Surveying Amphibians and Reptiles, Identifying Chameleon Habitat, and Developing Long-Term Monitoring Programs at Wildcliff Nature Reserve, South Africa

Proposed Research for May, June and July of 2008.

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Introduction

The reptile fauna in southern Africa is among the most diverse on earth. There are currently 498 species described, and present rates of discovery in some taxa are similar to those in the early 19th century (SARCA 2007). Frog diversity is also very high, and 110 species are currently known to inhabit South Africa alone (Paxton 2000). Of particular interest is that reptile fauna in southern Africa has a high level of endemism; that is, many of these species are found nowhere else on earth. For example, of the 498 described reptile species, 391 are endemic (78.5%) to southern Africa, while in birds and mammals, endemism is less than 25%. It will be particularly important to describe the ecology, life histories and geographic ranges of reptiles and amphibians of southern Africa, as many of these species are found nowhere else, and hence, they have a high conservation value.

In 2005, the South African Reptile Conservation Assessment (SARCA) was launched. The purpose of this initiative is to catalogue the reptiles and amphibians of South Africa and to increase our understanding of the distribution, ecology and conservation status of both native and non-native reptiles and amphibians (SARCA 2007). SARCA was initiated in conjunction with the South African National Bioinformatics Institute (SANBI), which has been established since 1996. SANBI's goals are more broad, but generally this organization focuses on the training of experts in bioinformatics, which is the use of mathematics, chemistry, statistics, computer science (etc.), to solve biological problems (SANBI 2006). However, both of these organizations indeed share common ground in endeavoring to conserve native species of reptiles and amphibians (e.g. Tolley et al. 2006, Tolley and Burger 2004).

Wildcliff Nature Reserve was founded in 2007. It consists of 955 hectares of mountainous fynbos ecosystem near Heidelberg, in the Western Cape of South Africa

Appendix 1). The directors of Wildcliff, Ian and Jenny Giddy, are conservation enthusiasts and are dedicated to the preservation of South Africa's natural heritage. Because Wildcliff was recently established, there is a paucity of baseline data on species diversity, particularly with regard to amphibians and reptiles. For example, Sloan (2007) recently completed a preliminary survey of frog diversity at Wildcliff. She found 36 frogs comprising 11 species, but given that 110 species of frog have been recorded in South Africa (Paxton 2000), it is possible that more than 11 species inhabit the reserve. Similarly, reptilian diversity at Wildcliff remains largely unknown, and importantly, there is a general lack of natural history information among those few taxa that are known to be found on the reserve.

Because there are many unanswered questions regarding the ecology of South African reptiles and amphibians, and because there is a general lack of information on the extent of occurrence of many of these species, of particular value would be a collaboration among researchers at Wildcliff reserve, and both SARCA and SANBI. The primary purpose of my visit to Wildcliff reserve will be to conduct surveys which assess the species diversity and relative abundance of lizards, snakes and frogs. These data will serve as baseline estimates of species diversity on the reserve. Moreover, the surveys and identification will be done in collaboration with SARCA and with Dr. Krystal Tolley of SANBI, and these data can then be organized into an existing database (SARCA 2007), which can then be used for a variety of scientific and conservation-oriented endeavors.

Given that Wildcliff reserve was established only recently, it would also be extremely valuable to develop standardized field protocol to monitor long-term trends in ecosystem integrity. One method for monitoring ecosystem integrity is to conduct annual surveys which assess the abundance of one or more keystone species, which is a species that has a disproportionate effect on its biotic and abiotic environment relative to its abundance, as its presence and abundance within the community affects ecological relationships among other organisms and their environment. The secondary purpose of my visit will be to identify one or more keystone species in the Wildcliff reserve, and to develop long-term monitoring protocols for this or these species (e.g. Sugar et al. 2000). An interesting course of inquiry, which could stem from the long-term monitoring program, would be to evaluate trends in the keystone species' abundance in relation to

long-term trends in the abundance of one or several invasive species present on the reserve. This would ultimately help us understand the effects of invasive species on the integrity of South African fynbos ecosystems.

Methods

Chameleon Research

In collaboration with Dr. Tolley, I will perform systematic searches for chameleons (in particular the Robertson Dwarf Chameleon, *Bradypodian gutturale*). These searches will take place in the evening when encounter rates are relatively high (Tolley and Measey 2007). Chameleons will be located, captured, and photographed. GPS coordinates will be taken and I will use a thick black marker to write a number on the underside of their belly. This should ensure (with some degree of error due to skin-shedding) that I can identify individual chameleons, which will ultimately provide preliminary information on the movement patterns of this species. I will also record detailed information on habitat features of every chameleon's location (e.g. type of substrate, size of substrate, % leaf cover, etc.) and compare these data to random locations (where no chameleon was observed) using discriminate function analysis. This will allow us to identify whether chameleons are selecting particular micro (or macro) habitat features on the reserve, and our findings can be compared to other locations to determine whether habitat selection in *B. gutturale* differs among South African locales. Finally, I will obtain a blood sample (DNA sample) from each individual by clipping a small piece of their tail tip. These tail tips will then be immersed in a preservative, which will be provided by Dr. Tolley in late April. The DNA data can be used to assess population and species divergence of chameleons in South Africa (Tolley et al. 2008).

Snake and Lizard Research

In general, snakes and some lizards tend to be found in relatively high densities in places where the thermal environment is conducive to precise thermoregulation (Blouin-Demers and Weatherhead 2001), and most studies which assess species diversity of reptiles rely on opportunistic capture/observation of reptiles while performing systematic searches in high-quality habitats (de Wall 1978, Gibbs et al. 1998, Blouin-Demers and Weatherhead 2001). Lizard and snake surveys will be performed in the late morning and

late afternoon, when temperatures are generally conducive to reptile activity and thermoregulation. Snakes will not be captured, but if possible, a picture will be taken, and I will identify specimens in the field. Lizards will be captured if they cannot be identified visually in their natural habitat. Any lizard that is captured will be placed briefly in a jar. If identification cannot be completed in the field, specimens will be released and subsequently identified from pictures taken while individuals were in holding containers, possibly with the help of experts such as Dr. Tolley (SANBI) and Marius Burger (SARCA). Data will be recorded in a notebook along with the time, date, habitat, weather conditions and a GPS location. Species data will be shared with SARCA to further our understanding of the geographic ranges of South Africa reptiles.

Finally, I will also attempt to use pitfall traps to capture lizards. This procedure will largely follow Sloan (2007), but with slight amendments. During the initial phase of my surveys, I will place pitfall traps in areas where target taxa appear to be found in reasonable abundance; I plan to ensure my pitfall traps are more cryptic than those used by Sloan (2007), who reports limited success due to interference by Baboons. I will assess whether this method is fruitful, and after an initial trial period, I will decide whether to continue (or discontinue) the use of pitfall traps.

Frog Surveys

Sloan (2007) reports limited success in assessing species diversity of frogs using pitfall traps, and a much greater success when performing opportunistic night searches. I will likewise try using pitfall traps to catch frogs (though as illustrated above, I will make the traps more cryptic to deter Baboon interference). My stay should also coincide with the height of the breeding season of most frogs at Wildcliff (e.g. Tobias et al. 2004, Cowling et al. 1996). The breeding season is an ideal time for surveying frogs as they will aggregate in breeding areas, such as streams and temporary ponds, and searches will be facilitated because males of most species will be calling during this time. Systematic searches of potential breeding areas will performed at dawn and dusk, or after heavy rains (Sloan 2007), when breeding activity is highest. Breeding aggregations and/or individuals that are calling will be located, and I will identify specimens either by observation, or by capturing individuals and briefly holding them in jars. If identification cannot be completed in the field, specimens will be release and subsequently identified from

pictures taken while individuals were in holding containers. All data will be recorded in a notebook along with the time, date, habitat, weather conditions at the time of observation/capture, and GPS coordinates. Finally, I may also attempt to record frog calls on the reserve, as frog calls are species-specific, and I may be able to detect the presence of certain species which would not have otherwise been visually detected. Species data will be shared with SARCA both to corroborate my species identifications and to further our understanding of the geographic ranges of South African frogs.

Developing Long-Term Monitoring Programs

The first two months of my stay will be spent performing herptile surveys. During this time, I will familiarize myself with the ecology of many other species present on the reserve, which will help me identify good candidate species for long-term monitoring. I will also become familiar with the geography or the area, and I will become more comfortable in assessing which types of projects could easily be undertaken by subsequent volunteers.

An ideal organism for long-term monitoring at Wildcliff will be reasonably abundant, relatively easy to observe/count, and it will be a keystone species (see definition above). Once this or these species have been identified, I will establish standardized long-term monitoring procedures so that the abundance of the target species can be estimated on an annual basis, and with minimal observer bias. Assuming the chosen species is indeed a keystone species, these long-term data can be extrapolated to explain variation in ecosystem integrity over time (Sugar et al. 2000). It would be extremely interesting to correlate long-term abundance of the keystone species with long-term abundance of invasive species on the reserve. Any particular hypothesis that stems from the long-term data will, however, need to be refined once the keystone species is identified. This is because the pathway through which an invasive species will affect the abundance of a keystone species (if any effect is present) will depend critically on the ecology and life-history of both the keystone and invasive species.

Field Equipment

Digital camera

Digital recorder/microphone

Large rubber boots

Net

Buckets and jars for lizard and frog collection

Gardening gloves

Head lamp

GPS

Field guides to reptiles and amphibians of South Africa

Small surgical scissors, preservatives, and antiseptics (e.g. Bactine).

Measuring tapes, rulers

Other everyday items (hat, sunscreen, etc.)

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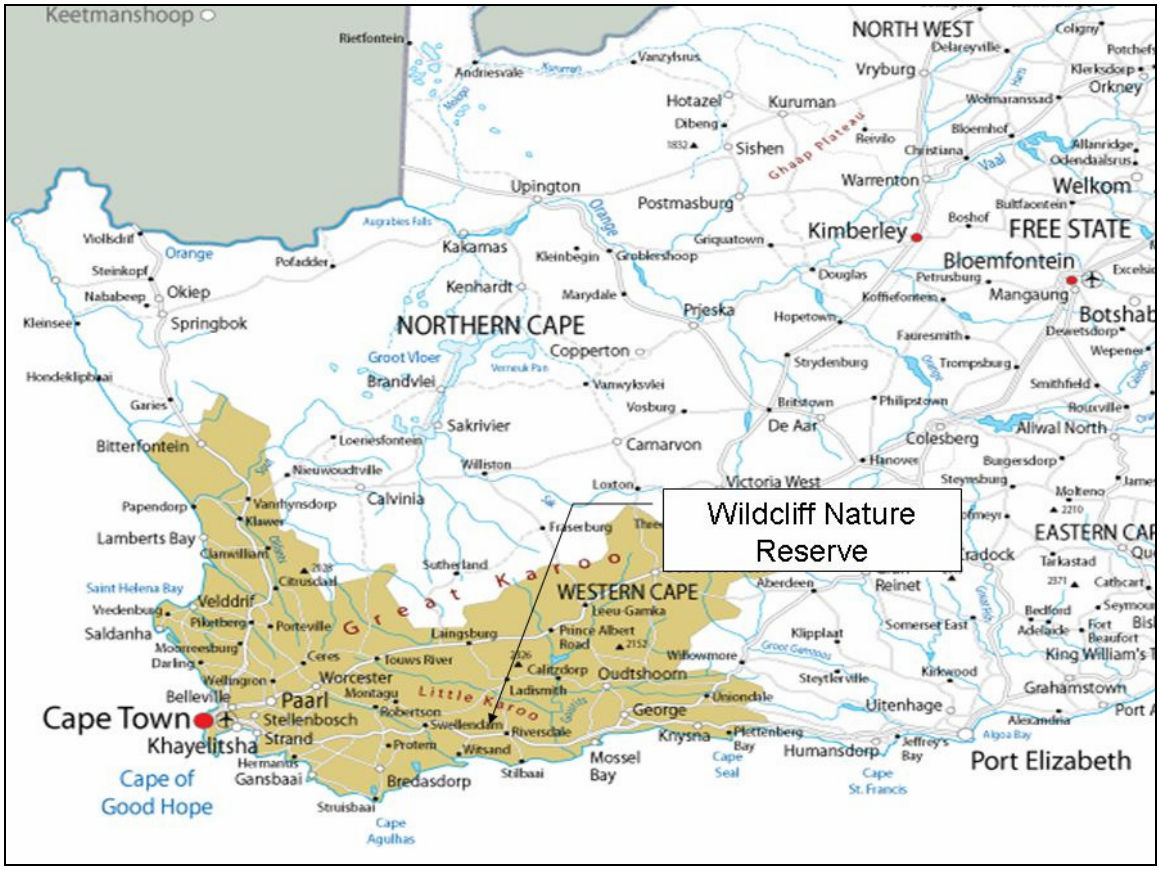
Appendix 1: Location of Wildcliff



Location of Wildcliff, in the Langeberg mountain range northeast of Heidelberg.

Wildcliff is 17km north-east of Heidelberg, Western Cape. It is centered at about 33º57'S, 21º2'E with elevations from 290m to 1130m. The boundaries lie between 20º58.9'E on the west to 21º3.0' on the eastern side, and 33º58.5'S on the south to 33º55.9' at the northernmost point.

Appendix 2: Topography of Wildcliff