

Foundational Biodiversity Information Programme

Postgrad Student Forum

16 August 2017

Salt Rock and Beach Hotel

Programme

Time	Topic	Speaker
14:30-14:35	Welcome & Introduction	Leigh Richards
Session 1: Guest Speakers		
14:35-14:55	Permitting	Karin Behr
14:55-15:15	Lessons from a (Biodiversity) Science communicator	Dane McDonald
15:15-15:30	Questions/Discussions	
Session 2: Student presentations		
15:30-16:40	DNA barcoding of <i>Parmelia</i> species for specimen identification and sensitivity to climate change	Nqobile Ndhlovu
	Diversity of fynbos rhizobia and their plant growth-promoting properties	Casper Brink
	Cladosporium in South Africa: biodiversity boost or silent killer	Gcobisa Ndlangalavu
	Ant diversity and composition in reforested landscape of Buffelsdraai landfill, KwaZulu-Natal	Sbongiseni Xolo
	The effect of bush encroachment on ant communities at Hluhluwe-iMfolozi Park, KwaZulu-Natal	Noma Mkhize
	A phylogeny-based comparative study of the phytochemical and pharmacological characteristics of <i>Croton</i> species occurring in KwaZulu-Natal.	Tanya Mathe
	An automated approach to amphibian diversity surveys: A case study for northern Zululand	Wentzel Pretorius
	A taxonomic revision of the <i>Brevipalpus phoenicis</i> and <i>Brevipalpus obavatus</i> species complexes (Acari: Tenuipalpidae) in South Africa	Risuna Ndzeru
	DNA barcoding and survey of earthworm species utilized in vermicomposting in the North West and the cape region of South Africa	Mthokozisi Mungwe
	A survey of <i>Fusarium</i> species in the Gauteng grassland biome.	Mudzuli Mavhunga
	The isolation of indigenous rhizobia from diverse locations across South Africa that are associated with root nodulation in pigeonpea	Francina Bopape
	Investigation of medicinal and cultural use and trade of plants by community members	Phumlani Cimi
	Taxonomic revision of the 'red millipede' genus <i>Centrobolus</i> (Spirobolida: Pachybolidae) of South Africa	Raetsesa Portia Mailula
	Checklists of the marine invertebrates of South Africa	Bahia Brady
Application of DNA Barcoding for Species Identification: An Overview	Ryan Rattray	
16:40-17:00	Questions/Discussions	
Session 3: Postgrad Student meeting		
17:00 -17:20	Postgrad Student meeting	Leigh Richards
17:20-17:30	Closure	Leigh Richards

Abstracts

DNA barcoding of KwaZulu Natal Afromontane forest *Parmelia* species (Parmeliaceae): A molecular approach to specimen identification and sensitivity to climate change

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Shifts in biomes because of climate change can result in adjustments in species distribution and potential extinction. Therefore, detailed monitoring is a requisite to access biologically meaningful shifts in community compositions and the distribution of species. Some lichens have shown sensitivity to climatic shifts associated with global change, this sensitivity plays a key role in monitoring the impact of climate change. Molecular-based techniques have shown to be a valuable tool for accurate specimen identification in fungi and therefore the internal transcriber spacer (ITS) region has shown to successfully discriminate a broad range of fungal species and because of that, it was introduced as the primary fungal barcode marker. The purposes of this study are to investigate the utility of DNA barcode identification of *Parmelia* species occurring in KwaZulu-Natal Afromontane forest. Also, test for stress in terms of elevated temperatures at different altitude and investigate sensitivity to UV stress. For these species, we will access genetic distances using the nuclear ribosomal internal transcribed spacer region (ITS), the standard DNA barcode for fungi. We will also compare intraspecific distance values to a proposed intra-interspecific threshold value for the family Parmeliaceae to identify nominal taxa potentially masking previously unrecognised diversity. To test for stress, two experiments will be carried out, one for the temperature to see if the lichens recovered from stressful conditions of elevated temperatures. The other experiments will include lichens being exposed to different UV light conditions to see if UV light influences lichens and if so, which one.

Diversity of fynbos rhizobia and their plant growth-promoting properties

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The fynbos region is known as one of the plant biodiversity hotspots in the world, but has nutrient poor and acidic soils. Legumes in the fynbos play an important role in nutrient cycling and form symbiotic relationships with rhizobia. The plants provide the bacteria with a carbon source through root exudates and in return the bacteria provide the plants with nitrogen. Some rhizobia species can produce plant growth-promoting compounds that can affect plants directly or indirectly. The aim of this study is to identify the rhizobia isolated from rooibos and honeybush plants and to determine the plant growth-promoting properties of these bacteria. Rhizobial strains were isolated from rooibos- and honeybush root nodules and identified by sequencing the 16S rRNA, *nifH*, *nodA*, *recA* and *atpD* genes. Isolated strains were plated on specialised media and tested for ammonia, HCN, phosphatase and indole acetic acid production. Results indicate that fixing nitrogen for the plant is not the only function of rhizobia. Rhizobia also produce indole acetic acid, HCN and phosphatase. Some species produced more plant growth-promoting compounds than other, and there was considerable variation between strains. The study highlights the importance of symbiotic interactions between microorganisms and plants. Knowledge about these interactions will result in more efficient farming practices of these plants, releasing the strain on the natural vegetation.

***Cladosporium* in South Africa: Biodiversity boost or silent killer**

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It is estimated that the country lost R4.29bn in outputs during 2012 due to sick-leave taken by employees. Of these, bronchitis, flu and upper respiratory tract infections was the most common reason for people to take sick-leave, and it is estimated that on average 11,8 sick days per person was taken in the public service and people missed 4,5 days of school or work in 2015 as a result of upper respiratory infections. Upper respiratory infections can be triggered or aggravated by exposure to allergens in our homes and workplaces. Approximately 135 000 fungal species have been described, however, its diversity is to be expected to be millions of species. The aim of this study was to examine the prevalence of a potent allergenic genus, *Cladosporium*, in indoor environments. Strains were isolated from air samples and identified based on multigene phylogenetic analysis using ITS, actin and EF- 1 α gene sequences. Different species of *Cladosporium* were found in indoor environments from the Western Cape and Gauteng. The predominant species was found to be *Cladosporium pseudocladosporioides*, a species known to colonize building materials, water and bathrooms. This study provides a foundation for health- and diversity related studies in South Africa.

Ant diversity and composition in reforested landscape of Buffelsdraai landfill, KwaZulu-Natal

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Deforestation of natural forests is considered a global threat to biodiversity. Management of protected and the restoration of degraded ecosystems are essential for protection of both biodiversity and ecosystem services. Although invertebrates and ants in particular, have been used as indicators of forest recovery, most focus on vegetation dynamics, neglecting dominant components of any ecosystem. The current study will assess the success of habitat restoration practices in Buffelsdraai landfill site at eThekweni Municipality, KwaZulu-Natal Province. The study will focus on ants (Formicidae: Hymenoptera) as they comprise a significant component of invertebrate diversity and are probably a keystone in the terrestrial ecosystems. The current study describe ant diversity and the fundamental environmental variables along a reforestation gradient. Ants will be sampled at five sites which include sugarcane, newly, intermediate and long-term restored sites, grassland sites and Afromontane forest sites. The study predicted to find peaks of ant diversity in more open habitats comprised of generalists ant specimen and less ant diversity in forested sites with some specialists. Results from this work should address whether the landfill site is a success in terms of biodiversity restoration and recovery in the reforested landscapes, and whether ant assemblages inhabiting reforested sites are ideal to assess the success of reforestation practices.

The effect of bush encroachment on ant communities at Hluhluwe-iMfolozi Park, KwaZulu-Natal

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Bush encroachment refers to the changes in vegetation structure of both grassland and savanna ecosystems. African savannas have been predicted that they would have switched from savanna to forest ecosystem by 2100, due to increasing atmospheric carbon dioxide levels. Changes in vegetation structure jeopardize the entire ecosystem by affecting animals that are responsible for the functioning of the ecosystem. Invertebrates occupy all ecosystems and they dominate in terms of richness, abundance and often biomass. Invertebrate play a role in the ecosystem services and they have been documented in many studies as organisms that met required criteria to be included in biodiversity studies. This study aims at evaluating how ant species

composition differs between the existing savanna and the encroached system; determining which environmental variables underlie the differences between ant assemblages and specificity of species in existing systems and also identifying the indicator ant species which are associated with existing savanna and encroached system. A total of six paired sites were chosen for sampling representing open and closed habitat. Sampling was conducted in January 2017 (wet season) and it will be done in September 2017 (dry season). Each site was replicated four times and there are ten traps per sampling grid.

A phylogeny-based comparative study of the phytochemical and pharmacological characteristics of *Croton* species occurring in KwaZulu-Natal

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The genus *Croton* (Euphorbiaceae) has a long history of medicinal use in different parts of the world. In KwaZulu-Natal (KZN, South Africa) five *Croton* species are known to have medicinal value. Two commonly used species *Croton gratissimus* and *Croton sylvaticus* share a common Zulu name 'umahlabekufeni', which may potentially leads to misidentification of the bark used in medicinal trade. Standard barcodes for all the five *Croton* species occurring in KZN will be developed as a tool for the identification of plant parts. These will also be used in phylogenetic analysis to determine if the medicinal properties are clade related. An analysis and comparison of the phytochemical composition of different *Croton* species and different plant parts will be conducted, in order to determine whether the use of the bark can be substituted for the use of leaves. The latter would result in less destructive harvesting. Pharmacological activity will be determined through antimicrobial and antifungal activity tests. Geo-referenced BRAHMS occurrence dataset of KZN *Croton* will be compiled; this can be used to determine their distribution in KZN.

An automated approach to amphibian diversity surveys: A case study for northern Zululand

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Global declines of amphibians refer to the phenomenon of the population declines and even extinctions of amphibian species around the world. One of the challenges of this enigmatic decline is the need for continuous monitoring. Thus a dire need for non-invasive, rapid, and objective monitoring techniques are necessary. Kwa-Zulu Natal (KZN) has rich anuran diversity, boasting over 50 frog species in the northern parts of the province. Historically, there have only been few studies to determine the frog biodiversity of KZN, with the last extensive study conducted more than 30 years ago. This study aims to determine the diversity and effects of atmospheric conditions on the frog communities in northern KZN, through the use of automated recorders set at eight different localities. The data analysed from the recordings are used to identify the different species present and calculate their abundance. Furthermore, the calling activity is combined with temporal (environmental) data to determine the seasonal patterns and mating activity. This monitoring data will provide valuable information on the distribution, diversity and ecological behaviour of frog communities in this area, ultimately assisting in their conservation.

A Taxonomic revision of the *Brevipalpus phoenicis* and *Brevipalpus obavatus* species complexes (Acari: Tenuipalpidae) in South Africa

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The overall aim of this study is to review the taxonomy and systematics of the flat mites (Acari: Tenuipalpidae) *Brevipalpus phoenicis* and *Brevipalpus obavatus* species complexes to clarify systematic inconsistencies previously reported for South Africa, and explore the relative importance of morphological and genetic traits for the systematics these mites. These flat mites represent some of the most economically important plant feeding

mite species in the world. They pose a significant threat to agriculture in many countries as a high risk exotic pest due to wide host range and destructive potential, on crops such as on pistachio, citrus, pomegranates, walnuts, grapes and various ornamentals. Their importance has also increased significantly over the past 40 years because of their association with plant viruses. This confusion could indicate that decades of host association and distributional data could be erroneous, complicating species identification and the separation of closely related species. This has indeed caused problems to the South African exportations and to the interception of quarantine species in the entry points. This study will perform a comparison of voucher specimens from various localities in SA, freshly collected in this study, and specimens deposited in NCA, with type specimens of the suspected synonyms, where possible, using several microscopy techniques and molecular genetics.

DNA barcoding and survey of earthworm species utilized in vermicomposting in the North West and the cape region of South Africa

M.S. Mungwe

Earthworms are an essential part of soil communities. These soil engineers are capable of improving soil fertility, regulating organic matter and nutrient availability in the soil. Earthworm farming is growing in South Africa. However, earthworm farmers tend to misidentify the earthworm species they deal with. DNA barcoding will be conducted in earthworm species utilized in vermiculture in the Eastern Cape, Western Cape, Northern Cape, and North West. The earthworm farmers will also be asked questions about the earthworm farming industry as part of a survey. For DNA barcoding, the gene of focus will be the cytochrome oxidase I (COI). I am expecting to improve taxonomic accuracy in the vermicomposting industry. This study will also provide information that should help improve vermicomposting practices in the aforementioned provinces.

A survey of *Fusarium* species in the Gauteng grassland biome

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The Gauteng grassland biome is a rich source of fauna and flora biodiversity, yet little is known of the distribution and diversity of fungal species that occur naturally in the biome's soils. The genus *Fusarium* comprises some of the world's most economically important species that inhabit soils as saprophytes, antagonists and plant pathogens. Rapid urbanisation and conversion of the biome increasingly threatens the sustainable use of the biome and often leads to irreversible loss in biodiversity. This prompted a survey of nature reserves within the Gauteng province of South Africa, to determine what the distribution patterns of *Fusarium* species across the biome are. Over 750 *Fusarium* isolates have been collected and are being characterised by applying morphological and molecular techniques. DNA barcodes from the Translation Elongation Factor 1-alpha gene region discriminated among isolates and determined that these represent several species complexes within the genus, including *Fusarium oxysporum*, *F. chlamydosporum*, *F. incarnatum-equiseti* and *F. solani*. These preliminary findings reveal that the grassland biome of Gauteng is home to some of the world's most important *Fusarium* species complexes. The biodiversity information gathered from this survey can be linked with global surveys that enable us to map biogeographical distribution patterns of these fungi.

The isolation of indigenous rhizobia from diverse locations across South Africa that are associated with root nodulation in pigeonpea

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Pigeonpea (*Cajanus cajan*) is an important grain legume, which is grown in many African countries and is largely used for human consumption. It contributes to the improvement of soil fertility through biological nitrogen fixation. It is highly tolerant to drought. However, the productivity of pigeonpea is low, compared to other tropical legumes. The objectives of this study were to collect and identify superior rhizobia isolates from diverse locations across South Africa that were associated with root nodulation in pigeonpea. Indigenous rhizobial isolates were collected from diverse locations across South Africa and trap isolated using pigeonpea genotypes (two improved cultivars and three local landraces). Two hundred and eighty new pigeonpea rhizobial strains were isolated from 40 soil samples in nine provinces of South Africa. These new strains were preserved in the South African Rhizobium Culture Collection (SARCC) based on their morphological characteristics on three media, namely yeast mannitol Congo red agar, nutrient agar and peptone glucose agar. The study generated novel information regarding the diversity of indigenous rhizobia associated with pigeonpea in South Africa, which could lead to future investigation into the improvement of the production of pigeonpea genotypes.

Investigation of medicinal and cultural use and trade of plants by community members

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This investigation was done in order to develop strategies that will prevent further loss of wild plant populations. Approximately 27 medicinal and cultural plants were mentioned by the interviewed community members and street vendors. The destructive harvesting methods and involvement of unscrupulous middlemen in collecting medicinal material, poses a serious impact on the survival of medicinal and cultural plants. These factors have led to a significant decline in the availability of some species in the Grahamstown area. A remedial action is needed to arrest the decline in availability of critical medicinal and cultural plant species. In South Africa, most people especially in rural and township areas use traditional medicine and medicinal plants to treat many diseases. They also use plants for cultural activities. The use of traditional remedies is because it is easily available and cultural reasons. Since the medicinal plants form an important health and cultural commodity, sustainable utilisation and conservation of this valuable bio cultural diversity resource is an urgent need.

Taxonomic revision of the 'red millipede' genus *Centrobolus* (Spirobolida: Pachybolidae) of South Africa

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The genus *Centrobolus* was first proposed by Cook in 1897 and has 39 known species, all of which are restricted to southern Africa. There are major gaps in the descriptions of species and distribution data is poor. Identification of material is challenging, and there appears to be variation in some species. Without accurate species descriptions and improved understanding of distribution it is not possible to assess the threat status of species, and to adequately protect them. The study will use specimens deposited in South African museums and collected through field work using active search methods.

Checklists of the marine invertebrates of South Africa

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Checklists are an important taxonomic tool, and form the baseline for further in depth study of any group of organisms. There is a huge gap in the knowledge of marine species recorded from South Africa. As a result, most marine invertebrates lack species checklists. To remedy this, the SeaKeys: Unlocking Foundational Marine Biodiversity Knowledge within South Africa was launched in 2014. The project enabled the collaboration of a suite of different government institutions, universities and researchers to increase marine biodiversity information, including the compilation of checklists, at a national scale. This presentation will highlight the what, why and who of marine species checklists, with a focus on the importance they have for biodiversity information on marine taxa.

Application of DNA Barcoding for Species Identification: An Overview

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Background: Correct species identification is crucial in understanding biodiversity and assisting in the development of correct and effective management programmes. Currently, South Africa faces numerous challenges within various areas that involve natural systems; from the commercial sector where traded herbal products are adulterated, border control at ports of entry, wildlife crime and forensics, as well as the control and spread of invasive species. Understanding patterns within these areas can aid in developing solutions.

Results: The African Centre for DNA Barcoding (ACDB) plays host to several projects whereby the identification and recording of species being studied are imperative and contribute greatly to data collections and effective management strategies. These projects include surveys from 'Muthi' markets and nurseries, solving taxonomical impediments, cataloguing invasive and endangered species as well as identifying species used in commercial herbal products. **Significance:** To date, the ACDB has contributed over 24 000 barcoding records. These new data now allow us to address questions beyond those related to taxonomy and systematics, which have traditionally been core to DNA barcoding, and help establish DNA barcoding as a key tool in environmental research and forensic science. Results and feedback will be presented.

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