SCIENTIFIC NOTE

A ground-based pheromone trap for monitoring *Agriotes lineatus* and *A. obscurus* (Coleoptera: Elateridae)

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The dusky click beetle, *Agriotes obscurus* (L.) and the lined click beetle, *A. lineatus* (L.) were introduced to British Columbia (BC) from Europe about a century ago, and are now serious pests of several crops (e.g. corn, cereals, potatoes) in the lower Fraser Valley and Vancouver Island (Wilkinson 1963). Prior to 1999, delimitation surveys of these species in North America were based on: inspections of click beetles in existing private or national collections (Eidt 1953; Vernon and Päts 1997); habitat searches (Brown 1950); or click beetles taken in strategic arrays of pitfall traps (Vernon and Päts 1997). A major breakthrough in the monitoring of *A. obscurus* and *A. lineatus* has been the identification of sex pheromones for these and other *Agriotes* species in the former USSR and Europe (e.g. Borg-Karlson *et al.* 1988). These pheromones were used successfully to survey the distribution of pest *Agriotes* species across the former USSR (Kudryavtsev *et al.* 1993). Based on this work, various pheromone blends were successfully tested for attractiveness to *A. obscurus* and *A. lineatus* in the lower Fraser Valley in 1999, and an effective prototype ground-based pheromone trap was concurrently developed (RSV unpublished data).

A simpler commercial version of the prototype pheromone trap was subsequently designed (currently known as the Vernon Beetle Trap, Phero Tech Inc., Delta, BC), and was used in delimitation surveys of *A. obscurus* and *A. lineatus* in BC and Washington State in 2000 and 2001 (Vernon *et al.* 2001). The trap design (details of which were not disclosed previously for proprietary reasons) has now been granted a U.S. Industrial Design patent (US Patent # Des. 465,254) and details of this trap can now be presented.

The trap (Fig. 1A) is constructed of durable polyvinyl chloride (PVC), and consists of two components formed from extrusion molds (Figs. 1B &C). The main component is an open ended box (Fig. 1B), the inside dimensions of which are 15.2 cm wide by 5 cm high. The other component is a ramp section (Fig. 1C), two of which are inserted into opposite ends of the open box. To assist beetles in climbing, the ramp section has 27, 0.2 mm high parallel ridges, spaced 2 mm apart, ending in a smooth downward curved section at the top. The ramp (width = 15.2 cm) slides easily into slots in the floor of the box component, with the ramp section angled upwards at 40^{o} from the box floor. The top of the ramp is held at 3 mm from the top of the box component by indentations in the upper box corners and by 3 ridges extending downwards 3 mm into the box. The gap formed between the ramp top and ceiling of the box enables *Agriotes* click beetles to enter, while impeding entry by larger insects (e.g. large carabids) and other insectivores (e.g. voles). The ramp section also contains 2 parallel 7.0 mm deep protrusions, spaced 0.2 mm apart to allow for insertion of bubble cap pheromone release devices (Phero Tech Inc.). The length of the box component is 15.4 cm, such that when ramp sections are fully inserted into the open ends the opposing ramps are 1 cm apart at the curved apex. When deployed, the traps are placed at ground level, with the downward edges of the box section pushed into the soil, and the fully inserted entry ramps flush with and slightly covered by soil to provide unimpeded beetle entry.

When properly installed, the traps can

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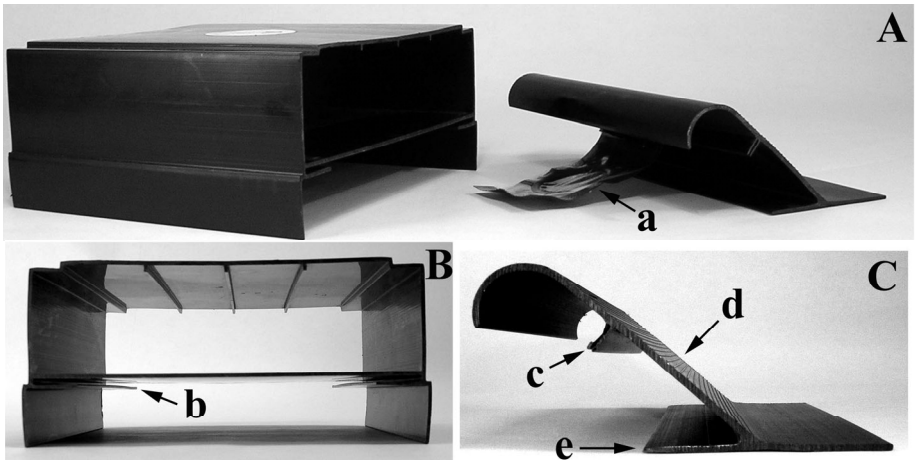

Figure 1. Photographs of a dismantled click beetle pheromone trap (A), showing the box section (B) and ramp section (C). Labelled details include: a) bubble-cap pheromone lure; b) floor slot for ramp insertion; c) lure clasp; d) ramp section with climbing ridges; and e) ramp insertion point.

often attract male *A. obscurus* and *A. lineatus* beetles within a few minutes. Trapping efficacy remains high throughout the adult generation of both species (Vernon *et al.* 2001), and other genera of click beetles are rarely captured. Traps with *A. lineatus* lures seldom catch *A. obscurus*, whereas *A. obscurus* traps will catch significant numbers of *A. lineatus*. Catch of *A. lineatus* in *A. obscurus* traps, however, can be almost eliminated if traps for both species are placed within 1.5 m of each other (RSV, unpublished data).

In a trial conducted in Agassiz B.C. comparing the relative efficacy of the new traps versus pitfall traps used in earlier elaterid surveys (Vernon and Päts 1997), the pheromone traps caught 54.3 *A. obscurus* per trap compared with only 1.6 *A. obscurus* caught per pitfall trap over a one month period in 2001. During this trial, escapes, and/or predation of click beetles caught in the pitfall traps was common, but was not observed in the pheromone traps. Some predation of click beetles by certain carabids (e.g. *Pterostichus melanarius* Illiger) will occur in pheromone traps left untended for 2-3 week periods late in the adult generations of *A. obscurus* and *A. lineatus* (RSV pers. obs.). When deployed in undisturbed areas and inspected routinely (10-14 days), however, the new pheromone traps provide an effective, convenient and inexpensive method for surveying and detecting *A. obscurus* and *A. lineatus* populations.

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