

Crocodiles: sentinels for river health monitoring?

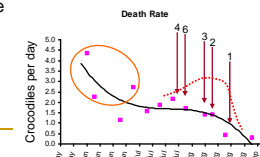
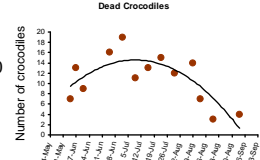


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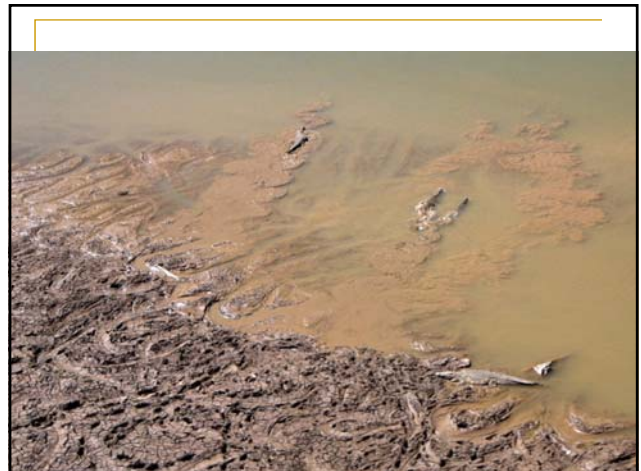
Recent crocodile deaths in Olifants River

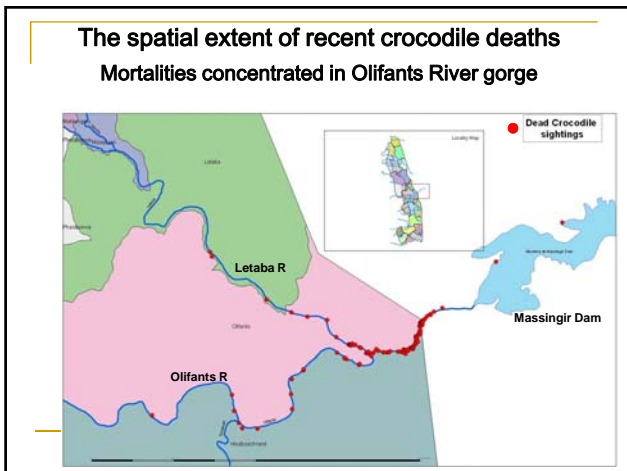
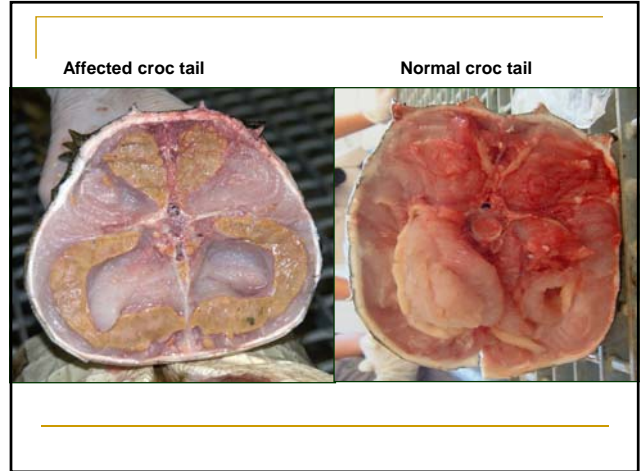
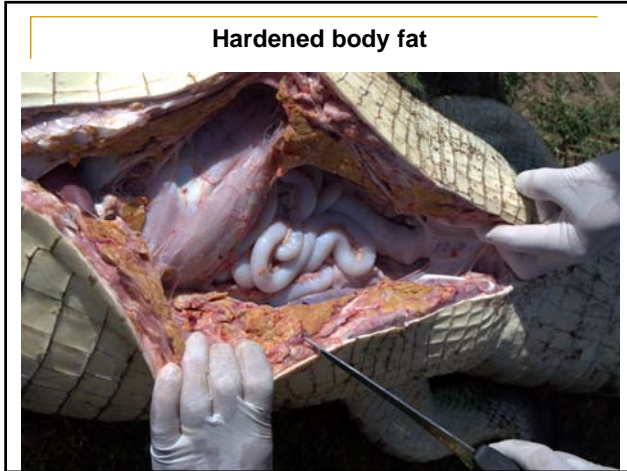
- 27 May '08 - reported 3 dead cros near trails camp
- PM on decomposed croc next day saw hardened orange fat in tail
- On 29 May, a helicopter survey down Olifants & Letaba river – found +/- 20 dead cros
- Weekly survey flights
- Croc deaths peaked June - July
- By the end of November, carcass count escalated to 170
- Several pm's were conducted and the findings were consistent
- Hardened body fat – Pansteatitis
- Mortality rate has slowed
- Never observed a fish kill
- Olifants R very polluted
- Massingir Dam – much silt deposited in gorge with preceding rain season

Crocodile deaths in the Letaba and Olifants



Deep pools filling up with sediments





Investigations focused on

- Water- POPs, heavy metals, water quality parameters
- Sediment – POPs, heavy metals
- Macro-inverts - RHP
- Fish – heavy metals, histopathology
- Crocodiles – POPs, heavy metals, histopathology, blood anti-oxidants

A photograph of a crocodile swimming in a river, used as a background for the investigation list.

<u>Water analysis (POPs)</u>		<u>Heavy metals in sediments</u>			
<ul style="list-style-type: none"> Atrazine 21.5 ng/L DDT 35 ng/L Diethyl phthalate 8.8 ng/L Dibutyl phthalate 4.5 ng/L Naphthalene trace Fluoranthene trace PCB 200092 trace 		<u>Site</u>	<u>Gorge</u>	<u>Ref</u>	<u>Olifants</u>
		Na 23	6.6	2.4	11
		Mg 24	130	15	21
		Al 27	2,000	220	640
		K 39	20	6.4	5.2
		Ca 43	0.2	0.017	0.064
		V 51	5	1.9	4.5
		Cr 53	14	2.7	2.7
		Mn 55	66	6.4	9.2
		Fe 57	2,700	570	1,000
		Co 59	2.2	0.38	0.52
		Ni 60	8.3	1.6	1.6
		Cu 63	3.2	0.66	0.54
		Zn 66	2.8	0.78	0.86
		As 75	0.29	0.11	0.12
		Se 82	0.088	0.054	0.063
		Au 197	0.0022	1.80E-04	1.40E-04
		Pb 208	0.49	0.12	0.11

<u>Croc fat analysis (POPs)</u>	
<ul style="list-style-type: none"> DDE 5.6 ug/g DDD 1 ug/g DDT 0.2 ug/g Unidentified peak 	

Other actions included

- Removing croc carcasses from water
- Removing gill nets from Olifants gorge
- Tagging crocodiles
- Crocodile census
- Fish surveys
- Quick scenario planning exercise
- Awareness campaign – freshwater deterioration in RSA
- 2 Workshops – research & monitoring focus
- Collaboration with – OP, NWU, DWAF, WRC, SAPS, IUCN Croc SG, UKZN, Mpumalanga Cons., fish specialist, various labs., LNP, ARA SUL, etc.



Removing dead fish from gill-net



Crocodile with radio transmitter & tags



Fish surveys

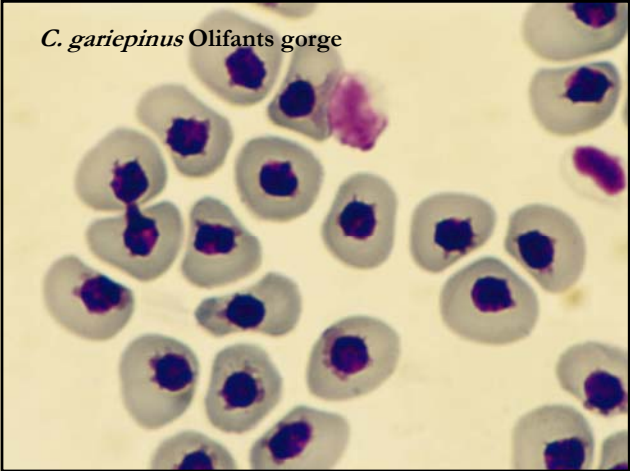
Normal gills



Pale, hyperplastic gills

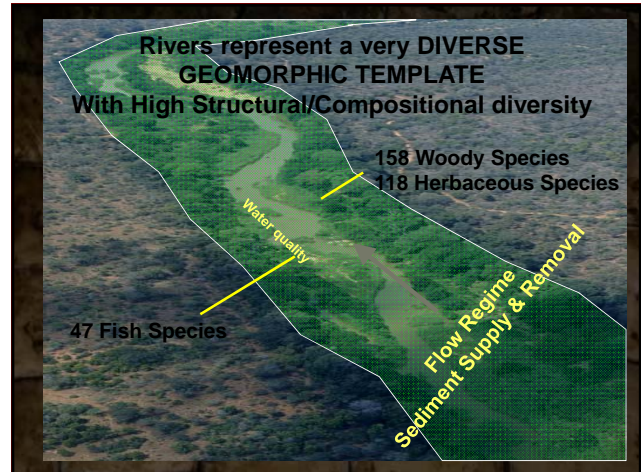


C. gariepinus Olifants gorge



Freshwater conservation

- ◆ There is general lack of emphasis and resources both in SANParks as well as the international arena, put into freshwater conservation issues
- ◆ Rivers are seen as small compared to land surfaces, with generally less charismatic biota and therefore considered merely one part of the terrestrial ecosystem
- ◆ However WWF's Living planet Indices show that freshwater is the most threatened, followed by marine and then some considerable distance behind by terrestrial. Estuaries are the most threatened of all



Concerns related to KNP river management over time

(KNP – A History S. Joubert 2007)

- 1926 Problems of pollution – legal actions taken.
- 1946 Pollution and concerns about diminishing water in rivers.
- 1960 Declining river flows - excessive abstraction of water! Increased need for water storage structures. Concerns about aquatic life.
- 1970 Conservation of riverine ecosystems. Inventories and monitoring of water flow and quality. Meetings with DWAF and projects initiated.
- 1985

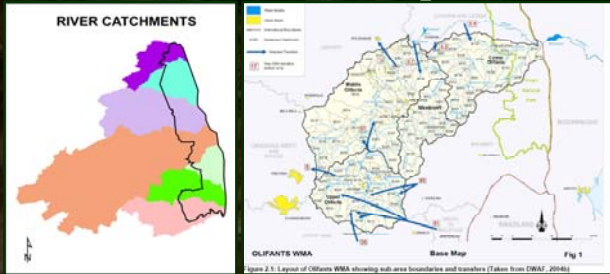
Then in 2005, the Olifants stopped flowing for 78 days



Attracting attention to the cause

- ◆ Engaging with the wider public, especially farmers, factory managers, municipalities and catchment managers have been identified as a key step in promoting freshwater conservation issues.
- ◆ Crocodile deaths in the Olifants River provided a perfect "mascot" for the cause.
- ◆ The Rivers' own charismatic megafauna was attracting a large amount of public attention and funding opportunities in the area. St. Lucia's research program on crocodile population dynamics and ecology was funded 5 years after the application was first made after news of Kruger's croc deaths got out.
- ◆ Crocodile deaths were getting out the message that scientists were saying for years. "there was only so much of abuse and degradation that the system could take before it reached "breaking" point"

Olifants is regarded as the SA's 3rd most hardest working river



Of the KNP's 5 perennial rivers, the Olifants is regarded one of the most impacted. Land use practices within its catchment include mining, commercial agriculture, urban land use. It traverses 3 provinces in SA and 2 countries. Truly transboundary

Development of the consortium for the restoration of the Olifants catchment – CROC

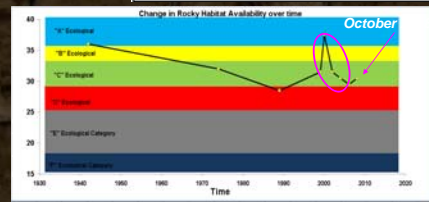
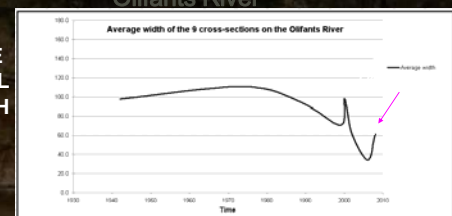
- ◆ The group was largely formed by inter-departmental and individual level involvement in trying to understand the crocodile deaths- initially rather a 'crisis-management' group to later a interdisciplinary forum with goals to:-
- ◆ Establish cause and effect of all issues relating to the crocodile crisis, and the wider implications, including human health, for managing the Olifants and other basins sustainably.
- ◆ To facilitate change in management and policy generation and implementation (including international obligations) for the equitable sharing of water resources.
- ◆ To promote increased awareness, inter-departmental, inter-agency and cross-sectoral coordination and an assertive watchdog function, and appropriate leadership.

River health Monitoring Program

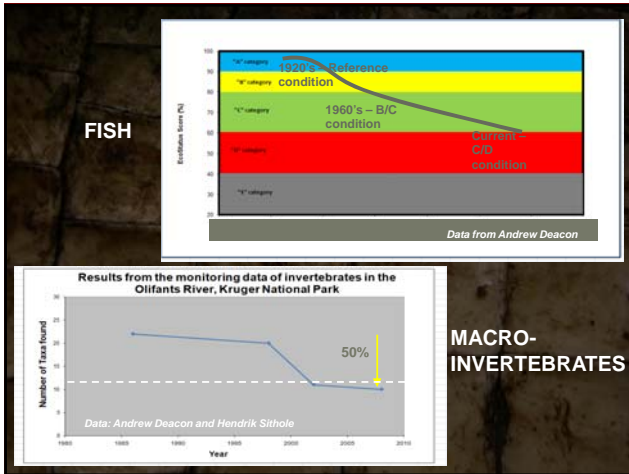
- ◆ After 1989, development of an integrated River health program that addressed various biophysical aspects; water quality, niche habitat availability, macro invertebrates diversity and fish composition
- ◆ The Olifants river had 5 registered monitoring sites.
- ◆ So up until the crocodiles started dying, these sites were still being monitored, so why was a change not picked up before?



ACTIVE CHANNEL WIDTH



Bedrock Habitat Availability



- ### Where to Now?
- Early analysis of monitoring data was not happening
 - Macro-invertebrate loss was not nearly charismatic enough to get authorities to respond
 - Water Quality monitoring indicated that quality was acceptable, fish composition and appearance appeared normal
 - The monitoring prog was hoping to detect by its indices an acute pollution event - chronic pollution parameters were not built in.
 - Need to investigate accumulation of toxins, pesticides, and metals in the river, - understand synergies existing between compounds.
 - Organisms at top of the food chain may be good indicators of bioaccumulating substances: crocodiles eggs, herons and raptors.
 - Various fish health parameters may also assist in assessing longer term, lower level pollution incidence.
 - Projects taking place: CSIR water quality in the upper and middle Olifants (mining and irrigation, DWAF water Quality and Eutrophication monitoring).
 - Potential Projects: Masingir Dam project to assess livelihood dependencies, fishing practices and sustainability of fish communities in the Dam. Human Health project in the area.
 - Better cross-country collaboration. Corumana Dam at risk of causing similar problem.

