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The attraction range of the Onderstepoort 220 V light trap for *Culicoides* biting midges as determined under South African field conditions

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ABSTRACT

Despite some limitations suction light traps are the primary tools used for the collection of *Culicoides* species (Diptera: Ceratopogonidae). The range of attraction of the Onderstepoort light trap is not known but an insight into the range of a trap will determine where the trap must be positioned relative to the hosts present, possible breeding sites and environmental structures in the trapping vicinity. It will therefore contribute to a more meaningful interpretation and comparison of results between trapping events. In the present study the number of *Culicoides* midges collected in a single trap was compared to those of traps made with an additional trap respectively 1 m, 4 m and 8.5 m away from the first. Treatments between sites were rotated in three replicates of a 4 × 4 Latin square design. While interactions were found in traps 4 m apart no statistically significant interactions were found when they were 8.5 m apart. The range of attraction, indicated by the interaction between two traps, will be between 2 m and 4 m. In interpreting light trap results the limitations of this collection method needs to be taken into consideration.

1. Introduction

Blood feeding midges in the genus *Culicoides* (Diptera: Ceratopogonidae) are associated with the transmission of several pathogens of veterinary importance (Meiswinkel et al., 2004; Borkent, 2005). At least three orbiviruses (*Reoviridae*), African horse sickness- (AHSV), bluetongue- (BTV) and epizootic haemorrhagic disease of deer virus (EHDV), transmitted by certain members in this genus, cause diseases of such international importance that they have been allocated Office International des Epizooties (OIE) list status (Mellor et al., 2000). Outbreaks of bluetongue (BT) in northern Europe have indicated that the virus can effectively be transmitted by several species in this genus (Mellor et al., 2009; Carpenter et al., 2009). A similar multi-vector potential has also been demonstrated for BTV, AHSV and EHDV in South Africa (Paweska et al., 2003, 2005; Venter et al., 2011b).

Risk assessment of vector-borne diseases obtained through entomological surveys will influence decisions on the implementation of effective integrated control measures. Entomological surveys can, however, be time consuming, expensive and can potentially delay control efforts. Information on vector presence and abundance must be obtained in the shortest possible time in order to make appropriate decisions without consuming unnecessary resources.

Since 1928 various models of light traps have been used for the collection and monitoring of night-active insects (Service, 1977). Despite being an artificial system and the

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great variety of factors that can influence light trap results (Nelson and Bellamy, 1971; Murray, 1987; Bellis and Reid, 1996; Garcia-Saenz et al., 2011) it has become a standard tool for the collection of *Culicoides* midges. In a comparative study in South Africa, the 220 V down-draught Onderstepoort black-light trap was shown to collect significantly more *Culicoides* midges under field conditions than the Rieb, mini-CDC, Pirbright and BG-sentinel light traps (Venter et al., 2009a). Taking into account the more powerful light source and fan of the 220 V Onderstepoort trap, compared to that of the others, this result was not surprising.

Onderstepoort light traps are routinely used to determine the risk of a virus moving into, becoming established and spreading in an area (Goffredo et al., 2004; Patakakis, 2004; Cagienard et al., 2006; Conte et al., 2007; Meiswinkel et al., 2008; Racloz et al., 2008). In the absence of laboratory colonies Onderstepoort light traps are also used to collect live *Culicoides* midges for biological studies requiring live specimens (Paweska et al., 2003, 2005; Veronesi et al., 2009; Venter et al., 2011b). Numerous factors that may contribute to variability in the numbers of specimens collected render the interpretation and comparison of data between different trapping events challenging. It is well established that the presence of livestock near the light trap will increase the numbers of certain species of biting midges (Bellis and Reid, 1996; Garcia-Saenz et al., 2011; Venter et al., 2011a). However, the range of attraction of the Onderstepoort trap is not known. An insight into the potential range and the factors that may contribute to this attraction may help in deciding where a trap needs to be positioned in relation to the hosts present, possible breeding sites and environmental structures in the trapping vicinity. This will contribute to the standardisation of a surveillance protocol, the interpretation and the comparison of light trap data between trapping occasions.

To gain some insight into this attraction range the distance of interaction between two light traps was determined. The number of *Culicoides* midges collected, species composition and age grading results, as determined using a single stationary trap, were compared to those of three other stationary traps each with a second trap 1 m, 4 m or 8.5 m away. The distance at which the second trap influences the numbers collected in the stationary trap could give an indication of the attraction range of the trap. Although not the main purpose, this placement provided an opportunity to compare the results obtained in two Onderstepoort traps which were respectively 1 m, 4 m and 8.5 m apart.

2. Material and methods

2.1. Collection sites

The study was conducted in early summer from 8 to 28 October 2010 in South Africa. Down-draught 220 V Onderstepoort black-light traps (Venter et al., 2009a) were deployed in four sites at the ARC-Onderstepoort Veterinary Institute and the nearby Onderstepoort Veterinary Academic Hospital, Faculty of Veterinary Science (25°39′S:28°11′E; 1219 m above sea level).

These four sites were at least 200–600 m apart. At the first site traps were placed underneath the eaves of an open-sided stable housing 15–20 cattle at night. During the day the cattle were in an open pen (900 m^2) with a concrete floor in front of the stable. The stationary trap was operated at one of the corners of the stable and the second trap, if present, was operated either 1 m, 4 m or 8.5 m, alongside the northern side, facing the open pen. Both traps were therefore in the immediate vicinity of the cattle. More cattle, in similar stables, were present in a radius of 50–100 m from the study area.

The second site where a stationary trap was operated was 200–250 m from the first. These two sites were separated by several office buildings. In this area the traps were placed underneath the eaves of a stable housing two horses. In the front of the stable was an open yard (50 m^2) with a concrete floor where the horses spent most of their time during the day and night. A stationary light trap was operated in the centre of this area and a second, if present, either at 1 m, 4 m or 8.5 m away. Both traps were operated inside the enclosure where the horses could move around freely.

The third site where a stationary trap was operated was 300–400 m from the second area. The traps were placed underneath the eaves of a stable housing 20–30 horses at night. The stable was surrounded by open camps with some trees and soil with patches of grass. In addition to the horses inside the stable 10–15 horses would usually spend the night in the open camps next to the stable. More horses were present in open camps 100–200 m away.

The fourth study area was at least 600 m away from the third. Here, the traps were operated in a roofed service area between five camps which housed 5–10 horses at night. More horses and some cattle were present in open camps and kikuyu pastures 10–50 m away.

The whole study area had relatively many trees and irrigated kikuyu lawns, varying in size, were located throughout the area. Wild birds and small rodents of various species were present at all of the sites.

2.2. Collection procedure

The stationary light trap at each of the four sites was not moved (Fig. 1a–d). On every night of collection a second Onderstepoort light trap (mobile trap) (Fig. 1e–g) was operated at three of the four sites where a stationary trap had been installed. The second trap was placed at respectively 1 m, 4 m and 8.5 m away from the stationary trap (Fig. 1e–g). Every night there would have been a trap with no other trap nearby, a site with two traps 1 m apart, another with two traps 4 m apart and one with two traps 8.5 m apart (Fig. 1). At each of the four sites an effort was made to keep comparable animal densities at the two collection points. To ensure that distance treatments were independent of site or occasion the distance at which the second trap was operated from the stationary one was randomised in three repeats of a 4×4 Latin square design (Snedecor and Cochran, 1980).

Traps were hung 1.4 m above ground level and as close to the host animals as possible. Insects were