Ecosystem health of the Phongola floodplain, South Africa, based on fish diversity, community structure and health of selected species

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Dissertation submitted in fulfilment of the requirements for the degree *Magister Scientiae* in Environmental Sciences at the Potchefstroom Campus of the North-West University

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May 2015

Abstract

Following the construction of the Pongolapoort Dam in 1974, the potential impacts on the lower Phongolo River and floodplain due to alterations in the natural flow regime have caused concerns. Fish communities and population structures are directly influenced by these alterations. The only protected section of the Phongolo River is a 15 km reach and its associated pans that flow through the Ndumo Game Reserve. Historic data shows that the community and population structure of the fish in the Phongolo Floodplain has changed as a result of irregular flood releases. The Ndumo Game Reserve plays an important role in the conservation of many ecologically and economically important species as the pans inside the reserve serve as a refuge area in which these species can breed to replenish the fish numbers in the Phongolo River. The fish diversity inside the Ndumo Game Reserve is also higher when compared to outside. During the high flow period fish move into the floodplain pans as a result of the higher water level. *Oreochromis mossambicus,* the most common species found in this area, utilize Nyamiti Pan for breeding but the health of this species is under pressure due to severe infestations of *Lernaea cyprinacaea* and nematode parasites. *Lernaea cyprinacaea* is a parasitic copepod associated with the introduced exotic fish species *Cyprinus carpio* which is found in large numbers in various pans inside Ndumo Game Reserve. The presence of this alien species in the refuge area raises concerns as it competes for the same resources as the economically important native fish species. Nyamiti Pan is largely populated by adult cichlid species between the ages of six and ten years old. The importance of flood releases which simulate natural flow regime is emphasised by the negative impacts irregular floods have on fish health, community and population structure.

Keywords: Age determination, *Coptodon rendalli*, *Hydrocynus vittatus,* Floods, Fish community structure, Fish health, Ndumo Game Reserve, *Oreochromis mossambicus*

Opsomming

Na die konstruksie van die Pongolapoort Dam in 1974 het veranderinge in die natuurlike vloei patroon van die laer Phongolo Rivier en die vloedvlakte kommer gewek. Vis gemeenskappe en populasie strukture word direk beïnvloed deur hierdie veranderinge. Die enigste beskermde deel van die Phongolo Rivier is ’n 15 km gedeelte en sy geassosieerde panne wat deur die Ndumo Natuur Reservaat vloei. Historiese data wys dat die gemeenskap en populasie struktuur van vis in die Phongolo vloedvlakte verander het as gevolg van onreëlmatige vloede. Die Ndumo Natuur Reservaat speel ’n belangrike rol in die bewaring van talle ekologiese en ekonomiese belangrike spesies aangesien hierdie spesies die panne binne die reservaat dien as ’n heenkome waar visse kan broei om die Phongolo Rivier se vis getalle te herstel. Die vis diversiteit binne Ndumo Natuur Reservaat is ook hoër in vergelyking met dié buite die reservaat. Gedurende die hoë vloei periodes beweeg vis in die panne van die vloedvlakte in as gevolg van die hoër water vlak. *Oreochromis mossambicus*, die algemeenste spesie in die gebied, benut Nyamiti Pan as ’n broei area, maar die gesondheid van hierdie spesie is onder geweldige druk as gevolg van ernstige infeksies van *Lernaea cyprinacaea* en nematode parasiete. *Lernaea cyprinacaea* is ’n copepod parasiet wat geassosieer word met die eksotiese vis spesie *Cyprinus carpio* waarvan hoe getalle in verskeie panne in die reservaat gevind is. Die aanwesigheid van hierdie indringer spesies wek kommer aangesien dit vir dieselfde hulpbronne kompeteer as die ekonomies belangrike inheemse vis spesies. Nyamiti Pan word hoofsaaklik deur volwasse cichlids bevolk tussen die ouderdomme van ses en tien jaar oud. Die belangrikheid van vloede wat die natuurlike vloeipatrone simuleer is beklemtoon deur die negatiewe invloede wat dit het op die vis gesondheid, gemeenskap en populasie struktuur het.

Acknowledgements

- I would like to thank my supervisors, Prof. Nico Smit and Prof. Paulus Fouché for their guidance and support during this study.
- The Water Research Commission for the funding of this project (WRC Project No. K5-218).
- I would like to thank Dr. Wynand Vlok, Dr. Rialet Pieters, Dr. Leon Viviers and Dr. Richard Greenfield for their help and guidance during fieldtrips.
- I would like to thank Francois Jacobs, Kyle Mchugh, Joppie Schrijvershof, Ruan Gerber, and Claire Edwards for their assistance in various fieldtrips and lab work.
- Dr. Wynand Malherbe for drawing the maps used in this study.
- Dr. Kerry Malherbe for her help with the drawings used in this study.
- I would like to thank the Water Research Group Aquarium staff, Franz Gagiano and Steven van der Walt for their help with preparing the equipment used in the fieldtrips.
- I would like to thank Mrs. Adri Joubert for the management of all administrational matters during the course of this project.
- I would like to thank my family for supporting me throughout the course of my studies.

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List of Abbreviations

APE	Average Percentage Error
CD	Circulatory Disturbances
CF	Condition Factor
CV	Coefficient of Variance
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen
EC	Ecological Category
FD	Fast Deep
FHAI	Fish Health Assemblage Index
FI	Fish Index
FRAI	Fish Response Assessment Index
FROC	Frequency of Occurrence
FS	Fast Shallow
GSI	Gonadal-Somatic Index
GI	Gill Index
H&E	Hematoxinilyn and Eosine
HSD	Honest Significant Differences
HSI	Hepato-Somatic Index
I	Inflammation
KI	Kidney Index
KZN	KwaZulu-Natal
LI	Liver Index
NEMBA	National Environmental Management: Biodiversity Act
NWA	National Water Act
OI	Ovary Index
PC	Progressive Changes

PCA	Principle Component Analysis
PRESPA	Pongolo River Ecosystem Services for Poverty Alleviation
RC	Regressive Changes
RDA	Redundancy Analysis
RHP	River Health Programme
SD	Slow Deep
SL	Standard Length
SS	Slow Shallow
SSI	Spleno-Somatic Index
T	Tumours
TDS	Total Dissolved Solids
TI	Testis Index
TL	Total Length
TOPS	Threatened or Protected Species
VBGM	Von Bertalanffy Growth Models
WRC	Water Research Commission
WUA	Water User Association

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