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A nondestructive tree trunk funnel trap for capturing insects ascending stems of trees

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Abstract

An efficient, simple, and inexpensive trap that catches insects as they ascend tree boles is described. The performance of the trap was tested in a capture-mark-recapture experiment on the Warren root collar weevil, *Hylobius warreni* Wood (Coleoptera: Curculionidae). A high percentage (77%) of the marked *H. warreni* were recaptured at least once and a high percentage of the weevils were recaptured several times, with one weevil recaptured eight times. These results indicate that the trap is efficient and that weevils were not conditioned to avoid the trap.

Introduction

This paper describes a simple and inexpensive trap for capturing insects ascending stems of trees. The efficiency of the trap was evaluated in a mark-recapture experiment on the Warren root collar weevil, *Hylobius warreni* Wood (Coleoptera: Curculionidae), a significant pest of lodgepole pine, *Pinus contorta* Dougl. *ex* Loud. var. *latifolia* Engelm. *ex* S. Watson (Pinaceae)(Cerezke 1994).

H. warreni attack trees from about age six years to maturity. It is considered a pest species since its larvae may girdle and kill small diameter trees. Mortality usually does not exceed 5 %, but much higher mortality rates have recently been reported in Western Canada (Schroff *et al.* 2006). There is a concern that this is in part due to the current unprecedented outbreak of mountain pine beetle, *Dendroctonus ponderosae* Hopkins, which has killed over 10 million hectares of mature lodgepole pine (Walton *et al.* 2008). There is an imminent risk of increased weevil-caused mortality since weevils from mountain pine beetle-killed stands may migrate to plantations, thus threatening future crop trees. Indeed, Klingenberg (2008) confirmed that *H.*

warreni causes more damage in young lodgepole pine plantations when these are adjacent to areas where mountain pine beetles have killed the mature trees.

Research on *H. warreni* has been hampered by the lack of a suitable sampling techniques. Cerezke (1994) developed a trap that he successfully used for a mark-recapture study. To my knowledge, this trap has not been used successfully since, probably because it is fairly complicated to build. For example, Lindgren[1] (pers. comm.) failed to catch *H. warreni* using a trap based on Cerezke's specifications. In short, Cerezke's trap consists of a metal strip that is nailed around the tree stem to guide weevils into an inverted nylon mesh funnel, which leads to a container from which the weevils can be collected.

Several techniques used to trap other species of weevils have also been tested on *H. warreni*, but without success, e.g., pitfall traps baited with a variety of monoterpene mixtures with ethanol and turpentine components (MacKenzie et al. 1989 cited in Cerezke 1994), circle traps (described in Mulder *et al.* (2000)) and split pine bolts (Lindgren[1], pers. comm.), night time limb jarring and transparent air bubble wrap (described in (Hausmann *et al.* 2004))(pers. obs.). The objective of this study was to develop an efficient and simple trap that could be used for ecological studies of the Warren root collar weevil and insects with similar behaviours.

Materials and Methods

Trap description

The aim of the trap is to catch insects as they ascend tree boles (e.g., *H. warreni*). It consists of a funnel that is attached at its lower end to the stem of a tree (Fig. 1).

[1] B.S. Lindgren, University of Northern BC, Prince George, BC, Canada.

Trap construction begins by drawing the contours of the trap, according to the photograph shown in Fig. 1A, on a kraft paper which has been saturated with asphalt (e.g. Vaporex 400S, Building Products of Canada Corp.). A foam brush is then used to paint a band of Fluon® (e.g., AD1070, AGC Chemicals Americas, Inc.). NB Teflon® should not be used since it will not prevent the insects from escaping (pers. obs.). After the Fluon has dried, the trap is cut out stacked in pairs with the Fluon-coated sides facing each other (Fluon on the outside of the trap will prevent the insects from entering the trap).

Traps should be installed at least a few centimetres above ground, but below the lowest branches, so that insects encounter the stem first, and then climb the outside of the trap (Fig. 1B). Removal of branches should be avoided, since that would influence the microclimate for the insects. However, if branches must be removed to attach the trap, the wounds should be covered with for example liquid paper so that pitch does not drip down into the trap.

Wrap tape around the stem a few centimetres above the point where the lower end of the trap will be attached, and paint it with Fluon. If the Fluon-coated tape is at the same height as the bottom of the trap all captured insects will be coated with Fluon. Tape with a glossy surface, e.g., standard packaging tape, is preferable. The trap is folded to form a cone with the lower part fitting tightly against the stem of the tree. A paper clip is attached to the top edge of the trap to stabilize it. Short pieces of tape are then attached around the bottom of the trap as a "skirt". A tape with a non-glossy surface, e.g., five cm wide masking tape, should be used for this. A few firm wraps of the tape around the stem are used to tightly attach the "skirt" to the stem.

For insects that can fly the probability of them escaping is minimized by keeping the distance without Fluon in the bottom of the trap to a minimum. Moistened paper may be used in the bottom of the funnel to provide shelter for the insects. Long forceps are useful to remove trapped insects from the trap. If the trap is going to be used for pest management purposes, contact insecticide treated cloth, or granular insecticides, can be placed in bottom of the funnel.

Field test of the trap

A field experiment was conducted near Prince George in northern British Columbia, Canada. Traps were set up on all 182 trees in one half of a young lodgepole pine stand. Tree diameters, measured at ground level, ranged from 4 – 14 cm. All *H. warreni* that were caught during the first day were individually marked using liquid paper and released. The traps were emptied daily during a twelve day long period in the end of May - beginning of June, 2006. All captured weevils were released below the trap where they were caught.

Results and Discussion

The following three results indicate that the tree trunk funnel trap is efficient and that there is no evidence of trap avoidance:

A high percentage (77%) of the marked *H. warreni* were recaptured at least once. Cerezke (1994) recaptured a lower percentage (43%) of individually marked *H. warreni* with his trap even though he used more traps and they were used during a longer time period. The relationship between time since release and the percentage of weevils that were recaptured was expected to be best explained by an exponential rise to max function. However, a simple linear regression explained more of the variation (Fig. 2A). This result may be because there was no enclosure around the experimental area. A substantial proportion of the marked weevils may therefore have visited trees outside the area and thereby avoided being trapped for a relatively long time period in comparison with the total duration of the experiment. It is therefore likely that an even higher proportion of the weevils would have been recaptured if the experiment had been continued.

There was no trend over time with regard to the total number of *H. warreni* caught each day (Fig. 2B).

A high percentage of the weevils were recaptured several times (Fig. 3), with one weevil recaptured eight times. This indicates that weevils were not conditioned to avoid the trap.

In a previous study it was shown that the tree trunk funnel trap catches both males and females in approximately equal proportions (Öhrn *et al.* 2008). Few non-target insects are captured with this trap compared to the mass of insects captured by conventional pitfall traps.

The tree trunk funnel trap is easy to construct, easy to attach to tree trunks, lightweight, easy to transport, and very cheap (<$1 each). The trap has already successfully been used to collect adult species of *H. warreni* in a study where two non-destructive techniques to determine the sex of live adults were developed (Öhrn *et al.* 2008) and to a feeding and ovipositional experiment (Hopkins *et al.* in press). The trap has also been used to study the dispersal of *H. warreni* within modified forest habitats (Klingenberg *et al.* submitted). In addition, the trap has proven to be efficient for trapping *Hylobitelus xiaoi* Zhang, a serious pest on slash pine, *Pinus elliottii* Engelm. (Wen[2], pers. comm.).

In the future the trap may be useful both for collecting insects for laboratory studies, field experiments, and possibly for pest management. It could potentially be useful to study any insect that crawl up the stems of their hosts; the following list of potential target species is far

[2] X. Wen, Jiangxi Forest Pest and Disease Control Station, Nanchang, China.

from complete: *Anthonomus pomorum* L., *Artipus floridanus* Horn, *Asynonychus godmani* Crotch, *Conotrachelus nenuphar* Herbst, *Curculio caryae* Hinds, *Diaprepes abbreviatus* L., *Hylobius pales* Herbst, *Hylobius radicis* Buchanan, *Pachylobius picivorus* Germar, *Pissodes strobi* Peck, *Sciaphilus asperatus* Bonsdorff, and members of the genus *Otiorhynchus*.

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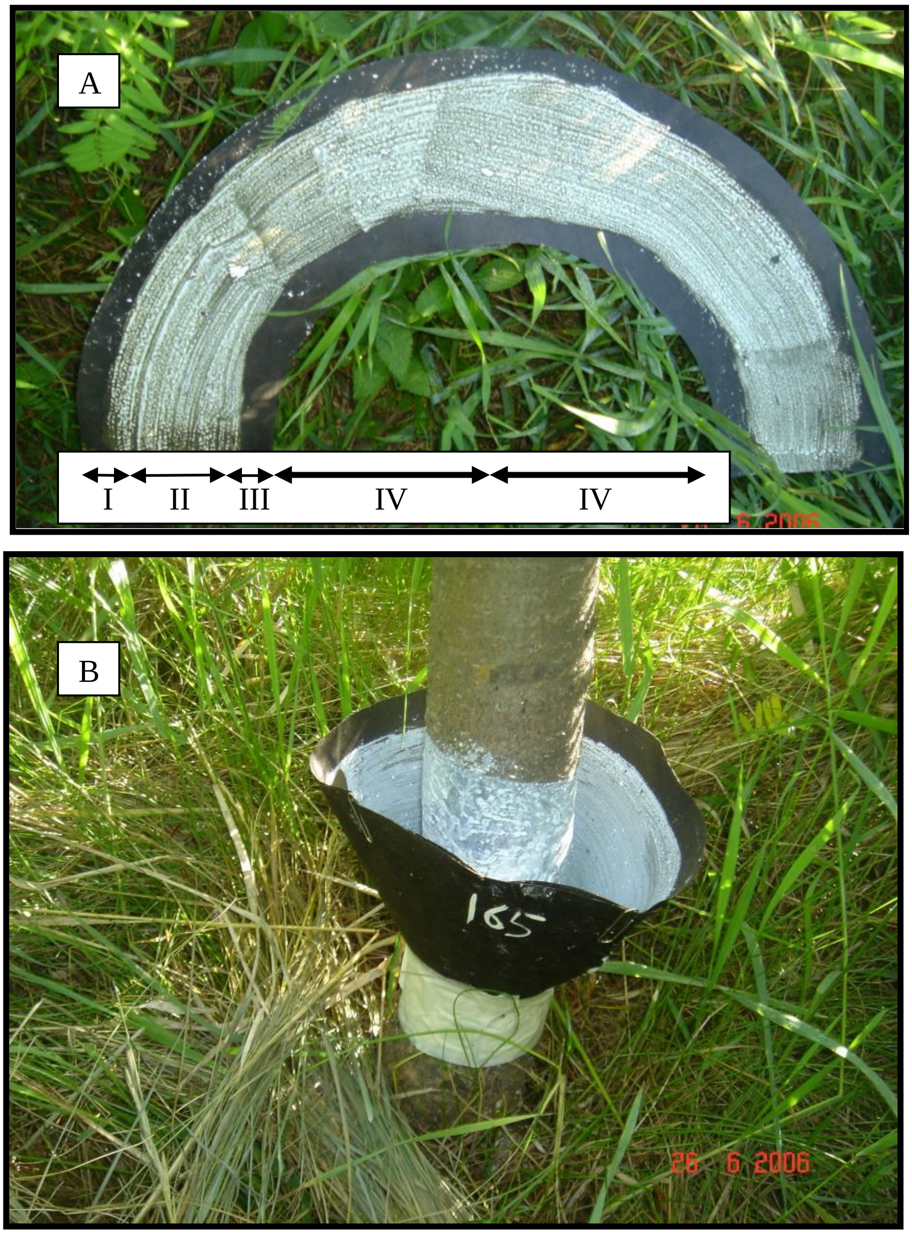
Figure captions

Fig. 1. The tree trunk funnel trap-unfolded (A) and the placement and appearance of a properly placed trap in the field (B). I = 30 mm (width of strip at the bottom of the trap without Fluon, which will prevent the insects from becoming covered with Fluon), II = 70 mm (this relatively wide area with Fluon will prevent litter from providing a bridge for insects to escape), III = 30 mm (width of strip at the top of the trap without Fluon, which will prevent that insects encountering the Fluon in II from grabbing the edge of the trap with their back legs, thus avoiding being trapped). IV = the maximum tree diameter that the trap can be attached to.

Fig. 2. Rate of recapture of individually marked *Hylobius warreni* (A), and total number of *H. warreni* caught each day (B).

Fig. 3. Number of recaptures for 35 individually marked *Hylobius warreni* during a 12-day period.

Fig. 1.



178 **Fig. 2.**

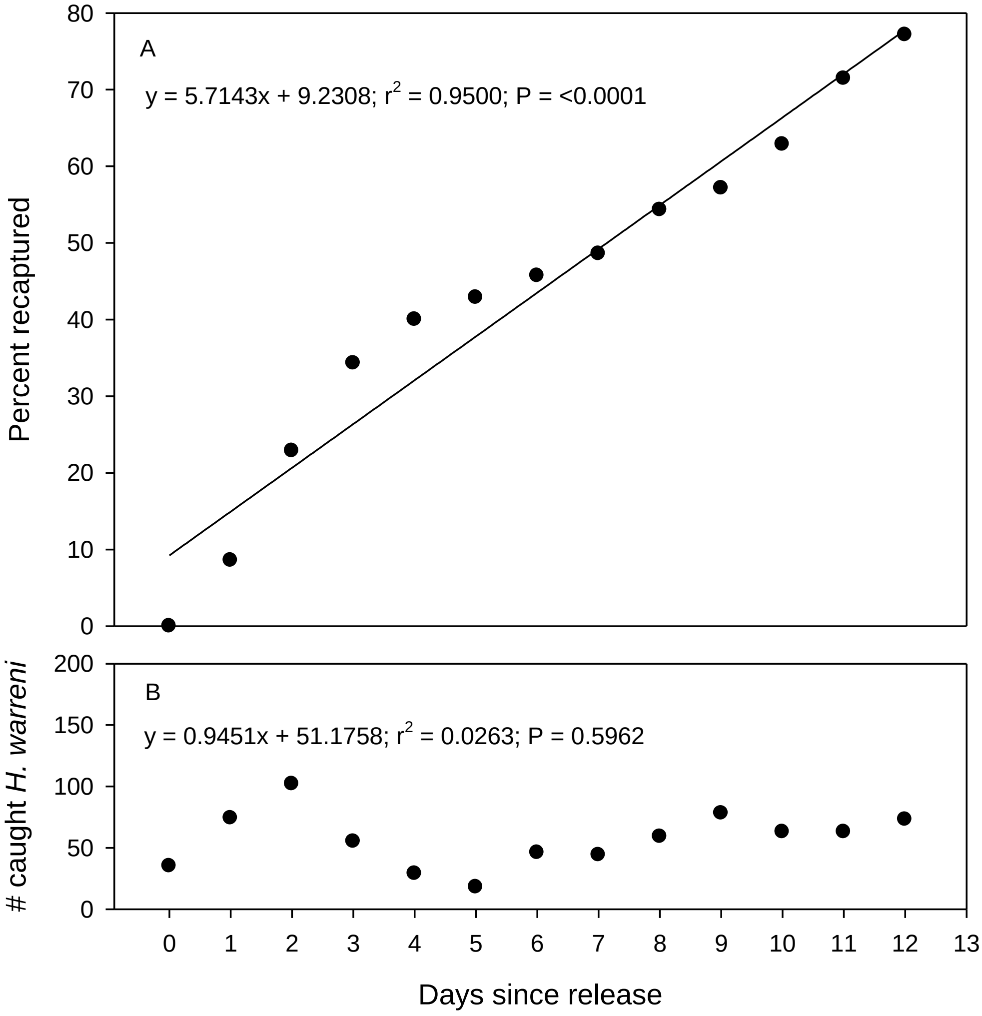


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Fig. 3.