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**A PRELIMINARY STUDY OF  
THE TERRESTRIAL AND AQUATIC BEETLES OF  
THE WILDCLIFF NATURE RESERVE**

with special attention to some vulnerable beetle species of the  
Cape Floristic Region, South Africa

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# 1 Introduction

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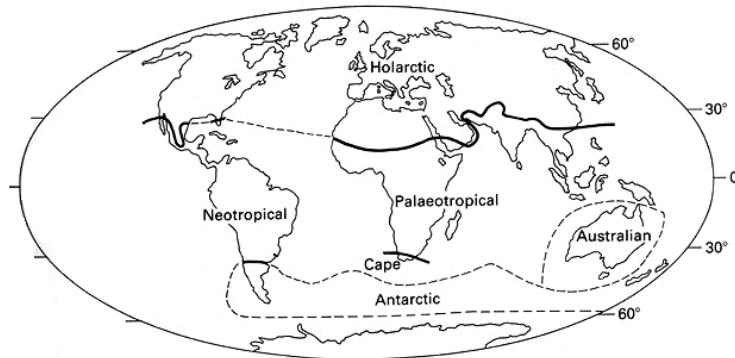
The Wildcliff Nature Reserve is a protected area of importance for wildlife, flora, fauna and features of geological or other special interest. It is reserved and managed for conservation and to provide special opportunities for study or research.

Because a part of the Wildcliff Nature Reserve was once a farm, the landscape is disturbed and alien species have invaded some areas. Moreover the degree of the biodiversity richness is known as inventorying is done in the different biotopes.

This study will investigate the diversity of the local beetle populations in the Wildcliff Nature Reserve, with special attention to some vulnerable beetle species of the Cape Floristic Region.

## 1.1 Cape Floristic Kingdom (or Cape Floristic Region)

The Wildcliff Nature Reserve is located in the Cape Floristic Kingdom. The world can be divided in six floristic kingdoms: the Boreal Kingdom, the Neotropical Kingdom, Palaeotropical Kingdom, Australian Kingdom, Antarctic Kingdom and the South African Floristic Kingdom, better known as the Cape Floristic Kingdom (Figure 1).



**Figure 1: The world's six floristic kingdoms**

Floristic kingdoms are characterized by a high degree of family endemism. The kingdoms can be divided in different floristic regions which are characterized by a high degree of generic endemism. Each floristic region, in its turn, can consist of floristic provinces with a high degree of species endemism.

The Cape Floristic Kingdom has only one floristic region (the Cape Floristic Region) and includes only one floristic province (the Cape Floristic Province).

The Cape Floristic Region is located at the south-western tip of the African Continent and lies entirely within the borders of South Africa (Figure 2). It is one of the five Mediterranean-type systems on the hotspots list, and is one of only two hotspots that encompass an entire floral kingdom (the other being

New Caledonia). This region has the greatest extra-tropical concentration of plant species in the world, with 9.000 plant species, 6.210 of them endemics, crammed into just 78 555 km<sup>2</sup>.



**Figure 2: The Cape Floral Kingdom**

The Cape Floristic Region includes five biomes: Nama- and Succulent Karoo, Thicket, Forest and Fynbos (Low & Rebelo, 1996). The vegetation on the Cape is dominated by *fynbos* (Kruger, 1979), a shrubland comprising hard-leaved, evergreen, and fire-prone heather that thrives on the region's rocky or sandy nutrient-poor soils. *Fynbos* is an Afrikaans word that translates as “fine bush”

Diversity and endemism among the fauna of the Cape Floristic Region appears to be much lower than in plants, although very little is known about some invertebrate groups (Johnson, 1992). However, the few groups that have been studied suggest very high levels of endemism. For example, of the 234 species of butterflies in the region, 72 are endemic (Rebelo, 1992). One regional study, carried out on the Cape Peninsula, recorded 111 invertebrate endemics in 471 km<sup>2</sup>, a higher number than for plant endemics (Picker & Samways, 1996).

## 1.2 Beetles

Beetles belong to the order Coleoptera, the largest and most diverse order, not only in the insect class, but in the entire animal kingdom. More than one third of all described animal species are beetles. Of the 370.000 described species that occur worldwide, about 18.000 occur in southern Africa.

Beetles vary in size from minute to very large. They have hard sclerotized bodies, three pairs of thoracic legs and mouthparts that are adapted for chewing. They usually have two pairs of wings. Unlike other insects where both pairs are flexible or membranous, the fore wings are modified into hardened covers called elytra. When the animal is at rest, the hind wings are folded under, and protected by the elytra. For flight, the elytra are lifted and the hind wings unfold and flap while the elytra are held up and act as stabilisers. However, not all beetles fly. In some cases the elytra are fused, the females are wingless or the hind wings are insufficiently developed for flying.

Beetles grow and develop through a process called metamorphosis from egg, larva, pupa to adult.

A classification of the beetles encountered in southern Africa can be found on:

<http://www.biodiversityexplorer.org/beetles/Classification.htm>.

### **1.2.1 Terrestrial Beetles**

### **1.2.2 Aquatic Beetles**

'Aquatic beetles' is a collective name of the several beetle families living in freshwater:

- **Family Aspidytidae (Cliff Water Beetles)**

This new family was established when a new genus and species, *Aspidytes niobe*, was found and morphological and DNA characters indicated that it had no living relatives (Ribera *et al.*, 2002). This relic group resembles Jurassic-Cretaceous fossil species and occurs in mountain rivers of the Western Cape in South Africa. Aspidytidae beetles are specifically adapted for a life in rivers, in crevices and on wet rock faces behind algae with just a trickling film of water running over them.

- **Family Dytiscidae**

Aquatic predatory beetles, ranging widely in size (1-45 mm). The colour varies from pale yellow/brown to brown. The mouthparts are strongly formed for dismembering prey while the mouthparts of the larvae pierce and suck. The hind legs are flattened and paddle-like and adapted for swimming. There are about 40 genera and 250 species of dytiscids in southern Africa.

Adults and larvae feed mainly on aquatic insects and crustaceans. They are able to remain under water for fairly long periods by keeping a supply of air in the subelytral cavity (i.e. beneath the elytra) and occasional replenishment of the air supply is needed for both respiration and buoyancy. They feed on aquatic insects and crustaceans and occur in both fresh, stagnant or running water.

Eggs are laid under various submerged objects such as vegetation or stones but in some species, eggs are laid within plant tissue. Larvae pass through three instars before pupating on land near the water.

- **Family Gyrinidae**

These are the beetles one sees darting round on the water surface at high speed, often in groups. They dive readily when disturbed and use air trapped beneath the elytra for respiration. The family is distinguished from other beetles in having the compound eyes divided into two: a dorsal pair for seeing into the air and a ventral pair for seeing under water. Adults feed mainly on insects on the water surface but there are species that feed on aquatic vegetation. There are four genera and about 45 species of gyrids in southern Africa.

The gyrids are a very good bio-indicator of the quality of the water as they are very sensitive to any type of pollution.

- **Family Haliplidae**

Small, phytophagous beetles, capable of swimming. They prefer standing, warm water bodies, overgrown with plants and algae. They are related to gyrids and dytiscids, and have some species in South Africa.

- **Family Hydrophilidae**

Diverse group of mainly aquatic beetles although some species occupy terrestrial habitats. They range in size from minute (1 mm) to large (50 mm). They are shiny (less water resistance), black or dark brown and are oval and convex to strongly convex. Adults have long maxillary palps. Fewer than 100 named species are known from South Africa but there are probably many undescribed species.

Larvae and adults are predatory while adults of some species scavenge on decaying organic matter.

This group is not related to the former groups. Most of the species are clumsy swimmers and prefer to creep on the bottom or on water plants.

### **1.2.3 Vulnerable beetle species**

#### **A. Red-listed *Colophon* species (Family Lucanidae)**

The specialized montane stag beetles in the genus *Colophon* are red-listed and CITES-listed (IUCN, 2004) endemic to the Western Cape Province and extreme western areas of the Eastern Cape Province mountains of South Africa. They are periodically threatened by commercial collecting and possibly vulnerable to global warming.

There are 17 described species, each restricted to its own mountain range or peak within a range, separated by deep gorges or low lying areas. Endrödy-Younga (1988) considered the species in this genus as representatives of a 'mountain relict biome', presently restricted to the higher elevations (1000–2000 m) of the western and southern Cape mountains. This elevated montane biome is regarded as a refugium in to which the beetles have retreated after the low-lying plainland became uninhabitable due to aridification and temperature increase (Endrödy-Younga, 1988).

One species group or lineage is restricted to the Hottentots Holland, Steenbras, Hex River, Stellenbosch and Wellington Mountain ranges. Another species group or lineage occur in the Table Mountain range, Swartberg, Meiringspoort, Swellendam and Heidelberg Mountains.

Very little is known of the biology of the 17 *Colophon* species (Bartolozzi, 2005). Barnard (1929) reported some general observations on *Colophon*. Beetles live on the summits of the mountain ranges and seem to be mainly nocturnal, or wandering around in misty weather, mostly in the early hours of the morning (6–8 am), hiding by day under stones or amongst low vegetation (Barnard, 1929; Bartolozzi & Werner, 2004). They are probably root-feeders, feeding on the low bushy Restionaceae always present on the Cape mountains (Barnard, 1929; Brinck, 1956).

#### **B. *Circellium baccus* (Family Scarabaeidae)**

*Circellium baccus* (Flightless dung beetle) has a conservation status of being vulnerable and is known to feed on elephant and buffalo dung and to breed exclusively in buffalo dung (Picker *et al.*, 2004). Its

vulnerability is attributed to: small, restricted and isolated populations; the habitat is constantly under threat from agriculture and general human encroachment; climate change; low fecundity; low dispersability as it is flightless; habitat specialisation; co-evolution with and dependence on falling numbers of vertebrates as elephant and buffalo.

While they are generalist dung feeders, they have a preference for elephant and buffalo dung but have been recorded feeding on rabbit, baboon, various antelope, human, ostrich and baboon dung/faeces. At the Wildcliff Nature Reserve the beetle has been observed making dung balls out of buck excretions (Houadria, 2008). Feeding might take place at the dung site or a small ball prepared and rolled away and eaten in a protected location. The younger adults usually do this.

However, buffalo dung is preferred for breeding. Females produce only one off-spring per breeding cycle, usually one but sometimes two per year so fecundity is therefore low. When breeding, the female removes a portion of dung from the pile, pats it onto a ball and rolls it away, from 7 to 80m, depending on when she finds a suitable site. Unlike other dung beetles, the male trails her by a few centimetres and does not help roll the ball. When the ideal site is decided on, the female excavates the hole and the male then positions himself on top of the dung ball and sinks down with it, the depth varying from 17 to 37 cm. Mating then takes place and the egg is deposited. The male returns to the surface and the female remains with her brood throughout the early (larval) development. This is critical for the survival of the larva as she constantly clears away fungus that develops on the outside of the dung ball. The development time from egg to adult ranges from 120 to 140 days. The young adult then feeds for another 50 to 65 days before becoming sexually mature (Kryger *et al.*, 2006).

## **2 Purpose of the Study**

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The goal of this study is to assemble a basic list of the number of species found in the order Coleoptera as inventorying gives a good idea of the state of biodiversity.

## **3 Method and Materials**

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### **3.1 Description of the Location**

Wildcliff is located 17 km north-east of Heidelberg, Western Cape. It is centered at about 33°57'S, 21°2'E with elevations from 290m to 1130m. The boundaries lie between 20°58.9'E on the west to 21°3.0' on the eastern side, and 33°58.5'S on the south to 33°55.9' at the northernmost point.

The Wildcliff Nature Reserve consists of 955 hectares, valleys of afro-montane forest, rocky mountaintops and high meadows of *fynbos*. It is in the Langeberg mountain range of South Africa's Western Cape. It borders on the Boosmansbos Wilderness Area, a UNESCO World Heritage Site.

On Wildcliff, there are three locations of natural wetlands. These are:

- Misty Meadow wetland: riparian wetland in a former pasture, next to the Wildcliff entry road and the river, approx 0.5 ha (meadow, wetland flora and kikuyu grass, approx 1 m at deepest except in rainy season when it can get flooded).
- Talari wetland, north and west of Talari house, approx 0.1 ha (meadow, wetland flora, approx 0.5m at deepest).
- Hidden Valley wetland, riparian wetland above Ena's falls, extending west alongside the stream in Hidden Valley, approx 2-3 ha, but not really known as unexplored (mountain fynbos surrounds the stream, approx 1-2 m at deepest).

In addition to the natural wetlands, three dams have been built: Rain Frog Dam, the Middle Dam, and the Island Pond.

## 3.2 Sampling

### 3.2.1 Sampling methods

The study will be conducted in the different biotopes of the reserve. Different biotopes will be isolated by their characteristic vegetation such as black wattle forest, pine tree forest, the meadow, the bushveld, the fynbos. All these different biotopes will be inventoried.

To collect as wide a range as species possible, several methods must be used. These include eye spotting, hand collecting, ground litter sampling and the use of pitfall traps. The combination of these sampling methods should make it possible to get an overview of the diversity of the beetles in the reserve. Each method is described more in detail here below.

#### A. Eye spotting

#### B. Hand collecting

Hand collecting consists of searching for beetles in all places where they are likely to occur. This includes on the ground, under rocks, on tree trunks, in vegetation,... There are different ways to hand collect, e.g. by

- a **butterfly net**: very useful for coleopters flying around

When the flying insect is at the bottom of the net, it can be flattened on the floor; then if you need to capture the insect just slide your hand through the loop hole with the appropriate container and manoeuvre it gently in.

- a **sweeping net**: very useful in the meadow, on small shrubs such as in the bushveld. The object is to knock insects off stems and flowers into the net through sweeping gestures. This method is very efficient and enables you to catch some of the more discreet and camouflaged insects. The net must always be taking air in as to maintain the insects against the cloth (to prevent them from flying out) which implies a little circular movement at the end of every sweep. This net should always be accompanied by a putter for collecting and you have to be quick to prevent some insects from flying out.

- a **Japanese net**: used with a stick. The aim is to literally beat the bush with 2 or 3 quick good stokes so as to knock off the insects which fall in the predisposed net. They may then be quickly gathered up with the putter before they can fly away. This method is essential on bigger shrubs and horny bushes and on most of the fynbos vegetation such as the proteas. Aquatic beetles will be captured with a large net, or simply picked up with hand.

### **C. Leaf litter sampling**

Many beetles are small and forage primarily in the layer of leaves and other debris on the ground. Hand collecting these species can be difficult. One of the most successful ways to locate these beetles is to collect the leaf litter in which they are foraging and extract the beetles from it.

This contraption comprises two net bags, the inner one of which contains the accumulated leaf-litter. The outer bag stands off from the inner approximately 2 inches and is drawn into a funnel shape below the inner bag. The end of this funnel of net is connected to a largish (2lb jam jar sized) bottle containing a preservative (e.g. ethylene glycol). The whole mechanism, once the inner bag has been filled with the collected substrate, is hung in an airy situation, but out of any direct sunlight, such as a garage. The substrate will slowly dry and the invertebrate animals will leave its confines and fall into the net funnel below the inner bag. From this position they will either slide or move down and fall into the jar containing the preservative. The much slower action of this method results in a much greater percentage of the available invertebrates leaving the substrate and being collected for further examination and identification.

### **D. Pitfall trapping**

The pitfall trap is another commonly used tool for collecting beetles. A pitfall trap can be seen as any small container placed in the ground with the top level with the surrounding surface and filled with a preservative. Beetles are collected when they fall into the trap while foraging. Traps using a liquid as preservative should have a drop of non odorant washing liquid added so as to make the insects sink in the liquid to prevent them from flying away or jumping out. However this can damage the DNA.

The pitfalls will be installed respecting certain protocols: Sample number / sample placement / sampling coverage and intensity / period of time to leave a trap (Brett, 1999).

## **3.3 Identification of beetles**

For the identification of the beetle species I will use following determination keys:

- Choate, P.M. (1999) Introduction to the identification of Beetles (Coleoptera)

This key is only intended to introduce to the terminology and morphology that is used in other, more comprehensive keys.

## 4 References

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### 4.1 Scientific references

- Barnard, K.H. (1929) A study of the genus *Colophon* Gray. *Trans R Soc S Afr*, **18**:163–182.
- Bartolozzi, L. & Werner, K. (2004) Illustrated catalogue of the Lucanidae from Africa and Madagascar. Taita Publishers, Hradec Kralove, Czech Republic. 189 pp.
- Bartolozzi, L. (2005) Description of two new stag beetle species from South Africa (Coleoptera: Lucanidae). *Afr Ent*, **13**(2):347–352.
- Brinck P (1956) Coleoptera: Lucanidae. *S Afr Animal Life* 3:304–335.
- Endrödy-Younga S (1988) Evidence for the low-altitude origin of the Cape Mountain Biome derived from the systematic revision of the genus *Colophon* Gray (Coleoptera: Lucanidae).
- Houadria, M. (2008) Inventorying Arthropods in the Wildcliff Nature Reserve, South Africa: A Preliminary Study.
- IUCN (2004) 2004 IUCN Red List of Threatened Species. Online available at: <http://www.redlist.org>.
- Johnson, S.D. (1992) Plant-Animal Relationships. In: R.M. COWLING (Ed.). *The Ecology of Fynbos: Nutrients, Fire and Diversity*. Oxford University Press, Cape Town.
- Kruger, F.J. (1979) South African Heathlands. In: R.L. SPECHT (Ed.). *Heathlands and related shrublands*. Elsevier, New York.
- Kryger, U., Cole, K. S., Tukker, R. & Scholtz, C.H. (2006) Biology and ecology of *Circellium bacchus* (Fabricius 1781) (Coleoptera Scarabaeidae), a South African dung beetle of conservation concern. *Tropical Zoology*, **19**:185–207.
- Low, A.B. & Rebelo, A.G. (1996) *Vegetation of South Africa, Lesotho and Swaziland*. Pretoria: DEAT.
- Picker, M.D. and M.J. Samways (1996) Faunal Diversity and Endemism of the Cape Peninsula, South Africa. *Biodiversity and Conservation*, **5**(5):591–606.
- Picker, M.D., Griffiths, C. & Weaving, A. (2004) *Field guide of insects of South Africa*. STRUIK.

Rebelo, A.G. (1992) Preservation of biotic diversity. In: R.M. COWLING (Ed.). *The Ecology of Fynbos: Nutrients, Fire and Diversity*. Oxford University Press, Cape Town.

Ribera, I., Beutel, R.G., Balke, M. & Vogler, A.P. (2002) Discovery of Aspidytidae, a new family of aquatic Coleoptera. *Proceedings of the Royal Society of London* **B**, **269**:2351-2356.

## 4.2 Internet references

[www.wildcliff.org](http://www.wildcliff.org)

[www.biodiversityexplorer.org](http://www.biodiversityexplorer.org)