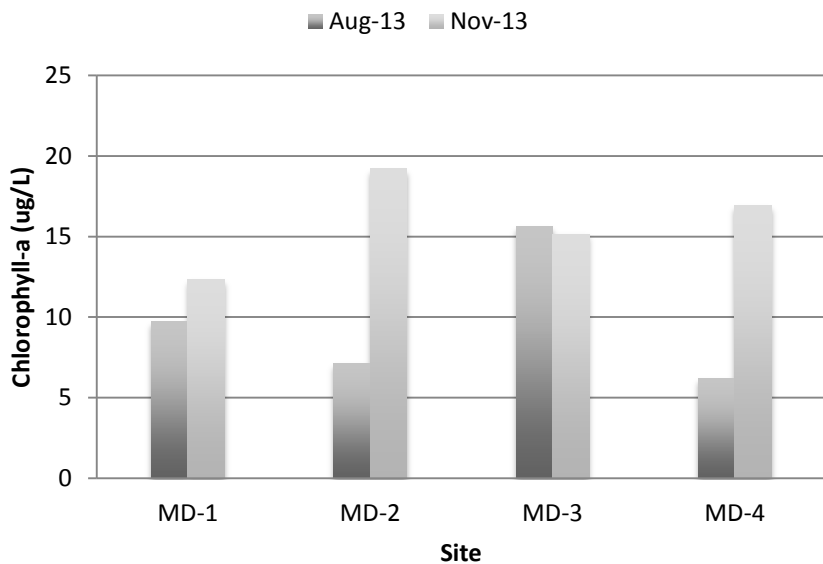


System Variables

- Mouth closed
- System Variables
 - Ave temp in Nov was 25.55 °C and 17.85 °C in Aug
 - Low salinities in both periods, much fresher in Nov:
 - Ave 0.56 PSU compared to 2.01 PSU in Aug
- D.O. very low in Nov (ave 1.09, even Zero)
- Transparency affected in Nov



Phytoplankton and Nutrients



Phytoplankton and Nutrients

- **Nutrients:**
 - High ammonia concentrations noted
 - 3.75 – 4.85 mg/L in Aug, 1.43 mg/L – 1.57 mg/L in Nov, after a fish kill event.
- **Phosphate 82 µg/L in Nov and 27 µg/L in Aug**
- **Phytoplankton**
 - Biomass higher in Nov, ave 15.90 µg/L throughout, compared to 9.67 µg/L in Aug
 - Highest at MD-2 in Nov, at 19.19 µg/L (drains golf course)
 - MD-3 in Aug, 15.63 µg/L (drains sugar cane)





Pics: S. Bachoo and G. Roberts

- Extensive kills of invertebrates and fish can manifest from hypoxia (or anoxia) in eutrophic aquatic ecosystems with low water turnover rates (Carmogo and Alonso, 2006).
- The situation at Mdlotane: very low O_2 ,
- Mostly closed and considered permanently closed (Harrison, 2000) – turnover rates
- Considered inhospitable due to O_2 levels (Begg 1978 and 1984)
- Demetriates and Forbes (2006) also indicated mostly fresh salinities, even below 1 PSU in summer, prolonged closure and noted a lack of large floods to reset



CONCLUSIONS

- Issues in the Mdlotane catchment are longstanding and cumulative
- Small events can have big impacts – nature of the environment
- Possible enrichment by fertilisers indicated by the high ammonia concentrations and the increase in phosphate levels in summer (high rainfall period)
- Also, high faecal coliform measured (Prince's Grant, not reported)
- Primary productivity accelerated and alters the physicochemical nature of the estuary. Oxygen levels also affected
- Thus, prolonged exposure to high concentrations of ammonia, depletion in oxygen levels and the increases in temperature could have cumulatively affected the fish community and led to the fish kill events
- However, further investigations are required, regular monitoring critical and prompt response to events will give a better understanding.



RECOMMENDATIONS/WAY FORWARD

- Estuarine systems are different and unique; cannot be generalised
- Set eco-specs for Mdlotane and the various estuaries in NESMP
- DWS to continue supporting the NESMP, especially to implement in data poor systems
- Future Systems:
 - ORANGE, ONERUS, HEUNINGNESS, KEURBOOMS, KLEI BRAK, GROOT BRAK, NTAUFUFU, MSIKABA, MTENTU



ACKNOWLEDGEMENTS

- Zinkwazi Blythedale Conservancy
- Ezemvelo KwaZulu Natal Wildlife
- CSIR- Durban
- Prince's Grant Golf Estate

Mdlotane

Prince's Grant Golf Estate

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Google earth

Imagery Date: 8/23/2013 29°20'45.74" S 31°22'09.68" E elev 13 m eye alt 566 m

220 m

2010