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Taxonomic characters for differentiating cohabitating larvae of *Dendroctonus ponderosae* and *Ips pini* (Col., Scolytidae)

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Abstract: *Dendroctonus ponderosae* Hopkins and *Ips pini* (Say) are often found cohabitating in *Pinus* spp. hosts, especially when *D. ponderosae* is in the endemic population phase. Although the adult stages are morphologically distinct, distinguishing between the species is difficult when only the larval stages are present. Using field collected specimens, several taxonomic characters of the larvae were identified which may be used to differentiate the two species. These results have application in studies of endemic *D. ponderosae* populations and competitive interactions between *I. pini* and *D. ponderosae* populations.

1 Introduction

Dendroctonus ponderosae Hopkins and *Ips pini* (Say) (Col., Scolytidae) are phloem infesting bark beetles often found in the same host tree. In the Intermountain west, both species commonly attack *Pinus contorta* Dougl. var. *latifolia* Engelm. and *P. ponderosa* Laws. Although *I. pini* typically colonizes downed trees and slash, it is also found in live trees weakened by other agents including diseases, mechanical injury (Furniss and Carolin, 1977), and when attack is coincident with other phloem infesting bark beetles such as *Pityogenes* spp., *Pityokteines* spp., *Pityophthorus* spp., and *D. ponderosae* (Schmitz, 1988). Due to the aggressive nature of *D. ponderosae*, however, *I. pini* is typically only found cohabitating in the same portion of the host tree during the endemic phase of *D. ponderosae*. When epidemic, the large numbers of *D. ponderosae* in the lower part of the bole competitively eliminate *I. pini*, although *I. pini* may be found in the upper bole and limbs (Amman and Safranyik, 1985). Depending on the elevation, *D. ponderosae* is typically univoltine (Amman, 1973), whereas *I. pini* may have two or three generations in a single year (Furniss and Carolin, 1977). In the Intermountain west, development time for the two species overlap such that larvae of both may be present in the same tree from August through November, and again in the spring and early summer.

Although parent galleries of *D. ponderosae* and *I. pini* have distinctly different forms, the larval galleries of both species (which branch off the parent gallery) are very similar. Adult beetles are easily distinguishable, but morphologically the larvae of both species are almost identical. In the endemic phase, both species are often found inhabiting the same space beneath the bark. When this occurs, because the larval galleries of *D. ponderosae* and *I. pini* can be intertwined and are very similar, discerning between species in the field is very difficult. Historically, the majority of *D. ponderosae* research has been conducted on epidemic populations which have caused extensive timber-related economic losses (Amman and Cole, 1980; McGregor, 1985). However, the important ecological role of this indigenous species in forest ecosystems is becoming more fully recognized, with increased research into low-level populations and causal factors triggering the switch from the endemic to the epidemic phase. Additionally, it has been suggested that the competitive interaction between cohabitating *I. pini* and *D. ponderosae* may be exploited as a control measure to reduce MPB population densities (Rankin and Borden, 1991). As more research is focused in these areas, it is essential to be able to identify consistent and reliable taxonomic characteristics which can be used to differentiate the larvae of these two cohabitating species. Other than Thomas (1957, 1965), little taxonomic work has been conducted on larvae of these two species. We examined several morphological characters, readily visible with a 25× microscope, to determine if any could be used reliably and consistently to differentiate between the larvae of the two species.

2 Materials and methods

2.1 Larval collections

Initial taxonomic comparisons were made with field collected larvae, while final verification of taxonomic characteristics was made using lab reared specimens. Field collections were performed as follows. 100 cm^2 round samples were taken from *P. contorta* trees at three geographic locations (Logan Canyon, Cache County, UT; Moose Creek, Teton County, ID; Galena Pass, Blaine County, ID). *D. ponderosae* and *I. pini* collected in each sample were placed in 70% alcohol and transported to the Forestry Sciences Lab in Logan, UT. All larval-instars of each species were collected. Larval examinations were performed using a 25× to 50× power microscope with each larvae placed ventral aspect up on a wax bead.

Specimens used for taxonomic character verification and scanning electron microscope (SEM) photographs were reared in the laboratory. In both, positive species identification was

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based on the adult lifestage which is easily identifiable. Adult *I. pini*, collected from slash near Couer d'Alene, ID, were allowed to mate and lay eggs in isolated *P. contorta* bolts. Larvae were then reared at constant temperatures (25°C) until collected for use in taxonomic character verification and SEM. *D. ponderosae* from an infested tree near Stanley, ID, were reared in a similar manner.

2.2 SEM preparation

Initially, live larvae were fixed with 3% glutaraldehyde in a 0.1 m phosphate buffer. However, in this solution the larvae died slowly, contracting the mouthparts and covering the postmentum. To avoid this problem, larvae of both species were prepared for SEM using the method described by GRODOWITZ et al. (1982). In addition to placing specimens in the super skipper fixative solution for 15 to 30 sec as described by GRODOWITZ et al. (1982), larvae were also given multiple injections in the body region with super skipper solution using a 1 cc tuberculin syringe and 25 gauge needle. This resulted in rapid death, extension of the head and maxillae, and clear visualization of the postmentum.

3 Results and discussion

The most reliable and consistent characters for differentiation of *D. ponderosae* and *I. pini* larvae for all instars were found on the postmentum. The postmentum, typical of Curculionoidea, is a broadly rounded, semi-membranous segment. The postmentum bears two groups of three setae, arranged in distinct patterns in each of the two species (fig. 1). Each group of setae on *D. ponderosae* larvae are arranged in a triangular pattern with the two most anterior setae closest together. The third, posterior seta of each group is clearly proximal and is not in line with the anterior pair, thus forming the triangular arrangement. *I. pini* larvae also have two groups of three postmentum setae, but the setae on each side are arranged in a straight line running aneromesally. The position of the third, most posterior setae is the key distinguishing feature between the two species (fig. 1).

Several other less reliable and more subjective features were found to be helpful in distinguishing between the two species, especially when a sample has been damaged and the setae are difficult to locate (fig. 2). In general, size, shape and head capsule colour are different. The head capsule of *D. ponderosae* larvae is a richer and deeper amber colour than *I. pini* larvae. *D. ponderosae* larvae are larger than the same *I. pini* instar, although later instar *I. pini* are similar in size to early instar *D. ponderosae*. The postmentum setae on *I. pini* tend to be longer than the setae on *D. ponderosae*. THOMAS (1957) mentions the shape of the premental sclerite as an additional distinguishing feature. He states that on *D. ponderosae* larvae the proximal part of the

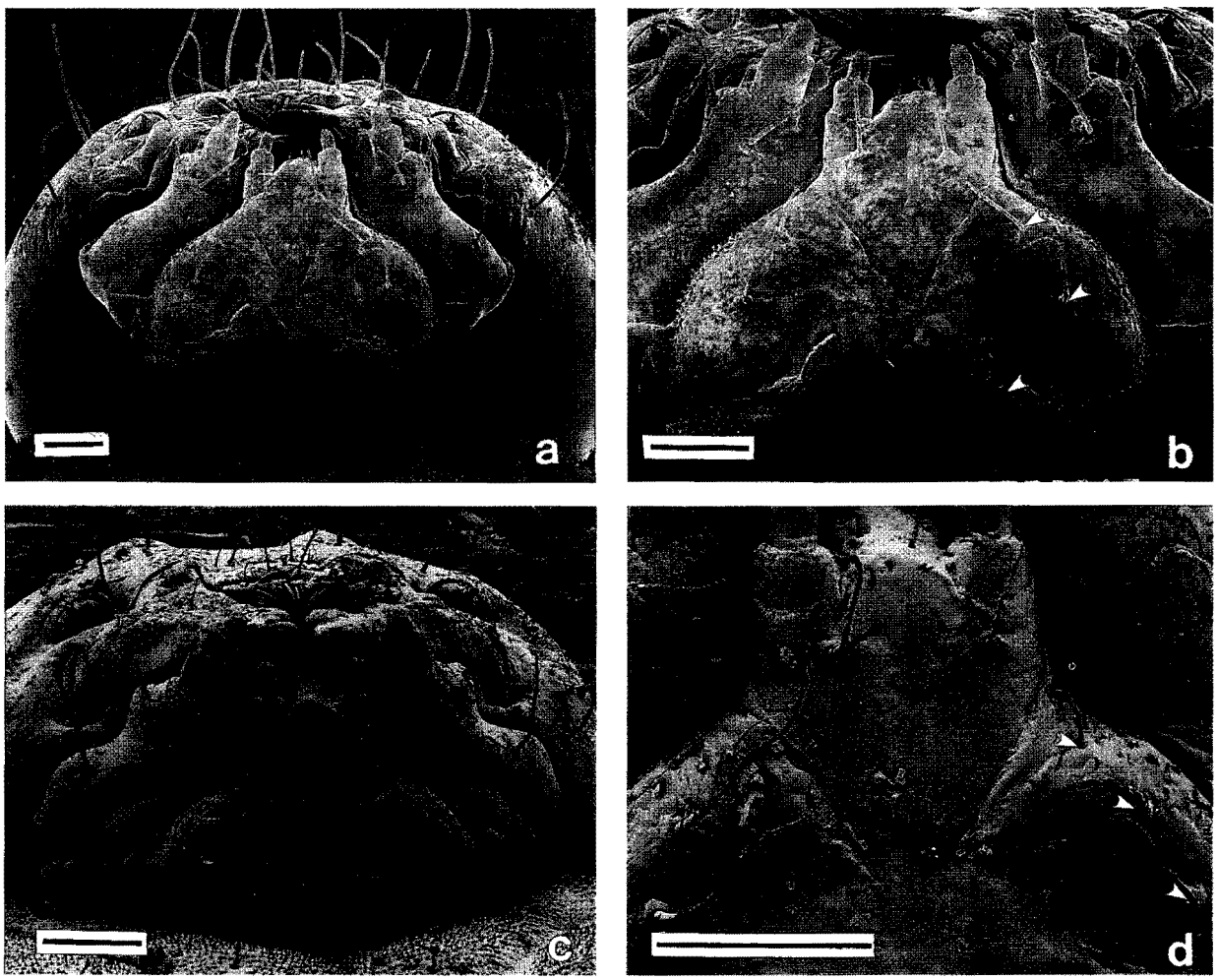

Fig. 1. *Ventral aspect of* D. ponderosae *larval head (a and b) and* I. pini *larval head (c and d) at two magnifications. Note the arrangement of postmentum setae indicated by the arrows. Bar = 100 μm*

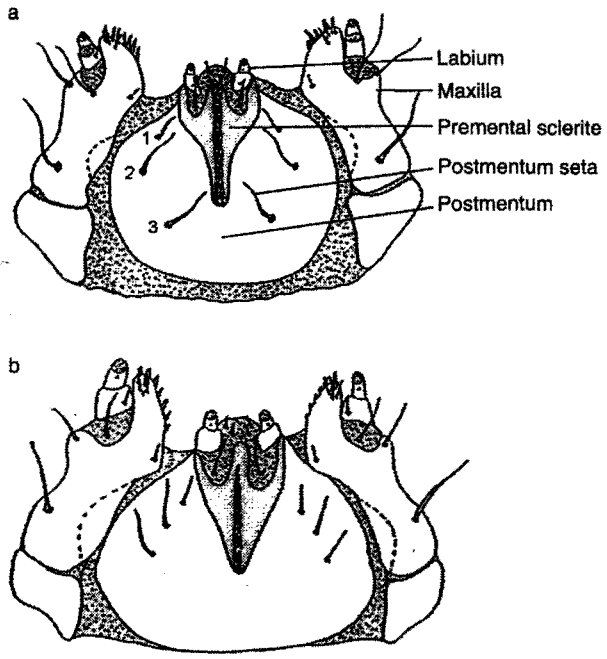

Fig. 2. *Ventral aspect of (a)* D. ponderosae *larval head, and (b)* I. pini *larval head showing morphological characters useful in differentiating between the two species*

sclerite is more or less uniform in width from the base to anterior arms, and on *I. pini* larvae the proximal part of the sclerite is more triangular in shape. However, we found this feature to be very subjective and hard to identify consistently. We are uncertain if any of the characteristics identified are appropriate for distinguishing other species of *Dendroctonus* or *Ips* larvae. Detailed examinations of other cohabitating bark beetle species need to be performed.

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