



SASAQS 2017

Southern
African
Society of
Aquatic
Scientists

25/26-28 June 2017
Birchwood Hotel & OR Tambo
Conference Centre



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Abstract Book





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Local Organising Committee

Dr R Green ield
Dr JC van Dyk
Dr R Gerber
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Programme

SUNDAY 25 TH JUNE			
	14h00-18h00	Registration Opens	
	18h00-19h30	Welcome and dinner	
MONDAY THE 26 TH JUNE			
	7h30-8h30	Registration Opens	
	8h30-8h45	House Keeping	
Plenary Session Richard Greenfield	8h45-9h30	Dr Jamie Dick	Metrics based on comparative functional responses and abundance reliably predict aquatic invasive species identities and ecological impacts
	9h30-10h00	Olaf Weyl	Is native fish conservation in headwater streams as easy as removing alien fishes?
	10h00-10h30	Ruan Gerber	Biomarker responses in tigerfish (<i>Hydrocynus vittatus</i>) as a tool to identify pollutant effects in ecologically sensitive subtropical systems
	10h30-11h00	Tea time	
Ecotoxicology:			
Morning session Session Chair Prof. Johan van Vuren	11h00-11h15	Nico Wolmerans	Organochlorine pesticide accumulation in African sharptooth catfish (<i>Clarias gariepinus</i>) and associated health risk, from a major South African urban area
	11h15-11h30	Chris Sihoka	Modelled serial blood sampling protocol for toxicokinetic studies in small to medium sized adult Tilapia
	11h30-11h45	Claire Edwards	Preliminary results of Oxidative stress biomarkers in <i>Synodontis zambezensis</i>
	11h45-12h00	Zviregei Jiri	Antioxidant enzymes in <i>Oreochromis niloticus</i> as early warning signals in assessing metal pollution from Acid Mine Drainage and diffuse sources of pollutants in a sub-tropical river
	12h00-12h15	Hannes Erasmus	Metal bioaccumulation in different macroinvertebrate functional feeding groups from a river impacted by gold mine effluent
	12h15-12h30	Tholoana Ntokoane	Determination of sample size sufficiency for a stereological study on the effect of trenbolone acetate on the ovaries of <i>Oreochromis mossambicus</i>
	12h30-13h30	Lunch	
Behaviour monitoring			
Mid Afternoon session Session Chair Dr Richard Greenfield	13h30-13h45	Bianca Hannweg	Behaviour and habitat association of <i>Pseudobarbus aferin</i> the Swartkops River South Africa”
	13h45-14h00	Ryan Wasserman	Using functional responses to quantify interaction effects among predators
	14h00-14h15	Fabracio Frehse	Evaluation of fish colonization and use of artificial habitats in a Brazilian reservoir using different sampling methods
	14h15-14h30	Nombongo Makati	Impact of seasonality on macroinvertebrate assemblage structure in the Tsitsikamma River, Eastern Cape, South Africa
	14h30-14h45	Sean Marr	Training the next generation of aquatic scientists through field exposure to river research and monitoring methods
	14h45-15h00	Rozwivhona Magoba	Temporal variability of macroinvertebrates of the Berg River catchment
	15h00-15h30	Tea time	
Macro-Invertebrates			
Late afternoon Session Session Chair Dr Richard Greenfield	15h30-15h45	Frank Akamagwuna	A trait-based approach to evaluating selected macroinvertebrate taxa response to elevated fine sediment concentrations in the Tsitsa River and its tributories, Eastern Cape, South Africa
	15h45-16h00	Nokonwaba Fasi	Assessment of the Tyhume River Health Status using Macroinvertebrates as indicators
	16h00-16h15	Lizaan de Necker	Assessing aquatic invertebrate succession of floodplain pans after a simulated flood: a mesocosm approach
	16h15-16h30	Elané Lubbe	Fish and aquatic invertebrate diversity of the Seekoivlei Nature Reserve

TUESDAY THE 27TH JUNE

	7h30-8h30	Registration Opens	
	8h30-8h45	House Keeping	
Plenary Session Richard Greenfield	8h45-9h30	Rob Hart	Evaluating outcomes of restorative biomanipulation management of a hypertrophic South African river impoundment through long-term cross-system comparison of remotely sensed trophic status monitoring data
	9h30-10h00	Johan v Vuren	Freshwater fish as indicators of pollution. Findings and challenges
	10h00-10h30	Gordon o Brien	Framework for regional evaluations of e-flows in the Nile Basin
	10h30-11h00	Tea time	
Morning session Session Chair Dr Sean Marr	Management		
	11h00-11h15	Anrich Koch	Diatom community structure and the relationship with water quality within Lake Sibaya
	11h15-11h30	Tascha Vos	Periphyton as a biomonitoring tool in non-perennial, regulated rivers in central South Africa
	11h30-11h45	Dumisane Khosa	Using angler data to map the extent of black bass distribution in South Africa
	11h45-12h00	Sanet Hugo	Keiskamma aquatic invertebrate communities: new multivariate modelling methods
	12h00-12h15	Hlulani Hlungwani	Assessing the potential to establish an inland fishery in flag Boshielo dam, Limpopo Province, South Africa
	12h15-12h30	Lubabalo Mofu	Using functional responses to assess relative impact potential of successfully introduced fishes in man-made aquatic environments
	12h30-13h30	Lunch	
Mid Afternoon session	Posters		
	13h30-15h00	POSTER SESSION	
	13h45-14h00		
	14h00-14h15		
	14h15-14h30		
	14h30-14h45		
14h45-15h00			
	15h00-15h30	Tea time	
Late afternoon Session Session Chair Dr Richard Greenfield	Invasion Biology		
	15h30-15h45	Nathan Baker	Preliminary results for an assessment of the aquatic macro-invertebrate diversity within the Nyl and Kogalakwena river system
	15h45-16h00	Simone Dahms	Toxicity range determination of vanadium on <i>Xenopus laevis</i> embryos via Frog Embryo Teratogenesis Assay-Xenopus (FETAX)
	16h00-16h15	Sarel Brand	Measuring the impact of nanogold (nAu) on the swimming performance of <i>Danio rerio</i> in an acute exposure study
	16h15-16h30		

WEDNESDAY THE 28TH JUNE

	7h30-8h30	Registration Opens	
	8h30-8h45	House Keeping	
Plenary Session Richard Greenfield	8h45-9h30	Nico Smit	A brief review of the socio-ecological system management of the lower Phongolo River and floodplain using relative risk methodology
	9h30-10h00	Wynand Malherbe	The aquatic biodiversity of selected South African Ramsar wetlands
	10h00-10h30	Darragh Woodford	Can trophic ecology indicate impacts of land management on savanna headwater streams?
	10h30-11h00	Tea time	
River and stream monitoring			
Morning session Session Chair Dr Gordon O'Brien	11h00-11h15	Jeff Hean	Using BRUVs to assess diversity and abundance of fishes in the Lake Niassa Reserve, Lake Niassa, Mozambique
	11h15-11h30	Carla Higgs	Four years of monitoring the health of rivers in Kwazulu-Natal
	11h30-11h45	Matthew Burnett	Evaluating seasonal habitat utilisation behaviour by <i>Labeobarbus marequensis</i> using telemetry techniques
	11h45-12h00	Céline Hanzen	Changes in distribution and genetic diversity of anguillid eels along the east coast of KwaZulu-Natal, South Africa
	12h00-12h15	Michiel Jonker	Spatial and temporal variation in two sub-catchments on the Wilge River System near Ogies
	12h15-12h30	Skhumbuzo Khubeka	Is <i>Pseudobarbus quathlambae</i> (Maluti minnow) really extinct? New sighting after 47 years!!!
	12h30-13h30	Lunch	
Ecotoxicology			
Mid Afternoon session Session Chair Dr JC van Dyk	13h30-13h45	Lee-Ann Modley	A comparative histological assessment of two indicator fish species from the three rivers flowing into the hyper-eutrophic Roodeplaas Dam
	13h45-14h00	Thato Bengu	Health effects in fish from the polluted Orlando Dam and Klipspruit wetland
	14h00-14h15	Clementine Nibamureke	The potential effects of the HIV drug nevirapine on the hatching success and survival of the Mozambique tilapia larvae
	14h15-14h30	Lesley Bloy	The thermal preference and tolerance of the endangered Eastern Cape redbfin, <i>Pseudobarbus afer</i>
	14h30-14h45	Anja Greyling	The use of stable isotope analysis to assess intertidal rocky shore food webs from different climatic zones and potential metal biomagnification
	14h45-15h00	Tarryn Botha	Using <i>Danio rerio</i> swimming behaviour as an indicator for nanomaterial ecotoxicity
	15h00-15h30	Tea time	
SASAqS AGM			
Late afternoon Session	15h30-15h45	SASAQS AGM	
	15h45-16h00		
	16h00-16h15		
	16h15-16h30		
	16h30-16h45		
	16h45-17h00		
	18h00-	Gala Dinner	

Posters

Poster No	Authors	Title
P1	Carla-Louise Ramjukadh, Michael Silberbauer, Susan Taljaard	A Discontinuity In Ph Values In The South African National Water Quality Monitoring Database
P2	Peter Mochechela, Bianca Hannweg, Sean Marr and Niall Vine	Detecting The Presence Of Native And Non-Native Fishes In The Krom River, Western Cape, South Africa: A Comparison Between Four Non-Destructive Fish Monitoring Techniques.
P3	Emiline Miller, Sean Marr, Anusha Rajkaran	The Impact Of Water Quality And Habitat Availability On Submerged Macrophytes In The Krom River (Cedarberg).
P4	Jamie-Lee Das Neves, Irene Barnhoorn, Ina Wagenaar	Do Environmentally Relevant Concentrations Of Methoxychlor And Aldrin Affect The Reproductive Health Of The Male African Sharptooth Catfish <i>Clarias Gariepinus</i> (Burchell, 1822)?
P5	Lolo Mokae, John Maina	A Pilot Study Of Stereological Analysis Of The Testes Of <i>Oreochromis Mossambicus</i> (Peters, 1852) Exposed To Different Concentrations Of Selenium
P6	Jeremy Shelton, Matthew Bird	Evidence For Dietary Overlap Among Three Native Sympatric Freshwater Fishes In South Africa's Cape Floristic Region
P7	Karabo Malakane, Abraham Addo-Bediako, Millicent Kekana	Assessing The Effects Of Water Quality On Aquatic Macro-Invertebrates In The Groot Letaba River, Limpopo Province
P8	Ilsa Coetzee, Tarryn Botha, Sarina Claassens, Victor Wepener	Determining The Effect Of Functionalized Nanomaterials On Different Bacterial Species
P9	Divan van Rooyen, Mark Maboeta, Tarryn Botha, Victor Wepener	Ecotoxicity Of Cdte And Its Functional Groups On <i>Enchytraeus Albidus</i>
P10	Suanne Bosch, Tarryn Botha, Mark Maboeta, Victor Wepener	The Ecotoxicity Of Nanodiamonds And Cdte Quantum Dots On The Soil Nematode <i>Caenorhabditis Elegans</i>
P11	Gerhardus Bouwer, Tarryn Botha, Mark Maboeta, Victor Wepener	Ecotoxicological Effects Of Cadmium Tellurium Quantum Dots And On <i>Eisenia Andrei</i>
P12	M.L Ramotjiki, S.H Foord, H Roux, L. Mofu, S.M. Marr	An Evaluation Of Rotenone Treatment By Comparing The Detection Probability Of Three Fish Survey Methods (Fyke Nets, Snorkeling And Camera) In The Rivers And Dams Of Cederberg Krom River
P13	Helené Coetzee, Jamie-Lee Das Neves, Irene Barnhoorn, Ina Wagenaar	Could Environmentally Relevant Concentrations Of The Pesticides Aldrin And Methoxychlor Compromise The Health Of The Freshwater Fish <i>Clarias Gariepinus</i>?
P14	Simone Dahms, Nathan Baker, Richard Greenfield	Judging The Performance Of The Nyl River Floodplain: Is It Doing Its Job?
P15	Marelize Labuschagne, Wynand Malherbe, Victor Wepener	The Relationship Between Metals In Macro-Algae And Grazing Molluscs From The Intertidal Zone Of The Tsitsikamma National Park
P16	Abraham Addo-Bediako, Lwendo Rasifudi, Antoinette Jooste	Heavy Metal Concentrations In Water And Sediment Of The Ga-Selati River, Olifants River System, South Africa
P17	Stephen Avidon, Jeremy Shelton, Sean Marr and Karen Esler	The Impact Of Rainbow Trout <i>Oncorhynchus Mykiss</i> On Cederberg Ghost Frog <i>Heleophryne Depressa</i> Tadpole Abundance Above And Below A Waterfall Barrier, Krom River, Olifants-Dooring River Catchment, Cape Fold Eco-Region.
P18	I.K Chauke, S.H Foord, H. Roux, L Mofu, S.M. Marr	A Comparison Of The Biology Of Bluegill Sunfish <i>Lepomis Macrochirus</i> From Lentic And Lotic Environments In The Krom River Catchment, Western Cape
P19	Julia Ndou, John Maina, Lolo Mokae	A Pilot Study Of Stereological Analysis Of The Testes Of <i>Oreochromis Mossambicus</i> (Peters, 1852) Exposed To Different Concentrations Of Selenium
P20	M. Oscar Mohale, Jean-Pierre le Roux, Bridget M. Corrigan	A Community-Led Integrated Approach To Conserving Freshwater Biodiversity In The Headwaters Of The Limpopo River Basin, South Africa

METRICS BASED ON COMPARATIVE FUNCTIONAL RESPONSES AND ABUNDANCE RELIABLY PREDICT AQUATIC INVASIVE SPECIES IDENTITIES AND ECOLOGICAL IMPACTS. (Plenary Presentation)

Jaimie TA Dick
Queen's University Belfast, Belfast, United Kingdom

Understanding and ultimately predicting the ecological impacts of existing, emerging and future aquatic invasive species is a research priority. However, this has been elusive when based on traditional species traits, such as fecundity and growth rates. Ideally, predictive metrics should be easy to derive and applicable across taxonomic and trophic groups. Parker et al in 1999 (Biol Inv 1: 3-19) famously proposed the equation that: Impact = Range X Abundance X Effect (*per capita*), but there has been little advance in the development or usage of such a metric. Additionally, invasion ecologists have until recently missed the classic equation describing the impact of a consumer towards a resource, where: Total Response = Functional Response (*per capita*) X Numerical Response, which is similar to the Parker equation. Here, I show that the functional response (FR) is strongly associated with the ecological impacts of aquatic invaders, with high impact aquatic invaders predictable from their comparatively high functional response curves; the corollary also holds true, with low impact of invaders characterized by relatively low functional responses. A further advance of this metric uses the abundance (AB) of invaders and natives as well as their functional responses, measured as maximum feeding rates, with a revised equation: Impact Potential = (FRinvader/FRnative) X (ABinvader/ABnative), where values above 1 indicate the degree of impact of invaders. I show that, across many aquatic study systems, taxa and trophic groups, both functional responses (FRs) and impact potential (IP) are consistent in their ability to identify high impact aquatic invaders.

IS NATIVE FISH CONSERVATION IN HEADWATER STREAMS AS EASY AS REMOVING ALIEN FISHES? (Invited Speaker)

Olaf LF Weyl¹, Johannes A Van der Walt², Martine S Jordaan², N Dean Impson², Darragh Woodford³

¹South African Institute for Aquatic Biodiversity (SAIAB), Grahamstown, South Africa, ²CapeNature, Stellenbosch, South Africa, ³Centre for Invasion Biology, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, South Africa

The global spread of non-native sport fishes has had severe impacts on native fish communities. Impacts are particularly severe when piscivorous fishes are introduced into ecosystems containing predator naïve fish communities. While the removal of non-native fishes is often a priority management action for conservation authorities, the response of native fishes to such removals is not well documented. Snorkel surveys of 22 tributary streams of the Olifants-Doorn River system in South Africa's Cape Fold Ecoregion showed that introduced sport-fishes had extirpated small native fish species from more than 80% of the river. To test the potential of non-native fish eradication as a remediation strategy, local conservation authorities eradicated non-native smallmouth bass *Micropterus dolomieu* from the Rondegat River, a small headwater stream, using the piscicide rotenone in 2012 and 2013. This provided a unique opportunity to assess the response of native fish populations to the removal of this non-native predator. Fish diversity and densities were monitored in 47 sites representing "treatment" and upstream "control" region from one year before, during and for four years after the eradication, using multiple survey methods. Data demonstrated that smallmouth bass had been effectively eradicated from the river and that four native fishes began colonising the river almost immediately thereafter. Differences in colonisation rates and population structure between species are discussed in the context of their life-history and dispersal behaviour and the impact of non-native fish removals as a conservation strategy is evaluated for each of the species.

BIOMARKER RESPONSES IN TIGERFISH (*HYDROCYNUS VITTATUS*) AS A TOOL TO IDENTIFY POLLUTANT EFFECTS IN ECOLOGICALLY SENSITIVE SUBTROPICAL SYSTEMS. (Invited Speaker)

Ruan Gerber¹, Nico Smit¹, Johan van Vuren¹, Yoshinori Ikenaka^{1,2}, Victor Wepener¹

¹Water Research Group, Unit for Environmental Sciences and Management, North West University, Potchefstroom, South Africa, ²Laboratory of Toxicology, Department of Environmental Veterinary Sciences, Graduate school of Veterinary Medicine, Hokkaido University, Sapporo, Japan

Biomarker responses in fish species have been shown to identify key polluted areas (i.e. watercourses) for pollution remediation. The aim of this study was to use a suite of biomarkers to determine the biological response of native *Hydrocynus vittatus* populations to the various anthropogenic stressors they are exposed to in the Olifants and Luuvuvhu Rivers. With the purpose of selecting principal biomarkers as a tool to identify key polluted areas within the rivers of the Kruger National Park. Biomarkers were selected to reflect measures of exposure, effect and energetics. Biomarkers of exposure include: acetylcholine esterase (AChE – pesticide and metal exposure), metallothionein (MT - metal exposure) and cytochrome P450 (CYP450 - organic compounds e.g. OCPs). Biomarkers of effect include: catalase (CAT), superoxide-dismutase (SOD), lipid peroxidation (LP) and protein carbonyls (PC), as well as the non-enzymatic reduced glutathione (GSH), primarily reflecting the oxidative status of cells. The cellular energy allocation (CEA) biomarker is an indication of cellular energy utilization during stress conditions. A wide range of uni- and multivariate statistics were applied and include ANOVA's, correlation coefficients, non-metric dimensional scaling, Bray-Curtis similarity and discriminant function analyses. Results indicated that the suite of biomarkers reflected the exposure to various anthropogenic stressors and that all biomarkers assessed were pertinent in discriminating between the various pollution profiles and identifying key polluted areas. Thus indicating that pre-exposed organisms in the form of native populations can be used to ascertain which watercourses should be prioritised for further study and remediation.

ORGANOCHLORINE PESTICIDE ACCUMULATION IN AFRICAN SHARPTOOTH CATFISH (*CLARIAS GARIEPINUS*) AND ASSOCIATED HEALTH RISK, FROM A MAJOR SOUTH AFRICAN URBAN AREA.

Wihan Pheiffer¹, Nico Wolmarans¹, Yared Beyene Yohannes², Yoshinori Ikenaka^{2,1}, Mayumi Ishizuka², Nico Smit¹, Victor Wepener¹, Rialet Pieters¹

¹North-West University, Potchefstroom, South Africa, ²Hokkaido University, Sapporo, Japan

Persistent organic pollutants in aquatic systems of Southern Africa remain a big challenge. Organochlorine pesticides (OCPs) in South Africa have for the most part been banned. Yet new data is regularly published on this topic showing concerning levels in aquatic organisms. The activity timeframe of these compounds in our systems also brings about secondary challenges such as long range transport. Even though the possibility of illegal use cannot be confidently excluded, the presence of OCPs outside of their areas of use indicate that these compounds not only stay in the aquatic systems long term, but may be of concern in areas previously not considered high risk areas for a specific class of pollutant. The aim of this study was to evaluate OCP residues in *C. gariepinus* muscle tissue from impoundments in the urban area of Soweto. This study also investigated the human health risk posed to the local populace by the presence of OCPs, as subsistence fishermen in this area rely greatly on *C. gariepinus* as a supplementary food source. Various OCPs were detected in the fish tissue with the DDTs being the most abundant at all sites. Of the three locations studied (Fleurhof, Lenasia, and Orlando) Lenasia's fish had the highest total OCP load ranging between 81 and 1190 ng/g ww. DDTs were the dominant OCP at all sites, and was determined to be historical residues. The OCP residues in *C. gariepinus* from the study area were found to pose a significant risk to human health through fish consumption.

MODELLED SERIAL BLOOD SAMPLING PROTOCOL FOR TOXICOKINETIC STUDIES IN SMALL TO MEDIUM SIZED ADULT TILAPIA.

Chris Sihoka, G.M Wagenaar

Department of Zoology, University of Johannesburg, PO BOX 524, Auckland Park 2006, Johannesburg, South Africa

Serial blood sampling (SBS) in which the same individual is sampled at different time points provides valuable information for toxicokinetic studies to evaluate the systemic exposure of toxicants. The aim of this study was to determine the optimum sample amount to meet analytical requirements in small to medium sized fish without causing severe anaemia or death. A SBS protocol for sampling small to medium sized adult tilapia is proposed. Twenty four fish were divided into six sampling groups of four fish per group. Four groups were initially serially sampled over a 96hr period. The sampled blood volume and haemoglobin concentration were recorded at each sampling time point. The volume, time and haemoglobin change were modelled in R environment. The validity of the model was tested on the remaining two sampling groups by sampling based on the model index. Sampled volume and time are significant predictors of haemoglobin ($p = 0.03875$ and 0.00474 respectively). Both have a negative association. The model significantly described the relationship ($p = 4.322 \times 10^{-5}$). No mortality were recorded during the model test. Model guided SBS offers an effective tool for toxicokinetic studies in small to medium sized fish as mortality during sampling is avoided by avoiding a drop in haemoglobin to a critical low which is predicted by the model.

PRELIMINARY RESULTS OF OXIDATIVE STRESS BIOMARKERS IN *SYNODONTIS ZAMBEZENSIS* DURING AN ACUTE EXPOSURE TO DDT.

Claire Edwards, Johan van Vuren, Richard Greenfield

Department of Zoology, University of Johannesburg, PO BOX 524, Auckland Park 2006, Johannesburg, South Africa

Oxidative stress within organs of fish has long been an indicator of exposure to Organochlorine Pesticides (OCP's). The tendency for OCP's to bio-accumulate within the environment and tissues of organisms' means that their effects are particularly important to understand. Dichlorodiphenyltrichloroethane (DDT) is an OCP that forms the focus of many studies throughout Africa and South Africa, because of its historic and continued use in the control of the malaria vector, *Anopheles sp.* Oxidative stress effects are caused by the production of reactive oxygen species (ROS's) or the deactivation of antioxidant defences within fish. The three most important enzymes for detoxification of ROS's in all aerobic organisms are Superoxide Dismutase (SOD), Catalase (CAT) and Glutathione (GSH). The inhibition or excitation of these three enzymes are analysed as biomarkers of effect, giving insight into the physiological adaptability of the target species, *Synodontis zambezensis*. Preliminary results of acute exposures to DDT show no significant differences in oxidative stress reactivity at different exposure concentrations, but trends in the physiological adaptations of *S. zambezensis* allow for preliminary conclusions to be reached. The closely linked SOD and CAT enzyme-relationship is clearly illustrated, with each group showing changes in reactivity in correlation with the other. Glutathione concentrations are naturally high within the hepatic cells of fish and play an essential role in neutralising ROS's. This non-protein compound tends to decrease in concentration during acute exposures and this is clearly illustrated in the preliminary results. Investigations into the chronic effects of DDT under controlled conditions are ongoing.

ANTIOXIDANT ENZYMES IN *OREOCHROMIS NILOTICUS* AS EARLY WARNING SIGNALS IN ASSESSING METAL POLLUTION FROM ACID MINE DRAINAGE AND DIFFUSE SOURCES OF POLLUTANTS IN A SUB-TROPICAL RIVER.

Zviregei Jiri^{1,2}, Richard Greenfield², Johan van Vuren²

¹Bindura University of Science Education, Bindura, Zimbabwe, ²Department of Zoology, University of Johannesburg, PO BOX 524, Auckland Park 2006, Johannesburg, South Africa

This study investigated the use of *Oreochromis niloticus* as a bio-indicator in active biomonitoring of the Yellow Jacket and Mazowe Rivers, Zimbabwe. Active biomonitoring exposures were conducted for four weeks in effluent contaminated sections of the rivers during two low flow (October 2013 and October 2014) and two high flow (April 2014 and April 2015) periods. Biomarkers of exposure and effect (glutathione-s-transferase, catalase and metallothioneins) were selected and their responses determined in the liver, gills and muscle and compared against control fish. Concentrations of As, Cd, Co, Cu, Fe, Mn, Ni, Pb and Zn were measured in water, sediments and muscle tissue. Spearman correlation tests were used to determine the relationship between biomarkers and metal concentrations in fish muscle and sediments. Key water quality parameters showed a pollution gradient from Iron Duke Mine. Enzyme expression was highest in the liver then gills and muscle and their expression was significantly lower ($p < 0.05$) in the control fish. Increased enzyme expressions with a strong positive correlation with increased Ni, Fe and Cu concentrations in the muscle tissue was observed. The general order of metal concentrations was sediments > water > fish. Using GST, CAT and MT responses, we concluded that the Mazowe and Yellow Jacket Rivers are contaminated and these enzymes can successfully be used as biomarkers in assessing metal pollution from acid mine drainage and diffuse sources. The biomarker responses indicate a physiological attempt to deal with and mitigate the impacts of pollutants by stimulating antioxidant protective mechanisms

METAL BIOACCUMULATION IN DIFFERENT MACROINVERTEBRATE FUNCTIONAL FEEDING GROUPS FROM A RIVER IMPACTED BY GOLD MINE EFFLUENT.

Johannes Hendrik Erasmus, Cornelius Tobias Wolmarans, Kenné Nicolaas de Kock, Victor Wepener
Water Research Group, Unit for Environmental Sciences and Management, North-West University, Potchefstroom, South Africa

Aquatic macroinvertebrates are generally regarded as good indicators of metal contamination due to their abundance and presence in a wide variety of freshwater habitats. They are further relatively sedentary and can reflect the conditions of a specific site. Due to their long life-cycles they may be exposed to pollutants, such as metals, in the aquatic environment. Metal accumulation in macroinvertebrates can differ due to factors such as the type of species, specific life stage, habitat preference (benthic or pelagic) and functional feeding groups (FFGs). These FFGs include scraper/grazers, shredders, collector-gatherers, collector-filterers and predators. During this study, metal concentrations in selected macroinvertebrate FFGs were determined, where associations between metal concentrations and associated habitat preference (benthic or pelagic) were also investigated. This was achieved by using inductively coupled plasma mass spectrometry analysis. From the results obtained during this study a significant variation ($p < 0.05$) in metal concentrations are evident between FFGs, as well as between benthic and pelagic macroinvertebrate families. Families from lower trophic levels had significantly higher ($p < 0.05$) metal concentrations than the predator families. This can be ascribed to the fact that these metals do not biomagnify within the food chain. Families associated with the benthos had significantly ($p < 0.05$) higher metal concentrations than the families associated with the pelagic environment. These higher metal concentrations can be due to their feeding habits, close association with the sediment, respiration, as well as adsorption to their exoskeleton.

STEREOLOGICAL ANALYSIS OF THE EFFECTS OF TRENBOLONE ACETATE ON GAMETOGENESIS IN THE OVARIES OF THE FISH, *OREOCHROMIS MOSSAMBICUS*.

Tholoana Ntokoane, John Maina, Lolo Mokae

Department of Zoology, University of Johannesburg, PO BOX 524, Auckland Park 2006, Johannesburg, South Africa

The increase in endocrine disrupting chemicals (EDCs) in the aquatic environment has resulted in intensification on understanding how these chemicals may affect wildlife. The sources of EDCs are pharmaceuticals, personal care products, organic sewage and manure. Studies have shown that EDCs like trenbolone acetate (TBA) can cause masculinisation in fish. This includes the development of incipient dorsal pads in female which are histologically similar to those found in males. Ototestes were observed in female fry exposed to TBA. The aim of this study was to qualitatively and quantitatively describe the histological changes in the gonads of fish exposed to TBA. Adult *Oreochromis mossambicus* fish were exposed to two concentrations (14.5 µg/L and 16.0µg/L) of TBA for 96 hours. No TBA was added to the control tank. The volume of the gonads was determined using weight displacement technique. Histological analysis was done using a light microscope to determine if there were any histological alterations due to exposure. Stereological analysis which entails the determination of the volume densities using the point count method was done. Histopathological alterations due to the exposure of fish to TBA included the disintegration of the vitellogenic theca layer, liquefaction of vitellogenic oocytes, fatty degeneration and atretic oocytes. Furthermore an increase in melano-macrophage centres (MMCs) were observed in ovaries exposed to TBA. The stereological study showed that vitellogenic oocytes are the most abundant in ovaries of mature adult *O. mossambicus* female fish.

BEHAVIOUR AND HABITAT ASSOCIATION OF *PSEUDOBARBUS AFER* IN THE SWARTKOPS RIVER SYSTEM, SOUTH AFRICA.

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The Cape Fold ecoregion has the highest proportion of threatened freshwater fishes in South Africa but their biological and habitat requirements have been poorly documented. Understanding the behaviour and habitat association of freshwater fish is therefore important for their conservation as one has better potential at rehabilitating natural habitats once there is a better understanding of the benefits each habitat provides for each species. Behaviour, traditionally perceived as an anthropomorphic characteristic, can be observed in many animals including fish. However, observing behaviour in a natural setting contributes to documenting and understanding fish behaviour and habitat associations; e.g. fish favouring certain habitats based on their function - refuge or foraging. Determining the behaviour and habitat use of freshwater fish is challenging due to observers influencing their behaviour in traditional snorkelling-based techniques. With recent advances in small video camera technology, including time lapse photography, underwater video analysis (UWVA) has become a useful tool for observing the behaviour and habitat associations of fish without the observer bias of other *in situ* observation techniques e.g. snorkel surveys. Here, we present data collected from *in situ* field surveys in the Cape Fold Ecoregion conducted to determine fish utilisation of specific habitats and the benefits they receive from these habitats. Five different natural habitats used by the Eastern Cape Redfin minnow, *Pseudobarbus afer* were quantitatively assessed using time lapse photography and their behaviour in each of these habitats was qualified using UWVA. The results are discussed in the context of using UWVA as an ecological assessment tool.

USING FUNCTIONAL RESPONSES TO QUANTIFY INTERACTION EFFECTS AMONG PREDATORS.

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Predator diversity alterations have been observed in most ecosystems as a result of the loss and/ or addition of species. This has implications for predator-prey dynamics as non-trophic interactions among predators, so called multiple predator effects (MPE), are known to influence predation success. While MPE investigations are common in the literature, functional responses have rarely been incorporated into this field of predation ecology. In the context of biological invasions, identifying potential MPE between native and non-native predators is also important, since the presence of one predatory species may hinder the success of another. Here, we outline an experimental procedure that uses functional responses to assess MPE among non-native bluegill (*Lepomis macrochirus*) and native southern mouthbrooder (*Pseudocrenilabrus philander*) and banded tilapia (*Tilapia sparrmanii*). This was done by contrasting observed functional responses of heterospecific and conspecific combinations of predators with expected responses based on those of individual predators. Multi-predator combinations produced variable results. Bluegill were the only species in which observed conspecific multi-predator functional responses matched those of expected based on individual performance (prey risk neutral effects). Heterospecific combinations revealed strong prey risk reduction effects for mouthbrooder-tilapia and bluegill-tilapia trials, while mouthbrooder- bluegill multi-predator functional responses combined additively. These results are discussed within the context of behavioural traits of the species, the development of a trait-based predictive framework and biotic resistance.

EVALUATION OF FISH COLONIZATION AND USE OF ARTIFICIAL HABITATS IN A BRAZILIAN RESERVOIR USING DIFFERENT SAMPLING METHODS.

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The effectiveness of artificial structures in providing suitable new habitat for fish has been increasingly investigated; however in developing countries these studies are relatively scarce, especially in freshwater environments. The present study experimentally tested fish colonization and use of three artificial habitats in the Piraquara Reservoir, southern Brazil. The Piraquara reservoir is one of the main water supply reservoirs of Curitiba city, and is located on the Piraquara River, in the Upper Iguazu River basin, in Paraná state (25°30'19.8"S, 49°01'42.8"W). In July 2015, three artificial habitats (tree branches, ceramic pipes and rocks) were installed at an average depth of 3 m in the Piraquara reservoir. Bimonthly sampling was carried out from August 2015 to December 2016, using two sampling methods: visual census (scuba diving) and underwater video analysis (UWVA). The results indicate that the ceramic pipes were used more by the native Cichlid *Geophagus brasiliensis*, whereas tree branches and rocks seem to be preferred by non-native species (*Micropterus salmoides* and *Oreochromis niloticus*). The comparison of sampling methods showed that the visual census was less effective in detecting small fish (<100 mm total length), which tend to remain hidden within the artificial structures; while UWVA was more effective at detecting larger fish (>100 mm total length), which tended to flee in the presence of divers. The results of this study are discussed in the context of using submerged artificial structures for management and conservation measures in aquatic environments.

IMPACT OF SEASONALITY ON MACROINVERTEBRATE ASSEMBLAGE STRUCTURE IN THE TSITSIKAMMA RIVER, EASTERN CAPE, SOUTH AFRICA.

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The impact of seasonality on macroinvertebrate assemblage structure was examined in the Tsitsikamma River, Eastern Cape. Sampling was done on eight sites using the rapid assessment method, South African Scoring System version 5 (SASS5). This study examined the river health condition, evaluated the patterns of macroinvertebrates assemblage structure in relation to selected physico-chemical variables, and determined the influences of seasonality on groups of macroinvertebrate taxa in order to establish taxa that are most and least influenced by seasonal changes. Ten (10) macroinvertebrate metrics were selected to evaluate the influence of seasonality on SASS5 and none of them significantly influenced the seasons whilst eight (8) of these metrics minimally influenced the seasons. There was no significant difference in SASS5 scores, ASPT and number of taxa throughout the seasons. The physico-chemical variables varied minimally between the sites and between the seasons.

TRAINING THE NEXT GENERATION OF AQUATIC SCIENTISTS THROUGH FIELD EXPOSURE TO RIVER RESEARCH AND MONITORING METHODS.

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Habitat modification, over-abstraction, pollution, and invasive alien fishes represent the greatest threats to South Africa's freshwater biodiversity; non-native fishes being the primary threat to the native fishes of the Cape Fold ecoregion. CapeNature have initiated a programme to rehabilitate native fish assemblages by removing invasive non-native fishes using the piscicide rotenone. Long-term research of the first intervention at the Rondegat River (Olfants/Dooring River system) was facilitated by WRC-support (K9/822, K5/2261) and provided comprehensive assessments of invertebrate and vertebrate distributions prior to, and for three years post treatment. This research demonstrated that rotenone was effective at removing invasive fishes from the treatment zone and that native invertebrate and fish communities recover post treatment.

A WRC-funded project (K5/2538) facilitates the continued long-term monitoring of the Rondegat River and new treatment sites, while concurrently building freshwater ecosystem monitoring capacity by exposing B.Sc. Honours level students to aquatic research techniques. Through in-the-field training and linking monitoring of aquatic ecosystems to B.Sc. Honours research projects, it is envisaged that SAIAB's partnership with the universities of Fort Hare, Venda, Western Cape and Stellenbosch will contribute to the achievement of national transformation goals and increase interest in aquatic ecology at the participating universities.

Here, we provide a synopsis of the results of the 2017 field trip to Krom River (Cederberg), highlighting how the field-based participation of students from diverse backgrounds has exposed them to techniques used in the research and monitoring freshwater systems while collecting data for the long-term monitoring programme and their BSc Honours research projects.

TEMPORAL VARIABILITY OF MACROINVERTEBRATES OF THE BERG RIVER CATCHMENT.

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This paper studies the aquatic macroinvertebrate composition changes of the Berg River Basin. Macroinvertebrates of the Berg River were first surveyed in 1951, then in 1991; same locations were re-sampled for this study in 2015. Sweep nets were used to collect samples from marginal vegetation while a box sampler was used for stones-in-current habitat, while gravel, sand/mud where no aquatic-stone habitat was available. Another set of data was collected following the SASS protocol during 1992, 2005 and for this study in 2015. The samples were collected to test if macroinvertebrate assemblages of the Berg River have changed over time, with the hypothesis that organisms present in 2015 are more tolerant to pollution than those found in earlier surveys. ANOSIM, CLUSTER analyses and MDS ordinations were used to identify similarities and differences in community structure between years and zones; while SIMPER analyses determined taxa that contributed strongly toward the dissimilarities. For all taxonomic levels explored stronger dissimilarities were shown between the years and habitat of collection than within sites or geomorphic zones. Samples from 1951 and 1991 were strongly related to each other than those from 2015, while the overall similarity between sites remained strongest 1951 when compared to that of 1991 and 2015. Highly tolerant families of Baetids, Chironomids and Simuliidae, were mostly dominant during 2015. Total SASS score, number of taxa and ASPT decrease down the length of the river for all years. Although these are preliminary results it may suggest a change in the quality of water.

A TRAIT-BASED APPROACH TO EVALUATING SELECTED MACROINVERTEBRATE TAXA RESPONSE TO ELEVATED FINE SEDIMENT CONCENTRATIONS IN THE TSITSA RIVER AND ITS TRIBUTORIES, EASTERN CAPE, SOUTH AFRICA.

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An elevated concentration of fine sediments in streams and rivers is one of the most common global water quality challenges affecting all streams and river ecosystems. No biomonitoring tool currently exists for predicting the potential response of macroinvertebrates to elevated sediment concentrations. The trait-based approach holds promise in this regard. This study aims at developing a trait-based predictive model based on the four important taxa; Ephemeroptera, Plecoptera, Odonata and Trichoptera (EPOT) generally deemed sensitive water quality deterioration. Eight sites in the Tsitsa River and its tributaries, representing a gradient of sediment loads, were selected and sampled in terms of water and macroinvertebrates, seasonality between spring 2016 and autumn 2017. Sediment particles sizes were characterized using the Mastersizer3000. A trait-based theoretical template was developed, and on the basis of traits possessed by taxa was classified along a vulnerability gradient *a priori*. The result revealed that taxa possessing a combination of external gills, filter feeding habit, preferring the stone biotope and propensity for attachment to substrate were more vulnerable compare to other taxa, and therefore were more likely to increasingly reduced in relative abundance along a sediment gradient. The results therefore, suggest that the use of traits in freshwater biomonitoring has the potential to add diagnostic and predictive value to existing tools.

ASSESSMENT OF THE TYHUME RIVER HEALTH STATUS USING MACROINVERTEBRATES AS INDICATORS.

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Benthic macroinvertebrates, are recognized as valuable organisms for bioassessment purposes due to their visibility to the naked eye, ease of identification, rapid life cycle often based on the seasons and their largely sedentary habits. The study presents the use of the SASS5 (South African Scoring System v5), as a tool to determine the river health of Tyhume River. SASS5 a rapid bioassessment protocol identifying macroinvertebrates at family level. The study was conducted between March and September 2006. Ten sampling sites were selected along the Tyhume River corresponding to the upper, mid and lower reaches of the River. In total 41 taxa were collected during the study. Both univariate and multivariate analyses were done using PRIMER V6. SASS5 score and average score per taxon (ASPT) discriminated between the impacted and non-impacted sites, and also exhibited significant correlations ($p < 0.05$) with physicochemical variables. Margalef's species richness and Shannon diversity indices, were statistically different between sampling sites ($p < 0.05$). Three major groups of sites based on similarity between macroinvertebrate communities were identified by cluster analysis. The cluster analyses showed that macroinvertebrates within sampling sites were dependent on biotope preference. The results also showed that good health conditions exist at the two most upstream sites than the lower reaches of the river, thus indicating impacts of pollution within the river.

ASSESSING AQUATIC INVERTEBRATE SUCCESSION OF FLOODPLAIN PANS AFTER A SIMULATED FLOOD: A MESOCOSM APPROACH.

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When a river floods and connects to a floodplain pan, depending on the intensity of the flood as well as the position of the pan in relation to the river, this connection may be either brief or prolonged. Consequently, invertebrate communities may potentially be influenced by the size of a flood as this affects the length of connectivity to the river. Water is released on an annual basis from the Pongolapoort Dam located upstream of the Phongolo River Floodplain. This controlled flooding is based on the volume of water available for release and has no ecological background. It is therefore not known if the amount of water that is released, and length of connectivity of pans to the river, is enough to allow ecological processes to occur. Making use of mesocosms, this experiment aimed to determine how the length of connectivity of floodplain pans to a river would affect invertebrate communities. Nine mesocosms were constructed next to a floodplain pan in the Ndumo Game Reserve, separated into three groups and water kept at three different levels. Each mesocosm was sampled 11 times over a five week period. Water samples were collected, *in situ* measurements taken and invertebrates collected for community analysis. Nutrient analyses were conducted on water samples and invertebrates were identified to lowest possible taxonomic level and then placed back into the mesocosms. Preliminary results indicate little difference in both water quality and macroinvertebrate communities between the mesocosms while competition for dominance was present in the zooplankton communities.

FISH AND AQUATIC INVERTEBRATE DIVERSITY OF THE SEEKOEIVLEI NATURE RESERVE.

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Water Research Group, Unit for Environmental Sciences and Management, North-West University, Potchefstroom, South Africa.

Seekoeivlei Nature Reserve is situated in the Free State, just outside the town Memel. The main wetland is the floodplain of the Klip River and it was declared a Ramsar site in 1999. This wetland is important in providing numerous ecosystem services like water purification, attenuate floods and provision of food for livestock during winter times. Thus far, there are no published records of zooplankton or macroinvertebrates of the Seekoeivlei Nature Reserve. Biotic assessments are done to determine the health of the wetland, which will include biological interactions. Two surveys were conducted during July 2016 and December 2016. Macroinvertebrates were sampled using a sweep net with a mesh size of 1 mm. Fish were sampled during the second survey using a seine net and cast net. Three fish species were found which includes *Barbus anoplus* (Chubbyhead barb), *Barbus paludinosus* (Straightfin barb) and *Barbus pallidus* (Goldie barb). In order to characterise the influence of environmental factors on biodiversity spatial and temporal variation in the wetland, sediment and water samples were taken at each site. The macroinvertebrate results showed a significant difference between the first and second survey. During the second survey Coleoptera diversity increased, as well as Odonata. For example, the results of the second survey had more Anisoptera present than the first survey, such as Aeshnidae. Mollusca increased significantly between the first and second surveys. This information will enhance the understanding of the biodiversity and therefore the management of the Seekoeivlei Nature Reserve as it is a Ramsar Wetland of international importance.

EVALUATING OUTCOMES OF RESTORATIVE BIOMANIPULATION MANAGEMENT OF A HYPERTROPHIC SOUTH AFRICAN RIVER IMPOUNDMENT THROUGH LONG-TERM CROSS-SYSTEM COMPARISON OF REMOTELY SENSED TROPHIC STATUS MONITORING DATA. (Plenary Presentation)

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Eutrophication, with its adverse effects on ecosystem and human health/welfare, impacts ± 75% of SA's impounded water. Regional efficacy of a restorative in-lake management intervention, the ambitious 'bioremediation' project on Hartbeespoort Dam (HBPD) is evaluated.

Integrated whole-lake monthly median average values for relevant trophic status response variables – chlorophyll ($\mu\text{g/l}$), cyanobacteria (as % of total chlorophyll) and cyanobacterial cover (% lake area), derived from ± bi-weekly MERIS satellite data spanning 114 months (2002 – 2012), were used to compare temporal trends in **HBPD** against 3 catchment (CC) and 3 regional/bioclimate (RC) un-manipulated 'control' reservoirs.

Phytoplankton was ubiquitously seasonal, with respective overall average chlorophyll values of **180 (HBPD)**, *91, 95, 197* (CC reservoirs) and *20, 74, 151* (RC reservoirs). Cyanobacterial content correspondingly averaged **45, 9, 15, 30** and ≤ 1 , with cyanobacterial coverage averaging **51, 14, 16, 33**, and ≤ 1 . Linear time series analysis of monthly response variable values and their anomaly profiles (to remove/minimize seasonal periodicity effects) revealed directionally inconsistent trends in all reservoirs; of 21 trends tested, 12 were significant ($p \leq 0.05$), either positively or negatively ($n = 6, 6$), excluding the existence of systematically consistent confounding environmental drivers of change at spatial and temporal scales investigated.

The absence of significant overall time series trends in HBPD, and lack of improvement in average values of chlorophyll (174 vs. 187), cyanobacterial content (44.9 vs. 45.2) or cover (50.2 vs. 51.7) in HBPD before/after treatment started (February 2008; $n = 62$ vs. 50), accordingly excludes attributing putative improvements in HBPD directly to bioremediation efforts to date, seriously questioning their effectiveness.

FRESHWATER FISH AS INDICATORS OF POLLUTION. FINDINGS AND CHALLENGES. (Invited Speaker)

Johan HJ van Vuren

Contaminants that accumulate in aquatic ecosystems through anthropogenic activities receive attention in many research programmes worldwide. Effluent from applications in agriculture, mining activities, urban development and industrial plants is the main source of metals, organic chemicals, pharmaceuticals, nutrients and bacteria that negatively affects water quality in natural streams. Acute and chronic stress responses are experienced by aquatic organisms exposed to high levels of these substances in the affected streams. The last three decades freshwater fish have been used in South Africa to provide information on the changes in specific physiological variables that are used to assess the health of the organism. Knowledge on these changes that may result in mortalities, impaired growth and a decrease in reproductive success can be used in the development and refinement of water quality guidelines as well as management programmes.

The selection criteria used for the selection of suitable experimental fish species are emphasised and the techniques employed in a number of completed studies summarized. The most important findings from these studies in polluted environments and from laboratory exposure experiments will be presented and discussed. The challenges for future research are identified.

FRAMEWORK FOR REGIONAL EVALUATIONS OF E-FLOWS IN THE NILE BASIN. (Invited Speaker)

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Regional E-flow frameworks for the holistic management of flow driven water resource use is established as best practice, for the sustainable use and protection of water across geo-political regions. The Nile E-flows Framework addresses the requirements of a robust framework, current best practice E-flows management frameworks and E-flows assessment methods into an adaptable, scientifically valid management framework. The framework established by the Nile Basin Initiative conforms to the principles of trans-boundary collaboration and benefit sharing, sustainable water resource use and protection using evidence based, transparent and adaptable tools. The framework, loosely based on the Ecological Limits of Hydrologic Alteration framework with local considerations, includes seven phases including: (1) Situation Assessment and Alignment, (2) Governance and Resource Quality Objectives Setting, (3) Hydrological Foundation, (4) Ecosystem Type Classification, (5) Flow Alterations, (6) Flow-Ecological-Ecosystem Services Linkages and (7) E-Flows Setting and Monitoring. The framework has been developed and implemented on multiple spatial scales through four trans-boundary case studies in the Nile Basin namely; the Dinder River (Ethiopia/Sudan), the Malaba River (Kenya/Uganda), Mara River (Kenya/Tanzania) and Kagera River (Burundi/Rwanda/Tanzania). The Nile E-flows Framework contributes to the future aim of managing resources on a regional scale, using information derived from sub-basin E-flow management activities. Although this basin scale E-flows assessment process requires the future establishment of scale relevant E-flow management objectives, and a better understanding of the flow-ecology and flow-ecosystem service relationships on a basin scale, the Framework allows for immediate regional scale assessments and highlights information needs for larger regional/basin scale assessments.

DIATOM COMMUNITY STRUCTURE AND THE RELATIONSHIP WITH WATER QUALITY WITHIN LAKE SIBAYA.

Anrich Kock, Wynand Malherbe, Jonathan Taylor
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Monitoring of wetland ecosystems are crucial as these ecosystems provide various ecological services and resources to humans. Lake Sibaya are one such wetland that requires monitoring due to increased forestry and rural development. However, due to wetlands' inundation time and varying depths it is often difficult to make use of invertebrates and fish as biological indicators. Diatoms thus are perfect for monitoring of wetland ecosystems as they have a worldwide distribution, are species rich and rapidly respond to environmental changes. Very little information is available on wetland diatom communities, especially some of our Ramsar wetlands like Lake Sibaya. The study aimed to determine the diatom community of Lake Sibaya as well as their relationship with the water quality. Diatoms and water samples were collected during three surveys in August 2015, December 2015 and February 2016. Diatoms and water were sampled, processed and analysed according to standard methodology. Relevant statistical analysis were used to determine the diatoms SPI, GDI and TDI index scores. The relationship between water quality and the diatom community structure were determined with a principle components analysis, redundancy analysis and a canonical correspondence analysis. The results indicated that the lake has a moderate diatom diversity with *Cocconeis placentula*, *Gomphonema* sp., *Epithemia adnate* and *Nitzschia* sp. being the dominant species. Both the water quality and diatom community indicated the lake were nutrient enriched. However, as nutrients accumulate in wetlands it is unsure whether the increased nutrients are problematic or natural.

PERIPHYTON AS A BIOMONITORING TOOL IN NON-PERENNIAL, REGULATED RIVERS IN CENTRAL SOUTH AFRICA.

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Conventional river biomonitoring indices have been developed for perennial systems, which are markedly different ecosystems than the less stable non-perennial rivers found throughout the more arid parts. These non-perennial rivers have added complexities in that they are also regulated systems.

The general aim of this research was to investigate epilithical periphyton (as a group) and identify which of its components would be best suited as indicators of water quality. In contrast to using diatoms (a highly specialised, time consuming and expensive application), epilithical periphyton is easily accessible for analysis – especially with the chlorophyll-*a* component of periphyton.

This research was conducted over two periods of 24 months on the Modder River system, part of the catchment sustain large parts of central South Africa. Physico-chemical factors (including chlorophyll-*a*) were sampled, the biota sampled were epiphytical periphyton, phytoplankton and benthic macroinvertebrates. Data were analysed to identify correlations and patterns between the physico-chemical factors and the various components of the biota in relation to seasonality and hydrological phases.

FIRST FLUSH ALGAL BLOOM EVENTS AND IMPLICATIONS FOR ADAPTIVE MANAGEMENT OF URBAN WATER BODIES.

(not delivered)

Candice Haskins

Catchment & Stormwater Management - City of Cape Town, Cape Town, South Africa

There are numerous wetlands, “vleis” and estuaries within the City of Cape Town area which perform valuable green infrastructure good and services such as flood attenuation and water quality improvement, but are also important nature and recreational areas that offer opportunities for people to escape the urban environment. Multiple municipal departments share responsibility for managing these systems with the objectives of balancing environmental health and integrity and ensuring that users are not exposed to risk due to floods or impaired water quality. Algal blooms have the potential to wreak havoc on these systems if they result in fish kills or pose a threat to users. The causes and consequences of a number of algal bloom events in two of Cape Town’s most important estuaries, Zandvlei and Rietvlei, are presented to illustrate the role of adaptive management and incremental learning which the City and other stakeholder used in responding to these events over the past decade.

USING ANGLER DATA TO MAP THE EXTENT OF BLACK BASS DISTRIBUTION IN SOUTH AFRICA.

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Freshwater fishes are the only taxon that continue to be introduced when their detrimental impacts on native freshwater biodiversity have been repeatedly demonstrated. In particular, species introduced widely for recreational angling are now considered one of the major threats to freshwater biodiversity. In South Africa, four black bass (*Micropterus*) species were introduced to boost recreational angling. Subsequently, these species have been spread throughout the country. While there has been considerable effort to document the introductions of alien fishes there is often a paucity of information on their subsequent establishment, spread and abundance. This paucity can be attributed to the substantial cost of carrying out large-scale post-introduction assessments. This study seeks to bridge this knowledge gap by using multiple information sources (unpublished data, scientific literature, angling magazines, fisheries databases and social media) to estimate the current spatial distribution of the four *Micropterus* species in South Africa. A database of *Micropterus* species records in South Africa was established and distribution maps generated using QGIS software. *Micropterus* species were recorded in all Water Management Areas across South Africa, with the Largemouth bass accounting for 50% of the records, smallmouth bass 35% and spotted bass 15%. Records of Florida bass were integrated with the largemouth bass as a result of morphological similarities between species. Seventy percent of the records were collected in river sections, while 21% were in large impoundments. The methodology used in this study was useful and cost-effective in giving information about the current distribution status of *Micropterus* species in South Africa.

ASSESSING THE POTENTIAL TO ESTABLISH AN INLAND FISHERY IN FLAG BOSHELLO DAM, LIMPOPO PROVINCE, SOUTH AFRICA.

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South Africa has no formal inland fisheries despite having numerous reservoirs on major rivers. Due to the prominent role inland fisheries play towards food security and poverty alleviation in most tropical African countries, the Water Research Commission has funded a project to evaluate the potential of establishing inland fisheries on major reservoirs in poverty stricken rural areas. To evaluate the fishery potential of Flag Boshello Dam in Limpopo province, fish surveys were conducted using composite gillnets for nine months of 2016.

Labeo rosae, *Clarias gariepinus* and *Oreochromis mossambicus* were the most dominant species contributing 66, 14 and 12% of the total catch rate (kg/100m-net/hr), respectively. Capture data revealed the length frequency distribution of *L. rosae* and *O. mossambicus* populations to be unimodal with most *L. rosae* exceeding 15 cm in total length, indicating low recruitment and a species vulnerable to overfishing. Similarly, no recruitment of juvenile *C. gariepinus* was evident. In contrast a wide length frequency distribution for *O. mossambicus* was recorded, indicating a population that could be sustained provided that restrictions are placed on using gillnets with mesh sizes > 70 mm.

Biological data collected will be used to establish appropriate harvest strategies using fishery models while surveys using questionnaires will determine the utilisation of fish stocks by fishermen and anglers. However, the fishery potential needs to be evaluated considering the metal contaminants recorded for fish from this reservoir in recent studies.

USING FUNCTIONAL RESPONSES TO ASSESS RELATIVE IMPACT POTENTIAL OF SUCCESSFULLY INTRODUCED FISHES IN MAN-MADE AQUATIC ENVIRONMENTS.

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The manner and mechanisms by which introduced species modify ecosystems is of great relevance for environmental management. Since interspecific interactions are key factors in the structuring and functioning of ecological communities, assessing exchanges such as competitive exclusion and predator-prey dynamics within the context of species introductions is necessary. Predator functional response (the relationship between prey density and consumption rate) experiments have been identified as a useful tool for the identification of potentially invasive species and as a measure of impact potential. This study compared the shape and magnitude of the functional response of an invasive species, *Gambusia affinis* to that of native *Oreochromis mossambicus* and *Glossogobius callidus* towards their natural shared prey, Chironominae. All fish species displayed an inversely density dependent predation of chironomids that increased linearly with prey availability at low densities, but decreased with further prey supply, thus a type II functional response. The invasive *G. affinis* consumed significantly more prey overall than did the native *G. callidus* and even more compared to *O. mossambicus*. Significant lower prey handling times by the invasive *G. affinis* resulted in substantially higher maximum feeding rates compared to the native species. These results are discussed in the context of incorporating species abundance with functional responses to enhance predictive assessment of the impacts of potentially damaging invaders.

PRELIMINARY MSC RESULTS FOR AN ASSESSMENT OF THE AQUATIC MACROINVERTEBRATE DIVERSITY WITHIN THE NYL AND MOGALAKWENA RIVER SYSTEMS, LIMPOPO, SOUTH AFRICA.

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The Nyl and Mogalakwena River system is a watercourse that is facing increasing pressure from increased urbanisation, industrial and mining development and agriculture. The system is one of the main tributaries of the Limpopo River and is an important water source for the semi-arid Limpopo Province. Preliminary results from low flow sampling, have shown that the Modimolle sewage treatment works (STW) is severely affecting the water quality within this river system, affecting the macroinvertebrate taxa that are present within the river. A student T-test conducted on the water nutrient data revealed that Klein Nyl Oog (KNO) and Donkerpoort Dam (DPD) are significantly different to that of STW and Jasper (JASP), a site 2km downstream of STW. From the available biotopes, it has been observed that Glen Alpine Dam (GAD) had the highest number of macroinvertebrate families present at the time of sampling with 60 families identified. KNO and DPD had 54 and 59 families respectively, whilst STW, a site severely affected by organic pollution had 15 families present at the time of sampling. Although JASP had 28 families present, the water nutrients data was seen to be worse than that of STW. This was attributed to the fact that JASP had a lower pH than that of STW. The number of macroinvertebrate families present at each site correlate with that of water nutrients data, showing that STW is having a significant impact on water quality and subsequent downstream sites within the Nyl and Mogalakwena rivers.

KEISKAMMA AQUATIC INVERTEBRATE COMMUNITIES: NEW MULTIVARIATE MODELLING METHODS.

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Aquatic macroinvertebrates are useful indicators of environmental gradients and disturbance in the lotic environment, and can be an important component in the diet of many fish species. We examined whether invertebrate species composition is influenced by the presence of non-native and native fish in the Keiskamma River system. To do this we used newly developed statistical techniques for analysing species assemblage data in relation to environmental covariates. The new techniques are comparable to classic techniques such as multidimensional scaling (MDS), similarity percentage (SIMPER) and multivariate analysis of variance (MANOVA). However, unlike classic techniques, the new modelling-based techniques have greater statistical power and are less influenced by a few dominant species (see Wang *et al.*, 2012, *Methods in Ecology and Evolution*, 3, 471–474, and Hui *et al.*, 2014, *Methods in Ecology and Evolution*, 6, 399–411). In addition, the new techniques are highly flexible. The response variable can be counts, presence-only, percentage cover or biomass, and the models can take into account environmental predictors, unknown covariates and species traits. We used multivariate regression to analyse the relationship between aquatic invertebrate species composition and the presence of fish, as well as environmental covariates such as flow rate, biotope and temperature. We also performed a Bayesian ordination (equivalent to MDS unconstrained ordination) to illustrate the relationship between sampling sites based on species composition. Based on the results, we suggest that invertebrate species composition is mainly determined by environmental covariates, with fish presence playing a smaller role.

TOXICITY RANGE DETERMINATION OF VANADIUM ON *XENOPUS LAEVIS* EMBRYOS VIA FROG EMBRYO TERATOGENESIS ASSAY - *XENOPUS* (FETAX).

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The FETAX protocol is a well-established method of determining the toxicity of certain materials in *Xenopus laevis* embryos. The refined-FETAX protocol incorporates a scoring system (1 -5) of the severity of malformations present in the larvae for a more sensitive and revealing experiment. Vanadium is a metallic element found naturally in aquatic systems at low concentrations, although it also enters the environment through various anthropogenic pathways like mining, fossil fuel combustion, sewage and fertilisers. Vanadium, in some forms, may have negative impacts on biota. There are limited studies of vanadium exposure in aquatic organisms and no studies are available for South African aquatic species. A preliminary toxicity range finding test was conducted to determine the range at which vanadium becomes toxic to *Xenopus laevis* embryos. An acute exposure (96 hrs) was done in concentrations from 0.001 mg/L -100 mg/L, increasing by a factor of 10. Each concentration indicated its own unique phenotypic malformations profile, with some features being heavily affected by some concentrations and normal in others. A dose-dependent response was seen in hyperpigmentation with incidences increasing steadily from 0.001 mg/L to 10 mg/L, but an opposite reaction was found in the 100 mg/L (hypopigmentation). Mortality rates indicated that 100 mg/L had the highest mortality (68%) followed by 0.1 mg/L and 0.001 mg/L (both 10%), then 1 mg/L and 10 mg/L (both 6%). The lowest mortality was found in 0.01 mg/L exposures (4%). Further studies are in progress to refine the range and ultimately determine a reliable LC50 value.

MEASURING THE IMPACT OF NANOGOLD (NAU) ON THE SWIMMING PERFORMANCE OF *DANIO RERIO* IN AN ACUTE EXPOSURE STUDY.

Sarel Brand, Tarryn Botha, Victor Wepener

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The development of nanomaterials holds great promise in a range of sectors with various possible applications. Production, use and disposal of products containing nanomaterials can lead to an increased presence of these particles in the environment and exposure to the organisms found there. As such, it has become increasingly necessary to develop methods for screening these materials for possible toxic effects. Measuring swimming performance serves as an important tool to predict survival of fish species, being a critical trait in avoiding predation and facilitating feeding and breeding behaviors. Previous studies have shown accumulation in muscle tissue as such during this investigation, critical swimming speed (U_{crit}) was measured in zebrafish subsequent to a 48h exposure to nanogold (nAu) particles in order to assess whether the nanomaterial altered swimming performance. Adult nAu-exposed vs. control zebrafish were individually placed in an enclosed swim respirometer and forced to swim against a set water flow. The velocity of the water flow was incrementally increased in 5 minute time intervals until the fish failed to sufficiently keep up with the increasing water flow for a full time interval due to fatigue. With U_{crit} being indicative of aerobic threshold, oxygen consumption was measured as an additional indicator of physiological strain induced by the increase in flow velocity. Compared to control, nAu-exposed zebrafish demonstrated diminished swimming performance. These initial observations serve as foundation for further investigations into the underlying mechanisms by which nAu-exposure affects swimming performance in adult zebrafish.

A BRIEF REVIEW OF THE SOCIO-ECOLOGICAL SYSTEM MANAGEMENT OF THE LOWER PHONGOLO RIVER AND FLOODPLAIN USING RELATIVE RISK METHODOLOGY. (Plenary Presentation)

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The construction of the Pongolapoort Dam in the Phongolo River started in 1960 with the purpose to supply irrigation water for the proposed sugarcane and cotton plantations in the adjacent floodplain, the Makhathini flats. The floodplain of approximately 10 000 ha increases in size to 13 000 ha at full inundation. The floodplain extends to the confluence of the Phongolo and Usutu Rivers in Ndumo Game Reserve (NGR) up to the border with Mozambique. Ndumowas proclaimed a game reserve in 1924 with the primary objective of strict protection of its biodiversity. Today, NGR is a RAMSAR site because of its unique wetlands. Surrounding the NGR is communal areas that are heavily dependent on resources from the floodplain. However, the environmental sustainability of the floodplain has been questioned over time, especially since the construction of the Pongolapoort Dam, there have been no major ecological studies that have monitored the floodplain wetlands of the Phongolo River. Very little is therefore known about the current ecological state as well as functioning and structure of the floodplain as a whole.

The health and diversity of the fish, amphibians, water-associated birds and invertebrate communities have also not been assessed recently. The project reported on in this presentation was established in 2011 with the aims to

1. Conduct an integrated regional scale risk assessment of the Lower Phongolo River and floodplain using the Relative Risk Model (RRM) to establish and evaluate threats to the ecosystem;
2. Carry out an ecological integrity state assessment of the Lower Phongolo River and floodplain using the EcoClassification Level
3. Methodology;
4. Determine and evaluate the bioaccumulation and biomagnification of DDT and other relevant organic pollutants and potential impacts thereof in the Lower Phongolo River and floodplain and the associated risk thereof to the local communities;
5. Provide all relevant data and information necessary to conservation authorities for the establishment of conservation plans for selected aquatic invertebrate and vertebrate species (macroinvertebrates, fish, amphibians and birds) of the Phongolo River and floodplain.
6. Evaluate the socio-economic implications associated with the use of fish as an ecosystem service (i); and (ii) evaluate the socio-ecological and cultural implications associated with the use of fish as an ecosystem service.

The above aims were all achieved and the final project completed and published in 2016. This presentation aims to highlight the most significant results from this multidisciplinary research project on the Phongolo River and floodplain.

THE AQUATIC BIODIVERSITY OF SELECTED SOUTH AFRICAN RAMSAR WETLANDS. (Invited Speaker)

Wynand Malherbe

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Wetlands provide numerous goods and services and therefore it should be protected from anthropogenic impacts. The Ramsar Convention on Wetlands of International Importance was approved as part of legislation in South Africa during 1975 and currently approximately half a million hectares is protected at 22 sites. The Ramsar Convention was created to protect wetlands from degradation and loss of biodiversity, especially the maintenance of bird habitats. However, many of the Ramsar wetlands in South Africa lack aquatic diversity and present ecological state information, specifically fish, macroinvertebrate and diatoms, and in cases where there is information it are often outdated. Therefore, this project was initiated to increase the available aquatic information of Ramsar sites. The Ramsar sites that have been selected include Kosi Bay, Lake Sibaya, Makuleke Wetlands, Barberspan, De Hoop Vlei, Heuningnes Estuary, Blesbokspruit, Ntsikeni Nature Reserve, and Seekoei Vlei. The project embarked on numerous surveys from 2014 to 2016. The project outcome provided updated aquatic biodiversity information for diatom, zooplankton, macroinvertebrate and fish communities at these sites. The results also reflected the uniqueness of each of these systems thereby highlighting the need for monitoring programmes suitable for each system. The results from this project will be able to support the information requirements that are specified within the Ramsar Convention.

CAN TROPHIC ECOLOGY INDICATE IMPACTS OF LAND MANAGEMENT ON SAVANNA HEADWATER STREAMS? (Invited Speaker)

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Headwater streams provide critical sources of water and other provisioning ecosystem services to downstream communities in the savanna biome of southern Africa. They are also inherently vulnerable to large scale impacts such as urbanisation, intensification of agriculture, and climate change. The recent El Nino-driven drought in southern Africa had a particularly devastating impact on the headwater streams of the western Limpopo River basin, causing many tributaries to become completely dewatered. Such short-term acute stressors are likely to interact with more chronic stressors such as urban creep and agricultural intensification, to disrupt the ecosystem functioning of these critical habitats. Recent research in the Highveld and Bushveld tributaries of the western Limpopo River basin has revealed a strong negative correlation between human land use and the structure and function of aquatic food webs. These findings suggest that food web structure may prove an excellent indicator for change in ecosystem function in savanna headwater streams, and could be used to assess the effectiveness of sustainable land management strategies to protect these critical environments and the ecosystem services they provide. This talk will introduce a new research programme that seeks to use food web structure as an indicator of how well UNESCO biosphere reserves, set up to promote sustainable development of land for the benefit of local communities, are capable of protecting savanna stream ecosystems.

USING BRUVS TO ASSESS DIVERSITY AND ABUNDANCE OF FISHES IN THE LAKE NIASA RESERVE, LAKE NIASA, MOZAMBIQUE.

Jeff Hean¹, Angus Van Wyk¹, Fabricio Frehse^{1,2}, Eugidio Gobo³, Thor Erikson¹, Antonio Pegado⁴, Carlos Jonasse⁴, Armindo Euzebio⁴, Michelle Thieme⁵, Olaf Weyl¹

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Lake Niassa (Malawi) contains more fish species than any other lake on earth. In 2011, the Mozambican government declared the Mozambican portion of the lake a national reserve. The creation of protected areas has long been a cornerstone strategy for protecting terrestrial species and ecosystems and, more recently, has been expanded into aquatic ecosystems. Lake Niassa now provides an exciting opportunity to evaluate the benefits and limitations of a freshwater protected area. To provide baseline information on the status of biodiversity within the Lake Niassa the current project deployed baited remote underwater video (BRUVs) at 400 sites ranging from 0 to 70m in depth. The sites represented areas of varying fishing intensity and substrates. Data on diversity and abundance of specific target species were assessed in the context of these variables. The results are discussed with specific reference to: 1) the diversity and relative abundance of fishes in shallow habitats within and outside of protected areas; 2) the utility of using BRUVs as monitoring tools in one of the most ichthyologically diverse ecosystems on the planet

FOUR YEARS OF MONITORING THE HEALTH OF RIVERS IN KWAZULU-NATAL.

Carla Higgs, Gordon O'Brien, Melissa Wade, Matthew Burnette, Celine Hanzen, Mahomed Desai, Perceverence Tenza

University of KwaZulu-Natal, College of Agriculture, Engineering and Science, Scottsville, South Africa

In KZN between 2014 and 2017, 43 sites were evaluated on a quarterly basis as a part of the RHP in KZN. Findings suggest that while the overall ecological state of the rivers in the province generally occur in a largely modified (Class D) or better ecological state overall, many components of the ecosystems occur in an unacceptable (< Class D) state across the province. Threats to the wellbeing of the ecosystems extend from alien invasive plants, fishes and crayfish in the upper reaches of the ecosystems to extensive agriculture developments, industrial and urban activities and waste water treatment works in the lower reaches of the rivers. The legal requirement to maintain a sustainable balance between the use and protection of water resources in KwaZulu-Natal (National Water Act, 1998) and protect biodiversity (National Environmental Management Act of 1998) appears to be skewed towards use and not to the protection of water resources which urgently needs to be addressed. The recent drought conditions in the North-Eastern parts of KwaZulu-Natal in particular, appears to have exacerbated the impact of water resource use in the area. Recent monitoring suggests that the synergistic impacts of the drought have reduced due to good recent rains in the province. These results suggest however that the resilience of the ecosystems to maintain its wellbeing during these high stress periods has been severely impaired by anthropogenic activities and that some ecosystems are under serious threat of potentially irreversible changes.

EVALUATING SEASONAL HABITAT UTILISATION BEHAVIOUR BY *LABEOBARBUS MAREQUENSIS* USING TELEMETRY TECHNIQUES.

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The seasonal movement and habitat utilisation of *Labeobarbus marequensis* was evaluated by externally attaching radio transmitters to 16 adult fish and manually tracking them from August 2009 to November 2011. Monthly monitoring surveys acquired 1620 observational fixes. Remote monitoring acquired over 64499 observation points of these 20328 points recorded activity (n=7) and 1262 recorded depth (n=1). Results showed adult yellowfish did not participate in any cordial migrations. The habitat preferences for yellowfish were deep runs and glides showing significant selection for boulders. In addition fish showed to select rapids and pools and avoided shallow sandy glides. Movement results for yellowfish showed fish to be affected by changes in flow (> 50 m³.s⁻¹). Further, movement results showed yellowfish to be diurnal fish dependent of water depth and clarity in acquiring food. It is suggested that predations, flow and water clarity affect the habitat selection and spawning of yellowfish. Further the investigation into the correlation of flow to the movement of yellowfish is needed to better understand these relationships.

CHANGES IN DISTRIBUTION AND GENETIC DIVERSITY OF ANGUILLID EELS ALONG THE EAST COAST OF KWAZULU-NATAL, SOUTH AFRICA.

Céline Hanzen ¹, Martyn Lucas², Colleen Downs¹, Gordon O'Brien¹

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As is the case for their temperate homologues, tropical eels face increasing threats due to anthropogenic global change including exploitation demands, habitat loss and water resource management schemes. Along the east coast of South Africa, four freshwater eel species are believed to occur and to undertake catchment-scale migrations (*Anguilla mossambica*, *A. bengalensis labiata*, *A. marmorata* and *A. bicolor bicolor*). From the south coast of South Africa, northwards along the east coast, their diversity is known to increase, reaching a peak in KwaZulu-Natal (KZN) Province. We investigated their distribution currently in KZN. Seasonal surveys were conducted over 54 sites in the major rivers of KZN between July and December 2016 with an additional survey in March 2017. Fin clips were obtained from all individuals caught for later genetic analyses. In 2016, 42 eels were recorded across 17 sites in KZN. *Anguilla mossambica* and *A. marmorata* were the most abundant while only one *A. bicolor bicolor* was caught and no *A. bengalensis labiata* were recorded. Fragmented historical data regarding their distribution are available and will be reviewed then compared with these more recent data. In addition likely impacts for change in distribution and abundance are being considered. Also the genetic methods employed will provide species genetic markers for validation of juveniles and respective species clarification.

SPATIAL AND TEMPORAL VARIATION IN TWO SUB-CATCHMENTS ON THE WILGE RIVER SYSTEM NEAR OGIES, MPUMALANGA: INSIGHTS FROM THREE RESPONSE GROUPS: DIATOMS, AQUATIC MACROINVERTEBRATES AND FISH.

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We report on the spatial and temporal variation within three instream response groups, diatoms, aquatic macroinvertebrates and fish associated with two sub-catchments (Wilge and Saalboom) of the upper Wilge River, in Mpumalanga. The main land use in the Wilge sub-catchment is agriculture, while coal mining dominates the Saalboom sub-catchment. Data have been collected for high flows and low flows between 2010 and 2016. The three diatom response metrics included: % Pollution Tolerant Values, Specific Pollution Index and Biological Diatom Index. All three metrics measured notable differences between the two sub-catchments. The Wilge sub-catchment yielded average %PTV and SPI scores of 14.03 (SD= 16.11) and 13.42 (SD= 3.27) respectively, whereas the Saalboom sub-catchment yielded scores of 23.57 (SD= 25.84) and 11.44 (SD= 4.77). Similarly, the macroinvertebrate response metrics, SASS score, Average Score per Taxa and % Ephemeroptera, Plecoptera and Trichoptera, yielded average scores of 99.00 (SD= 35.29), 4.89 (SD= 0.63) and 19.4 (SD= 6.6) for the Wilge sub-catchment, compared to 74 (SD= 41.64), 4.29 (SD= 0.85) and 12.17 (SD= 7.93) for the Saalboom sub-catchment. Average fish diversity scores measured were 0.71 (SD= 0.40) for the Wilge- and 0.30 (SD= 0.4) for the Saalboom sub-catchments. The study concludes that all the response metrics applied have the ability to differentiate differences in catchment use, although the causal relationship between the driver and response metrics are more complex than anticipated. The results emphasize the importance of a multi-metric aquatic biomonitoring approach in highlighting the implications of catchment uses associated with agriculture and mining.

IS *PSEUDOBARBUS QUATHLAMBAE* (MALOTI MINNOW) REALLY EXTINCT? NEW SITTING AFTER 47 YEARS!!!

Skhumbuzo Khubeka

Ezemvelo KZN Wildlife, Pietermaritzburg, South Africa

Pseudobarbus quathlambae known distribution is the headwater streams of the Orange River in Lesotho. There are five populations remain in the Tsoelikane, Sani, Maremoholo, Senqu and Matsoku Rivers in Lesotho, but the population in South Africa has gone extinct. Type locality of this species in South Africa is the Umkomazana River in Natal, but has not been recorded there since the 1930s. The latest record of this species was collected in 1970 in Lesotho. After 47 years the species has been recorded in Kwazulu-Natal and outside its known distribution range. Questions to be answered is it the same species (DNA analysis)? Did we ever know enough about this species? Is it outside its distribution range? What does this mean for this future of the species? In its current distribution is it viable, threads etc?

A COMPARATIVE HISTOLOGICAL ASSESSMENT OF TWO INDICATOR FISH SPECIES FROM THE THREE RIVERS FLOWING INTO THE HYPER-EUTROPHIC ROODEPLAAT DAM.

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The aim of this study was to assess and compare the histology of selected target organs of two indicator fish species, *Clarias gariepinus* and *Oreochromis mossambicus*, collected during both low-flow and high-flow conditions in the Pienaars River, Hartbeesspruit and the Edendalespruit; the three rivers that flow into the hyper-eutrophic Roodeplaat Dam. Six organs (gills, heart, spleen, liver, kidney and gonads) were sampled. A necropsy was performed to identify any macroscopic abnormalities. Tissue samples were processed for light microscopy analysis and histological alterations identified were semi-quantitatively assessed. Somatic indices and a condition factor were also calculated for each fish. Water and sediment samples were analyzed for selected inorganic and organic compounds. The semi-quantitative histological analysis showed a variation in the histological index values comparing results between species, rivers and seasons. Histological alterations were found in all organs assessed. However, the most affected organ in both species was found to be the liver and histological alterations included progressive, regressive and inflammatory changes. Macroscopically, affected livers were characterized by focal, nodular alterations. The respective hepato-somatic index and condition index values for both species were found to be within a similar range comparing seasonal sample groups. The water quality results indicated eutrophic conditions for all three rivers. Faecal coliform levels were detected at all sites with higher levels during high-flow conditions. The water and sediment samples also showed levels of specific metals, there were no phenols or pesticides detected however a number of Semi-Volatile Organic Compounds were detected in the sediment samples.

HEALTH EFFECTS IN FISH FROM THE POLLUTED ORLANDO DAM AND KLIPSPRUIT WETLAND SYSTEM IN SOWETO, SOUTH AFRICA.

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The aim of this study was to investigate the health of *Clarias gariepinus* sampled from two polluted water bodies located in the middle reaches of the Klipspruit wetland catchment area in Soweto; the Orlando Dam and a wetland pond at the confluence of the Baileyspruit and the Klipspruit. Limited fish health-related data is available for this highly impacted freshwater ecosystem. Fish (n = 46) were collected between July 2015 and February 2016. A necropsy and a histological assessment was done on various target organs of each fish. Water and sediment samples were collected for selected organic and inorganic analyses. The macroscopic evaluation revealed abnormally-shaped urogenital papillae, morphological alterations of the gonads as well as discoloration of liver tissue. These observations were supported by microscopic evidence of hepatic and gonadal histological alterations. 13.6% and 50% of the male fish from the wetland pond and the Orlando Dam respectively showed abnormal gonadal histology in the form of testicular oocytes; in some cases, distinct male and female gonadal tissue was observed within the same individual. The water quality analyses revealed high levels of faecal coliform bacteria and metal concentrations, while the sediment analyses revealed levels of potential endocrine disrupting chemicals.

THE POTENTIAL EFFECTS OF THE HIV DRUG NEVIRAPINE ON THE HATCHING SUCCESS AND SURVIVAL OF THE MOZAMBIQUE TILAPIA LARVAE.

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Nevirapine is a first-line HIV anti-retroviral (ARV) given to pregnant women and infants to prevent mother to child HIV type 1 transmission. This drug has been detected in surface waters in South Africa, but its effects on non-target aquatic animals is unknown. The aim of this study was to assess the potential effects of environmentally relevant concentrations of nevirapine in surface waters, on the hatching success and survival of *Oreochromis mossambicus* larvae through a chronic exposure. Newly fertilized *O. mossambicus* eggs and newly hatched larvae were exposed to 1.48 µg/L nevirapine in a static renewal system in a controlled environment (27 ± 1°C; 14:10 day/night cycle). The experiments started 24 hours after fertilization of eggs and continued till the 30th day post-hatching. The assessed endpoints included: hatching success, survival and behaviour of larvae. A morphological assessment was also done on whole individual samples on day 1, 5 and 30 post-hatching to identify any physical abnormality under a dissection microscope. At the end of each period, measurements of total length and weight were taken to determine the growth rate of larvae. Preliminary results indicate that the environmental levels of nevirapine in South African surface waters have no obvious effects on the hatching success, behaviour and survival of *O. mossambicus* larvae.

THE THERMAL PREFERENCE AND TOLERANCE OF THE ENDANGERED EASTERN CAPE REDFIN, *PSEUDOBARBUS AFER*.

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Climate change threatens to exacerbate the stress on freshwater ecosystems. Climate change projections predict an increase in the temperature of lotic systems in the Cape Fold Ecoregion with decreased flows as the ecoregion becomes hotter and drier. On the eastern boundary of the ecoregion, populations of the range restricted and endangered Eastern Cape redbfin *Pseudobarbus afer* persist in the pristine headwater reaches of the Swartkops and Sundays rivers. To develop conservation plans for *P. afer*, an understanding of how the species will be affected by increased water temperature is required. This was achieved by evaluating the thermal tolerance and preference of the species when acclimated to summer (19.8°C) and winter (12.2°C) stream temperature. Thermal tolerance experiments determined the critical thermal maximum (CTM) using a Julabo circulating heater that heated the water at a rate of 0.3°C per minute. The CTM was the temperature at which the fish lost equilibrium (a non-lethal behavioural endpoint). The mean winter thermal tolerance of *P. afer* was found to be 29.9 ± 0.7 °C, while the mean summer thermal tolerance was 35.2 ± 0.5°C. Thermal preference experiments were conducted in a customised thermal preference apparatus. Median preferred temperature was 16.9 ± 2.0 °C in winter and 26.1 ± 2.7 °C in summer. Comparisons with field temperature data demonstrated that although thermal tolerance and preference were influenced by acclimation temperature, stream temperature was mostly within the bounds of the two preferred temperature estimates and never exceeded CTM.

THE USE OF STABLE ISOTOPE ANALYSIS TO ASSESS INTERTIDAL ROCKY SHORE FOOD WEBS FROM DIFFERENT CLIMATIC ZONES AND POTENTIAL METAL BIOMAGNIFICATION.

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Globally, of all the services and functions that ecological systems provide to human welfare, 63 % are derived from the marine domain. In South Africa, 61 % of the marine resources are overexploited and several habitats are threatened. The study was conducted at Tsitsikamma National Park, a warm temperate Marine Protected Area and Sheffield Beach, a sub-tropical region with little formal protection. Both sites represent areas with limited chemical impacts. The aim of the study was to define the trophic structure of the intertidal rocky shores of a warm temperate and sub-tropical region by using $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ for stable isotope analysis and determine whether there is a potential for metal biomagnification through trophic transfer. Species were selected by availability and frozen after collection until the analyses could be conducted. At the laboratory, the samples were divided for the different analysis and prepared accordingly. For the stable isotope analysis, the samples were dried, lipids removed with Chloroform/Methanol and weighed for Isotope Ratio Mass Spectrometer analysis. Using the same species, metal analyses were conducted by Microwave digestion and Inductive Coupled Plasma Mass Spectrometry, analysing for metals such as Ag, Al, As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Se, Ti, V and Zn. From this data, the trophic structure of each intertidal rocky shore was established as well as metal concentrations in the selected species. Potential metal biomagnification and trophic transfer of these metals through the trophic structure was then determined.

USING *DANIO RERIO* SWIMMING BEHAVIOUR AS AN INDICATOR FOR NANOMATERIAL ECOTOXICITY.

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Danio rerio (zebrafish) is being developed as a model organism for applications in several fields of research forming a link between cell culture models and mammalian models. The close homology between the human genome and the zebrafish genome make it a model candidate for behavioural and sub cellular toxicity testing, the genetic parallels include physiological and anatomical similarities between the endothelial cells, blood brain barrier, social interactions and immunogenic responses. Adult *D. rerio* were housed in a Tecniplast Zebrafish housing system at 26°C were transported to a behavioral room kept at 25°C and individually placed into 1.1L Tecniplast tanks in front of a frontal camera setup. Fish were exposed to 5 mg/L and 20 mg/L of gold nanomaterials following standard OECD protocols and video recordings were taken for the duration of the 48 hour test. Fish were tracked per exposure concentration and compared to a control. Different arenas were set up; an upper and lower section was marked on each arena to determine where fish spent most of their time. Fish were left undisturbed for the duration of the recordings. Video recordings were interpreted by physically viewing them and interpolating any missing data points by placing the marker on the animal in the coordinates it appeared in the arena as well as reassigning any incorrect data points where the software had lost sight of the organism. Preliminary data showed a decrease in total distance moved, swimming speed and zone transitions in exposed groups.

A DISCONTINUITY IN PH VALUES IN THE SOUTH AFRICAN NATIONAL WATER QUALITY MONITORING DATABASE.

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South Africa's National Chemical Monitoring Programme (NCMP), is an extensive water monitoring programme coordinated and managed by Resource Quality Information Services of the Department of Water and Sanitation (DWS). The NCMP includes long-term records of several physical and chemical water quality variables, including pH. The pH data has been found to contain a discontinuity during the 1980s, with a series of lower than expected values that ends in about 1989. The discontinuity is higher in acidic waters with lower buffering capacities. While the cause of the discontinuity in pH data is uncertain, the pre-1990 automated method used a different rinse solution than the method currently used, which might explain why weakly buffered systems showed a greater change in pH values. Users of the NCMP database should take note of the uncertainty in pH results recorded before 1990 when analysing long-term trends.

DETECTING THE PRESENCE OF NATIVE AND NON-NATIVE FISHES IN THE KROM RIVER, WESTERN CAPE, SOUTH AFRICA: A COMPARISON BETWEEN FOUR NON-DESTRUCTIVE FISH MONITORING TECHNIQUES.

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Monitoring the remaining populations of imperilled native fishes and detecting the presence of introduced non-native fishes is fundamental for the conservation of native fishes. However, the techniques available to monitor freshwater fish populations differ in their ability to detect the presence of native and non-native species. It is therefore important to know the probability that a specific technique would detect the presence of fish species. This study compares four non-destructive fish monitoring methods to determine the detection probability of each technique and to report on the distribution of native and non-native fish species in the Krom River, Cederberg, South Africa.

Fyke netting, snorkelling, underwater video observation and underwater photos were selected for this comparison. Each technique has its pros and cons. For example, fyke netting allows for the correct identification of the fish species but is intrusive and involves handling of the fish which might injure the fish. Snorkel surveys are influenced by the fish species response to the presence of the diver and, along with the video and photos, the turbidity of the water. The visual observation based techniques may also fare poorly in detecting nocturnal species.

Twenty-nine sites along the Krom River were surveyed with each of the four techniques. The list of species detected by any means at each locality was compared to the list detected by each technique and a detection probability for each technique calculated. In addition, an estimate of the abundance of the respective species was determined using the combined fish dataset.

THE IMPACT OF WATER QUALITY AND HABITAT AVAILABILITY ON SUBMERGED MACROPHYTES IN THE KROM RIVER (CEDARBERG).

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Submerged macrophytes fulfil important roles within habitats by absorbing nutrients, generating oxygen, stabilising the banks and substrate, modifying physical conditions including flow patterns and providing habitat (hydraulic shelter and food) for fish, invertebrates and periphyton. Due to their sensitivity to both short- and long-term changes in environmental factors, submerged macrophytes can be useful indicators of aquatic ecosystem health. The Krom River in the Cedarberg has been severely modified by invasion of alien fish, dense stands of riparian alien vegetation, river bank clearing, intensive water abstraction and dam construction.

This study aims to evaluate the distribution of submerged macrophytes along the river in relation to physical and chemical characteristics and investigate changes in biomass and cover of submerged macrophytes above and below dam structures. The role of *Stuckenia pectinata* in altering water characteristics over an 18-hour cycle in relation to biological characteristics was also evaluated.

Preliminary results indicate that there could be a relationship between flow rate and water turbidity and the distribution of submerged macrophyte species in the Krom River. Further, the total biomass of *S. pectinata* was significantly higher in the river (22.51 ± 3.62) than in the dams (5.42 ± 0.934) during summer (t test 4.566; $p < 0.05$; $n = 12$). Finally, the presence of *S. pectinata* at the experimental site did not significantly change the summer pH of the water with respect to the control site where *S. pectinata* was absent (experimental pH 6.88 ± 0.60 and control pH 6.87 ± 0.50).

DO ENVIRONMENTALLY RELEVANT CONCENTRATIONS OF METHOXYCHLOR AND ALDRIN AFFECT THE REPRODUCTIVE HEALTH OF THE MALE AFRICAN SHARPTOOTH CATFISH *CLARIAS GARIEPINUS* (BURCHELL, 1822)?

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The organochlorine pesticides methoxychlor (0.23 µg/L) and aldrin (0.14 µg/L) were both present in the Albasini Dam, Limpopo Province during a field survey in 2014 and a decline in fish numbers was reported. The decline in fish numbers could be as a result of the extensive illegal netting of fish in conjunction with pesticide exposure. The aim of this study was to determine the potential effects of environmentally relevant concentrations of methoxychlor and aldrin on the reproductive system of male catfish, *Clarias gariepinus*. Mature males were exposed for 96 hours to the two pesticides under controlled laboratory conditions. Following exposure, each fish was weighed and measured and a necropsy performed to determine any macroscopic abnormalities. The fish were sacrificed and dissected and the testes removed, weighed and measured to determine the gonadosomatic index (GSI). The right testis of each fish was sectioned for histological assessment to determine the testes index (I_T) and the left testis used for Computer Aided Sperm Analysis (CASA). The histological assessment of the testes showed that all the groups had a mean I_T below 10 and no statistically significant differences ($p > 0.05$) were found in the CASA parameters between exposure groups. The results of this study showed that the environmentally relevant concentrations of methoxychlor and aldrin did not have a negative effect on the reproductive system and sperm motility.

A PILOT STUDY OF STEREOLOGICAL ANALYSIS OF THE TESTES OF *OREOCHROMIS MOSSAMBICUS* (PETERS, 1852) EXPOSED TO DIFFERENT CONCENTRATIONS OF SELENIUM.

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Selenium is a non-metallic element essential in small quantities for the normal development and physiological functions in animals, including fish. However, at higher concentrations and long-term exposure, it may be harmful to juvenile and adult fish. The study aimed 1) to evaluate the effect of selenium in fish testes and 2) to use stereological analysis to quantify histomorphological changes in the testes of fish exposed to different selenium concentrations. Twenty four fish were used. Eight fish were placed in the control tank; eight exposed to 0.040µg/L and the remaining eight to 0.066µg/L selenium concentrations for 96hrs. At the end of the exposure period a necropsy analysis was done and fish were sacrificed. Fish were dissected and testes removed. Pathological changes of the testes were macroscopically and microscopically examined. For the pilot study serial sectioning was done on whole fish testes from a single fish from the control group. Summation average graphs of the volume densities of the interstitial tissue, seminiferous tubules and the spermatozoa were plotted to determine the adequacy of the sections. No abnormalities were observed externally in the testes. Histomorphological findings showed nuclear vacuolation and chromatin clumping. These results were inconclusive as it was unlikely that these changes were caused by selenium exposure. Histomorphological changes have mainly been descriptive and qualitative while stereology enables quantification of these changes. No quantifiable histomorphological changes were observed in fish exposed to selenium. In conclusion, selenium had no adverse effect on the testes of *O. mossambicus* due to the short exposure period.

EVIDENCE FOR DIETARY OVERLAP AMONG THREE NATIVE SYMPATRIC FRESHWATER FISHES IN SOUTH AFRICA'S CAPE FLORISTIC REGION.

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The diets of three co-existing endemic freshwater fishes (Cape galaxias *Galaxias zebratus*, $n = 33$; Cape Kurper *Sandelia capensis*, $n = 73$; Breede River redbfin *Pseudobarbus burchelli*, $n = 90$) were characterised and compared in three CFR headwater streams, using gut contents and stable isotope analyses, to ascertain whether they exploit distinct trophic niches, and whether they display ontogenetic differences in diet. Both approaches revealed that diet composition and trophic niche breadth among species, and between different size classes within a species, were broadly similar, and that niche overlap between species and size classes was correspondingly high. Our results also suggest that *P. burchelli* consumed a more omnivorous diet than did the other two species, and that *S. capensis* occupied a higher trophic position than the other two species. Our findings suggest that these species occupy broadly similar feeding niches in CFR headwater streams, and that resource partitioning does not facilitate their co-existence in these systems.

ASSESSING THE EFFECTS OF WATER QUALITY ON AQUATIC MACRO-INVERTEBRATES IN THE GROOT LETABA RIVER, LIMPOPO PROVINCE.

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The health of most river systems in the world is deteriorating with time, mainly caused by anthropogenic activities. South Africa is not an exception when coming to water quality deterioration whereby mining, agricultural and industrial activities are the main sources of organic and non-organic metal pollution. Many organisms are very good bio-indicators of the environmental health. Aquatic macroinvertebrates are amongst the popular organisms used as bio-indicators because they can give a picture of the historical water quality at a site. In the Groot Letaba River between Tzaneen dam and Kruger National Park (study site) agricultural activities are dominating, as one of the leading sources of water pollution. The use of pesticides and fertilizers have a very negative impact to the river. The aim of the study is to assess the health of the Groot Letaba River System using the South African Scoring System (SASS5) protocol. The SASS5 protocol is suitable for the assessment of the river health, by using macroinvertebrates assemblages as the main tool producing three different indices, i.e. SASS Score, Number of Taxa and Average Score per Taxon (ASPT). Three samples of aquatic invertebrates were collected from riffles at each selected sites. Collected invertebrates were identified to family level in a laboratory. The SASS5 score is determined for the classification of invertebrates into tolerant, moderately sensitive, and highly sensitive to pollution. The Groot Letaba River may be classified as one of the polluted rivers with regard to the Ecological Categories for Interpreting SASS data formulated by Dallas (2007).

DETERMINING THE EFFECT OF FUNCTIONALIZED NANOMATERIALS ON DIFFERENT BACTERIAL SPECIES.

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Nanoparticles (NPs) can be defined as an ultrafine unit with measurements in the 1-100 nanometre range. These particles may occur naturally in the environment, be released unintentionally by industrial processes or engineered for consumer products. They have unique characteristics and are used in a variety of areas such as medicine, engineering, catalysis and environmental remediation. As the global use for and production of NPs increases the risk of environmental contamination increases. It may also affect bacterial species associated with the gut and environmental micro-organisms, it is therefore important to understand the mode of toxicity of these nanomaterials. The aim of this study was to determine the effect of three nanomaterials namely cadmium/tellurium quantum dots (QDs), nanodiamonds and nanogold on various bacterial species by using standard growth curves. Three functional groups, a positive group (NH₃), negative group (COOH) and a neutral group (PEG) were attached to the surface of the QDs and nanodiamonds -while nanogold was citrate capped. Bacterial cultures were incubated in Mueller-Hinton broth and the optical density (600 nm) was measured by using a 96 Micro-well plate reader over a period of 24 hours. Results obtained from the growth curves showed clear inhibitory effect associated with all the functional groups bound to the nanomaterials, with NH₃ showing the most pronounced effect.

ECOTOXICITY OF CDTE AND ITS FUNCTIONAL GROUPS ON *ENCHYTRAEUS ALBIDUS*.

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With the development of nanomaterials rapidly increasing it is evident that nanomaterials will likely be released into the environment. There is a large uncertainty regarding the toxicity and amount of engineered nanomaterials in the environment due to the rate at which they are being manufactured. The toxicity of CdTe quantum dots is largely unknown to terrestrial organisms. Quantum dots each with three different functional groups (COOH⁻, PEG and NH₃⁺) were assessed in the potworm *Enchytraeus albidus* after a 42-day bioassay. Two control assays consisting of a positive control containing cadmium chloride and negative control of soil only were used to compare the toxicity of CdTe QDs. For the quantum dots, the worms were exposed to a concentration range of 0.5, 1, 5, 15, 30, 100 and 500 mg/kg and 100 and 500 mg/kg of CdCl₂ in OECD artificial soil. Current results indicate that the range of CdTe quantum dot concentrations in the present study had no direct toxicity to the survival as well as the reproduction of *E. albidus*. Avoidance behaviour also showed that *E. albidus* didn't have any preference to the control or the spiked treatment. Oxidative stress was assessed utilizing a standard suite of biomarkers. Biomarkers include superoxide dismutase (SOD), catalase (CAT), reduced glutathione (GSH), malondialdehyde (MDA) and cellular energy (CEA). Results will indicate if these nanomaterials have caused any sub-lethal effects to *E. albidus*.

THE ECOTOXICITY OF NANODIAMONDS AND CDTE QUANTUM DOTS ON THE SOIL NEMATODE *CAENORHABDITIS ELEGANS*.

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Nanotechnology is a relatively new, but rapidly growing field of technology and can be used in a wide variety of products. Engineered nanomaterials therefore have the potential to be released into the environment during several stages of the process, from production to use and end of lifecycle release from the product. However, the fate of nanoparticles depends on several characteristics including concentration, charge, size and dissolution as well as the environmental system they are being released into. Current knowledge on the toxicity is scarce and further research is needed regarding nanoparticle characterization and detection in different media, toxicology, ecotoxicology, exposure, persistence, mobility as well as biological and environmental fate. This study exposed a model organism of Nematoda, *Caenorhabditis elegans*, to a range of concentrations of two types of nanomaterials. CdTe quantum dots and nanodiamond crystals (carbatiuous nanomaterial) containing representable functional groups (COOH⁻; PEG and NH₃⁺). The effects of the nanomaterials are determined by performing 24h mortality and growth tests; as well as a 72h reproduction test. This entails exposing organisms to increasing concentrations of nanodiamonds and quantum dots (0, 5, 10, 25, 50, 100 mg/l) to determine an LC50 and EC50. Exposures were carried out in pore water and artificial sediment. After exposure to sub-lethal concentrations, the biological stress of the organisms was determined. Results obtained give more information regarding the toxicity of these nanomaterials and the role functional groups play in their toxicity as part of environmental risk assessment

ECOTOXICOLOGICAL EFFECTS OF CADMIUM TELLURIUM QUANTUM DOTS AND ON *EISENIA ANDREI*.

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Nanotechnology is a modern developing discipline that is likely to produce a large quantity of consumer products and waste materials during the upcoming decades. Engineered nanoparticles with unique physiochemical characteristics are exposed in artificial OECD soil to determine the fate and behaviour of nanomaterials for environmental risk assessment. During this study acute toxicity test was performed over a range of concentrations to determine the effect of cadmium tellurium quantum dots (QD's) with representable functional groups (COOH; PEG; NH₃⁺) as well as cadmium chloride (CdCl₂) on the model organism of Annelida, *Eisenia andrei*. Effects are determined by performing the Earthworm Reproduction Test (ERT) utilizing the Organization for Economic Cooperation and Development (OECD) guideline 222. The bio-indicator species were exposed to increasing concentrations of QD's (0; 0.5; 1; 5; 15; 30; 100; 500 mg/kg) and CdCl₂ (100.0 and 500.0 mg/kg) as a positive control for 28 days. From this the 28EC₅₀, 28LC₅₀, LOEC; and NOEC were determined. Soil samples were left for another 28 days to assess the effect of the test chemicals on the reproductive output of the earthworm species. Sub lethal stress of the adult organisms was further assessed by utilizing biomarkers for an integrative biological response (IBR) index. Biomarkers included cellular energy (CEA) allocation; catalase (CAT) activity, reduced glutathione (GSH) content and malondialdehyde (MDA). Results obtained will give an indication of nanomaterial toxicity at different concentrations with different functional groups on the earthworm *E. andrei*.

AN EVALUATION OF ROTENONE TREATMENT BY COMPARING THE DETECTION PROBABILITY OF THREE FISH SURVEY METHODS (FYKE NETS, SNORKELING AND CAMERA) IN THE RIVERS AND DAMS OF CEDERBERG KROM RIVER.

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Alien fishes are the greatest threat to the native fish communities of the Cape Floristic Region. As a result, the conservation authority, CapeNature, has begun evaluating the effectiveness of the piscicide rotenone to remove alien fish populations from rivers of conservation value. Rotenone was used with great success to remove smallmouth bass from the Rondegat River in the Cederberg, Western Cape. Following the treatment, the aquatic invertebrate communities have recovered and the fish population has colonized the treatment area. Further successful treatments are required before rotenone is registered for use as a piscicide for the conservation of imperiled fishes. However, detection of the presence of fish in aquatic environments is problematic. This study compares detection probability of three non-destructive techniques (fyke nets, underwater videos and snorkeling) to determine the probability that they detect the presence of the invasive bluegill sunfish *Lepomis macrochirus* in an off-stream dam following treatment with rotenone.

Fish surveys using all three techniques were conducted at five sites in the Krom River and in two off-stream dams; one treatment dam (before and after rotenone treatment) and one control dam. The detection probability for bluegill will be determined for all three techniques from the river, control dam and treatment dam (prior to treatment) and used to determine whether the piscicide treatment had successfully killed all bluegill in the treatment dam.

COULD ENVIRONMENTALLY RELEVANT CONCENTRATIONS OF THE PESTICIDES ALDRIN AND METHOXYCHLOR COMPROMISE THE HEALTH OF THE FRESHWATER FISH *CLARIAS GARIEPINUS*?

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The organochlorine pesticides aldrin and methoxychlor were found in the water of the Albasini Dam, Limpopo Province. It was unexpected as aldrin is banned under the UNEP Stockholm Convention of 2004. Insufficient information is available on the registration and the effects of methoxychlor on fish in South Africa. The aim of this study was to determine the effects of environmentally relevant concentrations of aldrin and methoxychlor on fish health by means of a histology-based fish health assessment protocol using the African catfish, *Clarias gariepinus* as bio-indicator. The *C. gariepinus* (n=42) were exposed under controlled conditions (27°C; pH 8) for 96 hours and separately for 28 days to aldrin (0.14 µg/L) and methoxychlor (0.23 µg/L). The health assessment included; (1) blood collection to determine the red blood cell count, white blood cell count, haematocrit and leukocrit; (2) a necropsy on each fish to determine any macroscopic abnormalities externally and internally and (3) a quantitative assessment of the liver and kidneys. The organs were fixed in 10% neutral buffered formalin, processed and stained using standard techniques. Significant differences in the blood parameters were seen between exposure groups ($p=0.05$) in the WBC between aldrin and methoxychlor groups ($p = 0.015$). The semi-quantitative histological assessment indicated a mean liver index of 10 and kidney index of 7, indicating normal tissue structure with slight cellular damage. The most prevalent histopathology observed were melano-macrophage centres and vacuolation in both the kidneys and liver.

JUDGING THE PERFORMANCE OF THE NYL RIVER FLOODPLAIN: IS IT DOING ITS JOB?

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The Nyl River system located in Limpopo, South Africa is an ecologically relevant river that feeds the Mogalakwena River, and eventually the Limpopo River. The aim of this study was to determine the ecological risk posed by metals in sediments from the Nyl River system and to determine whether the Nyl River floodplain is performing its ecological function. Metals were extracted from sediment samples by *aqua regia* microwave digestion and were analysed using standard ICP-OES techniques. The ecological risk indices applied to the data included Contamination Factor, Pollution Load Index, Geo-accumulation Index and Enrichment Factor. Metal concentrations were generally low near the origin of the river and increased moving downstream. The levels of metals in the Ramsar accredited Nyl River floodplain, were high with CF scores ranging between 0.905 – 5.82, Igeo values with a range of -0.541 - 2.441 and EF scores ranging from 0.959 - 6.17, which posed a greater risk than the other sites. The Pollution Load Index revealed that the Golf Course (PLI= 4.586) and STW (PLI= 2.617) sites were polluted in the low flow period whereas the Nyl River floodplain (HF PLI= 79.845; LF PLI= 30378.768) and Moorddrift Dam (HF PLI= 1.903; LF PLI= 9.256) sites were polluted in both sampling periods. It was concluded that the Nyl Floodplain is performing its ecological function by acting as a sink for toxins in the water body.

THE RELATIONSHIP BETWEEN METALS IN MACRO-ALGAE AND GRAZING MOLLUSCS FROM THE INTERTIDAL ZONE OF THE TSITSIKAMMA NATIONAL PARK.

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Metals occur naturally in the environment, but due to pollution and other types of human activities these levels can increase in aquatic environments. Bioindicators are used to determine the metal concentrations that occur in the environment, thus metals are able to bioaccumulate in the tissues of these organisms. There are limited data available on all metal bioaccumulation in intertidal ecosystems of South Africa. This study was aimed at determining the relationship between metals in macro-algae and grazing molluscs in the intertidal zone of Tsitsikamma National Park. *Scutellastra longicosta*, *Cymbula oculus* and *Oxysteles sinensis* were used as the mollusc bioindicators, while *Ralfsia* sp., *Ulva* sp. and *Gelidium* sp. were used as macro-algae indicators. Following acid digestion ICP-MS analyses were performed to determine the concentrations of Al, As, Cd, Cr, Cu, Mn, Pb, Se and Zn within these organisms. It was found that *Ralfsia* had the highest concentrations of Al, As, Cd, Cr and Mn, while *Ulva* had the highest concentrations of Cu, Pb, Se and Zn. *Oxysteles sinensis* had the highest concentrations of As, Cr, Cu, Mn, Pb, Se and Zn, *Scutellastra longicosta* had the highest concentrations of Cd and *Cymbula oculus* had the highest concentration of Al. These results indicated that the three different mollusc species are able to bioaccumulate metals at different rates. The different macro-algae species also accumulated metals at different levels. It was observed that there is a relationship between the metal accumulation in the macro-algae and the bioaccumulation in the mollusc that feed on them.

HEAVY METAL CONCENTRATIONS IN WATER AND SEDIMENT OF THE GA-SELATI RIVER, OLIFANTS RIVER SYSTEM, SOUTH AFRICA.

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The Ga-Selati River is a tributary of the Olifants River which is one of the most polluted rivers in South Africa. During the past few decades, the river has been subjected to prolonged and cumulative ecosystem stress as a result of human activities such as mining, agricultural, industrial and human settlements in the catchment, all of which have caused a decline in the water quality. The results of the study show a gradient from upstream protected (pristine) sites with relatively good water quality to downstream sites with poor water quality. The pristine sites generally exhibited significantly lower turbidity, TDS, and conductivity values as compared to the agricultural, mining and industrial downstream sites. The concentrations of heavy metals in overlying water were low, however, high concentrations of some heavy and trace metals were found at certain locations signifying the occurrence of some local contaminants. The analyses indicated that there is a significant difference in the metal concentrations in the sediments among the sites for aluminium, chromium, nickel, iron and strontium. The high concentrations of certain metals in the water and sediment may pose health risk to the rural communities which rely on the river for drinking water and food (e.g. fish). Although acid mine drainage has been implicated in the mobilization of metals in rivers in South Africa, further research is required to elucidate the impacts of the increased metal levels to aquatic biota and human populations reliant on resources from the river.

THE IMPACT OF RAINBOW TROUT *ONCORHYNCHUS MYKISS* ON CEDERBERG GHOST FROG *HELEOPHRYNE DEPRESSA* TADPOLE ABUNDANCE ABOVE AND BELOW A WATERFALL BARRIER, KROM RIVER, OLIFANTS-DOORING RIVER CATCHMENT, CAPE FOLD ECO-REGION.

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Headwater streams provide critical refuge habitats for imperilled native species within the Cape Floral Eco-region's (CFRs) highly degraded riverscapes. Alien rainbow trout are one of the species likely to pose a serious threat to sanctuaries for native biota, with strong impacts having been demonstrated on native fish and entire streams food webs in the CFR. Amphibians are one of the most threatened animal groups globally, and while trout impacts on amphibians have been intensively studied elsewhere, only one study on this topic has been conducted in South Africa; in the KwaZulu-Natal Drakensberg.

In this study we assessed the abundance of Cederberg ghost frog tadpoles (a CFR endemic, headwater stream specialist) at 8 sites upstream and 16 sites downstream of a natural waterfall barrier to rainbow trout invasion in the upper Krom River (Olifants-Dooring River Catchment, CFR). Fish and tadpole abundance was determined using underwater video observation. Three videos (Go-Pro Hero 3+ in housing) were set in pools for 18 minutes. Three minutes was allowed for acclimation. This data was used to describe relationships between trout and ghost frog distribution and abundance, and to evaluate the potential influence of trout on the ghost frog population. Stream habitat parameters were also measured at each site to investigate relationships with ghost frog tadpole abundance.

Preliminary results show that ghost frog tadpole abundance below the waterfall was consistently lower than that above it, suggesting a negative impact of trout on this species in the Krom River.

A COMPARISON OF THE BIOLOGY OF BLUEGILL SUNFISH *LEPOMIS MACROCHIRUS* FROM LENTIC AND LOTIC ENVIRONMENTS IN THE KROM RIVER CATCHMENT, WESTERN CAPE.

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The introduction of fish species into new environments often precipitate change in the structure and functioning of the recipient environment. Non-native fishes affect their recipient environments by altering primary producers, zooplankton communities, stream invertebrates, and the composition of aquatic vegetation; reducing exchanges with neighbouring ecosystems; and altering light and nutrient availability by bioturbation and nutrient excretion. Bluegill sunfish are native to eastern North America and were introduced into South Africa in 1939 as a fodder species for North American bass species. Bluegill have subsequently established invasive populations in South Africa but little is known about their ecological impact in South Africa. The aim of this study was to compare the biology of bluegill in lentic and lotic environment in Krom River catchment, Western Cape.

Five sites along the Krom River (Cederberg, Western Cape) and an off-stream dam in the catchment were sampled for bluegill using fyke nets. The bluegill were sacrificed, measured, weighed, stomachs removed and preserved in ethanol and otoliths removed. The stomachs and otoliths will be examined and analyzed to compare diet, age structure, and maturity of bluegill in the two environments.

A total of 79 bluegill (mean length 78mm) were captured in the dam and 76 (mean length 75mm) were captured from the river. Understanding the biology of bluegill in these two environments will add to our knowledge of the species in South Africa and provide an understanding of their impact of native aquatic biota.

A PILOT STUDY OF STEREOLOGICAL ANALYSIS OF THE TESTES OF *OREOCHROMIS MOSSAMBICUS* (PETERS, 1852) EXPOSED TO DIFFERENT CONCENTRATIONS OF SELENIUM.

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Selenium is a non-metallic element essential in small quantities for the normal development and physiological functions in animals, including fish. However, at higher concentrations and long-term exposure, selenium may be harmful to juvenile and adult fish. This study aimed to: (1) evaluate the effect of selenium on fish testes and (2) use stereological analysis to quantify histomorphological changes in the testes of fish exposed to different selenium concentrations. Twenty four fish were used. Eight served as control group; an additional eight fish were exposed to 0.040µg/L and the remaining eight to 0.066µg/L selenium concentrations for 96hrs. At the end of the exposure period, fish were killed and externally examined for abnormalities and/or parasites. They were then dissected, the testes removed and examined both macroscopically and microscopically for any alterations that may have been caused by exposure to selenium. For the pilot study, serial sectioning was done on whole fish testes from a single fish taken from the control group. Summation average graphs of the volume densities of the interstitial tissue, seminiferous tubules and the spermatozoa were plotted to determine the adequacy of the sections. No abnormalities were observed on the external side of the testes. The histomorphological changes observed included nuclear vacuolation and chromatin clumping. These results were however, non-quantifiable and inconclusive as there was no direct link between them and selenium exposure. For conclusive results stereological analyses in conjunction with histomorphological ones should be done on a larger number of fish.

A COMMUNITY-LED INTEGRATED APPROACH TO CONSERVING FRESHWATER BIODIVERSITY IN THE HEADWATERS OF THE LIMPOPO RIVER BASIN, SOUTH AFRICA.

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The Marico River catchment is a strategically–important and unique freshwater ecosystem in the North West Province, South Africa. It is subject to degradation from various anthropogenic threats such as water abstraction, pollution, mining activities, ineffective local governance and invasive alien species. These are exacerbated by abject poverty, limited economic opportunities, inequalities in access to resources, inadequate access to voluntary family planning, and a crisis of water and sanitation. These threats jeopardizes the entire system of ecological functioning and human well-being and a multi-sectoral and holistic approach is required to protect this river system and the people that rely upon it.

Our approach addresses a number of Sustainable Development Goals to address the root causes of the threats and protect the biodiversity and ecological integrity, together with improving the lives of the people that depend on it. Through a community-led design, we implement and communicate a biomonitoring programme on river health, develop and support green economy opportunities, improve basic health and family planning services. Through an alliance of international and local partners, we are able to leverage maximum impact in a range of sectors and this integrated approach, together with strong local engagement, is key to our successes.

