water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

EZEMVELO KZN WILDLIFE
Conservation, Partnerships & Ecotourism

COMPARING THE WATER COLUMN DYNAMICS OF PROTECTED ESTUARIES IN KWAZULU NATAL; BASED ON MONITORING CONDUCTED BY EZEMVELO AS PART OF THE NATIONAL ESTUARIES MONITORING PROGRAMME

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Southern African Society of Aquatic Scientists Conference – June/July 2015

OUTLINE

- Background
- Monitoring
- Findings
  - Salinity and Oxygen
  - Nutrients
  - Phytoplankton
- Conclusions
- Recommendations

BACKGROUND

- Estuaries of KwaZulu-Natal are important as fish and crustacean nurseries, as exporters of detritus into the marine ecosystem, and for contribution to the marine commercial fishing
- Possess important biodiversity features (e.g. mangroves)
- But, various activities affect their integrity (highly developed & utilised coast)
  - Vulnerable estuaries

Brousse-James & Associates, 2013 (MNR BID); NBA, 2011

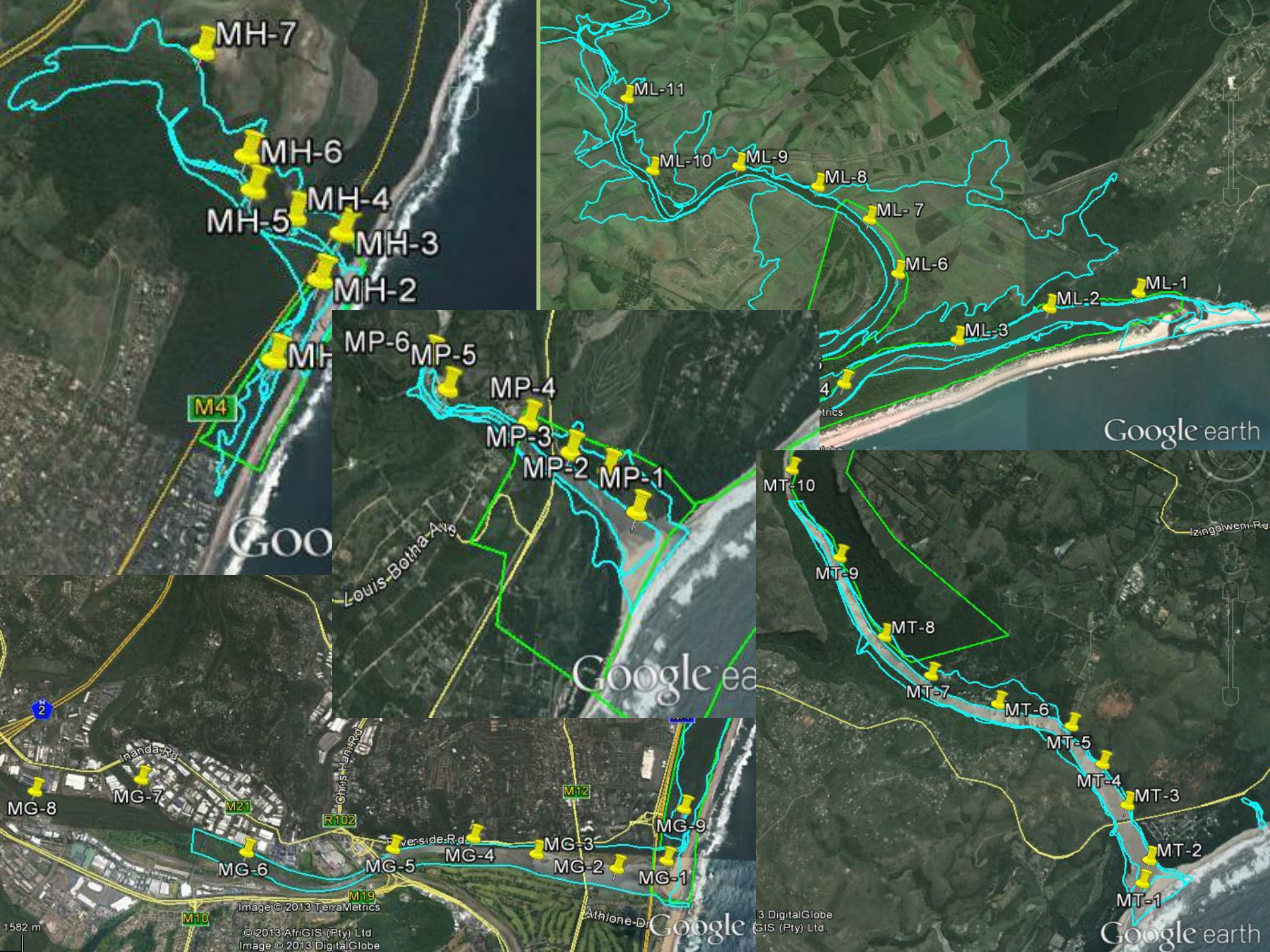
BACKGROUND

- Out of 74 estuaries in KZN, only 10 fall within official protected areas
- Ezemvelo as management authority, outside of iSimangaliso Wetland Park
- Collaboration: Ezemvelo & DWS for National Estuaries Monitoring Programme
- Monitoring on Mlalazi, uMhlanga, uMngeni, Mpenjati and Mtamvuna
- **Partial** estuarine area protected but full protection within that
  - Restrictions on fishing, boating, harvesting, development

Brousse-James & Associates, 2013 (MNR BID); NBA, 2011

MONITORING AND DATA ANALYSIS

- Initially monthly, quarterly from 2014
- 2014 data presented
- Mostly scheduled around Neap Tide
- Vertical profile per site (AquaRead):
  - Salinity
  - Oxygen
- Surface Samples for:
  - Phytoplankton Chlorophyll-a
  - Nutrients
    - DIN
    - DIP
    - Silica
- Contour Plots
  - R Software
- Rainfall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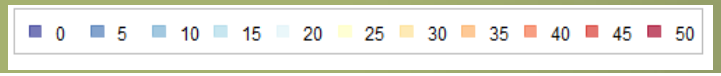
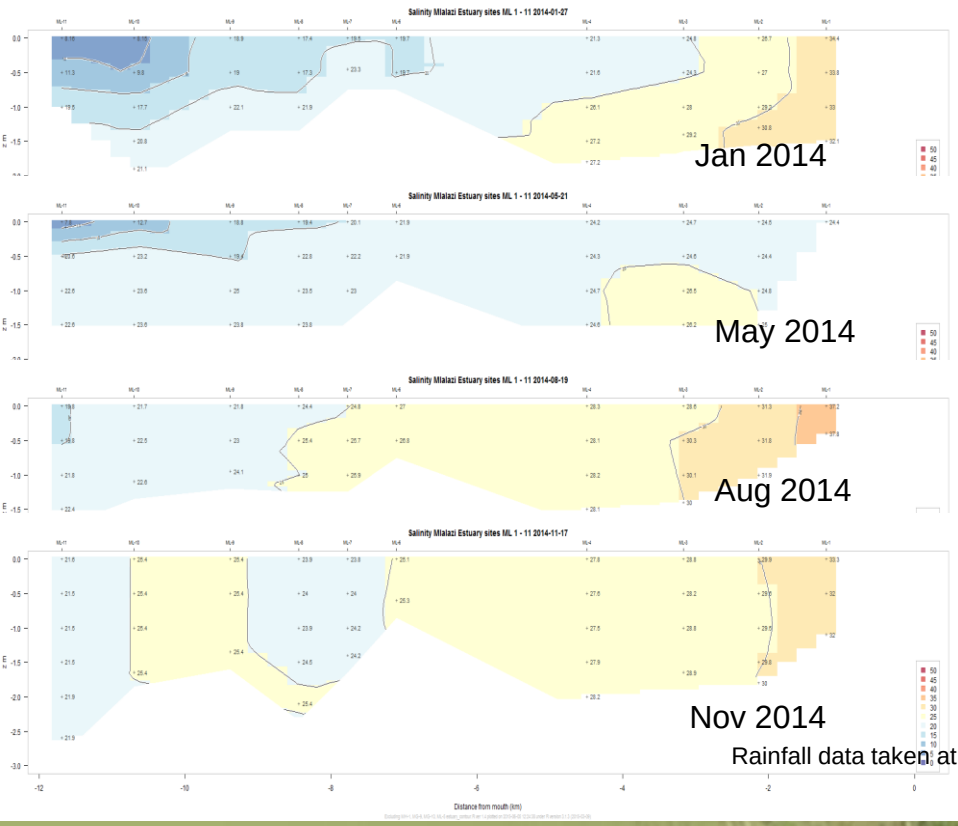
MLALAZI

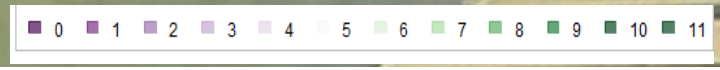
Estuary Info	Sampling Date	Rainfall on Sampling Day (mm)	Total Rainfall Day Prior Sampling (mm)	Total Rainfall 7 Days Prior Sampling (mm)	Tidal Influence
Permanently Open PES = B WWTW Important For Nursery Function Important Bird Areas Site Full no-take protection	27/01/2014	0.25	1.02	2.04	High
	21/05/2014	0.51	0	15.74	High to Low
	19/08/2014	0	0.25	11.43	High to Low
	17/11/2014	1.02	3.05	4.83	High

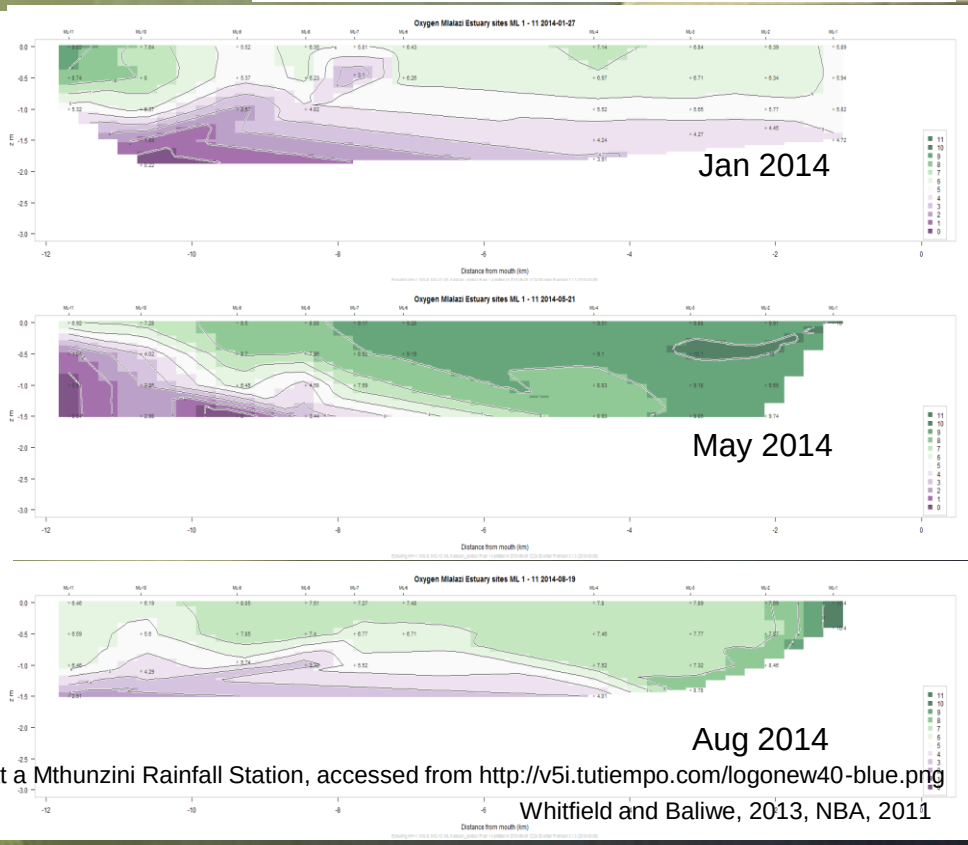
Salinity





Oxygen

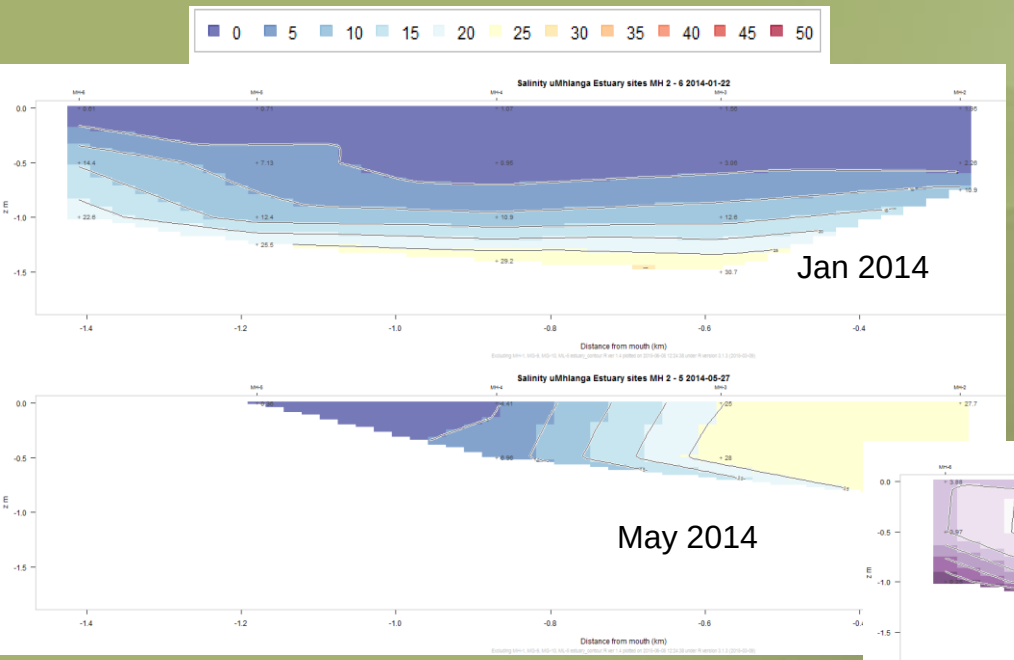




Rainfall data taken at a Mthunzini Rainfall Station, accessed from http://v5i.tutiempo.com/logonew40-blue.png

Whitfield and Baliwe, 2013, NBA, 2011

uMHLANGA

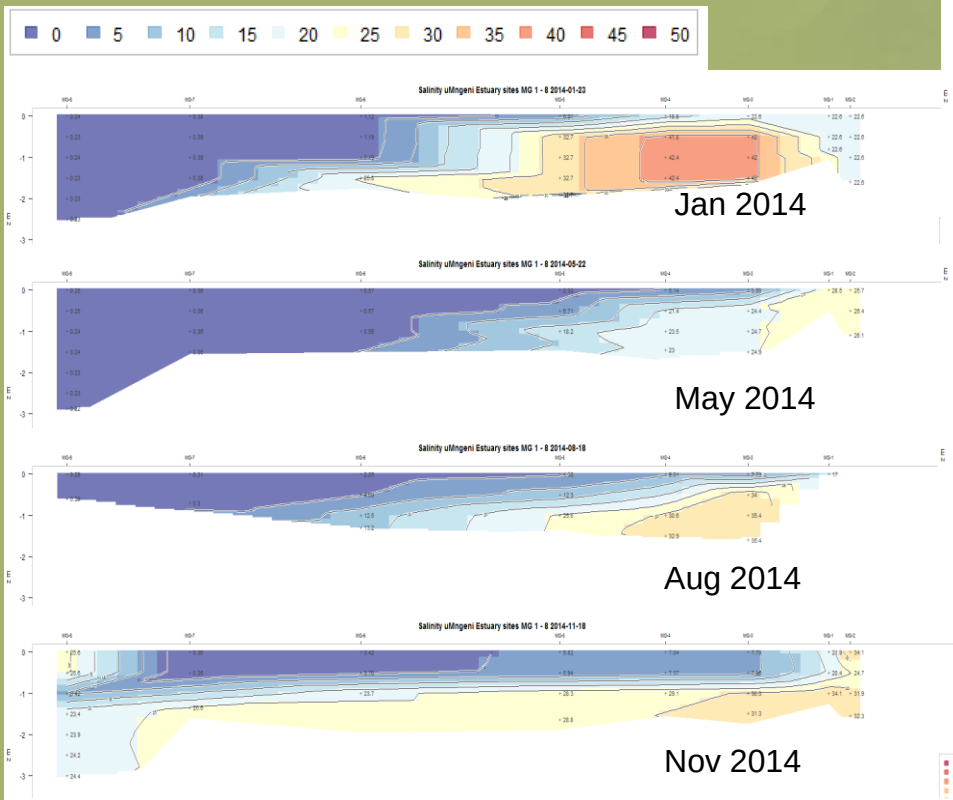


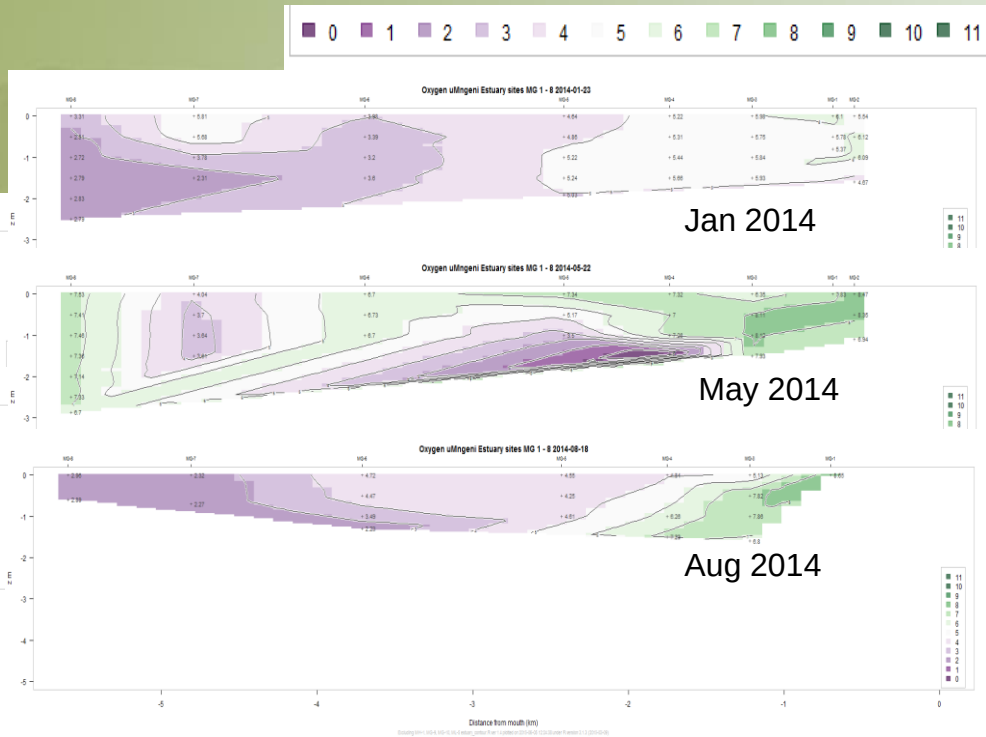
Estuary Info	Sampling Date	Rainfall on Sampling Day (mm)	Total Rainfall Day Prior Sampling (mm)	Total Rainfall 7 Days Prior Sampling (mm)	Mouth Status	Tidal Influence
TOCE PES = D Significant flow modification (increased), Poor water quality, Habitat destruction Full no-take protection (Umhlanga Lagoon Nature Reserve) Perched	22/01/2014	0	0	13.47	Open	High
	27/05/2014	0	0.51	1.53	Open	High

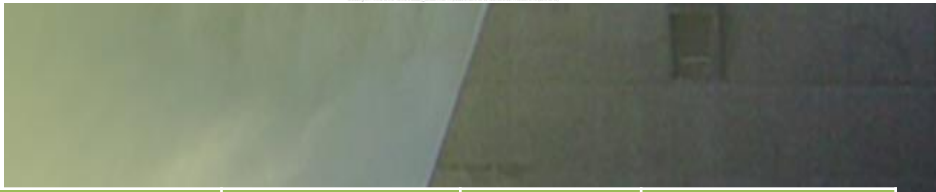
Rainfall data taken at a Durban-Virginia Rainfall Station, accessed from http://v5i.tutiempo.com/logonew40-blue.png

Whitfield and Baliwe, 2013, NBA, 2011, DWA, 2013 (Mvoti Classification)

uMNGENI





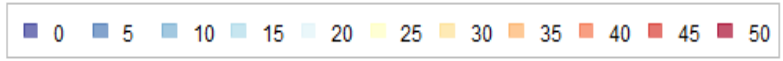


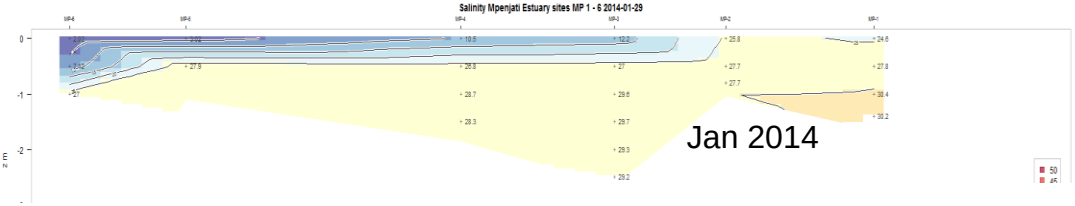
Estuary Info	Sampling Date	Rainfall on Sampling Day (mm)	Total Rainfall Day Prior Sampling (mm)	Total Rainfall 7 Days Prior Sampling (mm)	Mouth Status	Tidal Influence
TOCE PES = E Partial Protection (Beachwood Mangroves Nature Reserve) Significant flow modification, Very poor water quality, Severe habitat destruction	23/01/2014	0	0	12.96	Open	High
	22/05/2014	1.02	0	0	Open	High
	18/08/2014	0.25	0	2.28	Open	High
	18/11/2014	0	0.76	9.9	Open	High

Rainfall data taken at a Durban-Virginia Rainfall Station, accessed from http://v5i.tutiempo.com/logonew40-blue.png

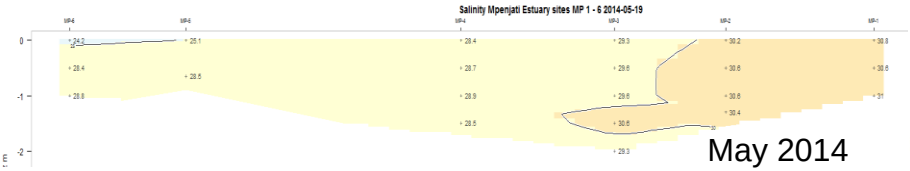
Whitfield and Baliwe, 2013; DWA, 2013 (Mvoti Classification Study-Desktp Ecoclassification and EWR)

MPENJATI





Jan 2014



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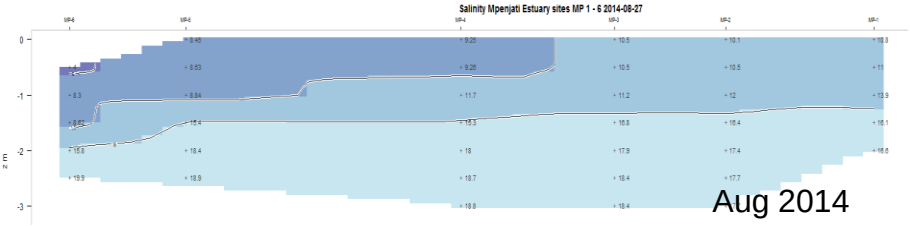

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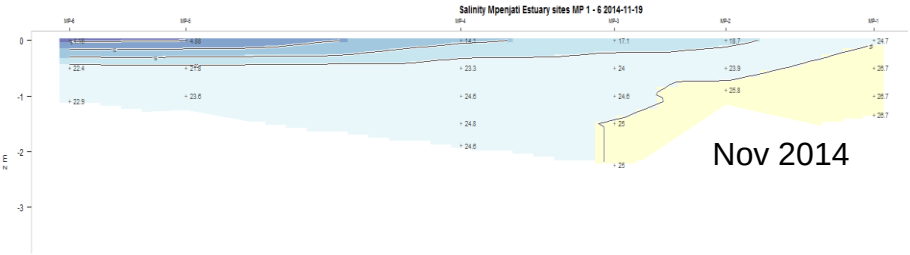

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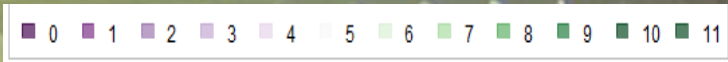

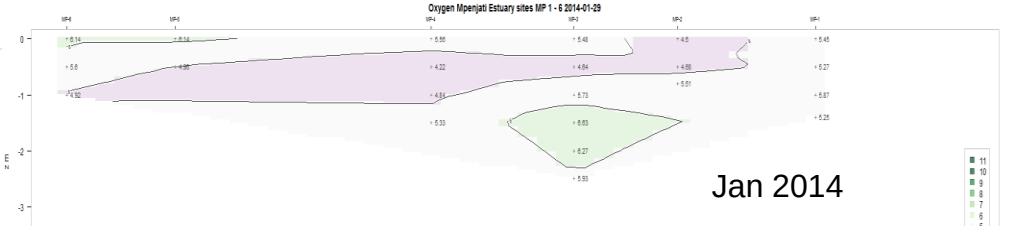

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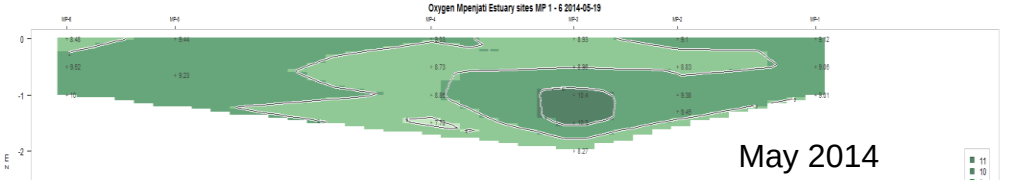

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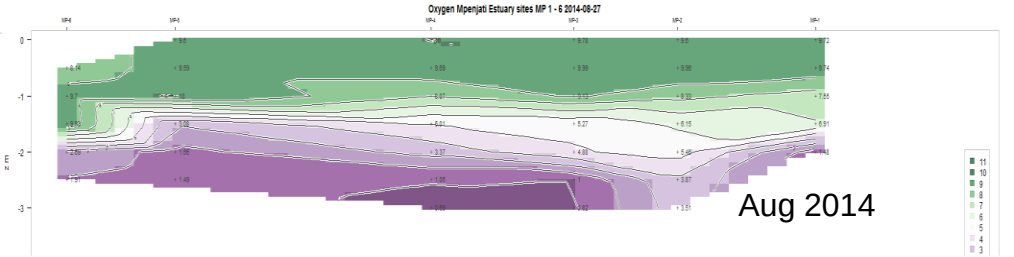


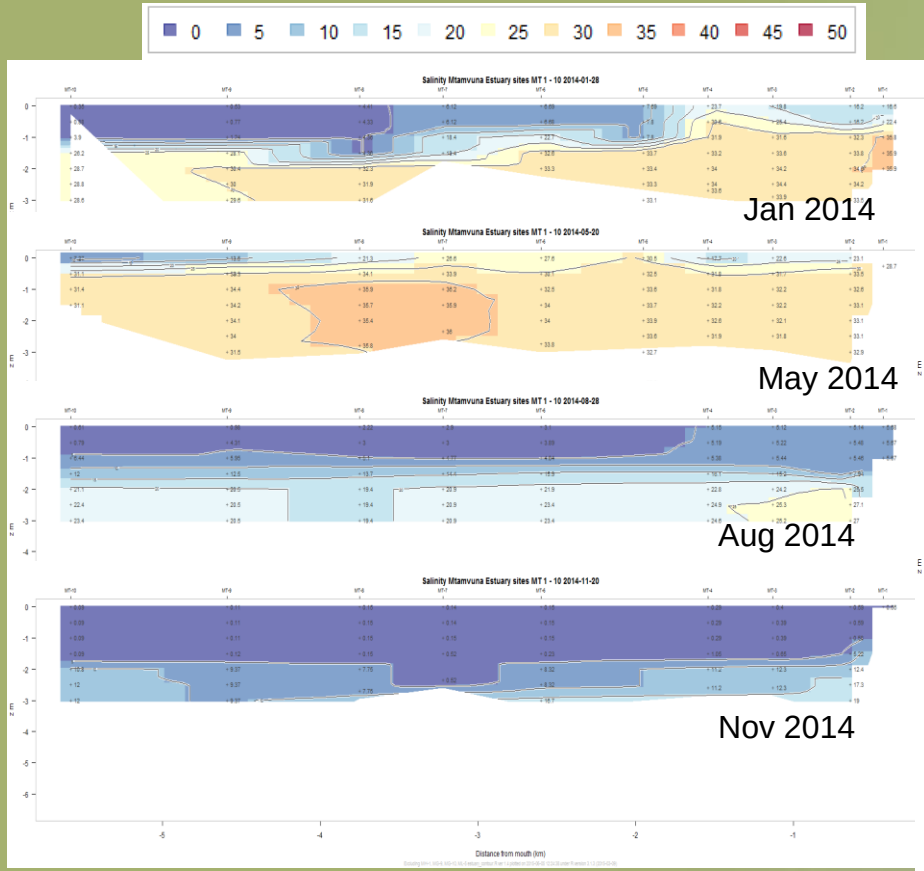
Aug 2014

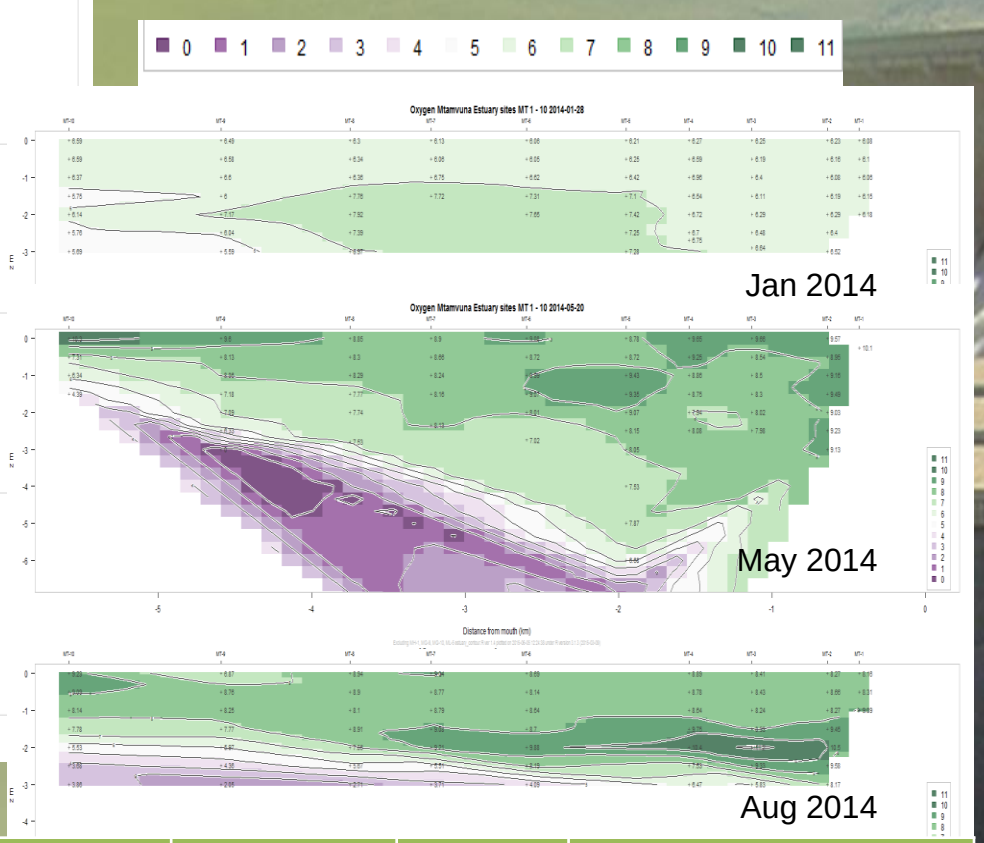
Estuary Info	Sampling Date	Rainfall on Sampling Day (mm)	Total Rainfall Day Prior Sampling (mm)	Total Rainfall 7 Days Prior (mm)	Mouth Status	Tidal Influence
TOCE PES = B Partial Protection (Mpenjati Nature Reserve, Trafalgar MPA) Water quality, habitat destruction	29/01/2014	1.02	0	12.19	Open	Low to High
	19/05/2014	0	0	14.73	Closed	Low
	27/08/2014	0	0	8.13	Closed	High
	19/11/2014	0	0	8.63	Open	High to Low

NBA, 2011, Whitfield and Baliwe, 2013, Ezemvelo, 2012 (Mpenjati EMP draft), DWA, 2013 (Mvoti Classification)

Rainfall data taken at a Port Edward Rainfall Station, accessed from http://v5i.tutiempo.com/logonew40-blue.png

MTAMVUNA





Estuary Info	Sampling Date	Rainfall on Sampling Day (mm)	Total Rainfall Day Prior Sampling (mm)	Total Rainfall 7 Days Prior Sampling (mm)	Mouth Status	Tidal Influence
TOCE PES = B Flow modification, water quality, some habitat destruction Full Protection (Pondoland MPA, Umtamvuna Nature Reserve)	28/01/2014	0	1.02	12.95	Open	High
	20/05/2014	0	0	14.73	Open	High to Low
	28/08/2014	0	0	1.02	Closed	Spring Low
	20/11/2014	0.51	0	3.55	Open	Spring Low to High

NBA, 2011, Whitfield and Baliwe, 2013, DWA, 2013 (Mvoti Classification)

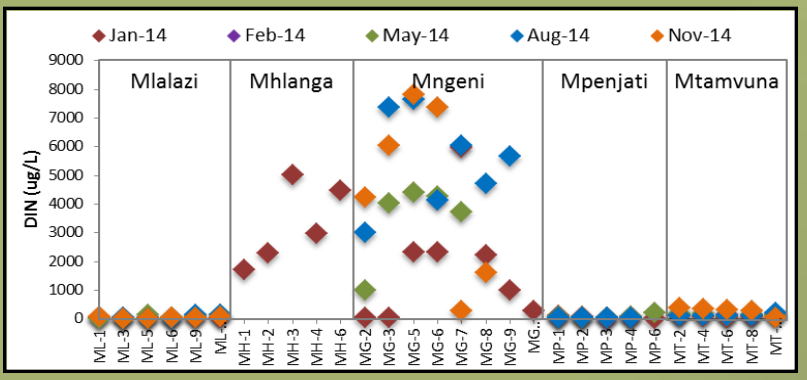
Rainfall data taken at a Port Edward Rainfall Station, accessed from http://v5i.tutiempo.com/logonew40-blue.png

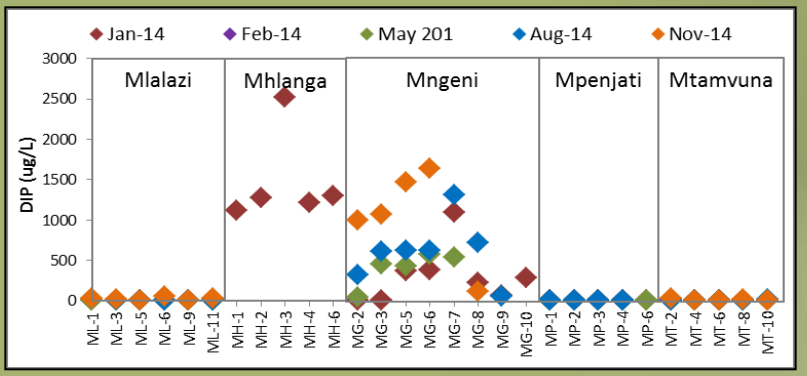
SALINTY AND OXYGEN SUMMARY

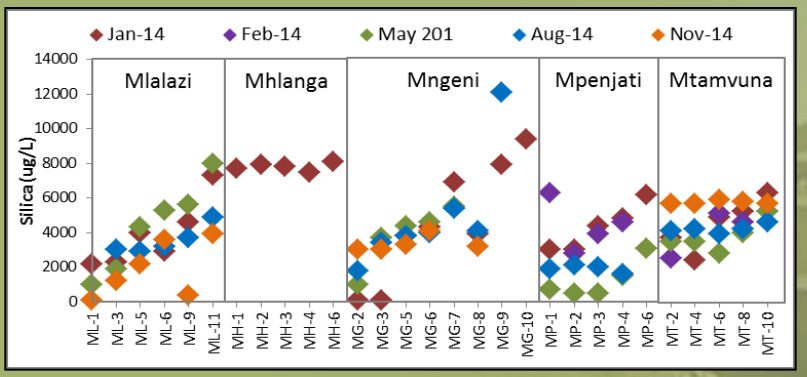
- Natural response to freshwater and seasons in the salinity profiles
- However, tide, degree of dryness of the catchments and mouth closure also play big role i.t.o vertical and horizontal gradients
- Attention to be brought to uMngeni, with the freshwater conditions throughout the year

- Hypoxic conditions with freshwater pulses and with stratification
- Low levels measured at the bottom than surface with less flow, below 4mg/L
- However, when water column well-mixed, higher than 5mg/L oxygen measured, mostly throughout the systems.
- uMngeni showing the highest frequency of hypoxia (layering and continuous nutrient-rich inflow)

NUTRIENTS





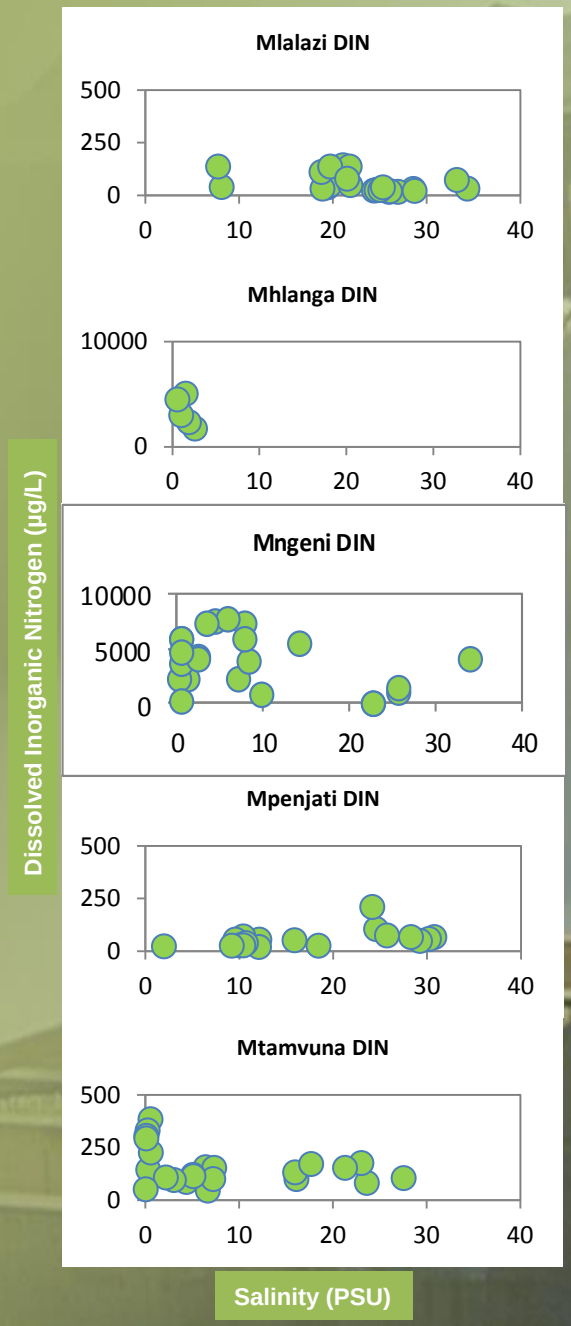


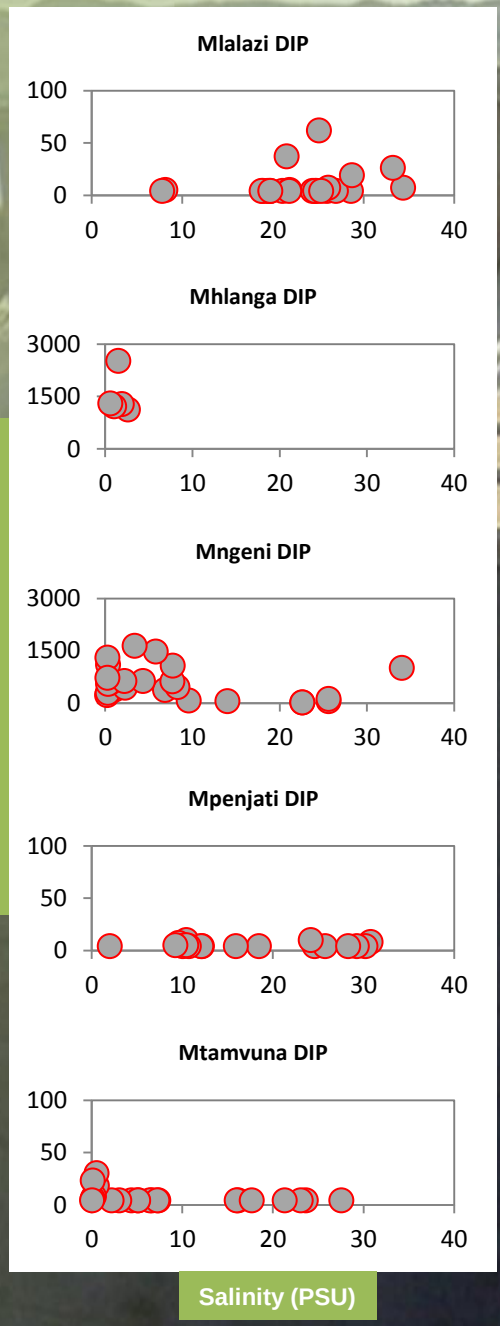
- Very high nutrient levels (DIN and DIP) in eThekwini estuaries
- Mostly below 100µg/L DIN and Mostly 4µg/L DIP in the rest of the estuaries
- The silica concentration increased gradually from the mouth towards the head of the estuary

NUTRIENTS

- Higher DIN and DIP concentrations in the uMngeni and uMhlanga estuaries linked to lower salinities, thus correlated with freshwater input

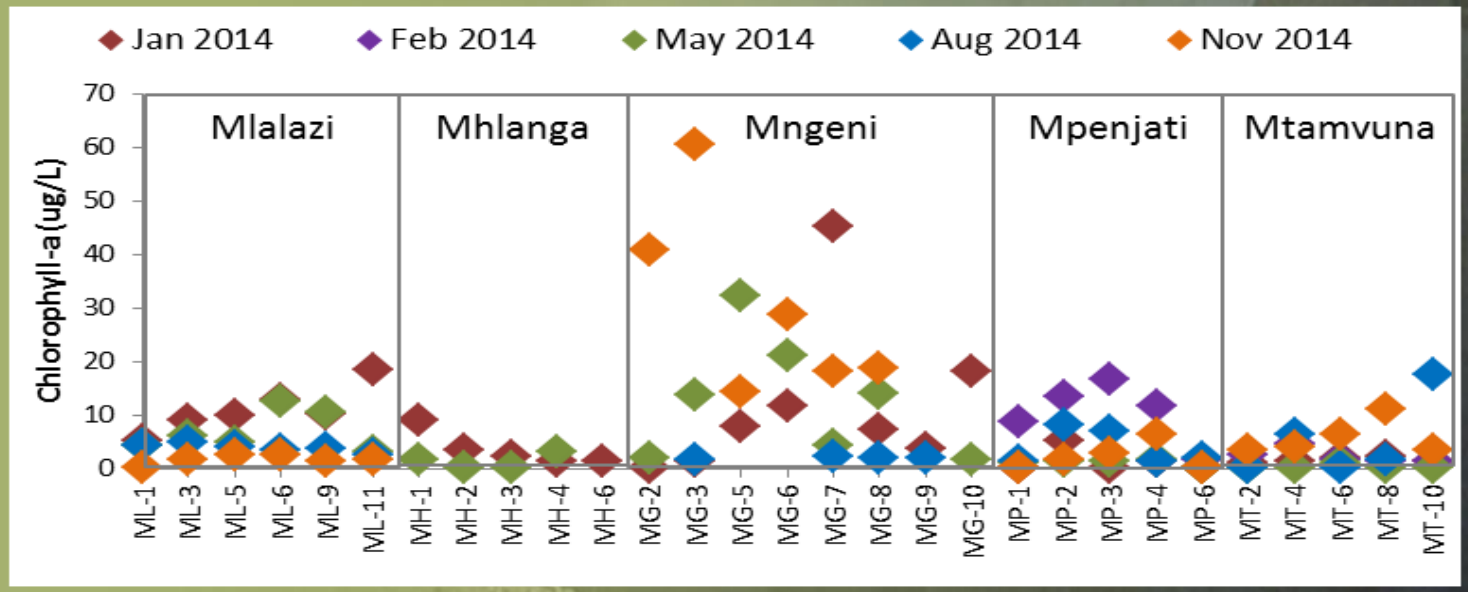
- The other estuaries had wider range of nutrient distribution along the salinity gradient





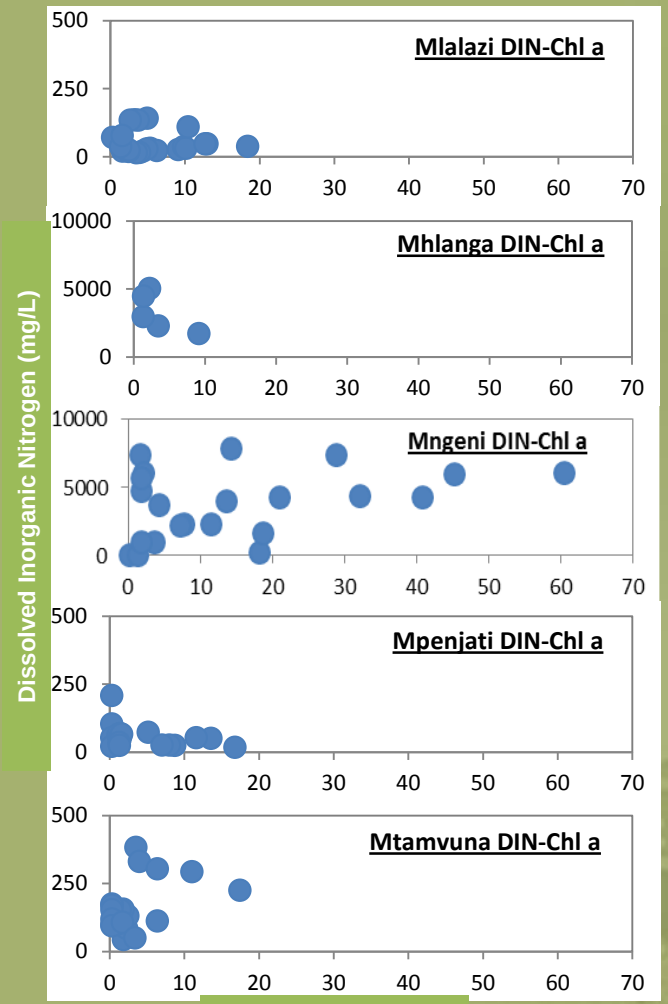
PHYTOPLANKTON BIOMASS

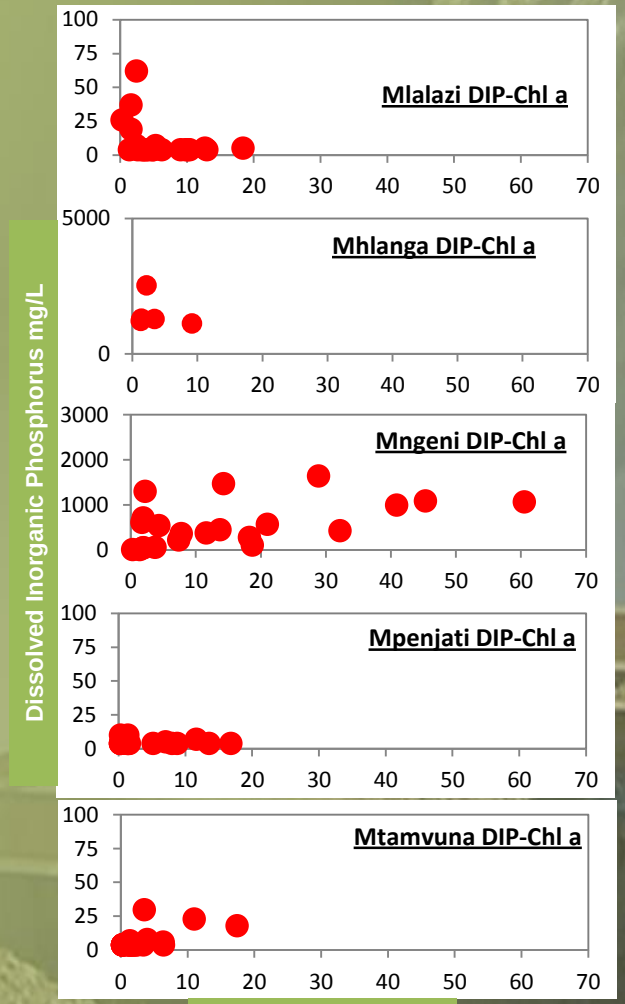
- The water column chlorophyll-a measurements mostly below 20 µg.l^{-1}
- Except for the uMngeni sites
  - But higher chlorophyll-a linked to the higher DIN and DIP
- Biomass increase towards upper reaches in Mlalazi and Mtamvuna
- Higher biomass in Mpenjati mid to lower estuary

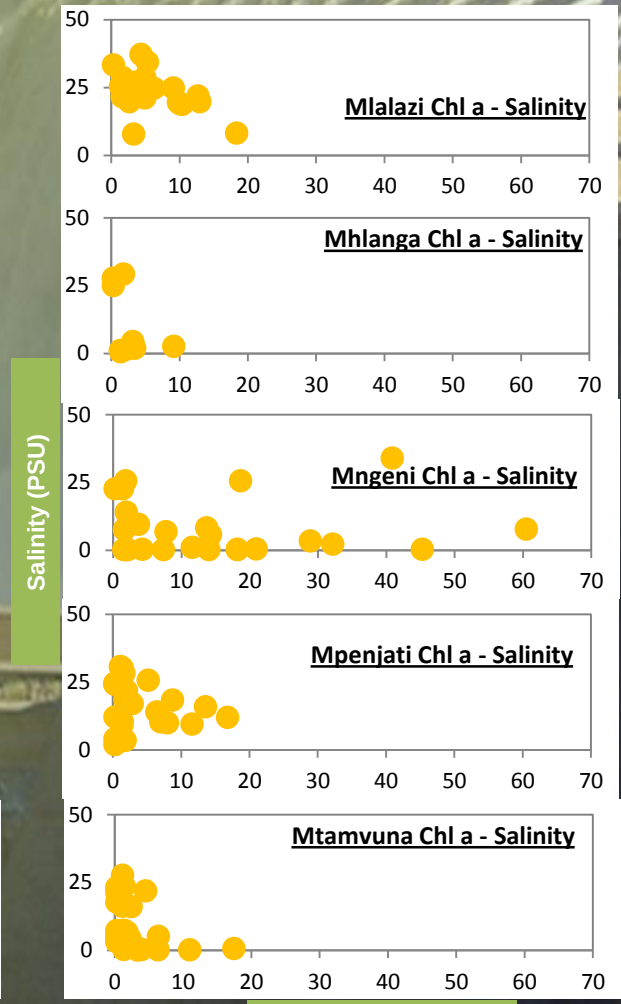


PHYTOPLANKTON BIOMASS AND RESPONSE

- High nutrients but low chlorophyll-a in uMhlanga (RETENTION TIME)
- Whereas, strong correlation in uMngeni
- Higher biomass with lower salinity but weak relationship with nutrients
- Lag in nutrient assimilation by phytoplankton.







CONCLUSIONS AND RECOMMENDATIONS

- Larger data set needed to show significant trends and responses in the estuaries
- The monitoring has indicated that effective estuarine management requires the protection of entire estuarine systems as opposed to partial zones
- Highly developed catchments = highly impacted, even with protection:
  - much harder to manage

CONCLUSIONS AND RECOMMENDATIONS

- Only setting aside areas for protection is not enough, should work with other interventions
- Collaborative management (Conservation agencies with municipalities, other government, farmers and communities)
- Better catchment management:
  - Buffer zones to mitigate impacts from catchment developments
  - Setting back sugar cane areas
  - Increasing treatment levels for WWTW
  - A re-look at the general and special standards
  - Considering treatment for re-use of waste water

THANK YOU

- Ezemvelo KwaZulu Natal Wildlife
  - Santosh, Mondli, Vasha
- DWS Colleagues:
  - M. Silberbauer, G. Cilliers, S Majola
- Prof J. Adams
- CSIR