A three-year survey of the *Lithops dinteri* subsp. *multipunctata* population in Namibia – a proposed method for long-term monitoring of *Lithops* populations and colonies

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Surveys of succulent plants using drone photography are becoming increasingly common, but the human element is still required. Photos by the author.

Introduction

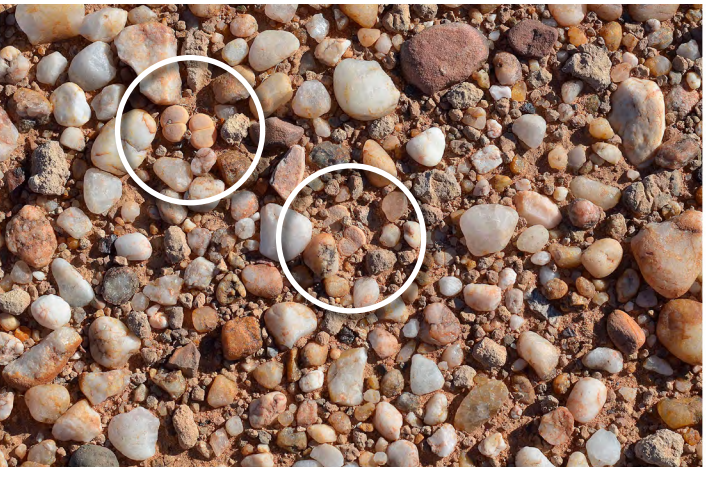
During several visits to Namibia as a member of the Lithops Research and Conservation Foundation, I noticed that the number of *Lithops* visible in a population or specific colony depended to a great extent on existing environmental conditions such as the amount of rainfall. Furthermore, it is often difficult to conduct a precise count of the plants in a colony. None of the methods used until now to count these plants in habitat, appear ideal for a short or single visit to a colony. In the present context of climate change and the threat of extinction of *Lithops* populations in habitat, it does seem important to be able to evaluate the state of a colony or the population as a whole in a defined time period. The aim of this study therefore was to devise a highly reliable, easily conducted and repeatable method of counting the plants in a *Lithops* population or colony, so that action can be taken in future if needed to conserve these unique plants.

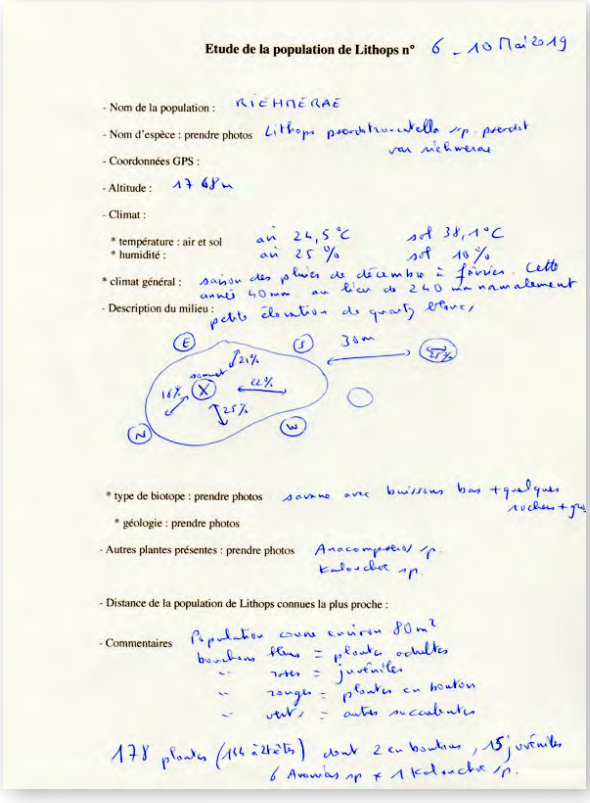
Material and methods

Being such good mimics, *Lithops* plants are often extremely difficult to locate in their natural habitat (Fig. 1). The main problems in the field, therefore, are being able to recognise individual plants, not losing sight of one when located and not counting the same plant twice during a survey. To avoid these problems during the counting of plants in habitat, each plant located was marked with a coloured plastic bottle cap. A big advantage to this method is that the bottle caps are clearly visible on drone photos taken from the air. The drone-bottle cap partnership thus became the key component in the *Lithops* population and colony surveys done to date.

The study began in 2018 with a few populations and colonies chosen entirely at random. We used different coloured bottle caps for different types of plants: dark blue caps for adult plants, light blue for juveniles, green for seedlings, white caps for plants in bud or in flower, red caps for plants either dead or damaged by a predator and pink caps for non-*Lithops* succulents. One bottle cap was used for each head of every *Lithops* plant.

▼ Fig. 1 Three very cryptic two-headed *Lithops vallis-mariae* plants in habitat and a *Lithops pseudotruncatella* subsp. *volkii* plant marked with a blue bottle cap during a survey





Etude de la population de Lithops n° 6 - 10 Mai 2019

- Nom de la population : RICHTERAE
- Nom d'espèce : prendre photos Lithops pseudotruncatella ssp. groederi var. richtersveld
- Coordonnées GPS :
- Altitude : 17 68 m
- Climat :
  * température : air et sol — air 24,5 °C — sol 38,1 °C
  * humidité : air 25 % — sol 10 %
- * climat général : saison des pluies de décembre à février. Cette année 40 mm au lieu de 240 mm normalement
- Description du milieu : petite élevation de granit effrité

- * type de biotope : prendre photos savane avec buissons bas + quelques rochers + gravier
  * géologie : prendre photos
- Autres plantes présentes : prendre photos Anacampseros ssp. Kalanchoe ssp.
- Distance de la population de Lithops connues la plus proche :
- Commentaires Population couvre environ 80 m²
  boutons fleurs = plantes adultes
  " roses = juvéniles
  " rouges = plantes en bouton
  " vert = autres succulentes

178 plantes (111 à 2 têtes) dont 2 en boutons, 15 juvéniles
6 Anacampseros ssp + 1 Kalanchoe ssp.

▲ **Fig. 2 A completed *Lithops* population study field data form**

We also used a portable GPS to record the coordinates and altitude of each colony and a small weather station to record the temperature at ground level, 1m above the ground and the ground-level humidity at the time of the visit. Where appropriate we used an inclinometer to measure the incline of the slope (Fig. 2).

The drone base-station was set up near the population being studied and aligned to the four compass points. The drone is then launched to take photos at varying heights as well as one high-altitude photo of the general environment. The final step is a quick study of the terrain by noting the general geology, morphology and other vegetation. Then the data are transferred to the computer, revealing the extent of the colony, the number of *Lithops* in each category as listed above and the number of other succulents present in the colony.

In summary, on arrival at the site the plants are all marked with bottle caps of the appropriate colour. The drone takes various photos. The measurements are taken and the plants are then individually photographed before the bottle caps are retrieved.

▼ **Fig. 3 A colony of *Lithops schwantesii* subsp. *schwantesii* var. *schwantesii* plants marked with blue bottle caps during a survey**

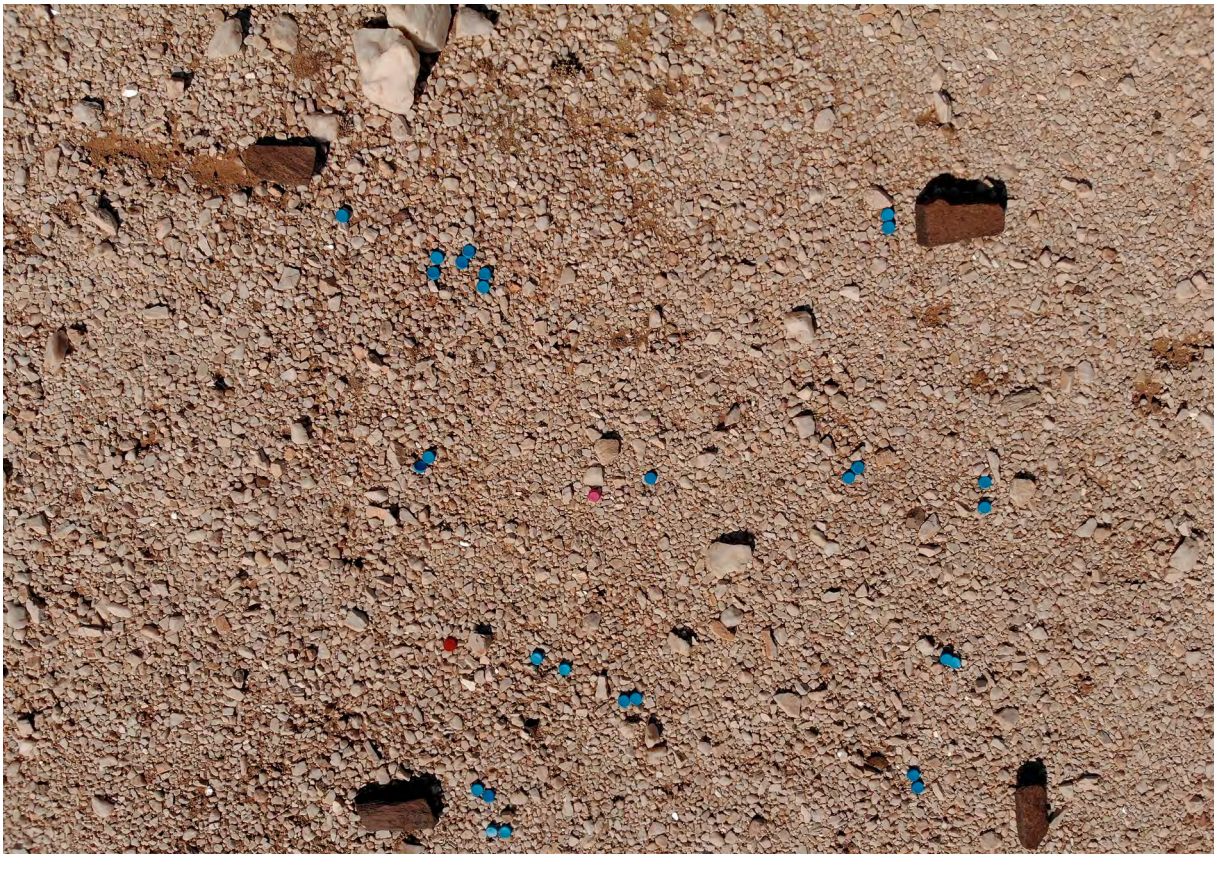
This protocol was tested on colonies of the following populations:

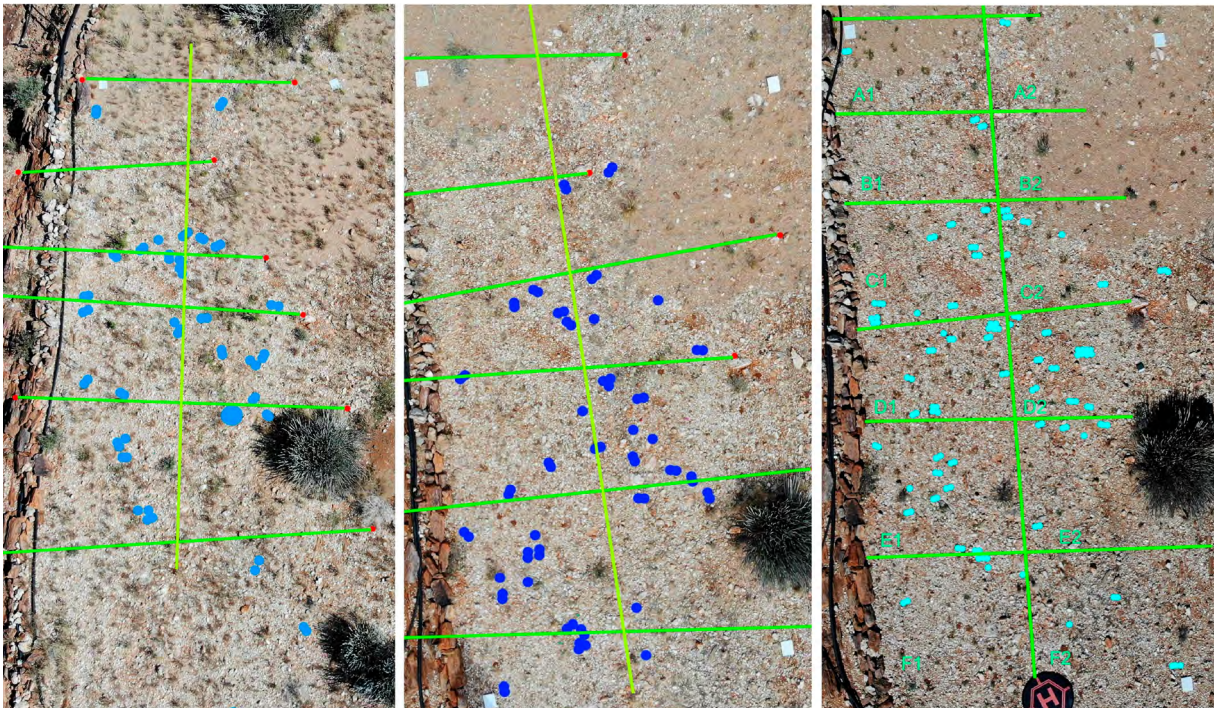
- *Lithops pseudotruncatella* subsp. *volkii* on 15 May 2018 (Fig. 1)
- *Lithops dendritica* subsp. *dendritica* on 15 May 2018
- *Lithops schwantesii* subsp. *schwantesii* var. *schwantesii* on 22 May 2018 (Fig. 3)
- *Lithops fulviceps* var. *fulviceps* on 7 May 2019
- *Lithops amicorum* on 8 May 2019 and 26 March 2025 (Fig. 4)
- *Lithops pseudotruncatella* subsp. *pseudotruncatella* var. *riehmerae* on 10 May 2019
- *Lithops fulviceps* var. *lactinea* on 24 April 2022 and 25 March 2025
- *Lithops julii* subsp. *rouxii* on 26 April 2022
- *Lithops dinteri* subsp. *multipunctata* on 25 April 2022, 24 April 2023and 21 April 2024

After the first few colony surveys the protocol was simplified. This was done because the study sites were often remote, leaving only 1–4 hours at the most for the actual work to be done. Furthermore, it can be very hot during a large part of the day making it difficult and uncomfortable to work. Because the number of different coloured bottle caps can be confusing for inexperienced helpers and the additional information gained from using different coloured bottle caps far outweighs the usefulness of the data, it was decided to use only one colour of bottle cap, the dark blue, which was the most recognisable on the photos taken by the drone. The additional information about each plant such as being in bud, in flower or damaged was recorded when each plant was photographed and before the bottle caps were picked up again. An important point was that the bottle caps had to be placed to the north of each plant or, if the colony was on a slope, above each plant, to make it clear exactly where each *Lithops* plant was in the photograph.

After using the same protocol more than once at the same colony it was decided to place a grid made of coloured string over the study area to help with the bottle cap count using the drone photographs. With this string in place, it was easier to recognise individual plants from the photographs taken on previous visits to the colony.

▼ Fig. 4 A section of the *Lithops amicorum* colony as seen by the drone during the survey





▲ **Fig. 5 A side-by-side comparison of the drone photographs of the *Lithops dinteri* subsp. *multipunctata* colony 1 during 2022, 2023 and 2024**

Results of a three-year study of a *Lithops dinteri* subsp. *multipunctate* colony

The count

Together with the other members of the Lithops Research and Conservation Foundation, in 2022 and 2023 the subsp. *multipunctata* study area was visited twice, both towards the end of April each year (Table 1). These two studies revealed that (a) the number of plants in the colony was stable, and (b) that there were other colonies extending out from the first. Furthermore, although the number of plants recorded remained the same, the plants found during the second visit to the area were not necessarily the same individual plants as those found during the first visit. This meant that some individual plants were not found and recorded during the initial visit to the colony. During the third visit to the colony in 2024 it was therefore decided to refine the research with two aims: first, to make a very accurate count of the *Lithops dinteri* subsp. *multipunctata* colony, and second, to search for other possible colonies in the surrounding habitat.

To get the most accurate assessment possible of the *Lithops dinteri* subsp. *multipunctata* colonies,

▼ **Fig. 6 Individual variation of plant leaf patterns of *Lithops dinteri* subsp. *multipunctata* in the population**

photographs from the previous two years, as well as the latest 2024 photographs, with an overlaying grid of the study area in 12 equal rectangular blocks, were used. In each one of the small rectangular compartments, each plant was marked with the blue bottle caps and when these photos were compared, any initially overlooked plants were discovered. A total of 64 plants were counted using the three sets of photographs of the three years (Fig. 5). This seemed to be a very accurate count of *Lithops* plants in this colony (Table 1).

As a second aim of the study, a search for new colonies started on the same hillock. We looked at the base of the north side up the hillock, and then down the south side all along the spine of the hillock where the quartzite pebbles was ideal habitat for these plants (Fig 6). An additional eight further colonies were located (Table 1).

The young plants

In 2024, six young plants were found in the colony. Using their size and rainfall records as an indication of the most suitable time for germination, these young plants were estimated to be at least 3–5 years old but possibly older. Local rainfall records for 2020–2024 showed that 2022 was probably the most favourable year for germination of the seeds and growth of the seedlings. A good downpour (30mm) on 11 March 2022 was followed by three months of regular rainfall totalling 59.5mm. Unfortunately, however, the drought that followed must have killed off all the younger plants, since none of the juveniles found were small enough to be of a size corresponding to germination in 2022.

Thus, although the young *Lithops* plants appeared to be 3–5 years old or more, in the absence of rainfall records prior to March 2020 one cannot be certain. What does seem certain is that in their natural environment the *Lithops* take many years to mature and flower. Experiments conducted by the Foundation showed that *Lithops schwantesii* subsp. *schwantesii* var. *urikosensis*, raised in the greenhouse, are capable of flowering for the first time when three years old. In contrast, the siblings germinating at the same time in their natural environment, only flowered when seven years old (Earlé pers. comm). It was also noted that the distribution of the young *Lithops* plants in the colony was not random. All the young plants were found in the lower half of the colony at the bottom of the slope. This probably is an indication of the seeds being washed down the slope during rainfall as was noted in other *Lithops* colonies resulting in the 'movement' of the colony over time (Earlé & Round, 2021).

The rainfall data

Rainfall data for 2020–2024 were available from a weather station, 7km in a straight line, to the south-west of the study site. The years 2021 and 2022 were relatively good rainfall years, with 114.5mm and 155mm of rain respectively. Prior to that, the year 2020 was a drought year, with only 49.5mm of rain, and 2023 was even drier,

▼ **Table I: The number of *Lithops dinteri* subsp. *multipunctata* plants in each of the nine distinct colonies within this widespread population**

	1 head	2 head	3 head	4 head	5 head	6 head	8 head	Total
Colony 1								
2022	5	27	3	1				**36**
2023	8	29	3	4		1		**45**
2024	13	44	6	2	1		1	**67***
Colony 2								
2022	1	3	1					**5**
2023	2	5	1	3				**11**
2025	5	9	3	2				**19**
Colony 3								
2023	1	7						**8**
2024	1	5	2					**8**
Colony 6								
2024		1	1					**2**
Colony 7								
2024	3	4	1					**8**
Colony 8								
2024		1		1				**2**
Colony 9								
2025	3	7	1					**11**

*This includes 3 plants close to the main colony (Colony 1) but not on the same slope.

with only 24mm. The year 2024 could turn out to be an average year, as 35mm fell in the first six months.

It was surprising that the three-year study of *Lithops dinteri* subsp. *multipunctata*, from 2022 to 2024, which included one good year and two dry ones, showed no difference in the general condition of the plants. In fact, in each of the three years and at the same period (late April), the plants were turgid and in flower. In 2022 it rained 49mm between 11 and 13 March, then 3mm on 1 April. Our study took place in April. In 2023 the colony received 5mm of rain on 7 February, then nothing until the end of May. Could it be that it rained at the study site and not at the weather station? In 2024 it rained 12mm on 10 April.

The Orange River is less than 11km from the farm, yet the owners of the farm where the weather station is situated are adamant that no fog ever reaches the study site. All this shows how very resilient the *Lithops* are, since even in drought years they can maintain their condition and reproduce despite the paucity of rain.

The geology

The substrate consists entirely of (acid) rocks, eruptive and metamorphosed, intersected by multiple seams of more recent pegmatites, mainly of quartz. The ensemble forms part of the Namaqualand Metamorphic Complex, one billion years old. There is no sedimentary rock.

The new colonies

To search for new colonies, Google Earth was used. The hill with the study colony and the three small adjacent colonies forms an arc with other geographically similar hills running north to south for 2.4km and curving to the west. All the new *Lithops dinteri* subsp. *multipunctata* plants discovered on this ridge, in outcrops of quartzite, were considered to be fragmented colonies but part of the same population.

Discussion

The method of studying *Lithops* populations, as described previously, has several advantages. Firstly, it is easy to set up and secondly, it is repeatable. In addition, it gives an accurate colony count as well as finding the precise locations of individual plants to the nearest 5cm. (GPS readings usually only give a reading of up to 1m, which is not accurate enough for such small plants). The drawbacks of this method are that it requires the researcher to be in good physical condition, as they might have to spend hours crouching down in great heat. It can only be used in fairly open habitats with little vegetation, in order to be able to see the bottle caps on the aerial photographs taken by the drone. It can be long-winded and exhausting in the case of populations of over 100 plants, the time it takes to carry out the work, and the resulting fatigue can be a hindrance unless there are enough people with the discipline to find the plants but not to crush them during their search. However, it is always possible to define a smaller sample within a large colony of *Lithops*. It is most effectively used after the rains, when as many plants as possible are visible.

Conclusion

This three-year study of a *Lithops dinteri* subsp. *multipunctata* colony shows that our evaluation method has improved year by year, and was perfected by 2024. We can state that the number of *Lithops* plants found in this particular colony is very accurate. This method of combining fieldwork and the use of computer-enhanced drone photography gives the precise number of the visible plants in a colony on a given date. The same study could be repeated in 5–10 years' time to show how, or indeed if, the population has changed.

Individual *Lithops* plants are often long-lived with several individuals known to be many decades old (Earlé & Round, 2021). This study of *Lithops dinteri* subsp. *multipunctata* reiterated that this population survived and is stable despite some years of very low rainfall and a low recruitment rate into the population. In contrast to this strategy, other succulents occurring within this *Lithops* colony, such as *Lapidaria margaretae*, have all but disappeared after the two years of well below-average rainfall, with a high number of new plants of this fast growing species again appearing as soon as adequate rain has fallen. The very large number of *Lithops* capsules, and thus seeds, present in the colony, combined with the impressive viability of the seeds often spanning a decade or more, will allow this *Lithops dinteri* subsp. *multipunctata* population to increase, or at least be stable, over the long term, which seems to have been the case hitherto.

[A population is here defined as all the individuals of a specific taxon, while a colony is defined as a group of individual plants of the taxon growing together but spatially separated from other plants of the same taxon]

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