



THE IMPACT OF ALGAE AND CYANOBACTERIAL BLOOMS ON SOUTH-AFRICAN FRESHWATERS

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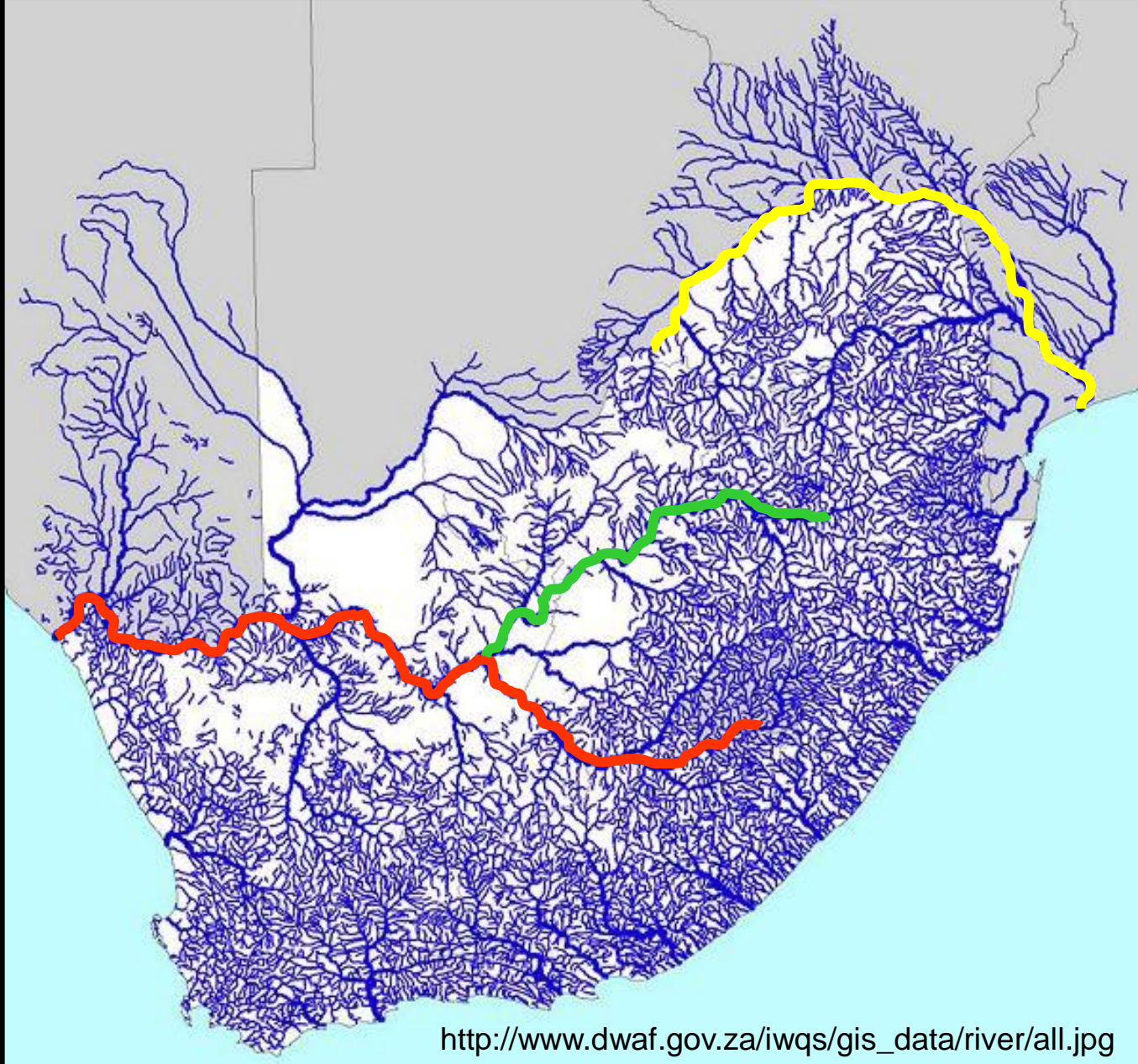


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ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Introduction

- Availability of fresh water – most limiting factor
- Rainfall less than 500 mm/year
- One of the 30 driest countries in the world
- Only three large rivers



Limpopo

Vaal

Orange

http://www.dwaf.gov.za/iwqs/gis_data/river/all.jpg

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Introduction

- Availability of fresh water – most limiting factor
- Only three large rivers
- Almost 200 dams (man-made):
 - Limpopo – 27
 - Mpumalanga – 23
 - KwaZulu Natal – 15
 - Gauteng – 4
 - North West – 20
 - Free State – 30
 - Eastern Cape – 29
 - Northern Cape – 5
 - Western Cape - 45

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Introduction



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Introduction



The Gariep Dam, in the Free State, is the dam with the largest storage capacity (5 500 million m³) ever built in South Africa. Constructed in 1972, it stores water from the Orange River in a 100 km-long dam with a surface area of 374 km².

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

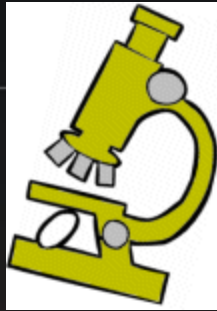


Introduction

- Mixed algal assemblage
- Research on the Vaal River:
 - Chlorophyta and Bacillariophyta
 - Cyanophyta
 - Crypto-, Chryso-, Dino- and Euglenophyta
- Results from long-term data base
- Introduction of “new” species



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS



Material and methods

- Samples taken from various rivers and dams in the country
- Fixed with formaldehyde or lugol's solution
- Gas vacuoles of cyanobacteria deflated
- Sub-samples transferred into a sedimentation chamber
- Left for 48 hours to settle
- Algae counted by means of an inverted light microscope
- Counts were expressed in terms of cells/ml water

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Hartbeespoort Dam (capacity 195 million m³)

- Place of beauty and pleasure
- Surrounded by the majesty of the Magaliesberg mountain range
- Villages of Hartbeespoort and Kosmos is situated along the shores of the dam, among undulating hills and panoramic views on the dam and the majestic Magaliesberg Mountains
- Activities:
 - Hot air ballooning and hang-gliding
 - Para-sailing, windsurfing, jet-skiing
 - Aquarium and snake park
 - Elephant sanctuary and a cheetah farm
 - Cable car
- Playground and home of millionaires



BUT



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Hartbeespoort Dam



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Hartbeespoort Dam



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Hartbeespoort Dam



<http://blog.dhec.co.za/2011/02/why-do-we-have-a-water-crisis/>

Photograph: Bill Harding

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Hartbeespoort Dam



- Death of cattle & livestock
- Impair recreation
- Skin rashes
- Eye irritations
- Vomiting
- Gastroenteritis
- Diarrhoea
- Oxygen depletion
- Fish kills
- Taste and odour
- Toxin production
- Costs of water purification

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Hartbeespoort Dam



Microcystis aeruginosa

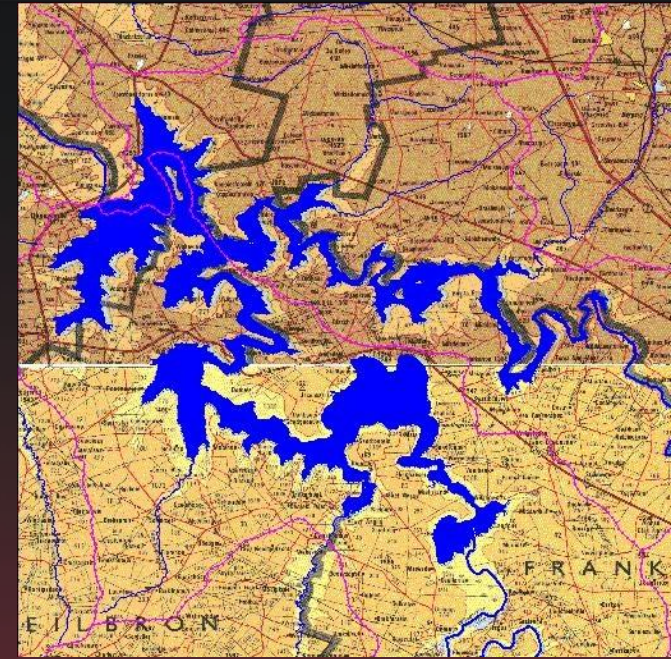
- Present for at least 10 months of the year
- Concentrations up to 1.76×10^9 cells/ml (Zohary, 1985)
- Chl *a* concentrations more than 100 mg/L
- Toxic strains:
Microcystin Geosmin
- Methylisoborneol (MIB)

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Vaal Dam (capacity : 2,188 million m³)



Vaal Dam, Department of Water Affairs and Forestry



Microcystis aeruginosa

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Vaal Dam

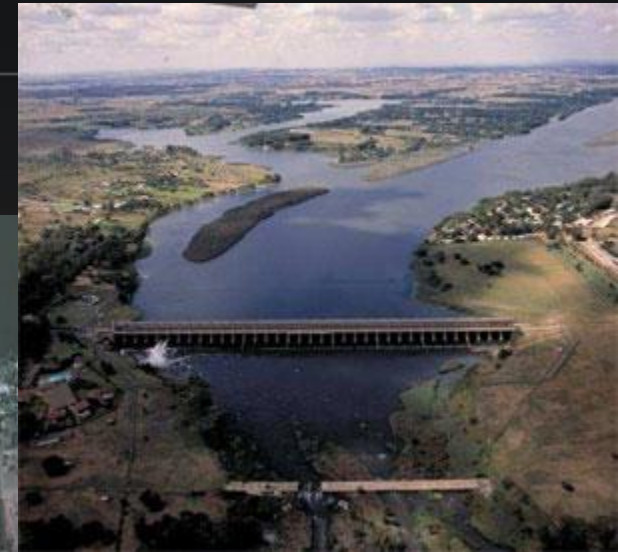


Vaal Dam, Department of Water Affairs and Forestry

- 1941-1943: Thousands of animals died including mules, donkeys, dogs, rabbits and poultry.
- Colour of “green pea soup”
- Treated by 360 tons copper sulphate

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Vaal River Barrage (capacity 56.7 million m³)



Imagery Date: 11/4/2011

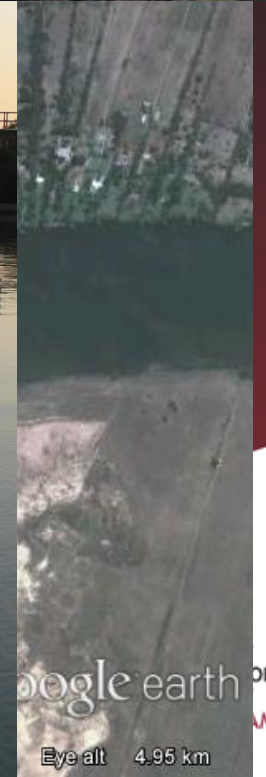
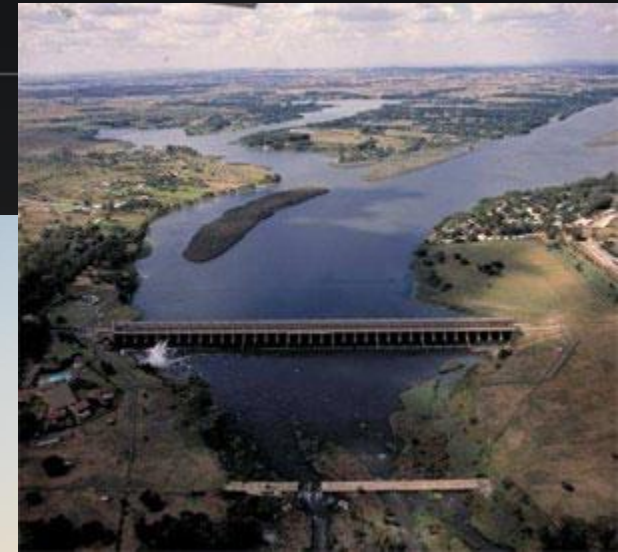
26°45'36.07" S 27°41'59.39" E elev 1430 m

Eye alt 4.95 km

OPHIRIMA
AMPUS

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Vaal River Barrage (capacity 56.7 million m³)



google earth

Eye alt 4.95 km

OPHIRIMA
AMPUS

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Vaal River Barrage (capacity 56.7 million m³)



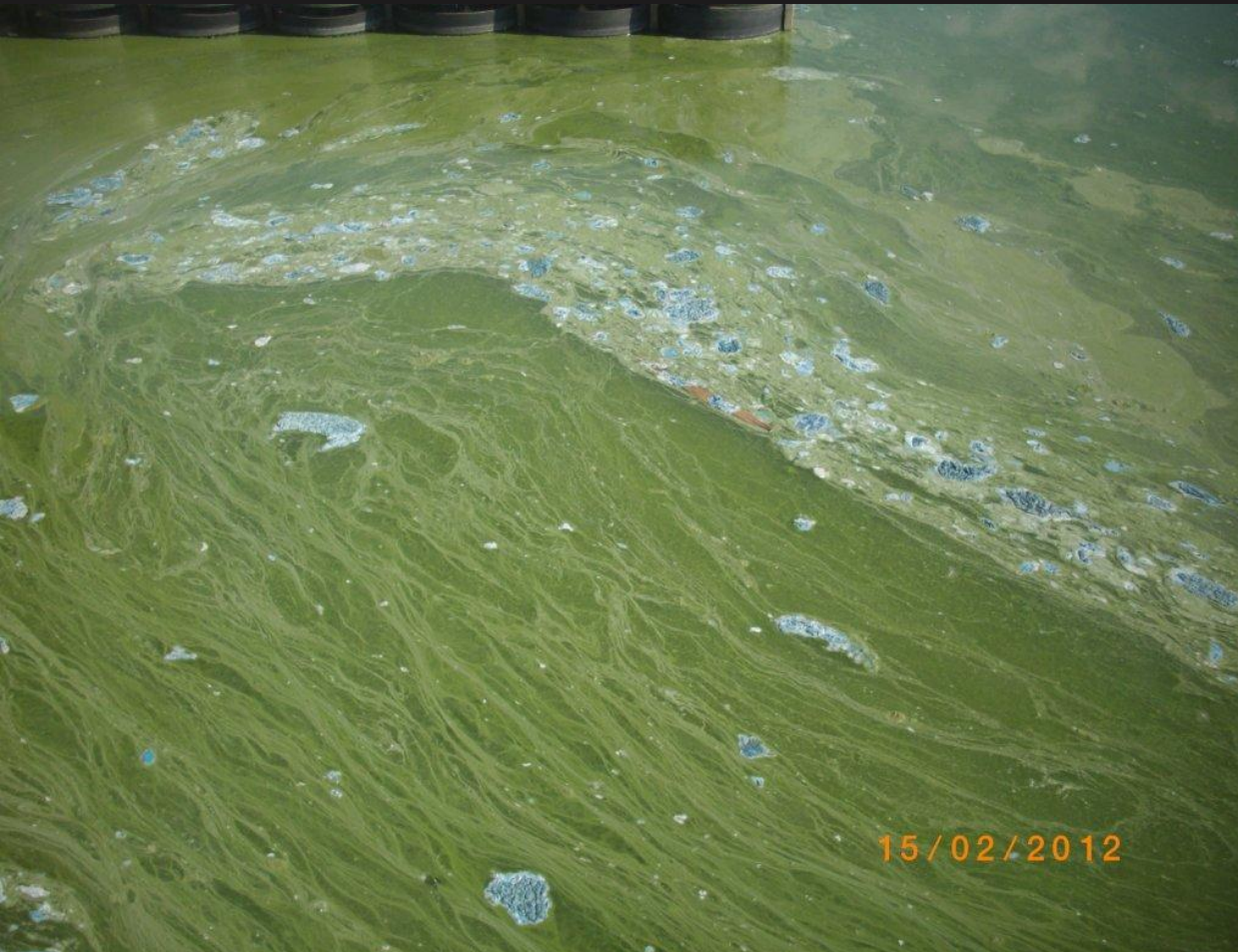
Oscillatoria sp.



Microcystis aeruginosa

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Vaal River Barrage (capacity 56.7 million m³)



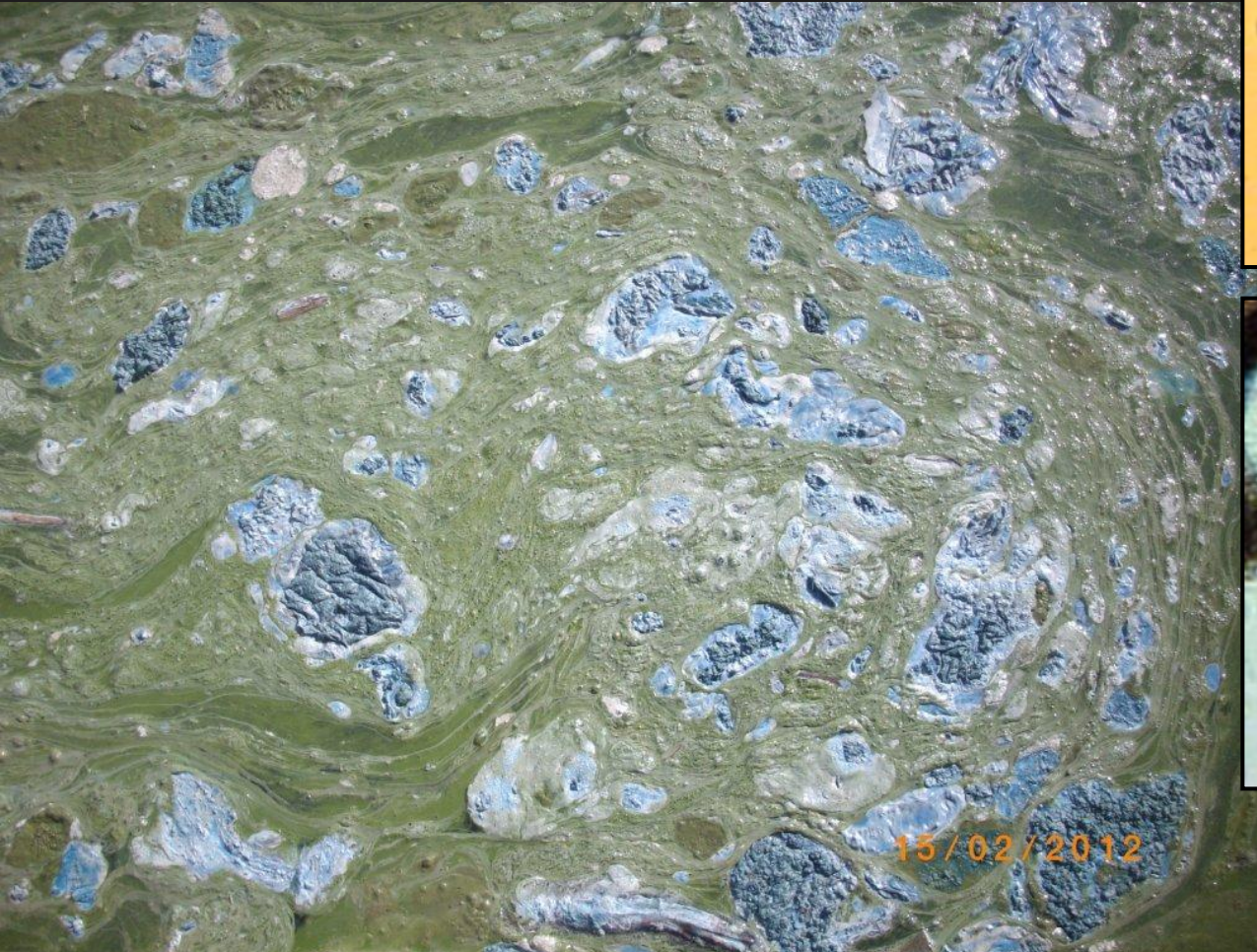
Oscillatoria sp.



Microcystis aeruginosa

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Vaal River Barrage (capacity 56.7 million m³)



Oscillatoria sp.



Microcystis aeruginosa

Woede oor 'groen mat'

Rioolvuil en alge besmet Vaalrivier

Elise Tempelhoff

Huiseienaars by Miljoenêrsdraai (Millionaire's Bend) is woedend vir die departement van waterwese omdat die Vaalrivier 10 km ver, tot naby die Barra-gebrug, soos " 'n massiewe groen tapyt" lyk weens rioolafval

300 beeste in die Vrystaat drink glo daaglik dié rioolwater omdat daar geen ander vars water in die gebied is nie.

Só het mnr. Colin Diab, inwoner van dié welgestelde buurt, dié week in 'n brief aan mnr. Marius Keet, senior bestuurder van watergehaltebestuur in die departement van waterwese, geskryf.

Daarin skryf Diab: "... ek praat namens baie woedende

Vaalrivier Barrage is nou 'n "tweede Hartbeespoortdam".

Diab vra Keet waarom sy departement nie bewus is van die blougroen alge wat hul rivier "versmoor" nie.

Hy wil ook weet waarom daar nie waarskuwingsborde langs die rivier opgerig word om mense teen die giftige water te waarsku nie.

"Ons huise se waarde het geval omdat dit langs 'n rioolrivier staan. Hierdie water – wat hier by ons voorstoepe verbyvloei – is rioolafval,



Voëls is nie deur die Almagtige geskape om rioolafval te drink nie.

skaptoernooi waaraan verteenwoordigers van 11 lande deelgeneem het, is verlede naweek in die rivier gehou en niemand het die deelnemers gewaarsku teen die alge in die water nie.

ons water binnegaan te waar- sku as dit gevaarlik is nie?"

Diab sê almal by die rivier is ontsteld omdat die watervoëls nou ook geen skoon drinkwater het nie. "Voëls is nie deur die Almagtige geskape om rioolafval te drink nie."

Keet het gesê nadat hy Diab se brief ontvang het, het die departement dadelik 'n span gestuur om ondersoek in te stel. Die span moet aanstaande week terugvoering gee.

Volgens Keet is daar meer as 22 rioolsuiweringaanlegte in

Oor waarskuwingsborde het Keet gesê dit is nie sy departement se mandaat nie.

"Ons waarsku mense op 'n ad hoc-grondslag. Soos die water nou lyk, is dit natuurlik dodelik om daarin te swem."

Mnr. Greg Mulzack, woordvoerder van Rand Water, het gesê dit is ook nie hul mandaat om mense te waarsku om nie die Vaalrivier se water te gebruik nie. Hy het beklemtoon dat dit waterwese se werk is.

Diab het gesê só word hulle van ook bakboord na stuur-

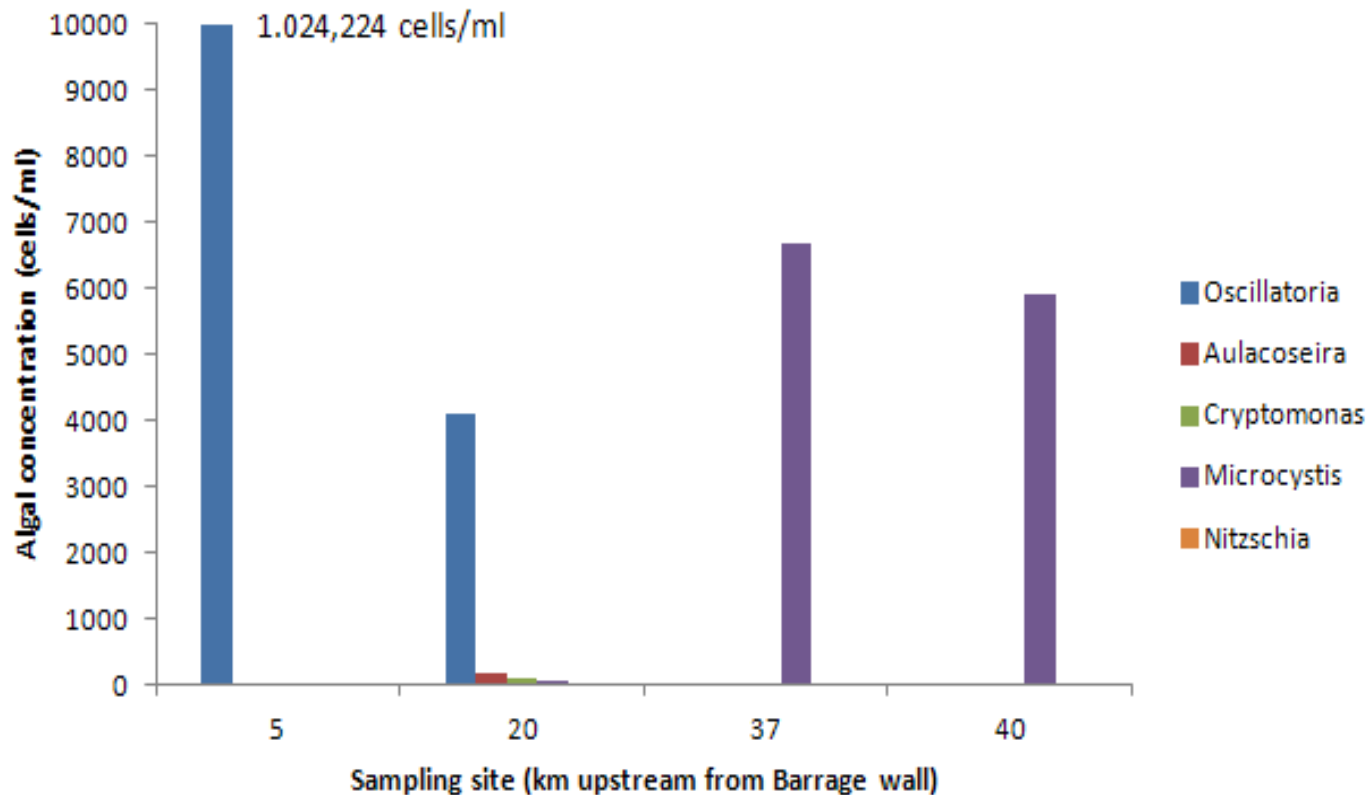


"Millionaire's Bend"
 300 cattle drink this water
 Many water birds dependant on this water since it is the only fresh water in the area

Mnr. Thomas du Toit lyk na die alge in die Vaalrivier Barrage wat al meer as twee weke in die water voorkom. Foto: JOHANN TEMPELHOFF

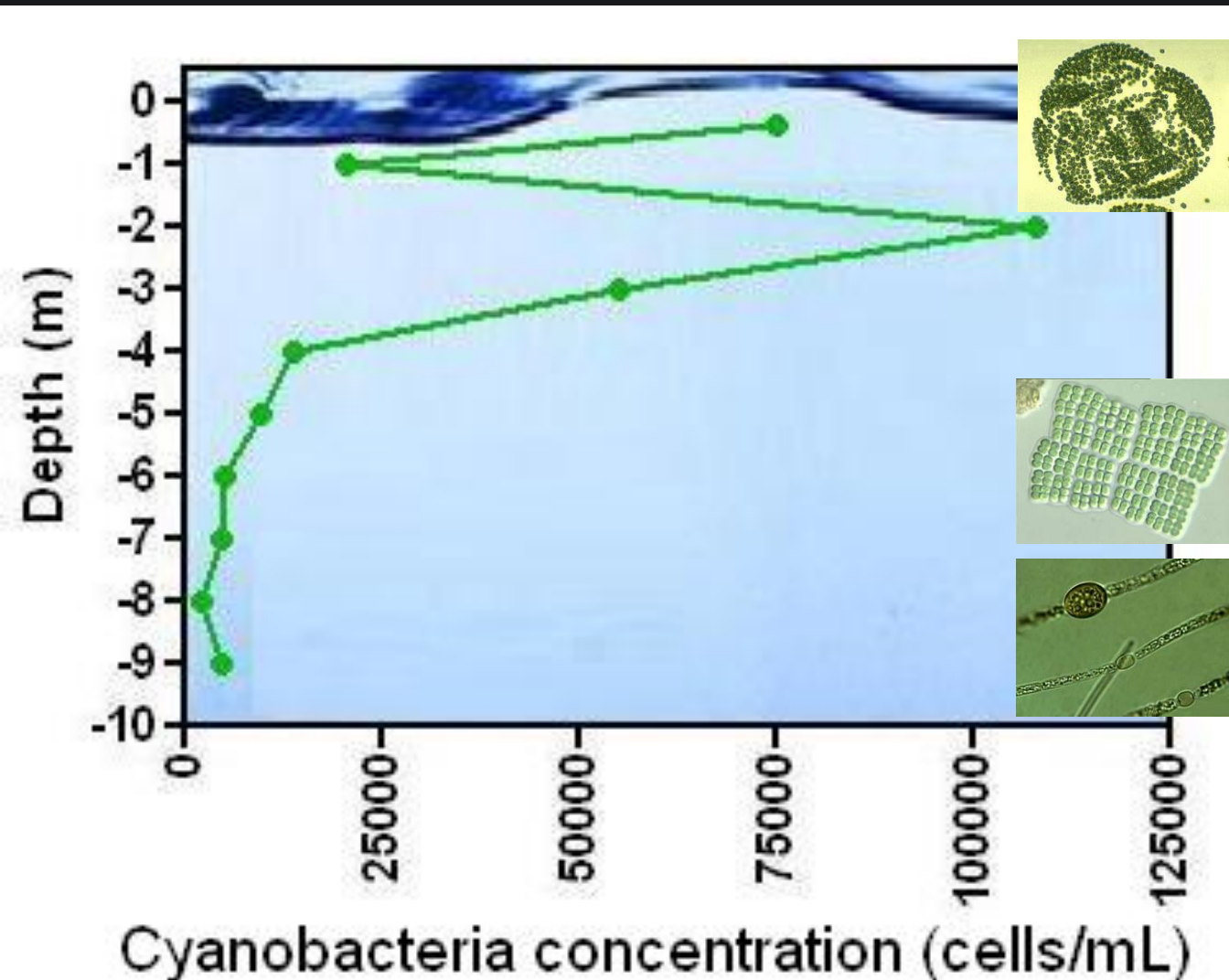
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Vaal River Barrage (22 February 2012)



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Vaalkop Dam (capacity 35 million m³)



Cyanobacteria depth profile at Vaalkop Dam intake tower (02/02/12)

VAALKOP DRINKING WATER PURIFICATION PLANT:

- 6000 cells/ml penetrated and were found in the DRINKING water
- Withdrew water from a deeper depth (4 m)
- Only 5 cells/ml penetrated into final water

ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

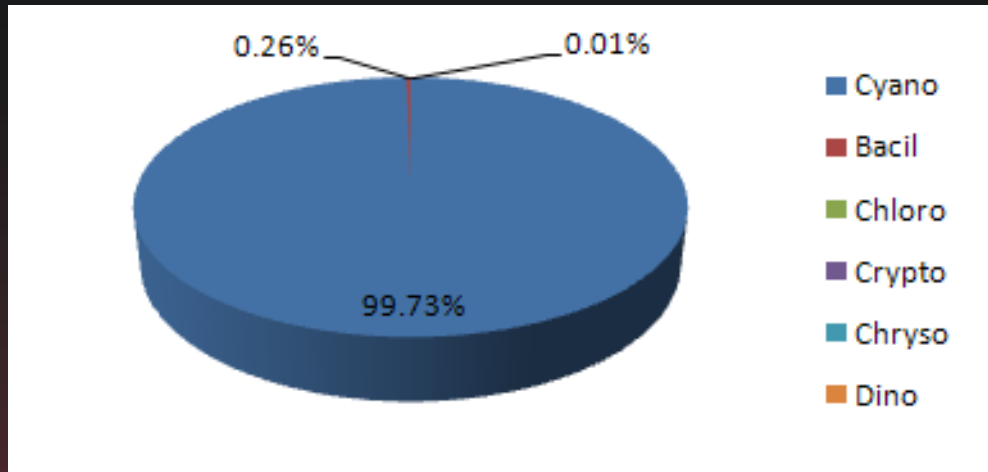
Allemanaskraal Dam (capacity 174.2 million m³)



17 March 2010

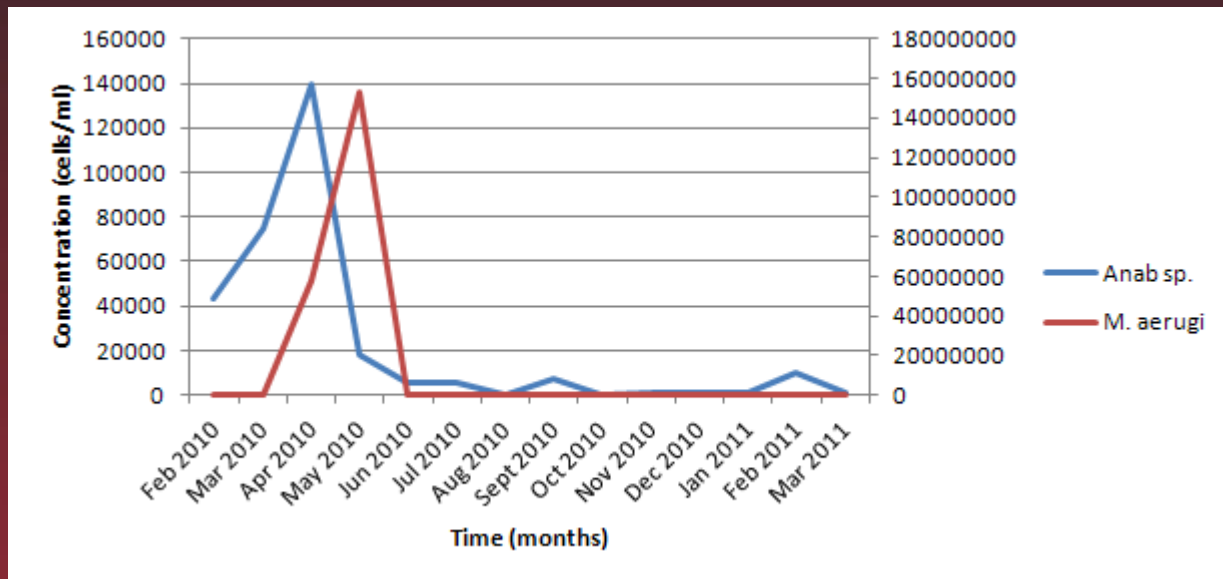
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Allemanaskraal Dam



Anabaena circinalis
Concentration of 140 000 cells/ml recorded during April 2010

Microcystis aeruginosa
Concentration of 160 million cells/ml recorded during May 2010



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

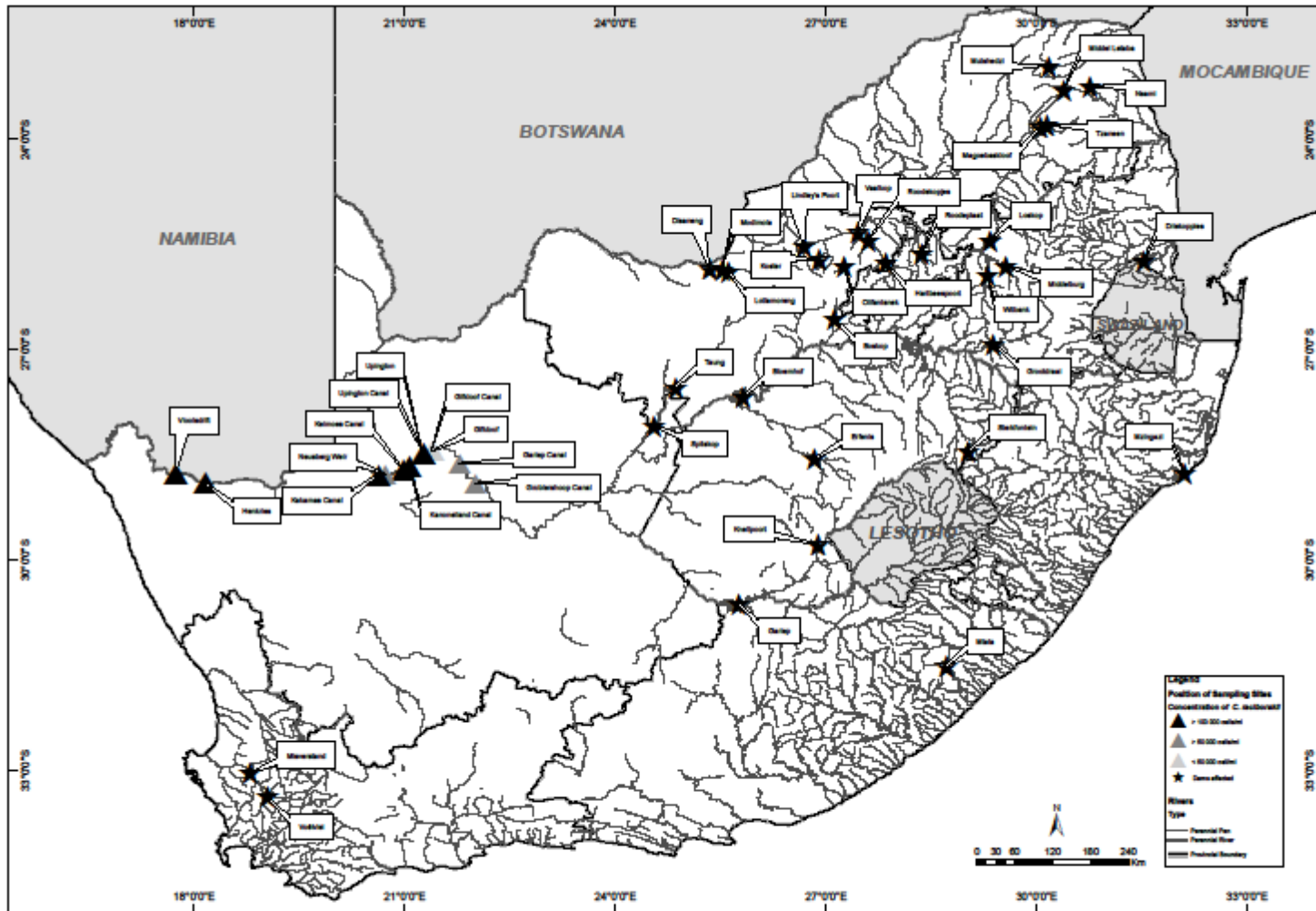
Lower Orange River



- Mixed algal assemblage
- Serious problems related to algal blooms seldom encountered.
- Summer of 2000 – massive bloom (> 1 million cells/ml) of *Cylindrospermopsis raciborskii*
 - Blocked sand filters
 - Water treatment
 - Taste and odours
 - Fish kills (cylindrospermopsin, saxitoxin & anatoxin-a)
- 2003 and 2005 similar blooms
- Spreading towards other rivers in SA



Cylindrospermopsis raciborskii



Map of South Africa, indicating rivers and dams invaded by *C. raciborskii*.

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Vaal River Barrage



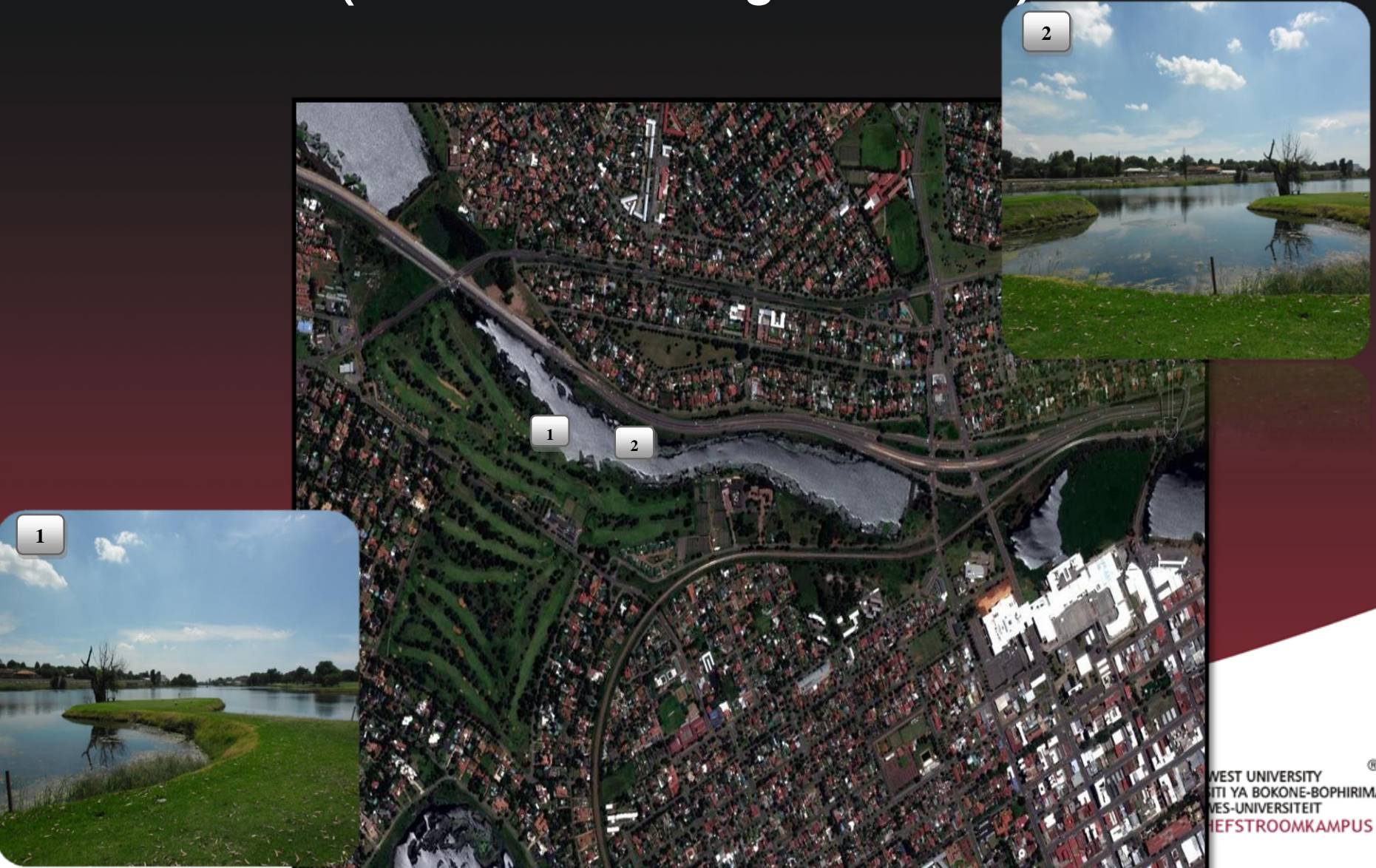
Pandorina morum

12 October 2011

Chlorophyll-a concentration ranged from 140 – 290 $\mu\text{g/l}$

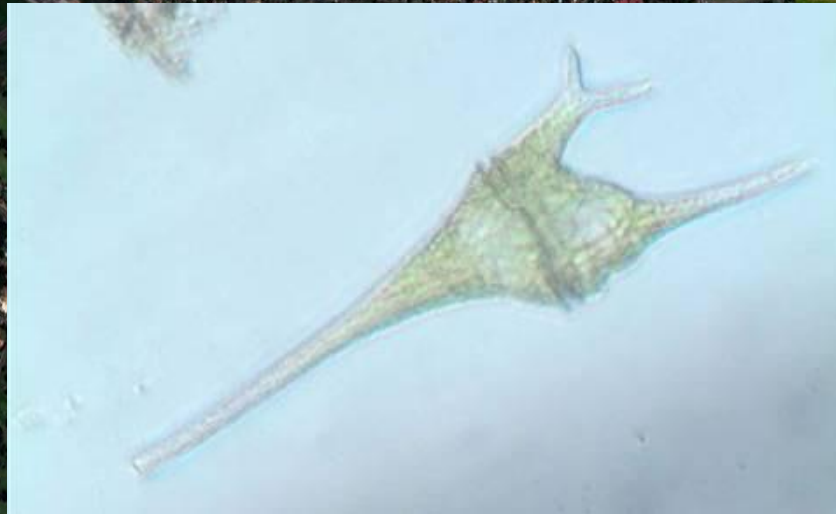
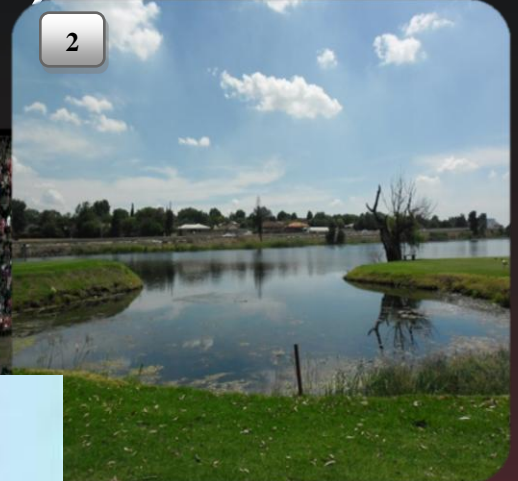
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Benoni Lake (situated next to golf course)



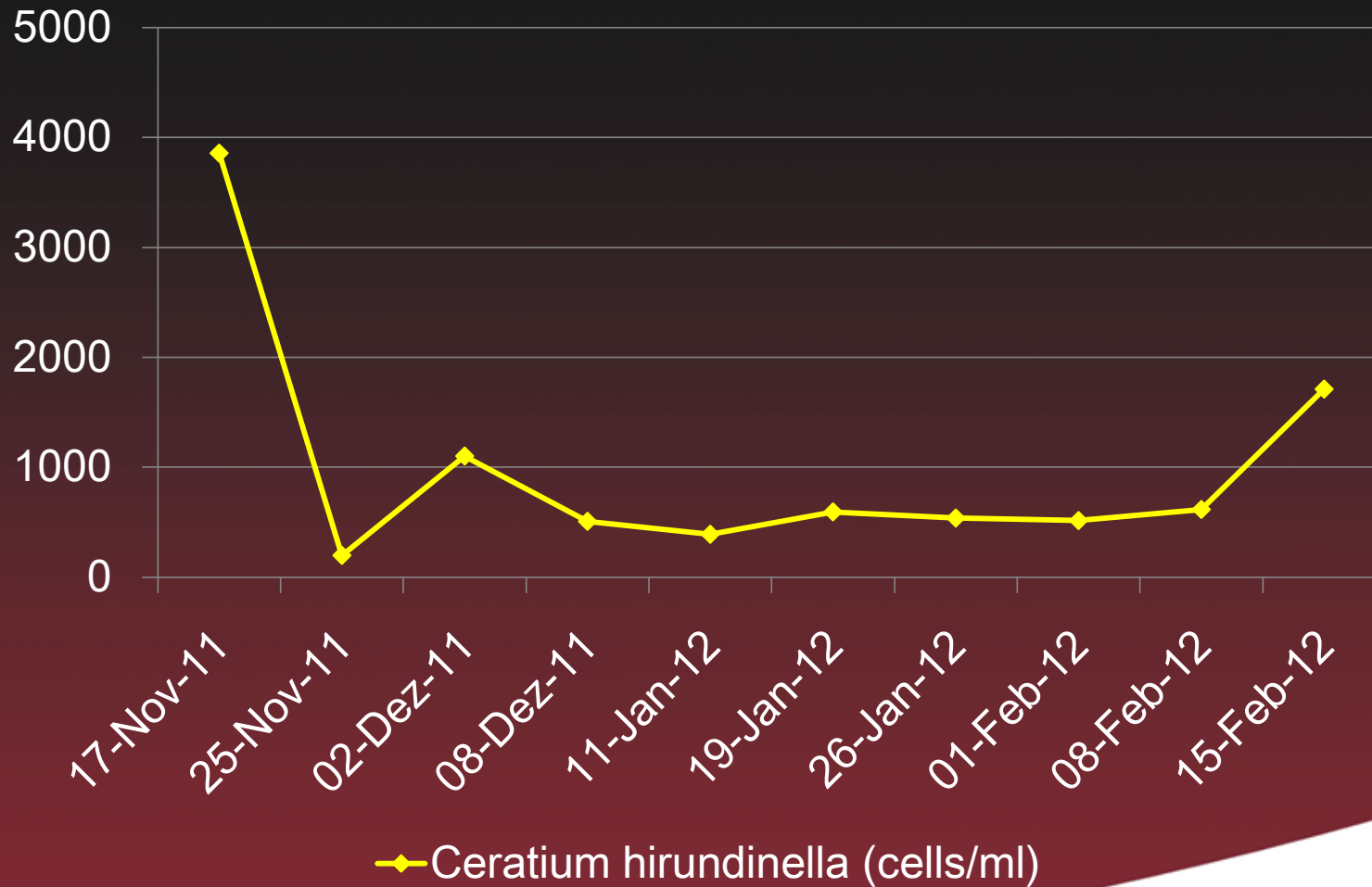
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Benoni Lake (situated next to golf course)



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Benoni Lake



ALGAE AND CYANOBACTERIAL BLOOMS IN SOUTH AFRICAN FRESHWATERS

Conclusions

- Cyanobacteria form severe blooms in several rivers and dams in South Africa, having a negative effect on the water quality.
- Blooms are particularly problematic during warm water summer periods.
- The most important bloom forming cyanobacterial species are *Microcystis aeruginosa*, *Oscillatoria simplicissima*, *Anabaena circinalis* and *Cylindrospermopsis raciborskii*.
- Of particular concern is the rapid spreading of *C. raciborskii* (which was previously restricted to the lower Orange River) to other rivers and dams in the country.
- Eukaryotic algae that frequently form blooms include *Ceratium hirundinella* and *Pandorina morum*.



THANK YOU



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