

Short communication

Chameleons and vineyards in the Western Cape of South Africa: Is automated grape harvesting a threat to the Cape Dwarf Chameleon (*Bradypodion pumilum*)?

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Abstract.—The use of automated grape harvesters in the Cape Wine Growing region has resulted in controversy regarding their effect on the chameleon *Bradypodion pumilum*. We investigated densities of *B. pumilum* during harvesting at a vineyard near Stellenbosch, South Africa. During dedicated surveys, no chameleons were found in vines, while vegetation surrounding the vines contained densities as high as 1.3 chameleons per 100 m of survey. In addition, the force required to remove ripe grapes was investigated and found to be substantially lower than that required to dislodge a chameleon. We conclude that the effect of automated grape harvesting on chameleons is negligible.

Key words.—Chamaeleonidae, viticulture, gripping strength, monoculture, urbanisation

There has been recurring media attention surrounding the use of automated grape harvesters in South African vineyards, with the suggestion that chameleons become entrapped by the harvester and enter into the wine making process. However, there is no evidence to this effect, and the issue may have been initially based on speculation (Anon, 1999). Anecdotal observations concerning the occurrence of chameleons in vineyards are contradictory with claims that animals are present or absent coming from both wine farmers and herpetologists. Nevertheless, there are no published studies concerning the relative density of chameleons inside and outside of vineyards with respect to automated harvesting.

Three species of chameleon occur within the "Cape Wine Growing Region" (*Bradypodion pumilum*, *B. gutturale* and *B. occidentale*) but of these, only the Cape Dwarf Chameleon (*B. pumilum*) has been implicated with automated harvesting (Anon, 1999). The Cape Dwarf Chameleon is distributed in the extreme corner of the Western Cape Province of South Africa (Tolley & Burger 2007), a region that is the heartland of the Cape Wine Growing Region (Fig. 1). Much of its habitat has been transformed by urbanisation and agriculture, and this chameleon has been pushed to the fringes of its natural habitat. These isolated patches are often around river courses or in other areas not subject to urbanisation or agriculture. Otherwise, they are most often found in gardens that have good vegetation cover or in patches of disturbed closed canopy vegetation. The aim of this study was to compare chameleon densities in a vineyard at harvest

Figure 1. Map of South Africa showing the distribution of Bradypodion pumilum (dark grey) and the area included within the Cape Wine Growing Region (black outline). The white dot shows the location of the Jordan Winery.

(February to March) to other vegetation types in and around vineyards. It was considered important to establish whether chameleons occurred at equal, higher or lower densities in vineyards, when compared to their surrounding vegetation. Vineyards do not appear to be prime habitat for chameleons: they are a monoculture of broad leaved vegetation, are deciduous, and they are occasionally sprayed for insect pests. We therefore posed a hypothesis that chameleons would be at higher densities in surrounding vegetation when compared to vineyards.

The Jordan Winery near Stellenbosch, Western Cape, South Africa comprises 105 ha principally given over to grape production for wines, and is typical of vineyards in the region. Jordan Winery has traditionally used manual harvesting, but since 1998, 50% of the grapes are harvested by an automated harvester (Pellenc model 3200, Pertuis, France). The area was surveyed for chameleons during peak harvest season on two nights in 2007 (6 and 21 February). Surveys were conducted at night, due to the ease of spotting perched, sleeping chameleons in torchlight as pale forms against dark vegetation. Two types of vegetation were surveyed: domestic, which included a mixture of indigenous and exotic planted vegetation, and vines (both manually and automatically harvested) which included five of the eight varieties grown on the farm (Chardonnay, Sauvignon Blanc, Chenin Blanc, Merlot, and Cabernet Sauvignon). As harvesting was ongoing during the survey period, both surveys included vines which had been harvested as well as unharvested vines. A single transect was made, which covered both types of vegetation (Fig. 2). The spotting was done by the same experienced observer (KAT) during both surveys from a vehicle, using a strong halogen spotlight. This procedure allowed for searching up to 15 m into the vines or domestic vegetation. The first survey covered a transect of 1765 m (665 m manually harvested and 1100 m automatically harvested) of vines and 1335 m of domestic vegetation. In the second survey, the transect of the first survey was duplicated, but included a detour which gained an extra 200 m of automatically harvested vines (1965 m).

During the first survey, eight chameleons were found in two patches of domestic vegetation (Fig. 2). The second survey produced 12 chameleons, all in one patch of domestic vegetation. No observations of chameleons were made in the vines despite a 30% greater search effort there. Chameleon density was estimated as an average over the two surveys per 100 metre of vegetation (for each type of vegetation). Therefore, the density of chameleons in the domestic vegetation over the two surveys was estimated as 0.75 chameleons per 100 m (an average of 10 chameleons over 1335m). However, chameleons were only found in two of the three domestic patches (see Fig. 2). Thus if only those two patches (totalling 745 m) are considered, the estimated density is 1.3 chameleons per 100 m. Although we found no chameleons in the vines, we cannot assume the density is exactly zero (see below). Thus, if we assume there were less than one chameleon in

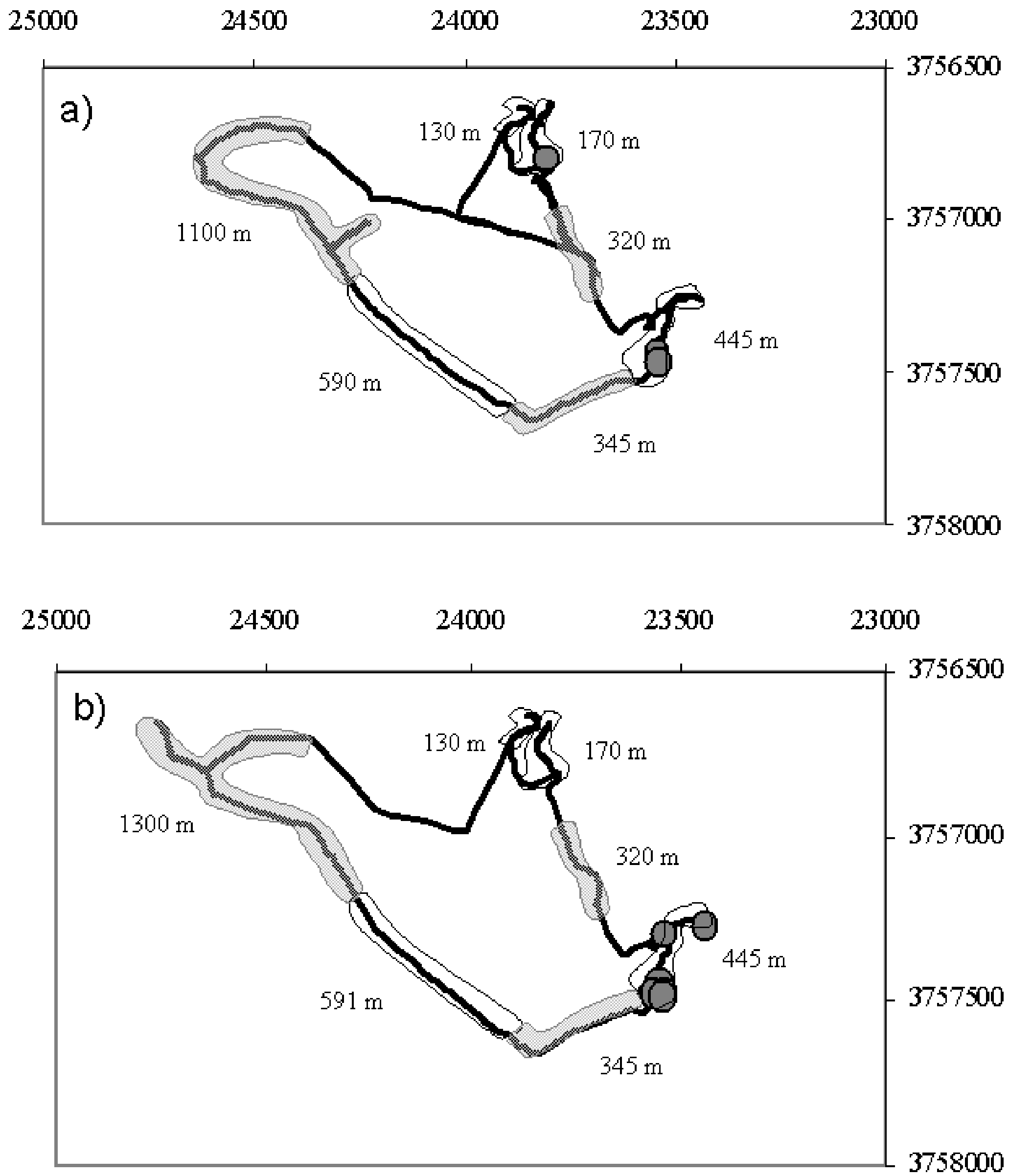

Figure 2. Schematic diagram of transect covered at Jordan Winery for the a) first survey and b) second survey. The dark line indicates the track taken. Areas surveyed are indicated by shading overtop of the transect line (grey = vines, white = domestic), and the length of those transects are given. Locations of chameleons are indicated by grey circles. Axes are labelled according to South African grid units.

the vines (*i.e.* < 1) the estimated density of chameleons in the vines during both of these surveys is < 0.06 animals per 100 m. A χ^2 test using data from the two surveys and the two vegetation types indicated the different densities of chameleons in different habitats cannot be expected by chance ($p < 0.001$). This suggests the two vegetation types have different chameleon densities and that the density of the Cape Dwarf Chameleon in grape vines during harvest is very low in comparison with the densities of chameleons in the immediate vicinity.

There are several possible sources of error in the survey design, but none of them make these comparative density estimates tenuous. In order to minimise error, the same person was spotting in both vegetation types on both nights to reduce variation in search effort between habitats. Furthermore, some chameleons could be present on the transect line but not spotted by the observer. However, this source of error is present in both vegetation types and is arguably a greater source of error in the domestic vegetation than in the vines. Because the vines are in rows, both surfaces could be easily scanned for chameleons. This was not possible in the domestic vegetation which is multidimensional and could easily hide chameleons that are not directly on the plain of viewing along the transect. Finally, we have minimised error by using the value of <1 chameleon in estimating densities and when using the χ^2 test, allowing for the possibility that there were unobserved chameleons in the vines. Despite the error inherent in this kind of survey, the comparative nature of these density estimates can be made with confidence.

The results also show that there is a wide variation in chameleon densities in the domestic vegetation, and that this can be as low as densities of animals in the vines themselves. This is not altogether surprising, and in our experience in surveying for *B. pumilum*, we have found that some vegetation consistently appears inappropriate for chameleons. While this includes monocultures (agricultural fields), plantations (*e.g.* pine and eucalyptus), as well as broad-leaved deciduous invasive trees or bushes (*e.g.* oaks), the observation also extends to some types of domestic or natural vegetation. As there was no appreciable difference in chameleon density between areas which are automatically harvested and those harvested by hand, this study suggests that the reduced density of chameleons in vineyards is not related to automated harvesting.

Although these surveys are not conclusive concerning the presence or absence of chameleons in vineyards, they confirm our original hypothesis that the density of chameleons in vineyards is much lower than that of the surrounding vegetation and we believe that it is reasonable to conclude that the co-occurrence of a chameleon and an automated harvester is an unlikely event. Without further and more widespread sampling, which is beyond the scope of this study, it is not possible to estimate absolute densities of chameleons in vineyards.

Regardless, we considered what could happen in the improbable event that a chameleon was present on a vine on the one day in the year where the automated harvester passes. An automated harvester removes berries from the vines by passing a Teflon bar (approx. 1.5 cm diameter) through the mid point of the vines. Bunches containing berries are displaced by the shaking bar, then the ripe berries fall and are recovered at the bottom of the machine. The frequency at which the bars move can be decreased in order to remove berries which are progressively riper. Hence, if present, a chameleon would have to withstand the movement of the Teflon bars across the middle section of the vine. Chameleon feet are specialised in order to grip small perches; they have fused toes (with long nails) and long prehensile tails which help them retain their purchase. Unpublished data (GJM & A. Herrel, pers. comm.) shows that chameleon strength is related to their size, such that individuals between 60 and 80 mm in snout-vent length (the size of an adult *B. pumilum*) can retain a grip with a force of *ca*. 2.0-2.5 Newtons with only their front legs. We load tested the force required to remove a grape from the vine; and thus, the force at which the automated harvester would need to remove a chameleon from its perch. Six grapes of two varieties each (Sauvignon Blanc and Merlot) were removed by placing each grape in a harness attached to a balance where the force at which the grape came loose from the vine was recorded. The grapes required approximately 0.40 Newtons of force (Sauvignon Blanc mean 0.41 ±0.03N and Merlot 0.39±0.03N). Given that an adult Cape Dwarf Chameleon requires more than 2.0 Newtons of force to be removed from a perch, it is unlikely that the automated harvester would remove a chameleon from its perch. In addition, chameleons (even when sleeping) tend to grip with all four feet plus their tail. This behaviour would add to their ability to grip a perch, and suggests the 2.0 - 2.5 Newtons measured (for their front feet only) is an underestimate of their ability to resist the actions of a harvester.

In conclusion, while the survey results cannot provide an estimate of true chameleon density in vines, it is apparent that vines are not optimal habitat and are generally avoided by the Cape Dwarf chameleon, *B. pumilum*. Vines which are manually harvested do not have an appreciably different chameleon density from vines which are automatically harvested. In the unlikely event that a chameleon was on vines targeted by the automated harvester (1 day out of 365, over 105 hectares of vineyard), the harvester does not produce enough force to remove a chameleon under ordinary conditions.

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