

Natural history observations of the Knysna Dwarf Chameleon, *Bradypodion damaranum* (Boulenger, 1887): thermal extremes and feeding on flora

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Abstract. Chameleons are rarely observed during the daytime due to their very effective camouflage, making studies of their behaviour during their active period quite rare. Using radiotelemetry methods, we observed the behaviour of six Knysna Dwarf Chameleons (*Bradypodion damaranum*) in South Africa during the daytime over a 12-day period. We recorded thermoregulatory behaviour, feeding events, and interspecific interactions. During our observations for standardized behaviour categories, we also recorded some unexpected and unusual behaviours. These included feeding events at low air temperature (12°C) and escape behaviours associated with an extreme heat event (ca. 38°C) – both behaviours not previously recorded in wild chameleons. We also recorded foraging on unusual items (berries and flowers) and although there have been a few observations of wild chameleons consuming fruit, the consumption of flowers is a novel finding. While these observations are *ad hoc*, natural history observations such as these form the cornerstone of biology and ecology and allow for more rigorous hypothesis testing to be formulated.

Keywords. Africa, behaviour, Chamaeleonidae, diet, reptiles, thermal biology.

Introduction

The Knysna Dwarf Chameleon (*Bradypodion damaranum*) is endemic to Afrotemperate forests along the southern margin of South Africa (Tolley and Burger, 2007). Although it is considered a species of Least Concern under IUCN criteria (Tolley, 2022), much of its forest habitat has been destroyed due to urbanisation, agriculture, and plantations (Tolley et al., 2023), with some populations now isolated in urban greenspaces (Petford et al., 2023). One of the largest *Bradypodion* species, *B. damaranum* is the only dwarf chameleon where sexual size dimorphism is male biased. Furthermore, populations from urbanised areas have larger body size than those from natural forest habitat (Barends and Tolley, 2024).

Adapted for arboreality, chameleons have a somewhat exceptional lifestyle among squamates because they

may be exposed to thermal extremes and cannot seek refuge in holes or crevices (Alexander et al., 2024). At nighttime, they sleep on exposed branches and are essentially poikilothermic, with body temperatures closely matching air temperature and they must be able to tolerate the lowest air temperature of their perch site (Alexander et al., 2024). During the day, chameleons thermoregulate to maintain body temperature (T_b) within a preferred range (Tolley, unpubl. data). However, they are sometimes exposed to daytime low and high temperature extremes, during which they may need to seek thermal refugia. As part of a larger study aimed at quantifying behavioural thermoregulation and foraging behaviour of *Bradypodion* from differing thermal environments, we were able to make several interesting and novel observations of *B. damaranum* at an urban park in George, South Africa, during both extreme cold and warm events.

Materials and Methods

Fieldwork for the primary study, which involved focal animal analyses on *B. damaranum* through radiotelemetry, was carried out from 13–24 October 2025 at a recreational park in George, Western Cape, South Africa (Fig. 1). Specifically, the study site was located along the Camphersdrift River with most of the park occurring in the Heatherlands suburb and a small portion in the Camphersdrift suburb (Fig. 1). Although restoration of the vegetation in the park is underway to

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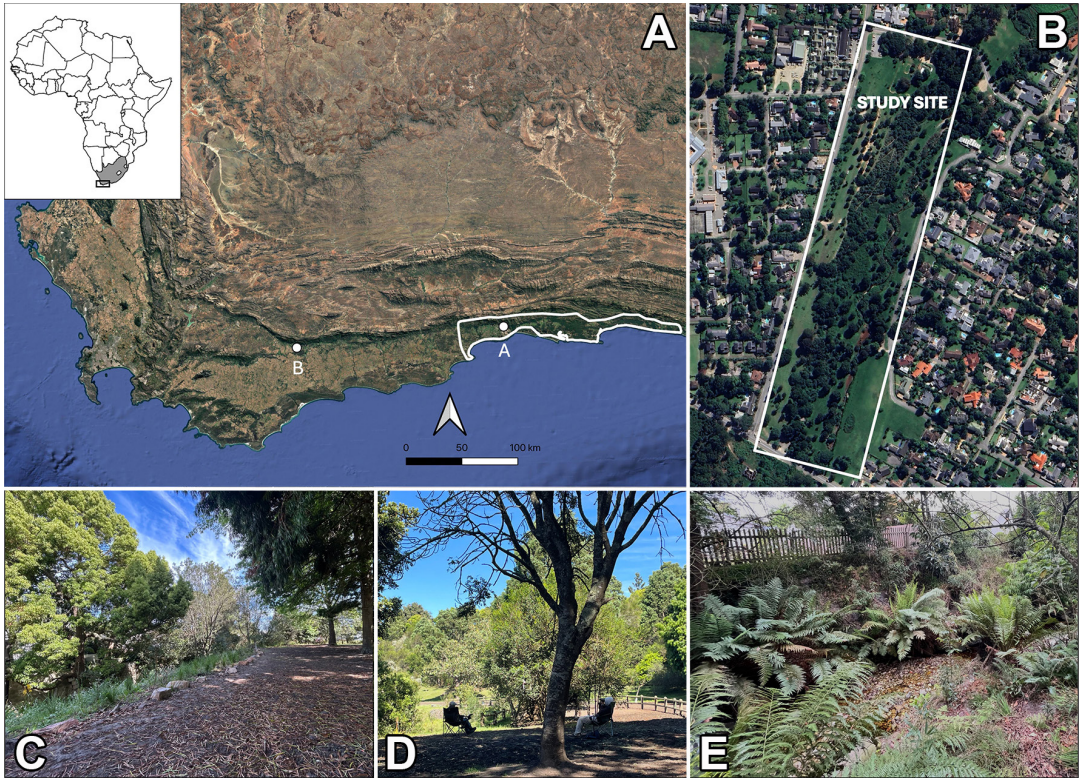


Figure 1. (A) Distribution of *Bradypodion damaranum* at Camphersdrift in George, Western Cape, including the study site indicated at Point A (33.9472°S, 22.4583°E). The location of the introduced population at Swellendam is marked as Point B. The study site (B) is a recreational park along the Camphersdrift River in George. The other images (C–E) show the range of habitat at the main study site in George. The map of Africa and the aerial view of the park was created using QGIS Version 3.40.5 (www.qgis.org) with Google satellite imagery. The species distribution polygon is from <https://www.iucnredlist.org>.

remove exotic species and reintroduce more indigenous vegetation (Dabrowski, 2025), the park essentially comprises a variety of exotic and indigenous floral species with a mixture of short and tall trees (some of which are connected at the canopies), bushes, shrubby vegetation, and lawn paths. The park is also frequented by the local community (e.g., runners, hikers, dog walkers) and as such, chameleons may be habituated to the presence of humans.

In general, the climate in George may be described as “mild and moderate” (Climate Data, 2022a) with rainfall occurring year-round. During the month of October, George experiences an average rainfall of < 70 mm, a monthly average maximum temperature of 20°C, and a minimum of approximately 16°C (Climate Data, 2022b). However, it is important to note that the maximum temperature may exceed 35°C and the minimum temperature may be < 10°C.

On the evening of 13 October 2025, six adult chameleons (> 6 g body weight) were located via torchlight, captured by hand, individually placed in cloth bags with ample vegetation, and brought back to the field accommodation to be fitted with radio-transmitters. The following day, morphometric data (snout–vent length, tail length, body weight) were recorded, and a small (0.31 g) radio-transmitter (Holohil LB-2X, Holohil Systems, Carp, Ontario, Canada; holohil.com) was secured to the flank of each chameleon at midbody (Fig. 2), following the methodology of Rebelo et al. (2022) and Stanton-Jones et al. (2025). Histoacryl tissue adhesive was used to affix a transmitter to each chameleon. Following the fitment of a transmitter, chameleons were individually placed in separate Exo Terra terraria (30 x 30 x 100 cm) that included vegetation suitable as perches for chameleons, and the animals were observed for several



Figure 2. A male *Bradypodion damaranum* from Camphersdrift in George, Western Cape, South Africa, fitted with a radio-transmitter secured to its flank using Histoacryl tissue adhesive.

hours prior to being released that evening to ensure that there was no observable discomfort to each telemetered individual. All individuals were kept for < 24 h and were released to their exact capture site.

Our observations commenced after sunrise the following morning (between 05:45 h and 08:00 h). While our focus was to locate (through triangulation using the Telonics TR-8 Handheld Scanning Receiver) and observe the behaviours of telemetered individuals, additional chameleons were also located and observed. Upon locating a chameleon, whether telemetered or not, an observer was stationed > 5 m from the chameleon and used focal animal recording to quantify time spent on behaviours associated with thermoregulation (e.g., movements into and out of direct sunlight), foraging (e.g., feeding events), interactions, and movement and sedentary behaviours. Air temperature (T_a) was also recorded at the start and end of each observation session with occasional measures taken during the observation period. Each chameleon was observed for up to 4.5 h per observation period. Our observations for the day concluded at approximately 17:00 h. A total of 30 chameleons (six telemetered and 24 additional chameleons) were observed for more than 140 cumulative hours by four observers. At the end of our data collection period, all telemetered individuals were recaptured, the transmitters removed using light acetone applied to the transmitter site and released to their exact capture site.

Results and Discussion

Extreme heat observations. While tracking and observing chameleons on 22 October 2025, T_a at our field site reached 36–40°C around midday, prior to which the temperature had steadily risen from about 22°C at 08:30 h to 30°C by 11:00 h, and at least 36°C by 12:00 h. As temperatures peaked, we observed one chameleon rapidly descend from its high perching site at 09:15 h and five chameleons rapidly descend from their high perching sites between 11:00 h and 12:00 h. All headed groundward by either moving down the tree trunks or through the branches of bushes. Three of these six were our telemetered focal animals, one was not telemetered but was already part of our observational study, and the other two individuals were previously unobserved individuals.

Of the three telemetered focal individuals, two descended from their perching sites beginning around 11:00 h, when T_a climbed above 36°C. One of these individuals moved from a height of approximately 2 m to ground level in 1 min, the other from approximately 1.5 m and just as quickly. Both chameleons entered the low herbaceous/leaf litter mixture where we lost sight of them. One of them was observed again approximately 30 min later on a thin vine overhanging a shady stream channel, about 1.5 m from where it had initially contacted the ground. The other was not observed again until the afternoon. The third focal individual

had been observed for nearly 2 h that morning (from 08:45 h) on a large Lightning Bush (*Clutia pulchella*), where it basked in an exposed position, was dark in colour, and made several body position adjustments and movements. Approximately 30 min into the observation period (at 09:15 h) it turned pale and rapidly retreated into a clump of vegetation (~30 cm below basking position) that created some shade. It remained on this perch for the rest of the observation period and turned nearly white in colour. About 15 min after the observation period ended, the individual had left the perch and was only seen again the following day. Given our observations on the other chameleons, it is likely that this individual also travelled further down and into thick vegetation to escape the heat.

A short time later, closer to midday, three previously unrecorded individuals were observed. One individual was observed descending the small tree trunk in a relatively shady part of the field site, but our presence may have disturbed its descent, and it veered into some thick leaves of a native Outeniqua Yellowwood tree (*Podocarpus falcatus*) where it was lost from view and not seen again. Two female chameleons were observed rapidly descending the main trunk of a ca. 20 m high exotic Crimson Bottlebrush tree (*Callistemon citrinus*). Both were very pale in body colour. One of them stopped approximately 3 m high in the tree to take shelter in a shallow crook, where it remained pale in colour making it easily visible. The other female descended to about 1.5 m height (Video 1; see Appendix for more information) where it went into a crook in the tree trunk and took refuge deep within a hollow padded with dirt and vegetation detritus (Fig. 3). As it scratched its way into the hollow, it rapidly turned a dark black/brown colour, perfectly matching the detritus in the crook, making it flawlessly camouflaged. It is notable that of the six chameleons observed during the heatwave, this is the only one that we observed changing from pale to dark in colour. This background colour matching is consistent with observations made of *Chamaeleo dilepis* (Major et al., 2025), although those measured for *C. dilepis* were under controlled experimental conditions.

By 15:00 h, when the temperature had dropped to approximately 32°C, neither of the two female chameleons were found in their refugia. However, a female was observed close to the 3-m-high crook but clinging to the trunk slightly higher (ca. 20 cm) than the crook, close to some branches. This likely was the same individual that had sheltered in the shallow crook. Focal observation of this chameleon over the

next ~1:45 h showed it to move higher, with several instances of perching amongst the vegetation observed before it moved deeper into some branches where we lost sight of it.

On the same day and over the same time period, T_a in the town of Swellendam (just over 200 km west of George) were similarly high, reported as approximately 37°C by midday (C. Stuart, pers. comm.). Swellendam is not part of the natural range of *B. damaranum*, but an isolated introduced population has been present in the town's greenspaces since at least the early 2000s (Fig. 1; Tolley, 2020). Several individuals in Swellendam were observed descending from the trees in a leafy-green garden around midday (Video 1), where they remained grasping onto the lower part of the tree trunk until 15:30 h (C. Stuart, pers. obs.).

Given these multiple and independent observations of *B. damaranum*, we conclude that many individuals were forced to take action to reduce heat uptake by turning pale and to seek thermal refugia in deep, shaded environments when the environmental temperatures started to exceed 36–37°C. This suggests that the primary motivation for colour change and movement by these chameleons during this time was the thermoregulatory demand to reduce T_b and avoid approaching their maximum thermal limit. We observed no interactions among these chameleons, despite observing them in close proximity to each other, nor did we observe any foraging events (or signs of foraging behaviour). We suggest that the behavioural repertoire of chameleons might be challenged, given the prediction for more frequent extreme thermal events under climate change (Luber and McGeehin, 2008; Ridder et al., 2020, 2022), and such a constraint could limit foraging times (e.g., Sinervo et al., 2010) as well as opportunities for intraspecific interactions.

Extreme cold observations. While tracking chameleons on 15 and 17 October 2025, environmental temperatures at sunrise were quite low (~8°C). Focal animal observations during that time revealed that even though some of the focal chameleons moved into patches of sunlight to bask, movement to the patches was very slow in comparison to their normal movement speed. Some were very sedentary until temperatures rose. This is in line with the fact that *Bradypodion* species are ectothermic and have been shown to be almost perfect poikilotherms at night (Alexander et al., 2024). Surprisingly, we observed two chameleons feeding at 12°C air temperature and given that it was still warming, it is likely that the chameleon T_b s were 12°C or lagging ambient temperature and perhaps slightly lower.

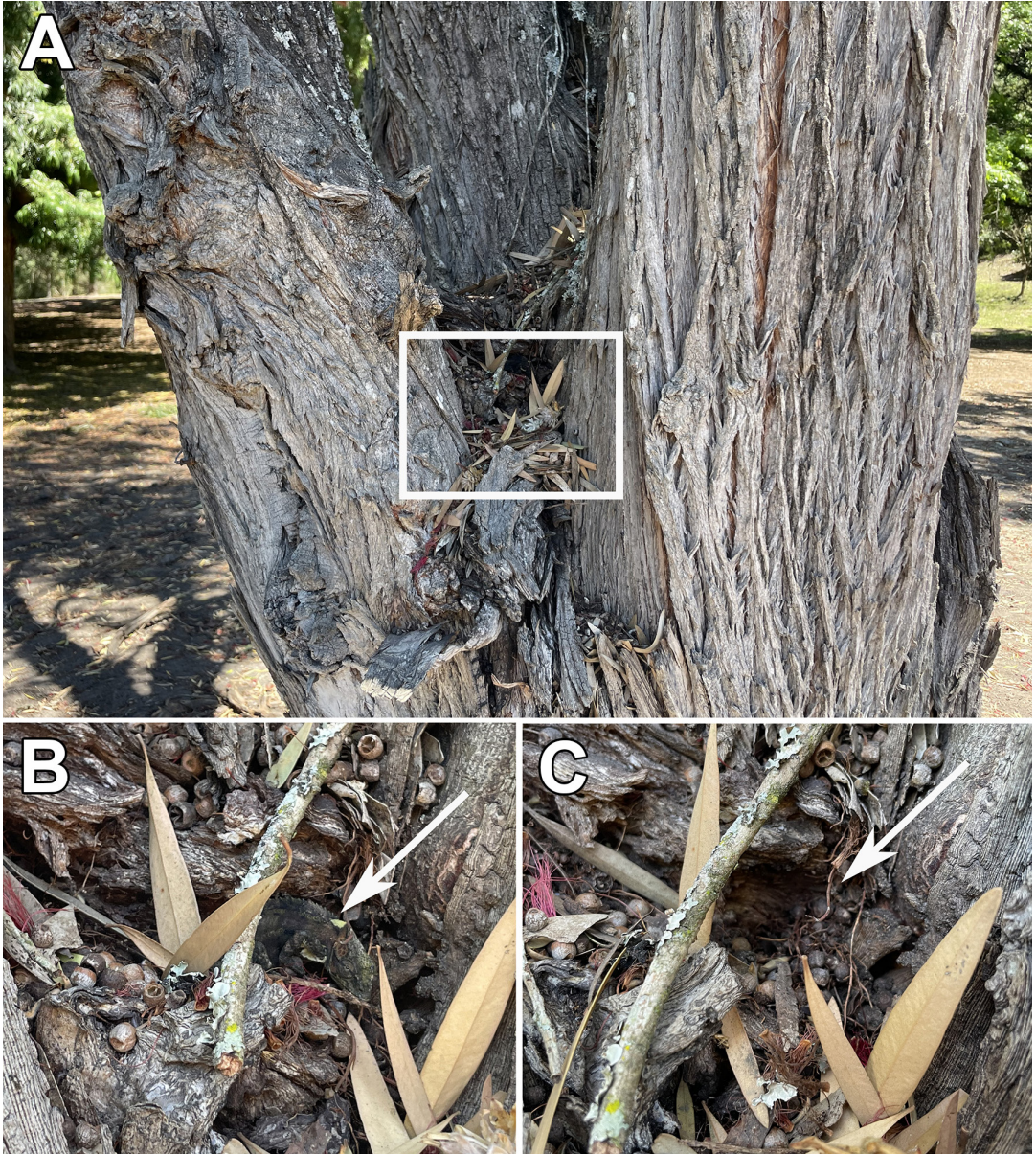


Figure 3. (A) Large Crimson Bottlebrush Tree trunk (*Callistemon citrinus*) showing the crook where an adult *Bradypodion damaranum* took refuge (white rectangle). The zoomed in photos show a close-up of the crook with (B) the chameleon (arrow) sheltering in the crook, and (C) the empty shelter site (arrow) as of about 15:00 h on the same day.

Both of the individuals observed feeding fed twice in quick succession (within 2 min and then 15 min). These observations support the lab-based findings of Anderson and Deban (2010) that tongue projection of feeding Veiled Chameleons (*Chamaeleo calyptratus*) is not very thermally dependent since projection is powered by recoil of highly elastic tissue, allowing

chameleons to feed over a broad range of temperatures.

Floral feeding. Chameleons are ambush predators that feed primarily on invertebrates (Measey et al., 2013; Stanton-Jones et al., 2025). While other invertebrate specialist lizards are also known to consume plant material, only rarely have wild chameleons been documented directly and intentionally consuming plant

material (i.e., fruits, flowers, leaves), with such reports being limited to only a few species, including *Furcifer oustaleti*, *Chamaeleo africanus*, *C. calyptratus*, *C. chameleon*, and possibly *C. namaquensis* (Table 1). In addition, online websites about chameleon pet keeping and breeding (e.g., www.chameleonacademy.com, www.chameleonforums.com, www.dragonsdiet.com) mention instances of captive chameleons eating plant matter and recommend supplementing their diets with fruit and vegetables, suggesting that these lizards will accept such food items when offered. Plant material has also been found in the stomach and/or faecal contents of chameleons, including in some species of *Bradypodion* (Table 1). However, in these cases it is unclear whether the plant material was intentionally or accidentally ingested.

During our daytime field focal animal recordings, we observed two instances where a male *B. damaranum* plucked and then consumed a comparatively large, ripe berry from a Tree Fuchsia (*Halleria lucida*) branch (Fig. 4a). In both cases, the chameleon approached a branch with berries and purposefully bit into a ripe berry, while disregarding unripe berries. The chameleon tugged at the ripe berry 3–5 times before dislodging at least half the berry, which it then chewed and swallowed. During the same period of observations, a female chameleon was observed to approach, bite off and swallow a flower from a Lightning Bush (Fig. 4b).

While consumption of plant matter has rarely been recorded in free-ranging chameleons, we surmise that this merely reflects the lack of daytime observer effort involving chameleons, which appear to regularly and intentionally consume plant matter. Our observations confirm that *B. damaranum* at least occasionally consumes fruit and flowers, and it is plausible that other members of the genus share this ecological trait. Plant matter has been found in the stomach contents and faecal remains of several other species of *Bradypodion* (Table 1), most of which are also forest dwellers. While it is uncertain as to whether those individuals ate plants directly or indirectly, given our observations here it is likely that at least some of them have consumed the plant matter intentionally. More species of *Bradypodion* probably include plants in their diets to some degree. However, this behaviour certainly appears to be rare, as we only observed three instances of plant consumption over > 142 h of monitoring. Moreover, we did not record any instances of plant consumption during similar focal observations of both ecomorphs of *B. pumilum* (Stanton-Jones et al., 2025; Stanton-Jones et

al., unpublished data). Further observations are required to uncover the full extent of herbivory/frugivory in the genus, and more broadly across the Chamaeleonidae.

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Table 1. List of reported cases from the scientific literature of wild chameleons consuming plant matter.

Chameleon species	Plant Species	Plant Matter	Method	Reference
<i>Bradypodion barbatulum</i>	n/a	"vegetation"	gastric lavage	Dollion et al. (2017)
<i>Bradypodion damaranum</i>	n/a	leaves	gastric lavage	Dollion et al. (2017)
<i>Bradypodion</i> sp. 'emerald'	n/a	"vegetation"	gastric lavage	Dollion et al. (2017)
<i>Bradypodion kentanicum</i>	n/a	"vegetation"	gastric lavage	Dollion et al. (2017)
<i>Bradypodion melanocephalum</i>	n/a	leaves & seeds	gastric lavage	Dollion et al. (2017)
<i>Bradypodion occidentale</i>	n/a	"vegetation"	gastric lavage	Dollion et al. (2017)
<i>Bradypodion setaroi</i>	n/a	flowers	gastric lavage	Dollion et al. (2017)
<i>Bradypodion thamnobates</i>	n/a	"vegetation"	gastric lavage	da Silva et al. (2016)
<i>Bradypodion thamnobates</i>	n/a	leaves and seeds	gastric lavage	Dollion et al. (2017)
<i>Bradypodion transvaalense</i>	n/a	leaves	gastric lavage	Dollion et al. (2017)
<i>Chamaeleo africanus</i>	n/a	seeds	dissection	Dimaki et al. (2001)
<i>Chamaeleo calyptratus</i>	n/a	leaves	direct observation	Nečas (1999)
<i>Chamaeleo chamaeleon</i>	n/a	flowers, leaves & seeds	faecal analysis	Burmeister (1989)
<i>Chamaeleo chamaeleon</i>	n/a	fruits	direct observation	Keren-Rotem et al. (2006)
<i>Chamaeleo chamaeleon</i>	n/a	fruits	faecal analysis	Keren-Rotem et al. (2006)
<i>Chamaeleo chamaeleon</i>	n/a	fruits	dissection	Ibrahim (2013)
<i>Chamaeleo chamaeleon recticrista</i>	n/a	"plant material"	dissection	Sagi et al. (2025)
<i>Chamaeleo namaquensis</i>	<i>Vitis vinifera</i>	fruits (grapes)	dissection	Burrage (1972)
<i>Furcifer oustaletii</i>	<i>Zygophyllum stapfii</i>	"fleshy parts"	dissection	Takahashi (2008)
<i>Furcifer oustaletii</i>	<i>Grangeria porosa</i>	fruits	direct observation	Takahashi (2008)
<i>Furcifer oustaletii</i>	<i>Chassalia princei</i>	fruits	direct observation	Takahashi (2008)
<i>Furcifer oustaletii</i>	<i>Malleastrum gracile</i>	fruits	direct observation	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Antidesma madagascariense</i>	fruits	direct observation	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Terminalia boivini</i>	fruits	direct observation	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Chassalia princei</i>	fruits	direct observation	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Grangeria porosa</i>	seeds	faecal analysis	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Trilepisium madagascariense</i>	seeds	faecal analysis	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Bridelia pervilleana</i>	seeds	faecal analysis	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Phyllanthus casticum</i>	seeds	faecal analysis	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Doratoxylon chouxii</i>	seeds	faecal analysis	Fukuyama et al. (2025)
<i>Furcifer oustaletii</i>	<i>Persea americana</i>	leaves and stems	dissection	Krysko et al. (2012)

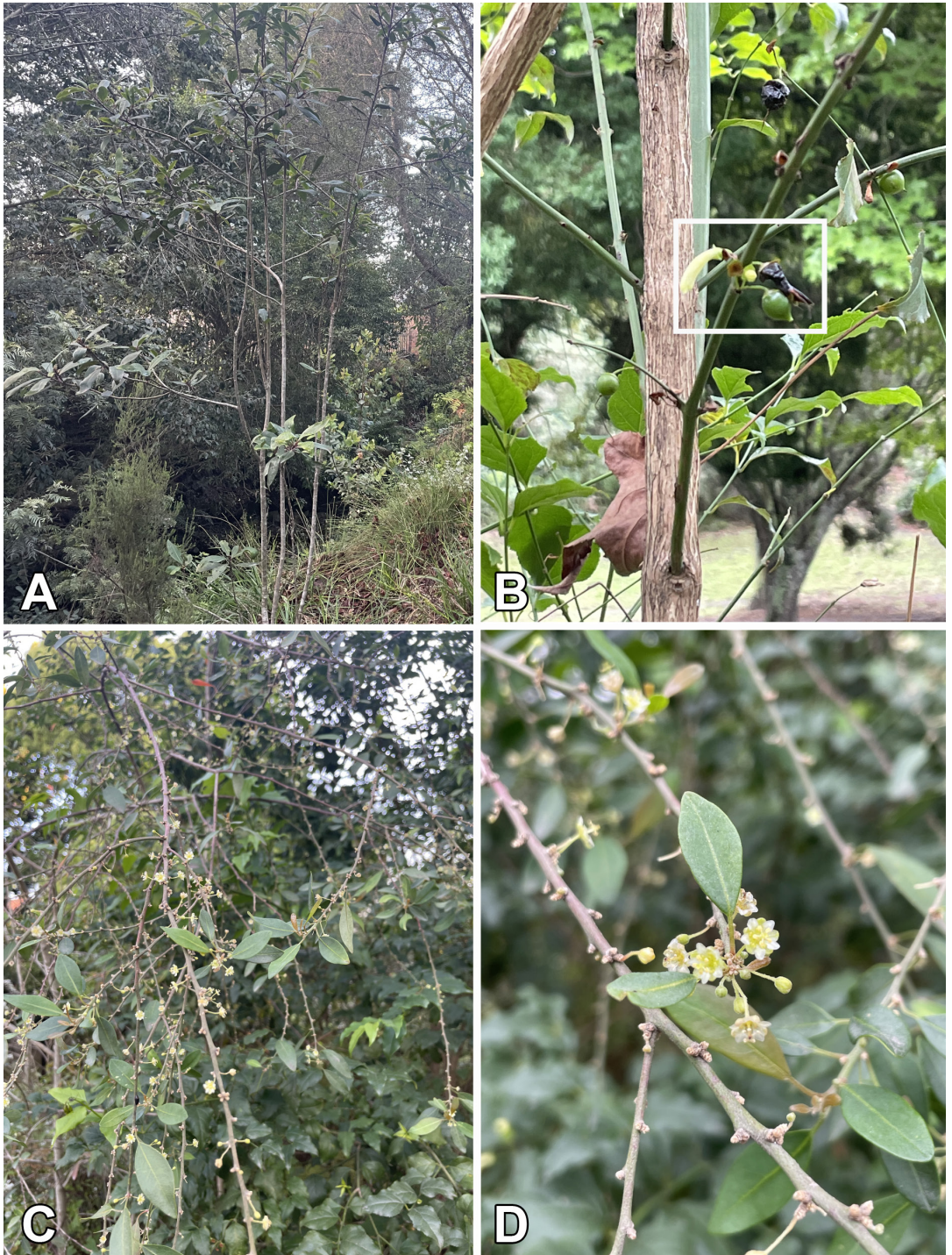


Figure 4. (A) Small *Hallaria lucida* tree (foreground) where an adult *Bradypodion damaranum* was foraging on berries. (B) Close-up of *Hallaria* berries (white rectangle). Visible is a *H. lucida* flower (yellow tube), a green unripe berry, and a partly eaten ripe berry (black object near the ripe berry). (C) Lightning Bush (*Clusia pulchella*) where another individual foraged upon a flower. (D) Close-up of flowers.

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Appendix

Video 1. *Bradypodion damaranum* in the West Cape, South Africa. In the first part, a female *Bradypodion damaranum* is seen descending a Crimson Bottlebrush trunk toward the crook where it took shelter. Taken at Campersdrift Park, George. The second part shows several individuals sheltering low on tree trunks. Taken in Swellendam. Video available for viewing [here](#).