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The Wynberg Cave System, the most important site for cave fauna in South Africa at risk

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Abstract

The Wynberg Cave System, located on the Cape Peninsula, represents one of the most significant sites of cave fauna in southern Africa. However, the continuous increase in cave visitation is severely impacting the system as evidenced by graffiti, the trampling and destruction of cave habitats and even a reduction in the sizes of bat colonies. In October 2019, the Wynberg Cave System was visited by a group of scientist, who discovered unregistered troglomorphic species. This, subsequently increased the number of troglobites occurring in the system to 19, which likely means that this system has the potential to become the first hotspot of subterranean biodiversity in Africa. Protecting the Wynberg Cave System is therefore of great importance. Here, we propose short and long-term strategies that include educating local communities on the importance of conserving caves and installing gated entrances.

Keywords

Cave protection, Invertebrates conservation, Subterranean biodiversity

The caves from the Cape Peninsula in South Africa are associated with quartzite rocks, occurring at altitudes ranging from 450 m to 750 m asl. The region is characterized by a temperate climate with hot and dry summers and cold and humid winters (Marker and Swart 1995). Inside the caves, the average temperature is approximately 10 °C (Sharratt 1998). Caves within Table Mountain National Park are at higher altitudes and vary in morphology, but are predominantly vertical with passages of different sizes. These passages were formed by the removal of debris from cracks and joints by the action of water (Marker and Swart 1995). The caves such as Bats, Climbers, Giants, Hangman, Metro, Smugglers and Wynberg, along with other smaller caves, form the largest cave system in the region (more than 1.2 km in length), which is referred to as the Wynberg Cave System (WCS; CPSS 2017).

The Cape Peninsula is a biodiversity hotspot, in the heart of the Cape Floristic Region, with the highest concentration of plant species in the world (Forest et al. 2007), presenting a remarkable set of endemic taxa of epigean fauna and flora (Picker and Samways 1996; Trinder-Smith et al. 1996). Similarly, the caves harbour several endemic invertebrates, substantially contributing to the biological importance and conservation priority of this area (Sharratt et al. 2000). Studies on the cave's ecology and conservation were carried out mainly by Picker and Samways (1996), Sharratt (1998) and Sharratt et al. (2000), which generated a comprehensive list of references regarding the cave fauna (e.g. Attems 1928; Lawrence 1931, 1932, 1935, 1964, 1984; Dybas 1960; Grindley 1963; Cook 1991; Griswold 1987, 1990) and added important information on the ecology and distribution of many subterranean taxa. A more recent study focused on the ecology of cave invertebrates (Giribet et al. 2013).

The WCS hosts remarkable cave fauna, especially when considering the endemicity and rarity of some species. Sharratt et al. (2000) listed 13 cave-restricted species occurring in the Table Mountains quartzite caves, plus another 72 non-troglobitic invertebrate species. All troglobitic species mentioned by these authors from the WCS are Cape Peninsula endemics. Some of these species are considered as highly specialized Gondwanan relicts and many can be considered rare. Such cave adapted species account for 12% of the total endemic invertebrate fauna of the Cape Peninsula (Picker and Samways 1996).

The cave-restricted species occurring in the WCS include *Peripatopsis alba* Lawrence, 1931 (Onycophora: Peripatopsidae) (Fig. 1A); *Spelaeogriphus lepidops* Gordon, 1957 (Spelaeogriphacea: Spelaeogriphidae) (Fig. 1B); *Paramelita capensis* (Barnard, 1916) (Amphipoda: Paramelitidae) (Fig. 1C); *Trichoniscus tabulae* (Barnard, 1932) (Isopoda: Trichoniscidae) (Fig. 1D); *Harpethrix caeca* Lawrence 1962 (Diplopoda: Dalodesmidae) (Fig. 1E); *Hahnia* sp. (Araneae: Hahniidae) (Fig. 1F); *Crozetulus scutatus* (Lawrence, 1964) (Araneae: Anapidae); *Lepthyphantes rimicola* Lawrence, 1964 (Araneae, Linyphiidae); *Purcellia argasiformis* (Lawrence, 1931) (Opiliones: Pettalidae) (referred in Sharratt et al. 2000, as *Speleosiro argasiformis*) (Fig. 1G); *Speleomontia cavernicola* Lawrence, 1931 (Opiliones: Triaenonychidae) (Fig. 1H); *Selachochthonius cavernicola* (Lawrence, 1935) (Pseudoscorpiones: Pseudotyrannochthoniidae) ((referred in Sharratt et al. (2000), as *Cthoniella* [sic.] *cavernicola*); Japygidae sp.n. (Diplura – probably erroneously referred to as Dermaptera in Sharratt et al. 2000) (Fig. 1J); *Anisocampa leleupi*

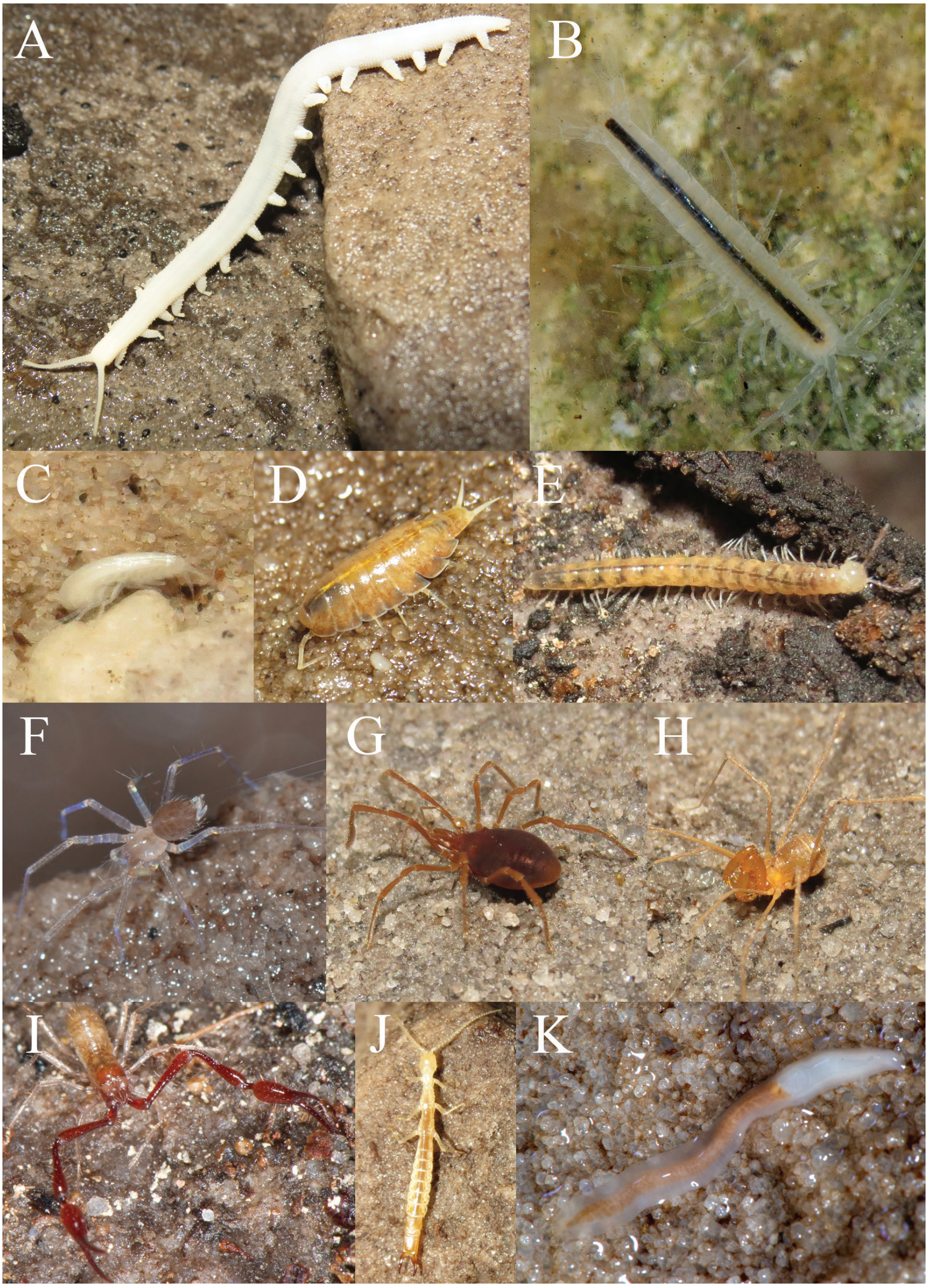

Figure 1. Wynberg Cave System and some troglomorphic taxa: **A** *Peripatopsis alba* (Onycophora: Peripatopsidae) **B** *Spelaeogriphus lepidops* (Spelaeogriphacea: Spelaeogriphidae) **C** *Paramelita capensis* (Amphipoda: Paramelitidae) **D** *Trichoniscus tabulae* (Isopoda: Trichoniscidae) **E** *Harpethrix caeca* (Diplopoda: Dalodesmidae) **F** *Hahnia* sp. (Araneae: Hahniidae) **G** *Purcellia argasiformis* (Opiliones: Pettalidae) **H** *Speleomontia cavernicola* (Opiliones: Triaenonychidae) **I** *Gymnobisium inukshuk* (Pseudoscorpiones: Gymnobisiidae) **J** Japygidae sp.n (Diplura) **K** *Prorhynchus* cf. *brincki* (Platyhelminthes: Prorhynchida). Photographs **A, C–E, G, H, J** from Rodrigo Ferreira; photographs **B, I, K** from Gonzalo Giribet; photograph **F** from Peter Swart.

Condé, 1964 (Diplura Campodeidae) and *Prorhynchus* cf. *brincki* (Platyhelminthes: Prorhynchida – probably erroneously referred to as *Dendrocoelum* sp. in Sharratt et al. 2000) (Fig. 1K). Further on, Harvey et al. (2016) described the first troglobitic Gymnobisiidae pseudoscorpion from the region (*Gymnobisium inukshuk* Harvey & Giribet, 2016) (Fig. 1I), increasing the number of cave-restricted species of the WCS to 14.

Furthermore, during a visit to WCS in October 2019, by some of the authors of this study, troglomorphic species not previously recorded were found. This included two spiders (eyeless Pholcidae and Symphytognatidae), one Sminthuridoidea springtail (Collembola), one eyeless Ptiliidae beetle (Coleoptera) and one Rhagidiidae mite (Trombidiformes). The discovery of these species raised the number of cave-restricted species of the WCS to 19. Culver and Sket (2000) defined hostpots of subterranean biodiversity as those caves (or cave systems) with 20 or more cave-restricted species. Thus, the discovery of only one more new species may turn the system in the first hotspot of subterranean biodiversity in Africa, according to those authors. However, it is important to stand out that this number (20 species) is arbitrary, so that the WCS can be already considered a hotspot in South Africa.

Some of the previously mentioned species are considered Critically Endangered according to the IUCN Red List Categories criteria (1994). This includes the onychophoran *Peripatopsis alba* (Vulnerable) and the crustacean *Spelaeogriphus lepidops* since their known extent of occurrence is smaller than 100 km^2 (Sharratt et al. 2000).

With regards to the vulnerability of the WCS, Sharratt (1998) was one of the first researchers to highlight that the main threat to cave species in the Table Mountain area is human visitation. This threat is not only a concern due to trampling on fauna and the consequent alteration of micro-habitats, but also because of its potential to pollute terrestrial and aquatic environments with food scraps and waste (including batteries containing toxic chemicals). Additional risks include potentially disturbing the bat population and altering temperature and moisture conditions. Furthermore, Sharratt (1998) pointed out that although human visitation to Table Mountain caves was still relatively low, the steady increase in tourism levels was a cause for concern. Another factor mentioned by the latter author was the potential for introducing pesticides into the trophic cave webs through the feeding of fruit bats in the region that could start producing contaminated guano in the caves. Recently, the disturbance to caves was mentioned again in regards to the conservation of spiders listed on the South African National Red List (Foord et al. 2020), thus reinforcing the need to protect such habitats in the country.

In the same visit previously mentioned (October 2019), it was possible to verify several impacts in the cave interior, along the stretch considered the "Wynberg cave", even considering the external landscape surrounding the cave is quite preserved (Fig. 2A). This is one of the most popular caves for visitors, given the easy access to one of the entrances (there is a well-marked trail from the main concrete pathway) (Fig. 2B). In addition to the graffiti on the walls (Fig. 2C), several passages are clearly overused, which is evidenced by the friable quartzite turned into sand after being trampled. It is important to note that several species shelter themselves under fallen blocks on the cave floor and therefore continuous trampling will almost certainly modify the micro-habitats inside the cave.

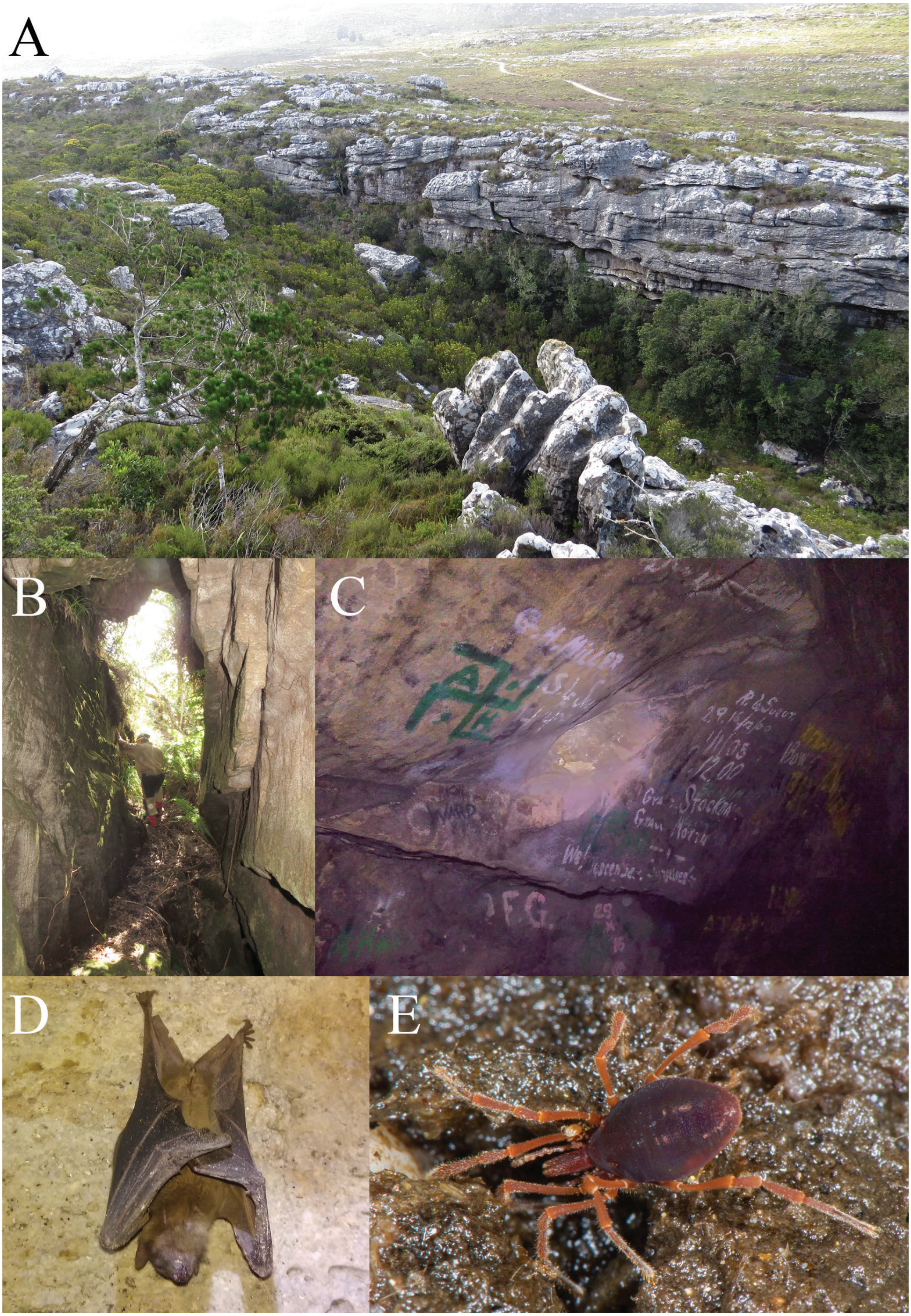

Figure 2. A External landscape surrounding the WCS **B** one of the entrances of the Wynberg cave **C** graffiti on the walls of Wynberg cave **D** Dead bat pending on the cave wall **E** *Purcellia argasiformis* with a parasitic mite attached to the first leg. Photographs **A, B** from Rodrigo Ferreira; photographs **C, D** from Oresti Ventouras; photograph **E** from Gonzalo Giribet.

One of the authors (O. Ventouras) attested that over the years speleologists have never seen Wynberg Cave in the state that it is in now. For the past three years, on every trip down into the cave they removed waste material (e.g. plastic bags, food remnants, and even discarded batteries).The area in which the majority of these items were observed is on the cave floor in the cave lowest level. This represents an important habitat (with flowing water) for the majority of the cave-restricted species inhabiting the WCS, although sometimes troglobitic species can be observed relatively close to the entrance. As an example, the velvet worm *Peripatopsis alba* is so rare that it has never been sighted by speleologists who have been visiting this cave for over 20 years. Furthermore, a noticeable reduction in bat colonies (Horseshoe Bats – *Rhinolophus capensis* and Egyptian Fruit Bats – *Rousettus aegyptiacus*) was observed within the last few years, which may be a result of uncontrolled visitation. These bats are extremely important to the cave trophic chain, directly contributing as food (guano) for many detritivorous species. During an excursion into the WCS, one of the authors (O. Ventouras) observed more than 10 dead bats within a stretch of 2–8 meters on the same sandy floor, as well as additional dead specimens still hanging on the cave walls (Fig. 2D).

Sharratt et al. (2000) suggested that management-orientated research, long-term population monitoring and the conservation of pseudokarst areas, were urgent requirements for the conservation of these rare and threatened isolated island-like habitats. However, as previously reported, most of those proposed actions were not implemented, which unfortunately resulted in an increased threat to the caves and its inhabitants. Considering the significant increase in the impacts arising from human visitation on the system in recent years, we would suggest two additional measures to the previous list presented by Sharratt et al. (2000). The first, which is a long-term goal, would be the implementation of environmental education programs for the visitors of the Table Mountain protected area, focusing on the caves and cave fauna. As indicated by Kastning and Kastning (1999), eliminating misconceptions and teaching well-established concepts in a clear and concise manner could considerably reduce environmental problems in cave ecosystems. Hence, such programs can directly contribute to the mitigation of impacts, since they increase the public's awareness on the importance of these environments for the unique fauna that depends on them. Such programs can include recurring lectures, booklets, pamphlets and other materials that can be released to visitors and to the larger human population (e.g. at schools, universities, etc.). Furthermore, it is highly recommended that the entire system is subjected to targeted studies linked to a management plan (as already recommended by Sharratt et al. 2000). Such plans are important in establishing visitation rules and restrictions in a given cave system. Such plans should indicate suitable areas for tourists (e.g. those without important bat colonies, troglobitic species populations or even with some dangerous species, as venomous spiders). Physical aspects should also be considered regarding the ease of access, the risk of injury and/or a boulder collapse, among others. Therefore, considering whether or not some parts of the WCS should be opened to tourism can only be determined following an environmental impact assessment.

Additionally, a short-term action (before a management plan is put in place) could be gating the caves to prevent uncontrolled visitation. Cave gates are steel structures usually installed at a cave's entrances to protect their resources by keeping out human visitors, while allowing air, water, and wildlife to migrate without restrictions (Elliott 2004). Although cave gating has been used to eliminate human disturbance elsewhere (Martin et al. 2003), this is not a consensual procedure, since unsuitable cave gates can harm wildlife and cave resources (Elliott 2006). Furthermore, knowledge of the cave's ecology (especially bats) is required before gating can be considered (Elliott 2006). Among the "good reasons" to gate a cave, as mentioned by Elliott (2006), include: i) protecting the endangered species inhabiting the cave; ii) minimizing or even eliminating cave vandalism, and iii) cherishing the cave's important ecological value, which can best be studied and appreciated with a good permitting system combined with a gate. These criteria are currently applicable to WCS, thus justifying cave gating as a potential measure of protection. However, since the WCS has many entrances, the first step would be to determine which entrances could be the target of gating. Those most frequently accessed should be prioritized.

Finally, it is important to mention that further research should be undertaken in the WCS. The new species recorded in the cave in 2019 indicate that there are still unknown species awaiting to be discovered. This is quite plausible especially when considering the quartzite rock structure (highly fractured) which enables invertebrates to migrate or even use mesocavern spaces. Furthermore, ecological interactions, which were poorly explored in the previous studies, are another potential subject of further research, as is the case of parasitism in both vertebrates and invertebrates (Fig. 2E).

The Wynberg Cave System is of paramount importance, due to both its potential to become the first hotspot of subterranean biology in Africa. Emergency measures are required in order to ensure the conservation of this cave, threatened by the uncontrolled human impact.

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