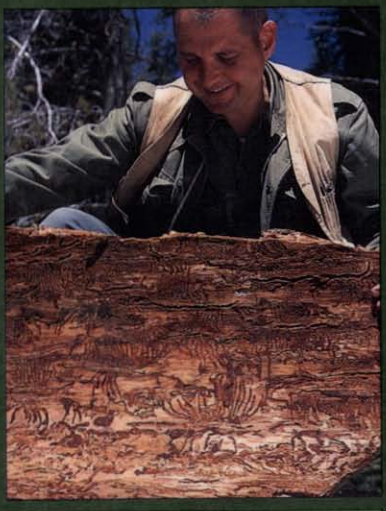
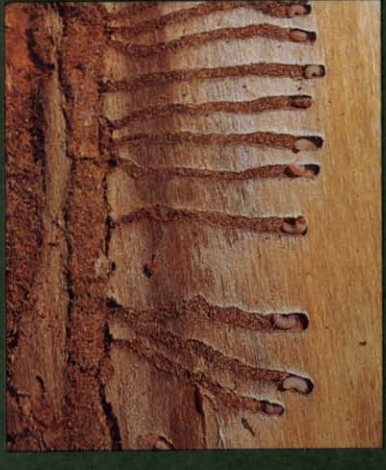
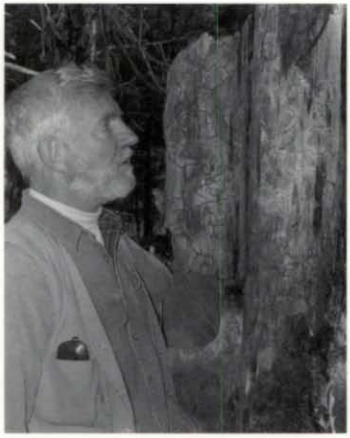
Field Guide to the Bark Beetles of Idaho and Adjacent Regions





Malcolm M. Furniss and James B. Johnson

THE AUTHORS



Malcolm "Mal" Furniss adopted Idaho as his home in 1955 after having grown up in Waverly, New York, and studying forestry at the University of California, Berkeley. He received his M.S. degree in entomology from the University of Idaho and worked as a research entomologist and project leader with the U.S. Forest Service until being appointed visiting research professor of entomology at the University of Idaho in 1982. He has studied bark beetles throughout western North America including Alaska and Mexico and is an avid photographer and outdoor sportsman.

James "Ding" Johnson studied zoology at the University of Michigan and received his Ph.D. degree in entomology from the University of California, Berkeley. He came to the University of Idaho in 1981 and is professor of entomology, in charge of the Idaho Insect Survey, and curator of the William F. Barr Entomological Museum. He is a popular teacher of insect identification and other courses. He specializes in beetles, lacewings, and wasps, including their utilization in biological control of destructive insects, and he enjoys fishing and searching for fossils.

THE COVERS

A common, native bark beetle inhabitant of Idaho forests is the Douglas-fir beetle (center right). When windstorms uproot Douglas-fir trees, the beetle breeds to abundance in the inner bark where it excavates characteristic egg galleries (upper and lower right). A year later, the progeny emerge and fly in search of fresh host trees. When downed trees are not available, the beetles may infest mature, live trees that are growing densely and that are moisture-stressed; thus, the forest is thinned and regenerated. Foliage of such trees fades the following spring (left).

Back cover: Two Y-shaped egg galleries in a stem of curlleaf mountain-mahogany are the work of the mountain mahogany bark beetle, *Chaetophloeus heterodoxus*. Larvae engraved the tunnels [illegible] he eggs hatched.

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CONTENTS

PREFACE

This guide includes 102 species of bark beetles and 12 relatives of different habit, referred to collectively as "scolytids."[1] The information presented here will be of use especially to owners and managers of trees that grow in the forest, around homes, or in orchards in Idaho and surrounding areas. Indeed, three-quarters or more of these beetle species also occur in Oregon, Washington, and Montana, and all but 10 occur in neighboring British Columbia, Canada.

College teachers and students, too, will find among these pages information useful for field trips and in the laboratory. They will also note, however, that biological features of many species are still unknown and deserving of study.

Most of these scolytids cause no real harm and we particularly wish to cultivate the throngs who seek out the mountains and forests for recreation and whose outings may be enhanced by learning more about these denizens of our natural environment. Whittling away the bark of a storm-broken or recently killed tree to discover the intricate etchings (galleries) made by bark beetles is an experience similar to splitting rocks in search of fossils. There is joy in discovery and learning, and bark beetle galleries take fascinating shapes not seen elsewhere in nature. Aided by this guide, much can be inferred from these gallery patterns including the identity of their makers.

[1] Bark beetles belong to the family Scolytidae. Herein, we also include 12 species of Scolytidae having different habit: nine ambrosia beetles that inhabit sapwood, two species that infest pine cones, and an accidentally introduced oddity infesting roots of red clover.

ACKNOWLEDGMENTS

In bestowing credit for information contained herein, we can scarcely overlook early day taxonomists such as John Lawrence LeConte, James Malcolm Swaine, and Maulby Willett Blackman who, together, named 69 of our species. And Andrew Delmar Hopkins (1857-1948), a self-taught entomologist, merits our praise for similar reasons but more so for his brilliant and energetic personal investigations that ushered in American forest entomology, beginning at West Virginia University in 1890 and subsequently from 1902 through 1922 at the USDA Bureau of Entomology where he served as first chief of forest insect investigations. His revision of the genus *Dendroctonus* (1909) was a classic study of its time. More recent works that made this guide possible are the outstanding monograph of North American Scolytidae by Stephen L. Wood (1982); publications by Donald E. Bright, Jr., on bark beetles of Canada (1976), *Pityophthorus* (1981), and others cited herein; and the manual *Western Forest Insects* by R. L. Furniss and V. M. Carolin (1977).

This guide was reviewed by Stephen L. Wood, Brigham Young University, Provo, Utah; Sandra J. Kegley, USDA Forest Service, Coeur d'Alene, Idaho; and Frank W. Merickel, Division of Entomology, University of Idaho, Moscow. Sources of figures other than those of the senior author are noted in the captions. We wish to acknowledge particularly photos and drawings provided by Donald E. Bright, Jr., Agriculture Canada, Ottawa; Mark D. Deyrup, Archbold Biological Station, Lake Placid, Florida; David R. Lauck, Humboldt State University, Arcata, California; and Torolf R. Torgersen, USDA Forest Service, La Grande, Oregon. The manuscript was edited by Diane S. Noel and Kate Painter, Agricultural Communications, University of Idaho. Cover and book design is by Melissa Rockwood of Rdesign. This research was funded in part by the University of Idaho, Idaho Insect Survey. It is published as Idaho Agricultural Experiment Station Research Paper No. 00704.

INTRODUCTION

Idaho (Fig. 1) is a large and diverse state. Its climate and, in turn, its plants and insects, including bark beetles and their allies, are influenced by Idaho's geologic past and related factors such as the prevailing westerly airflow and proximity to regions like the Great Basin and Rocky Mountains. The elevation of Idaho ranges from 225 meters at Lewiston, where the Snake River flows westward into Washington State, to 3,860 meters on the summit of Mount Borah in the Lost River Range.

The diversity of Idaho's flora reflects a temperate climate that includes annual precipitation in the form of rain and snow ranging from less than 25 centimeters in the Snake River plains of the south to over 150 centimeters in the mountains north of the Salmon River. Contributing further to the state's diversity of plants (and their scolytid inhabitants) are extensive areas of three large soil groups: granitic batholith, basalt, and sedimentary material. Numerous woody plant hosts of Idaho's scolytids reach their limits of distribution here as exemplified by the remnant Columbian flora (such as western redcedar), white spruce, subalpine larch, and pinyon pine.

The foregoing factors have resulted in 114 species of scolytids occurring in Idaho (Furniss and Johnson 1987).[2] Many of them are rare, however. No doubt others are here but remain to be discovered, and some exotic species are likely to find their way here in the future, either to settle quietly into their niches or to attract attention and perhaps cause concern to tree owners, for scolytids have both behaviors. In truth, however, only a few species of Idaho's bark beetles, and no ambrosia beetles, kill forest trees, fruit trees, or ornamentals. Instead, most are beneficial in helping to process dying or dead branches and stems into simpler molecules that are available as nutrients to plants and other organisms. Thereby, they help to maintain the well-being of the forest ecosystem. That, in our view, warrants high marks.

How to Use This Field Guide

Bark beetles and ambrosia beetles are unique in that they are often identifiable by knowing only their host plant and the pattern of their tunneling (gallery) without needing to examine the insects themselves. This is so because these beetles tend to be "host specific" (infesting only one or a few closely related plants), and they construct galleries that are often distinctive. Thus, a scolytid collector should have access to a guide to the trees of

[2] Since that publication, we have collected nine additional species that are included herein.

Idaho such as the one by Johnson (1996) and if necessary should retain for later identification foliage and reproductive parts of uncertain host plants. A handy way to preserve foliage is pressed between layers of newspapers, accompanied by collection locality, date, and insect collection number. With such information, the diagnostic host index at the back of this guide should be consulted for possible species of beetles involved and for pages containing information on them. Another approach is to use this guide's diagnostic key to genera of Idaho Scolytidae utilizing a combination of host species, gallery characteristics, and anatomical features of the beetles themselves.

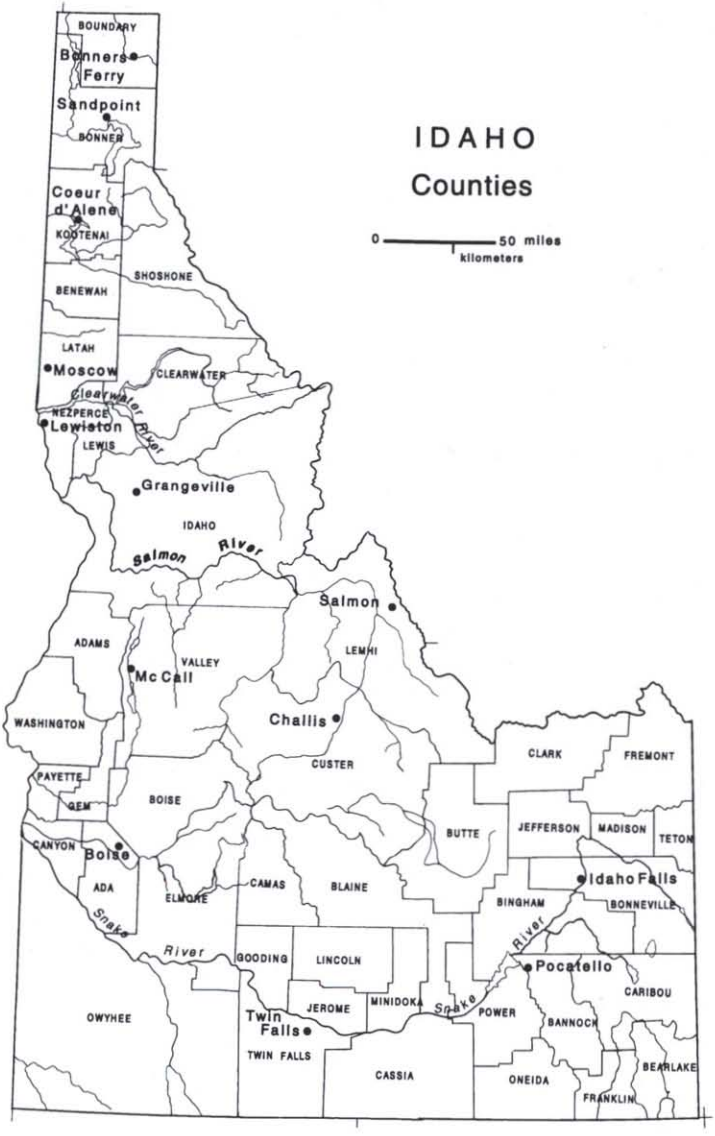


Figure 1. (A) Idaho counties, selected cities, and major drainages. (B) Idaho in physiographic relief with selected cities and drainages.

Then, the species may be tracked down using the species key for the genus involved and the information and illustrations of beetle species that follow such keys. Within the hosts section of the species descriptions, plants in bold type have been reported to be hosts in Idaho. The others have been reported as hosts elsewhere. A glossary explains unfamiliar terms.

In this guide, the Scolytidae are grouped by subfamily (Hylesininae or Scolytinae), by habit (e.g., bark beetles, ambrosia beetles, etc.), then alphabetically by genus and species. Measurements of egg galleries and beetles are in metric units. A metric scale is printed inside the back cover.

B

COLLECTING HINTS

Once, at Lottie Lake in the Selway Crags of northern Idaho, I was surprised to find a scolytid in the gut of a brook trout and gained the only specimen with a trout "host" label in our collection. The hapless beetle must have tired and alighted on the lake at feeding time. Other specimens have been collected from generally less unique hosts on fall hunting trips when the action had slowed. And, surprising as it may seem, I have collected benumbed scolytids after they had alighted in summer on snowfields on Mt. Hood and other Cascade mountains in Oregon and Washington (Furniss and Furniss 1972). So, by keeping alert for them you may run into scolytids in odd places but especially where trees grow naturally and abundantly for they have evolved together.

—Malcolm Furniss

Collecting scolytids is a rewarding activity that can complement other outdoor experiences. Only a few items are needed for most collecting situations (Fig. 2). They include a hand ax, sharp knife, tweezers, and vials containing alcohol. We use 70% ethanol, but rubbing alcohol will do. Other useful items are a 10x hand lens for viewing specimens and a notebook for recording collection data and sketches of galleries. We customarily reference the vials to the notebook by inserting paper labels containing serial numbers prefixed by year of collection (2001-1, etc.).

A larger arsenal is needed if sections of limbs and trunks are to be cut into short lengths for transportation home where they may be examined further or put into cages to rear adults for identification. For that, we carry an ax and bow saw in the vehicle or lashed to the saddle.

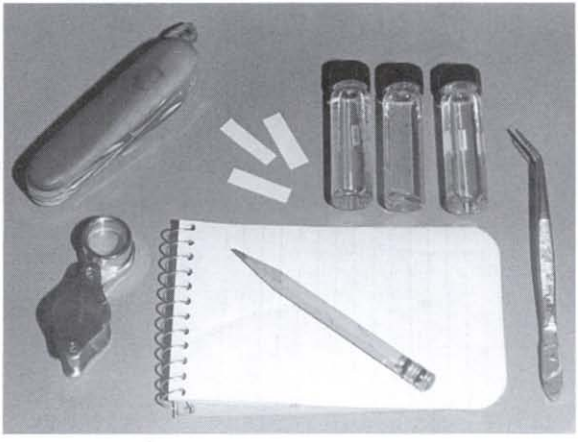


Figure 2. Collecting bark beetles requires very little equipment, including a pocketknife for cutting bark, tweezers, vials of alcohol for preserving specimens, a hand lens, and a notebook and labels for recording collection data.

Figure 3. The presence of some bark beetles such as *Dendroctonus brevicomis* is indicated by pitch exuded from entry holes in the bark. Most species, however, cannot tolerate a resinous environment, and their presence is indicated by dry fragments of bark or wood (frass) expelled onto the bark from their galleries. (Boyce Thompson Institute.)

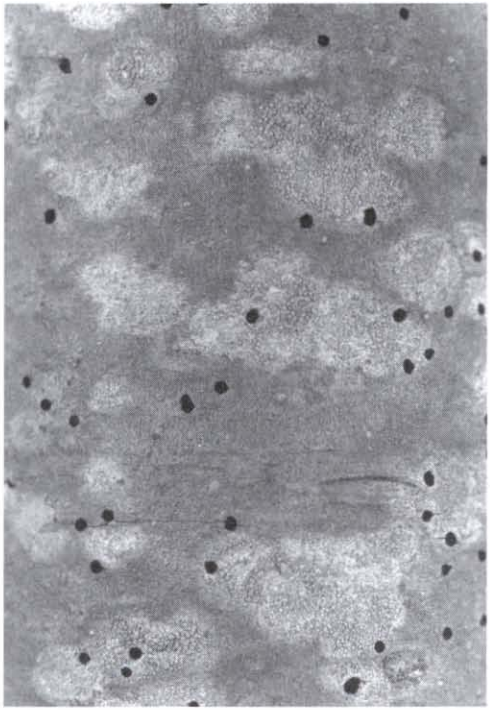


Figure 4. When bark beetle broods mature they bore out of the bark, leaving tell-tale exit holes such as these made by *Alniphagus aspericollis* in alder; their density, however, varies with species of beetle. The gray areas on the bark are lichens.

So, now that you have outfitted yourself, what sort of trees should you look for to collect scolytids? Conifers are the exclusive homes for all but 16 species of Idaho's scolytids. And conifers are most apt to be encountered on recreational outings in Idaho's forests. So, start with them.

Presence of scolytids in freshly infested trees that still have foliage of normal green color is usually evident by fragments of bark (frass) expelled onto the bark surface by tunneling beetles. Frass of bark beetles consists of dry fragments of yellowish orange or reddish bark whereas that of ambrosia beetles is powdery white—derived from wood, not bark. Additionally, in pines and spruce, invasion by some species of *Dendroctonus* bark beetles causes tree resin to flow out of their tunnel entrances, forming a pitch tube (Fig. 3). After a while, a tree or branch colonized by scolytids will die, and its reddened foliage will attract your attention. Some beetles may even have matured and flown from such a tree before your arrival as evident by exit holes in the bark (Fig. 4). In that case, you should sketch the gallery pattern or save a sample.

Figure 5. Bark beetle larvae are white, legless, and curl into a C-shape. The adult stage is required for specific identification.

Eventually during your forays you will find a branch or stem with parents in their tunnels (egg galleries) or their broods present in the surrounding bark. If the broods are immature, legless, white larvae (Fig. 5), you will need to take a stem or branch section home for rearing them to the adult stage for retention in your collection.

When your outing is over, take time to box up the branches and stems for rearing. We use plastic or metal cages but any serviceable cardboard box (Fig. 6) with cover flaps will do. Let the wood dry for a few days if it is rather moist, then seal the box against light leaks. Cut a neat hole in the front to hold a vial or jar. Beetles that emerge from the bark or wood will be attracted to light and fly into the jar. Put a strip of tissue paper into the jar to absorb condensation and to provide footing, otherwise beetles will damage each other.

Label the rearing box with collection data: tree species, locality, and date. Keep the box at room temperature, out of the sun, and examine the jar

Figure 6. Immature bark beetle broods in branches or stems can be reared to adults in darkened cardboard cages having a vial or jar to catch emerged beetles that fly toward light.

Figure 7. Specimens in vials of alcohol may be stored in homemade racks indefinitely or until pinned.

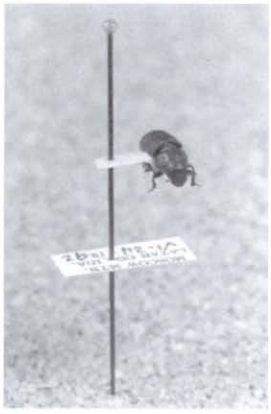


Figure 8. A bark beetle mounted with glue on a paper point and pin. The pin also contains a label with collection data. Such pinned specimens can be viewed without being handled directly and can be stored safely in a covered box.

periodically for specimens. Provide a labeled alcohol vial to hold emerged beetles (use a pencil, as ballpoint pen ink will dissolve in alcohol).

You will be surprised at the diversity of insects that emerge. Besides the intended bark beetles (ambrosia beetles may not rear well due to a proliferation of fungus in the moist sapwood), there will be other insects such as parasites, predators, and species that merely co-exist there (commensals). Most species will emerge after a few weeks. If, after 2 or 3 months, none has emerged, or emergence has stopped, carefully open the box; specimens may have emerged and died inside.

Transfer fragile, dead specimens to vials by touching them with a moistened camel hair brush. Before casting away a branch or stem that produced no beetles, cut away the bark to look for beetles that may not have emerged. In nature, some species of beetles remain in the bark, either as adults or as larvae, until exposed to winter temperatures and then to warmth in the following spring.

Your specimens can be kept indefinitely in alcohol in vials stored in a homemade rack (Fig. 7). For examination of their diagnostic (identifying) features, representative specimens need to be removed, dried, and glued to triangular points (cut from card stock paper) on pins (Fig. 8). An array of

useful items for this "curating" is shown in figure 9. By convention, the card point is bent at its tip and attached to the right side near the middle of the beetle with clear fingernail lacquer or white glue. Special insect pins, 38 mm ($1\frac{1}{2}$ inches) long, are best. They come in a range of diameters for directly impaling specimens of different sizes through their right wing cover near the base. All but the largest scolytids are better mounted on card points with a fairly stout (No. 3) pin. It won't bend as easily as lighter weight pins when thrust through a stiff card point.

A box having a tight cover and a bottom layer of Styrofoam, balsawood, or even corrugated cardboard will hold your pinned specimens well. During subsequent storage, however, precaution is needed against damage to specimens from larvae of dermestid beetles, including the common carpet beetles. In time, dermestid larvae can find their way into any such box unless protected by a sealed container or a fumigant such as mothballs. Should you observe hairy dermestid larvae or damaged specimens, commit the specimen box to the freezer for a few days to kill the intruders.

For general information on collecting and preserving insect specimens, consult Borror et al. (1989) or *Collection and Preservation of Insects* by Oman & Cushman (1948). Current sources of entomological supplies may be located on the Internet. Two longstanding suppliers are BioQuip, Gardena, California, and Wards Natural Science Establishment, Rochester, New York.

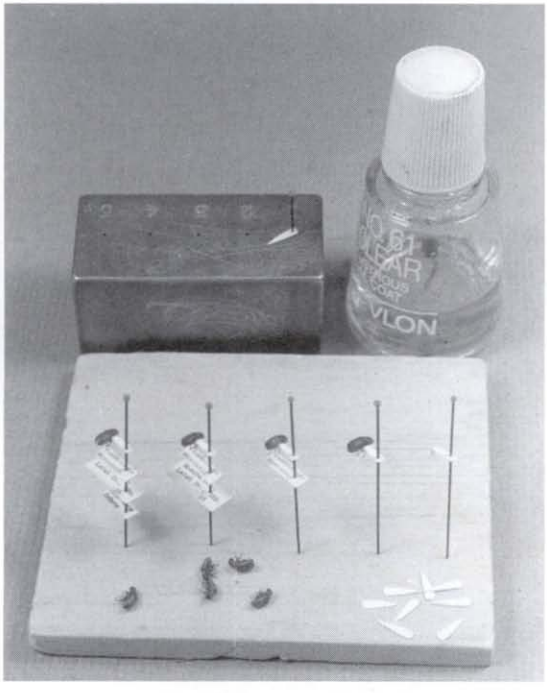


Figure 9. Items used for pinning and labeling specimens. A wood or metal "step-block" (upper left) with holes of different depths facilitates setting labels and specimens at uniform heights.

SCOLYTID BIOLOGY

Life History and Developmental Stages

Scolytids have four life stages: egg, larva, pupa, and adult (Fig. 10). Eggs are deposited in galleries that are made by female parents as they tunnel in the inner bark (phloem) or wood (xylem) of newly infested tree hosts. Eggs hatch in a week or so.

The resulting larval stage is variable in its duration, depending upon the species. For example, the first generation of the pine engraver, *Ips pini* (Say), matures in about 2 months whereas larvae of the red terpentine beetle, *Dendroctonus valens* LeConte, require a year or more to mature. Most species have one generation per year, but not all eggs are laid at one time so different broods and brood mates may mature at different times.

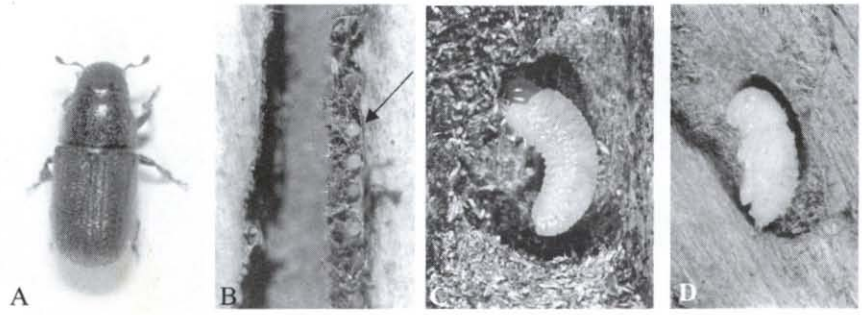


Figure 10. Life stages of all bark beetles and their allies. (A) Adult. (B) Egg (arrow) on side of gallery. (C) Larva. (D) Pupa. The adult and larval stages are of longest duration and are encountered most frequently.

When larvae transform to pupae their features are somewhat intermediate to those of the larval and adult stages, being white like a larva (but their head capsule lacks pigmentation) and having rudimentary adult features such as appendages. Pupae, however, are not mobile and do not feed. The pupal stage is of short duration and will not be encountered often.

The adult stage is our primary concern. Because it has more anatomical complexity, it is the stage used for all species descriptions (and hence is used in our identification keys). It also is the stage that disperses to new host trees and is the architect of the egg galleries that aid in identification.

How Bark Beetles Communicate

Scolytids are remarkably sophisticated in their ability to communicate chemically and sonically. In 1966, a species of pine engraver beetle (*Ips*

paraconfusus Lanier) was the first beetle of any kind to be shown to communicate with secreted chemicals called "pheromones." The attractive odor of certain pheromones, enhanced by the odor of tree resin, aggregates beetles, thereby helping them to overcome a tree's defenses. When sufficient beetles have invaded a tree, their pheromone factories shift output to a preponderance of "antiaggregative" pheromone. That nullifies the attraction and avoids detrimental competition among the beetles for space and food.

Some scolytids also communicate by rubbing their body parts together to make sounds. Some *Ips*, for example, make a "stridulating" sound when they rub the ridges on the back of the head against the inside of the body segment that supports the head (prothorax). *Dendroctonus* species emit sounds by rubbing a scraper on their abdomen against a file inside their shell-like left wing cover (elytron) (Fig. 11). Males of this genus stridulate to warn others that their female is taken, and sounds exchanged between male and female pairs provide recognition, which in turn controls the output of various pheromones.

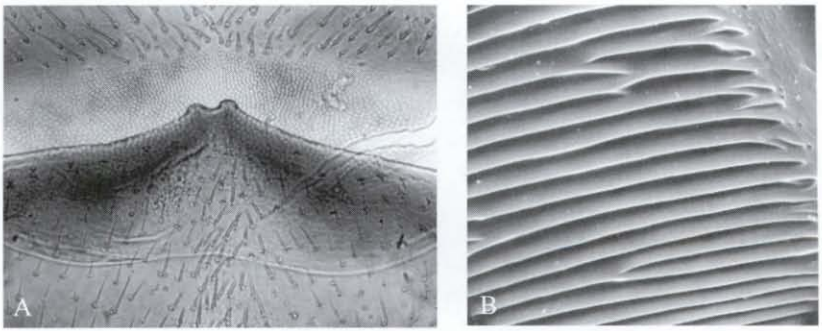


Figure 11. Bark beetles of the genus *Dendroctonus* emit sounds by rubbing a scraper on their abdomen (A) against a file on the underside of their left wing cover (B). These sounds are influential during mating and colonization of host trees.

Larvae of many bark beetles avoid each other while mining in the bark (Figs. 33B, 44, 62B) as a means of lessening competition, possibly by sounds made by their chewing. Larvae of a few *Dendroctonus* species, however, aggregate in a common chamber (Fig. 34C) in order to complete their development in live trees without killing the host. This behavior is evidently controlled by an aggregation pheromone. Thus, scolytids have evolved differing strategies for their perpetuation, at least two of which are controlled by "chemical messengers": massive aggregation of flying adults to overcome live trees in a brief time and aggregation of larvae designed to survive in a suitable host for perhaps several generations without killing it. As might be surmised, the latter behavior is restricted to a few species (e.g., *Dendroctonus valens*) that attack trees in low numbers.

Food and Shelter

Idaho scolytids are mostly true bark beetles; that is, they live in the inner bark of their hosts and obtain their nutrition by ingesting phloem (Fig. 12B). Besides the bark beetles, we have nine species of ambrosia beetles that tunnel in the sapwood (Fig. 12C), two cone-infesting beetles (*Conophthorus* species), and an introduced renegade (*Hylastinus obscurus* (Marsham)) that infests root crowns of red clover. The ambrosia beetles feed on yeast-like "ambrosia" fungi that grow on the walls of their tunnels, whereas the cone beetles tunnel lengthwise in the center of pine cones and their larvae feed on the cone and seeds.

Representative gallery systems of most of these beetles are illustrated in this guide. The galleries of a few bark beetles (e.g., *Procryphalus*, *Trypophloeus*) lack distinctive patterns or are hidden when bark is removed. Those species will not be encountered often, but they may be searched for by the serious collector using provided information on their hosts, habits, and descriptions of the adult beetles.

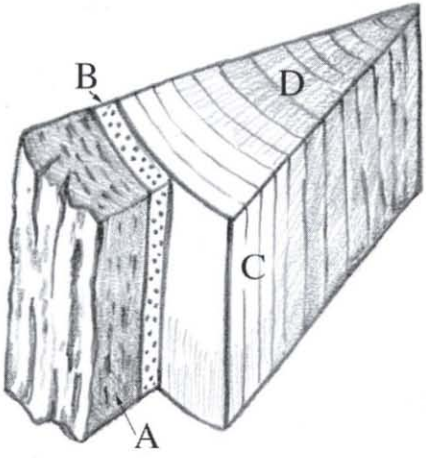


Figure 12. Radial section of a tree showing the components of bark and wood. (A) Dead outer bark. (B) Live inner bark (phloem) in which bark beetle broods feed and develop. (C) Live wood (sapwood) in which ambrosia beetle broods develop. (D) Dead wood (heartwood).

SCOLYTID ECOLOGY

Relationships with Host Plants

Scolytids, like many other insects, suffer "bad press" because of the attention given to species that kill or damage trees. However, a great majority of scolytid species, including those of Idaho, infests only dead or dying parts of their hosts. In the beginning, the ancestors of today's scolytids probably all behaved that way. We believe that the few "bad actors" developed their capacity to infest living trees as land masses rose and plants such as conifers of the family Pinaceae (e.g., pines, firs, spruces) evolved in the drier, harsher, temperate environment thus created. The capacity of these troublesome few to kill trees involves their secreting attractant chemicals called "pheromones" to concentrate beetles on a tree under attack and the mutualistic, tree-pathogenic fungi that they carry into the tree on their bodies (Fig. 13).

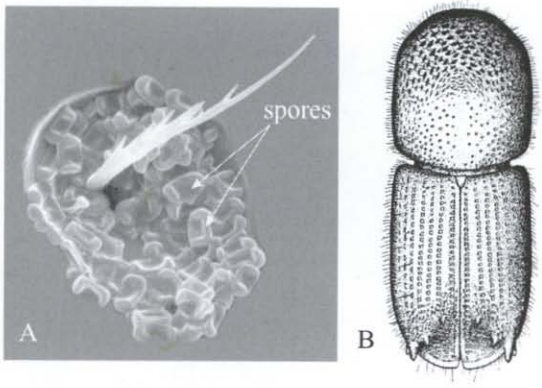
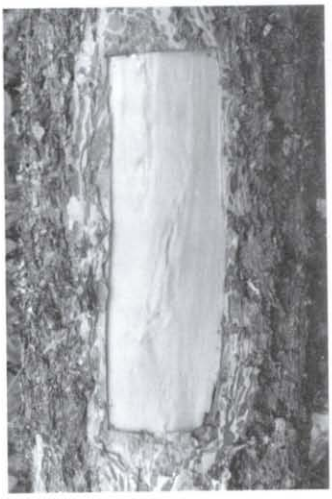


Figure 13. Spores of tree-pathogenic fungi are carried in pits (A) on the bodies and wings of bark beetles such as *Ips pini* (B). Such fungi penetrate the sapwood, disrupting the life processes of the tree and thereby enabling the beetle brood to develop. (B: Hopping 1964.)

But even these few tree-killing scolytids appear to have a narrow window of host condition and environment that limits their detrimental impact on the host. For example, some bark beetles breed to destructive numbers only in freshly downed trees or in overly dense, drought-stressed stands. Years of observation have led us to view such bark beetles more as symptoms of tree condition than as the basic problem themselves.

But bark beetles sometimes err in their selection of a live tree, and searchers of scolytids may occasionally encounter attacked trees in which egg galleries are impregnated with resin and which produce no surviving brood (Fig. 14). Such galleries become grown over with callus tissue like that around a fire scar. How does the tree manage this? Conifers such as pines, Douglas-fir, and western larch have resin canals in their annual rings (Fig. 15). When these canals are severed by the chewing of scolytids, such as *Dendroctonus*

A



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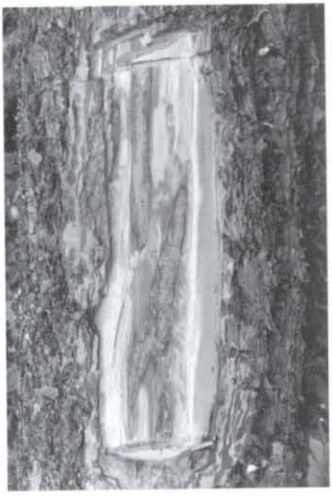


C

Figure 14. (A) Living trees may survive bark beetle attack and (B) subsequently grow over the resinous, unsuccessful beetle galleries. (C) Overgrown wood of (B) has been cut away to expose unsuccessful galleries that were made seven years earlier.

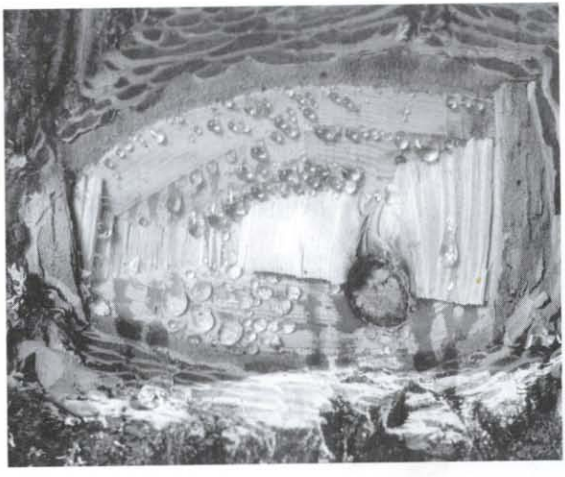


Figure 15. The primary mechanism for defending against bark beetle attack in conifers such as Douglas-fir consists of resin canals in the sapwood and phloem. When these canals are severed, resin flows into the wound under pressure created by the turgidity of the epithelial cells lining the resin canals. Moisture-stressed trees are less able to resist bark beetles.

Figure 16. Some conifers have a secondary wound response mechanism in which a tree's energy reserves are converted to resin when attacked. This dark-colored resin-impregnated lesion (arrow) on a ponderosa pine was induced by experimental inoculation with a culture of a pathogenic blue-stain fungus carried by the pine engraver beetle, *Ips pini*. The pathogen is thus isolated from surrounding live tissue.

species, resin exudes under pressure into the beetle gallery and may overwhelm the invader. Additionally, in these and other conifers, a wound response mechanism may come into play wherein the tree attempts to isolate or "wall-off" the beetle-caused injury and its accompanying pathogenic fungus (Fig. 16).

The outcome of this contest depends upon circumstances such as the number and intensity of beetle attacks and the condition of the tree, which in turn is influenced by tree age, moisture availability, and other factors. Trees, like people, differ in their susceptibility or resistance to organisms that invade them. Scolytids have no particular advantage until conditions of the forest or tree tilt in their favor and their numbers exceed a tree's defenses.

The importance of host condition as it affects susceptibility to beetle attack is exemplified dramatically by the pine engraver, *Ips pini* (Say), and the Douglas-fir beetle, *Dendroctonus pseudotsugae pseudotsugae* Hopkins. The pine engraver has two generations annually. The overwintering generation does not infest living ponderosa pine in the spring months, requiring instead downed trees such as logging slash, windthrow, and snow-broken tops in which to propagate. Their summer-flying progeny, however, may readily infest and kill thickets of young pines, especially in droughty years. Similarly, attacks by the Douglas-fir beetle do not kill living western larch trees, yet the beetles readily infest recently felled larch. The mechanism responsible for live larch being immune to these attacks remains to be explained.

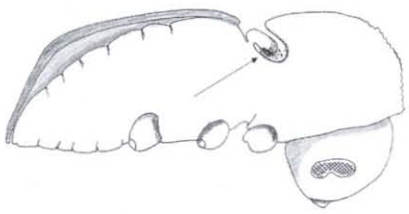


Figure 17. In addition to bark beetles, the family Scolytidae in Idaho includes nine species that tunnel in wood. These species carry "ambrosia" fungi in special repositories located at various places on their bodies such as illustrated here (arrow) for *Xyleborus dispar*. The larvae feed on the nutritious yeast stage of these fungi, which grow in their tunnels.

Dependence on Fungi

Many scolytids, if not all, are associated with fungi. Some fungi kill scolytids, but probably no scolytid could survive and function normally without certain fungi. Well known is the dependence of xylem-infesting scolytids (ambrosia beetles) on sweet-smelling, yeast-like "ambrosia" fungi for food. This dependence has been accompanied by the development of repositories (mycangia) on their bodies (Fig. 17) to contain and transport spores of the mutualistic fungi that subsequently grow in their new galleries. Idaho has nine species of Scolytidae that culture such fungi in their galleries and are referred to, appropriately, as "ambrosia beetles."

Fungal associates of bark beetles, on the other hand, include tree pathogens such as blue-stain fungi of the genus *Ophiostoma* (=*Ceratocystis*), so named because infected wood often appears bluish. After certain bark beetles introduce fungal spores into a susceptible tree, mycelia of these pathogenic fungi grow rapidly into the sapwood, hampering the movement of water and disrupting the tree's defenses against the invading beetles. An example is *Ophiostoma ulmi* (Buisman), carried by *Scolytus multistriatus* (Marsham), which causes Dutch elm disease. This beetle, of European origin, has become established in Idaho and many other states where it contributes to the decadence and eventual mortality of American elm trees at residences and in city parks.

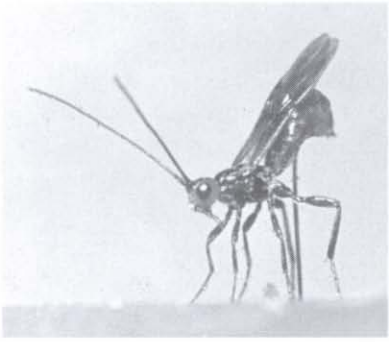
Parasites and Predators

A distinction between a parasite and a predator is the rapidity with which it kills its prey and the numbers of them that it consumes. Predators such as clerid beetles (Figs. 18A, 18B) actively bite and consume several to many scolytid victims. A parasitic insect, on the other hand, usually spends its entire larval life slowly feeding and growing on a single scolytid larva. Remarkably, the parasitized larva does not putrify during the lengthy time that it is fed upon. What prevents putrification is unknown to us, but it would seem to have application in human medicine if understood. Parasitic insects of scolytids are primarily small wasps (Figs. 18C, 18D) that are harmless to humans.

Predators and parasites of destructive bark beetles in Idaho's forests help to maintain their prey at low population levels. However, when severe

A

B



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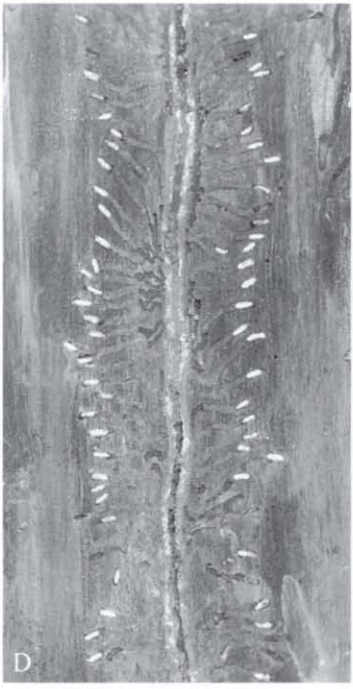


D

Figure 18. Bark beetles have an array of predators and parasites. (A) Adult clerid beetles capture adult bark beetles that land on trees. (B) Larvae of clerids stalk bark beetle larvae in galleries in the bark. (C) Insect parasites of bark beetles are mostly small wasps as seen here ovipositing on a Douglas-fir beetle larva hidden in the bark below. (D) White cocoons of this parasite mark the demise of beetle larvae at the ends of their mines. (C, D: R. B. Ryan.)

droughts occur, or when forests become old, crowded, or damaged such as by snow-breakage or wind, the balance tilts in favor of a certain few species of bark beetles and an outbreak may ensue. When the susceptible trees have been harvested by scolytids or by man, and the forest environment returns to normal, parasites and predators may again have some controlling influence over the beetles, aided in great measure by the increased resistance of the residual forest trees themselves. Nothing in the forest operates alone.

RECOGNIZING BARK BEETLES AND THEIR ALLIES

To borrow a shopworn analogy, "If it looks like a duck, and quacks like a duck, it's probably a duck." A species of scolytid has a particular anatomical "look," as well as specific biological and behavioral traits that substitute for the duck's vocal identity.

Anatomically, our scolytids are small (1-9 mm long), shiny or dull, rather cylindrical (not flat), and have elbowed, club-like antennae (Fig. 19). Their closest look-alikes are weevils, especially of the genus *Rhyncolus* (family Curculionidae). Adding a little to the confusion are some superficially scolytid-like beetles of the family Bostrichidae that also bore into trees. We will deal with, and dismiss, all of these impostors in "Genera of Idaho Species."

It will bear reminding, however, that species of Idaho scolytids may be identified most often merely by knowing their host plant, the part of the plant infested, and, especially, the beetles' often unique gallery patterns.

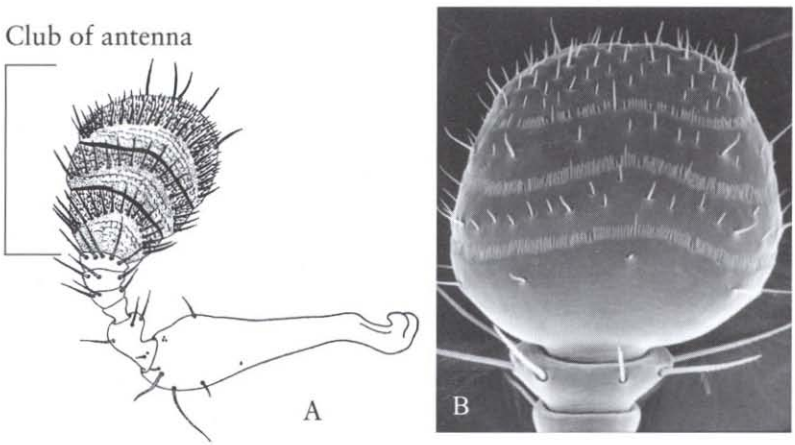


Figure 19. Elbowed antennae ending in an inflated club are characteristic of bark beetles. The shape of the club is helpful in identifying genera and species. Projections on the clubs include chemical sensors and are the "nose" of these beetles. (A) Antenna of *Gnathotrichus retusus* (Schedl 1931). (B) Club of *Dendroctonus pseudotsugae pseudotsugae*.

Types of Parental Galleries in Bark and Wood

Bark beetles tunnel in the inner bark (phloem), creating distinctive gallery patterns. Some bark beetles, such as *Phloeosinus* (Fig. 40) and *Scolytus* (Fig. 62), also engrave the wood (xylem), their tunnels being sandwiched between the phloem and adjacent xylem. Most tunnels (egg galleries) made by adult bark beetles are linear (e.g., Fig. 40) or radiate (e.g., Figs. 55E, 55F). Linear galleries are made by monogamous species (one male, one female), whereas radiate galleries are made by polygamous species (one male, several females) in which each branch is occupied by a separate female. In monogamous species, the female initiates the gallery; in polygamous species the male does so. Radiate galleries have an enlarged entrance (nuptial chamber) to accommodate the several females that congregate there to mate with the lone male occupant.

Ambrosia beetles, on the other hand, bore through bark radially into the sapwood, after which their entrance tunnel usually branches to either side. They lay their eggs in niches above and below the side branches (Figs. 65C, 65D). An Idaho exception is *Xyleborinus saxeseni* (Ratzeburg), which lays its eggs in a common chamber (Figs. 68D, 68E) at the end of its unbranched tunnel. The larvae of ambrosia beetles feed primarily on ambrosia fungus, which grows on the tunnel walls from inoculum transmitted by their parents.

CLASSIFICATION OF BARK BEETLES AND THEIR ALLIES

Living organisms such as bark beetles are classified by a system in which species is the basic entity. Simply stated, a species is one in which a male and a female can mate with each other and produce viable offspring. However, taxonomists usually rely on anatomical differences to distinguish species. This procedure works quite well for the scolytids covered here except the spruce-infesting *Ips tridens engelmanni* Swaine, which produces progeny having heads that are strikingly different (polymorphic) between broods even in the same tree (Figs. 53D-F).

When a new species is found, it is described and given a scientific name (genus and species). A genus (always capitalized) is a group of related species. Scientific names have Latin or Greek roots, some of which are now obscure. They typically convey something regarding physical appearance, host plant, or the name of the person who discovered that species. Scientific names (genus and species) are in italics. Rarely, a species (always lowercased) is divided into two or more geographic populations (subspecies), each given a third name that is also italicized, e.g., *Phloeosinus scopulorum neomexicanus* Blackman is a subspecies that infests juniper in Idaho. An unitalicized name (e.g., Blackman) following a scientific name is the "author" or person who named and described the species.

Common names are given to species of economic importance or to species of special interest otherwise. These names are usually descriptive of the host (e.g., Douglas-fir beetle) or an anatomical feature (e.g., four-eyed bark beetle). Most of the scolytids herein have not merited common name assignments, due apparently to their inconspicuous nature.

Just as species are grouped under a genus, genera are grouped by their relationships under higher categories such as subfamilies (ending with "-inae") and families (ending with "-idae"). In the family Scolytidae, all genera belong to either the subfamily Hylesininae or Scolytinae.

Subfamily Hylesininae

In this subfamily, the basal (forward) margin of each elytron is procurved and adorned with a row of rounded crenulations of varying prominence (Fig. 20A). The body is generally dull, due to roughened surfaces or surface scales, and the head is generally visible from above. Forty species representing 13 genera occur in Idaho. All are true bark beetles except *Hylastinus obscurus* (Marsham), which infests root crowns of red clover. This beetle and its clover host came from Europe. Without doubt, our most well-known

"hylesines" are several species of *Dendroctonus*, a name that literally means "tree killer."

Subfamily Scolytinae

In this subfamily, the basal margin of each elytron is straight and smooth (Fig. 20B). The body is generally shinier than that of hylesines, and the head is generally hidden from above. Seventy-four species in 16 genera are known from Idaho. Of these, 63 species are true bark beetles, two infest cones, and nine are ambrosia beetles that infest wood. This mix of species in favor of bark beetles is typical of northern climates; ambrosia beetles predominate in tropical environments. The most economically important species of Idaho Scolytinae are bark beetles of the genera *Ips* (pine engravers), *Scolytus* (fir engravers), and *Dryocoetes*.

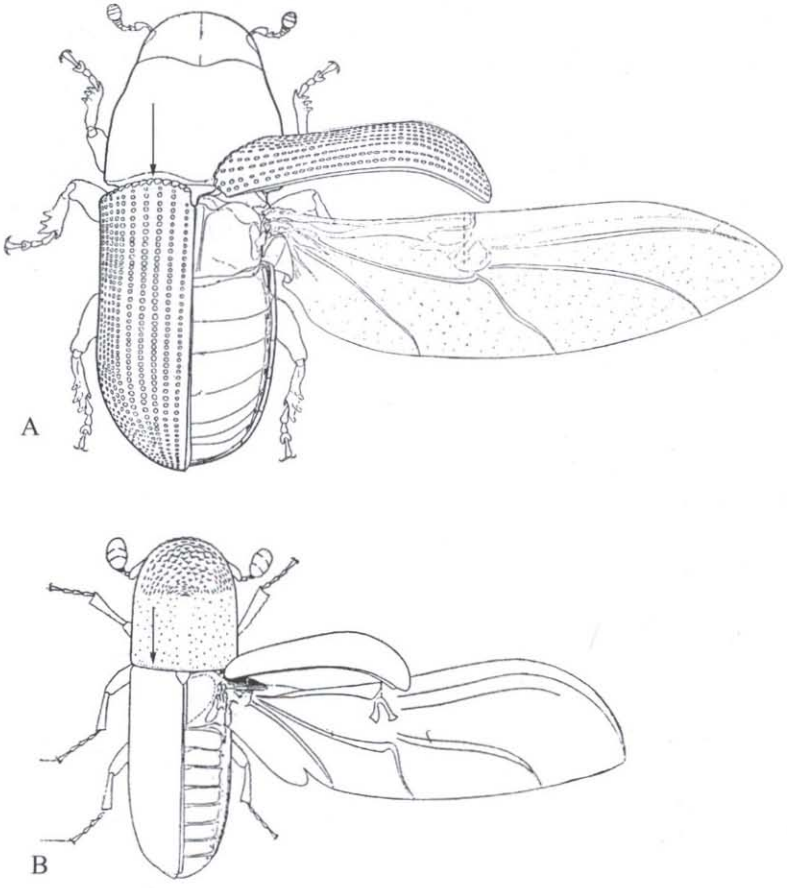


Figure 20. Bark beetles and allied species are grouped into two subfamilies. (A) Hylesininae has roughened wing bases (arrow). (B) Scolytinae has smooth bases (arrow). Here, the right wings are extended as in flight. The shell-like forewing (elytron) is hard and protects the folded membranous wing when at rest. (A: Hopkins 1909; B: Schedl 1931.)

GENERA OF IDAHO SPECIES

Scolytids share their host plants with a few other beetles that also have clubbed antennae and that might be confused with them. In particular, some weevils of the genus *Rhyncolus* (Fig. 21A) resemble some bark beetles of the genus *Hylastes* (Fig. 21B). These imposters may be encountered in the base of coniferous trees killed by bark beetles. They persist in decaying wood after the bark beetles have emerged and flown. Such weevils are among the many organisms that avail themselves of a habitat that bark beetles create by killing a tree. Although *Rhyncolus* differs from *Hylastes* in not laying eggs in galleries, indentifying adults is a very techinical matter, better left for a day indoors with a microscope. The median longitudinal suture on the underside of weevil heads (Fig. 22A) is straight; that of scolytids including *Hylastes* is branched (Fig. 22B). Don't worry if some expert finds a few *Rhyncolus* weevils in your scolytid collection; every sizable collection probably has some.

Treptoplatypus wilsoni (Swaine) is another scolytid relative (family Platypodidae) that tunnels into the wood of some Idaho conifers where it cultivates ambrosia fungi for its brood to feed on. Only two collections from Idaho are in the W. F. Barr Entomological Museum at the University of Idaho, so you probably won't run into it often. Its tunnel is somewhat similar to that of scolytid ambrosia beetles of the genera *Gnathotrichus* (Fig. 65C) and *Trypodendron* (Fig. 66E), but it differs by penetrating heartwood (Fig. 12) instead of being restricted to sapwood. Also, the adult of *Treptoplatypus wilsoni* (Figs. 23A, 23B) differs from scolytid ambrosia beetles in being longer (5.5 mm), having the head wide as the prothorax, and having the male with a forked, spiny elytral declivity (Fig. 23A). Species of *Gnathotrichus* and *Trypodendron* that infest conifers are less than 3.7 mm long, their heads are narrower than the prothorax, and their elytral declivities lack spines.

Less closely related but similar to scolytids in appearance and behavior are some species of Bostrichidae. For example, *Stephanopachys substriatus* (Paykull) bores into the bark and outer sapwood of pines, Douglas-fir, and true firs. Their masquerade is faulty, however, because their antennae are not elbowed.

The most useful adult features for identifying scolytids involve the front of the head (frons), elbowed antennae (especially the swollen outermost portion or club), and the sloping posterior (declivity) of the shell-like wings (elytra). The frons of some species, especially in the subfamily Scolytinae, is convex in females and flat or concave in males (e.g., *Scolytus* [Figs. 60A,

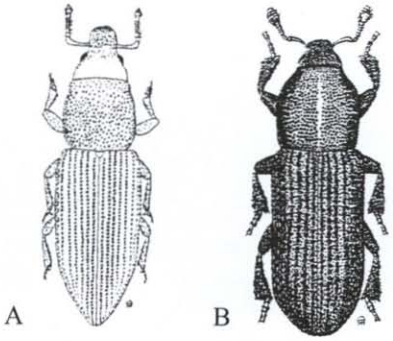
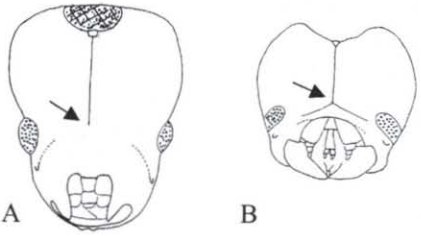


Figure 21. Bark beetles and weevils are related closely as shown by the similarity in appearance of a *Rhyncolus* weevil (A) and the bark beetle *Hylastes gracilis* (B). (M. D. Deyrup.)

Figure 22. Most weevils have long snouts, most bark beetles don't. Those with similar snouts differ in the sutures (arrows) on the underside of their heads. (A) The suture of weevils is straight. (B) The suture of bark beetles is forked. (Wood 1982.)



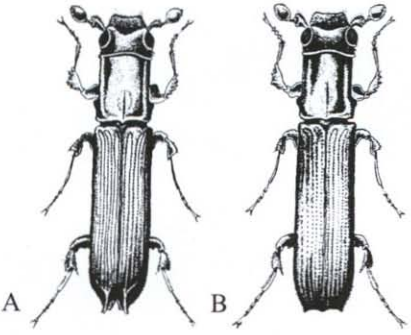


Figure 23. Another Scolytidae imposter is *Treptoplatypus wilsoni* of a related family. Its tunnels, however, penetrate heartwood whereas ambrosia beetles remain outward in sapwood. Its adults differ in appearance from that of scolytids as explained in the text. (A) *T. wilsoni* male. (B) *T. wilsoni* female. (A, B: Chamberlin 1958.)

60B], *Trypodendron* [Figs. 66C, 66D]). Females of some species of Scolytinae also have dense setae on their frons, while their male counterparts lack such dense setae (e.g., *Pityophthorus* [Figs. 57C, 57D]). The antennal club (Fig. 24) varies among species in shape and segmentation.

Other commonly useful physical characteristics include body shape (Fig. 25), especially features of the posterior of the elytra (declivity), color (e.g., *Hylastes ruber* Swaine is the only reddish species of that genus), and size (e.g., *Crypturgus borealis* Swaine is our smallest species at 1 mm in length, whereas our largest species, *Dendroctonus valens*, may attain 9 mm). These features, taken together with the host plant species and location and appearance of galleries in the bark or wood, will usually identify the scolytid at hand.

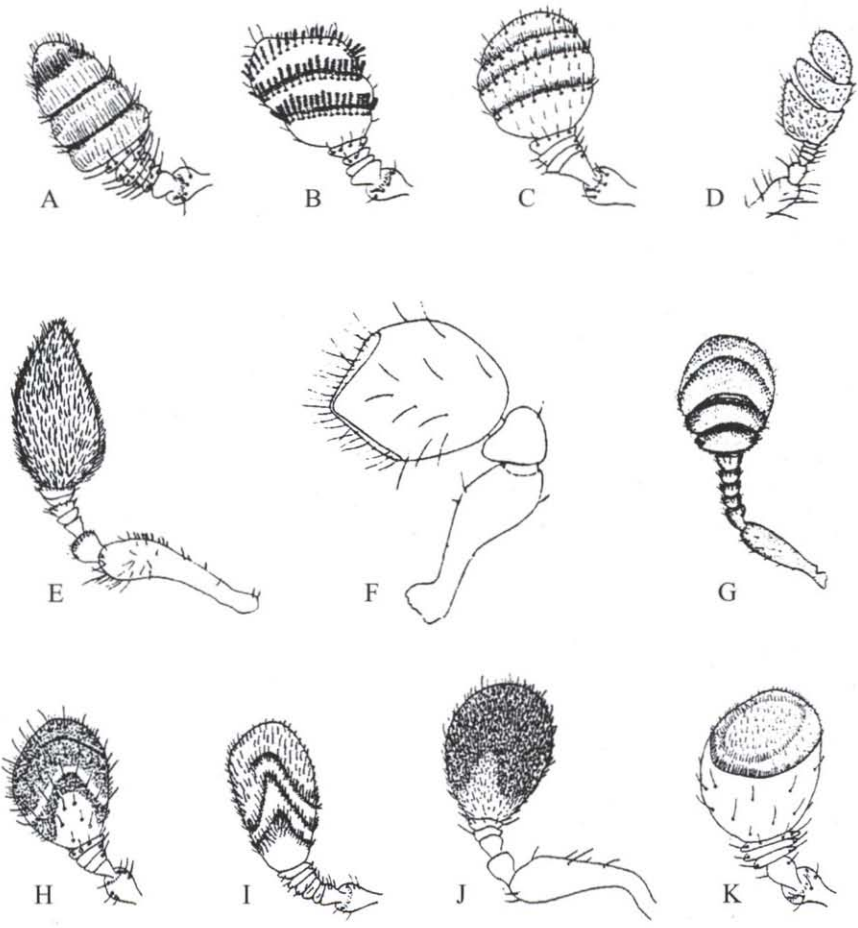


Figure 24. Antennal clubs of Scolytidae vary in shape. Examples are shown here and throughout the guide. (A) *Alniphagus*. (B) *Carphoborus*. (C) *Dendroctonus*. (D) *Phloeotribus*. (E) *Polygraphus*. (F) *Crypturgus*. (G) *Pityophthorus*. (H) *Ips*. (I) *Scolytus*. (J) *Trypodendron*. (K) *Xyleborinus*. The shape of clubs is difficult to see even with a hand lens due to their small size. Fortunately, other features are usually sufficient to identify a genus or species. (A-C, H, I, K: Bright and Stark 1973; D, F: Beal and Massey 1945; E: Hilton 1968; G: Hopping 1960; J: Wood 1982.)

Diagnostic Key to Genera[3] *of Idaho Scolytidae*

1. Infesting angiosperms (broad-leaved, deciduous) 2
— Infesting gymnosperms (conifers) 14
2(1). In roots of red clover, *Trifolium pratense* ..... ***Hylastinus obscurus*** **(Marsham)**
— In woody plants 3

[3] Including species, if the genus has only one known in Idaho. See the glossary for unfamiliar terms.

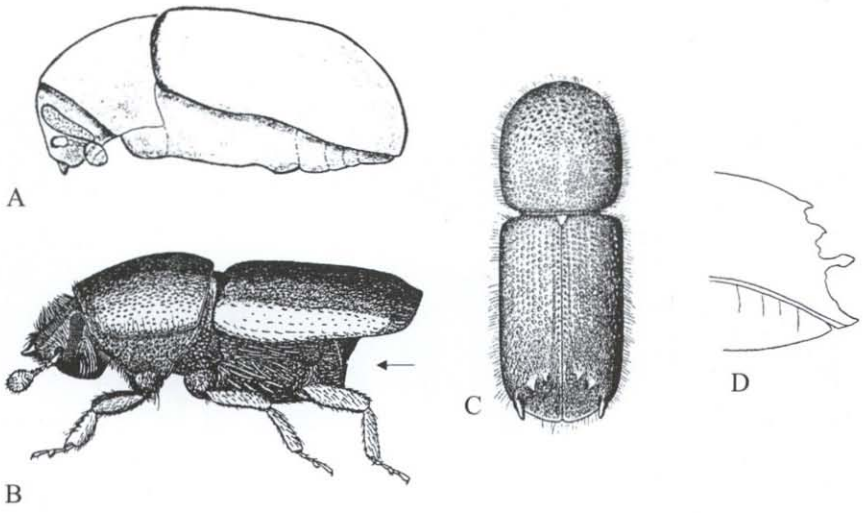


Figure 25. Variations in the body shape of scolytids are of three major kinds: (A) "normal," lacking modification of the posterior, typical of Hylesininae including *Dendroctonus*; (B) venter (arrow) of abdomen sharply ascending (*Scolytus*); (C, D) elytral declivity excavated or impressed, sometimes armed with spines as in *Ips*. (B: M. D. Deyrup; C, D: Hopping 1963c.)

3(2).	Bases of elytra procurved and crenulated; body usually dull; head usually visible from above (Hylesininae)	4
—	Bases of elytra straight and smooth; body usually more shiny; head usually hidden from above (Scolytinae)	5
4(3).	In bark of *Alnus*	***Alniphagus***
—	In bark of *Cercocarpus* (mainly), sometimes *Prunus*, *Malus*	***Chaetophloeus heterodoxus*** (Casey)
5(3).	Adult tunnels located in wood, radially at first, then branching (ambrosia beetles)	6
—	Adult tunnels located in bark, assuming varied shapes, sometimes etching wood surface (bark beetles)	11
6(5).	In *Betula*	7
—	In other angiosperms	9
7(6).	Slender; uniformly dark brown	***Gnathotrichus retusus*** (LeConte)
—	Stouter; black or mottled dark brown and pale yellow	8
8(7).	Uniformly black	***Xyleborus dispar*** (Fabricius)
—	Dark brown, usually with pale yellow area lengthwise on each elytron	***Trypodendron betulae*** Swaine
9(6).	Smaller, 1.9-2.4 mm; dark brown	***Xyleborinus saxeseni*** (Ratzeburg)
—	Larger, 2.8-4.6 mm; black	10

10(9). Smaller, 2.8-3.5 mm; antennal club thick, obliquely truncate; many broadleaf hosts (including *Populus*) ..... ***Xyleborus dispar*** (Fabricius)

— Larger, 3.8-4.6 mm; antennal club strongly flattened, not truncate; in *Populus* ..... ***Trypodendron retusum*** (LeConte)

11(5). Posterior of underside of abdomen concave ..... ***Scolytus***

— Posterior of underside of abdomen not concave 12

12(11). Larger, 2.8-3.8 mm; galleries radiate, visible on inner bark surface; in *Betula* ..... ***Dryocoetes betulae*** Hopkins

— Smaller, 1.2-2.2 mm; galleries lacking any pattern, not visible on inner bark surface; in *Salix* and *Populus* 13

13(12). Body stouter, appearing hunchbacked in side view (Fig 63A); declivity less steep ..... ***Trypophloeus***

— Body more slender, appearing more elongate in side view (Fig 59A); declivity steeper ..... ***Procryphalus***

14(1). Bases of elytra procurved, crenulated; body usually dull; head usually visible from above (Hylesininae) 15

— Bases of elytra straight, smooth; body usually more shiny; head usually not visible from above (Scolytinae) 24

15(14). In *Juniperus* and *Thuja* (Cupressaceae); males especially with prominent teeth on elytral declivity ..... ***Phloeosinus***

— In other conifers: *Abies, Larix, Pinus, Picea, Pseudotsuga, Tsuga* (Pinaceae) 16

16(15). Eye nearly divided at middle; in *Picea*, sometimes *Pinus contorta* ..... ***Polygraphus rufipennis*** (Kirby)

— Eye entire or emarginate 17

17(16). Body and elytra prominently mottled with areas of dark and light brown scales; in *Abies, Pseudotsuga* ..... ***Pseudohylesinus***

— Body uniform in color 18

18(16). Antennal club with segments off-center, nearly lamellate (deeply constricted at sutures) ..... ***Phloeotribus***

— Antennal club symmetrical, not off-center, not deeply constricted at sutures 19

19(18). In dying branches of standing trees 20

— In stems and roots of standing or felled trees 22

20(19). Body very stout (1.8-1.9 times longer than wide); elytra not prominently ridged; sutures on antennal club obliquely transverse; in *Picea glauca* (Henrys Lake) ..... ***Phloeosinus pini*** Swaine

— Body less stout (2.3-2.4 times longer than wide); elytra more prominently ridged; sutures on club not obliquely transverse 21

21(20). Eye prominently emarginate; antennal club flattened, truncated at its end; elytral declivity with prominent ridges; in *Picea, Pinus* ..... ***Carphoborus***

— Eye virtually entire; antennal club not flattened, elongate, and rounded on its end; elytral declivity less prominently ridged; in *Picea* ..... ***Xylechinus montanus*** Blackman

22(19). Generally stouter (2.1-2.4 times longer than wide); length 2.0-9.0 mm; antennal club rather flattened, subcircular, not pointed; extensively infesting trunk (except *D. valens and D. punctatus* in base, roots) ..... ***Dendroctonus***

— Generally less stout (2.5-3.0 times longer than wide); length 2.1-5.3 mm; antennal club conical, gradually increasing in diameter to its center, then tapering to a point; infesting basal trunk, roots 23

23(22). Pronotal pits more uniform in size; pronotum more evenly rounded; setae on declivity shorter, not aligned in rows ..... ***Hylastes***

— Pronotal pits of large and small size, intermixed; pronotum sometimes constricted anteriorly; setae on declivity longer, aligned in rows ..... ***Hylurgops***

24(14). Adult tunnels located in wood (ambrosia beetles) 25

— Adult tunnels located in phloem (inner bark) sometimes etching wood surface or in pine cones 27

25(24). In rotting wood of stumps and bases of standing trees; expelled, pulverized wood not evident at tunnel entrances ..... ***Xyleborus intrusus*** **Blandford**

— In moist, sound sapwood generally in basal stem or stump of recently killed or dying tree; expelled, finely pulverized white wood (xylem) evident at tunnel entrances 26

26(25). Slender, uniformly dark brown beetles; frons convex, not sexually dimorphic ..... ***Gnathotrichus***

— Stouter; dark brown with lighter area lengthwise on elytra and on posterior of pronotum; female frons convex; male frons strongly concave ..... ***Trypodendron***

27(24). In cones of *Pinus* ..... ***Conophthorus***

— In bark (phloem) 28

28(27). Posterior underside of abdomen concave ..... ***Scolytus***

— Posterior underside of abdomen almost horizontal, not concave 29

29(28). Extremely small (1 mm); enters galleries of other bark beetles from which they construct a fine network of inconspicuous, interconnected galleries; antennal club appearing unsegmented under high magnification ..... ***Crypturgus borealis*** **Swaine**

— Larger (1.2-6.9 mm); galleries independent of other scolytid galleries and conspicuous on inner bark surface; antennal club segmented ... 30

30(29). Elytral declivity convex or flat 31

— Elytral declivity concave or impressed 32

31(30). Smaller (1.7-1.8 mm); rather dull brownish black; hunchbacked in side profile due to short body and gradually sloping declivity; frons lacking conspicuous setae, not sexually dimorphic ..... ***Cryphalus ruficollis*** **Hopkins**

— Larger (2.3-4.4 mm) except *D. sechelti* (1.6-2.2 mm); shiny, yellowish to dark reddish brown; relatively longer body with steeper declivity; female frons with moderately dense to dense setae; setae sparse in male ..... ***Dryocoetes***

32(30). Antennal club thick, obliquely truncate 33

— Antennal club flattened, rounded, not truncate 34

33(32). Smaller (1.6-2.9 mm); frons dimorphic: female with long, abundant setae, setae sparse on male; declivity with three teeth mounted along lateral edge of each elytron (inconspicuous in female *P. lasiocarpa*) ..... ***Pityokteines***

— Larger (2.4-3.3 mm); frons lacking abundant setae in both sexes; declivity with three prominent teeth (two along lateral edge, one inward of that edge) ..... ***Orthotomicus caelatus*** (Eichhoff)

34(32). Generally smaller (1.3-3.1 mm); declivity not deeply concave, either smooth or with minute tubercles aligned in one or two rows ..... ***Pityophthorus***

— Generally larger (1.8-6.9 mm); declivity deeply concave, with two to five conspicuous teeth along each side 35

35(34). Generally smaller (1.8-2.9 mm); each lateral edge of elytral concavity with two to three spines; female frons with a fossa (deep concave depression) ..... ***Pityogenes***

— Generally larger (2.3-6.9 mm); each lateral edge of elytral concavity with three to five spines; female frons without a deep fossa ..... ***Ips***

SPECIES OF THE SUBFAMILY HYLESININAE

Clover Root Borer

Hylastinus

Monogamous. One species, of peculiar habit (infesting a nonwoody plant, red clover), has reached Idaho after being accidentally introduced into the United States from Europe.

Hylastinus obscurus **(Marsham)**, clover root borer

Distribution: North Africa; Europe; Canada: B.C., Ont.; USA: Several eastern states. In the West: Calif., Ore., Utah, Wash. In Idaho: Ada, Adams, Canyon, Clearwater, Kootenai, Latah, Owyhee, Twin Falls counties.

Hosts: ***Trifolium pratense*** (red clover), other wild and cultivated legumes.

Adult: 2.0-2.5 mm; dark reddish brown. Frons with a slight horizontal depression between the eyes. Body and elytra clothed with fine, short, yellow hair. Elytra with rows of large punctures (Figs. 26A, 26B). Antennal club conical and tapered (Fig. 26C). The host will distinguish it.

Gallery: The gallery is initiated in the root crown and apparently extends in two directions from the entrance for a total length of 1.5-3.0 cm.

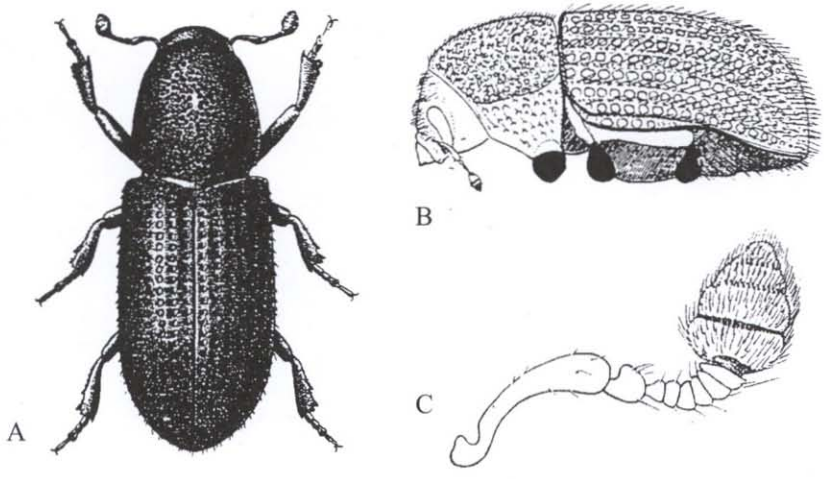


Figure 26. *Hylastinus obscurus*. (A, B) Adult. (C) Antenna. (A: Rockwood 1926; B, C: Balachowsky 1949.)

Biology: Monogamous. One generation per year, overwintering as adults and larvae. Brood adults emerge from roots in early spring and mate prior to flight. Parent tunnels contain four to nine eggs, each laid in well-separated pockets. Occasionally two females will occupy a tunnel, in which case up to 12 eggs may be laid. Larvae mine 2-4 cm downward in the roots. Pupae begin to appear in July and adults about a week later.

Reference: Rockwood 1926.

Bark Beetles

Alniphagus

Monogamous. Our only bark beetles infesting alder. Represented in Idaho by two species. They differ in appearance from our other genera of Hylesininae by having asperites on the sides of the pronotum.

Key to Species of Alniphagus

1. Larger (2.6-3.4 mm); crenulations on declivity prominent (coarse), their setae relatively short, appearing to be only slightly longer than height of crenulations; egg galleries 2.0-4.5 cm long ..... ***aspericollis*** **(LeConte)**

— Smaller (2.1-2.8 mm); crenulations on declivity much smaller, their setae much longer than height of crenulations; egg galleries 1.0-2.0 cm long ..... ***hirsutus*** **Schedl**

Alniphagus aspericollis **(LeConte)**, alder bark beetle

Distribution: Canada: B.C.; USA: Alaska, Calif., Ore., Utah, Wash. In Idaho: Bonner, Boundary, Cassia, Clearwater, Idaho, Kootenai, Latah, Lemhi, Nez Perce, and Valley counties.

Hosts: *Alnus* spp., including ***A. incana*** (Lemhi Co.) and ***A. rhomnifolia*** (Nez Perce Co.), and the only known record from other than *Alnus*, ***Betula occidentalis*** (Valley Co.). Infests progressively downward in dying stems.

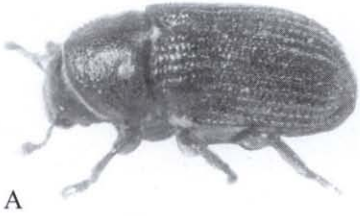
Adult: 2.6-3.4 mm; dull (roughened) dark brown (Fig. 27A); elytra usually lighter. Pronotum with one to three coarse asperites located anterolaterally. Elytra with coarse crenulations and prominent, deep pits. Elytral setae equal or only slightly longer than height of crenulations.

Gallery: 2.0-4.5 cm long; generally lengthwise of stem, varying from straight to strongly sinuous (Fig. 27B).

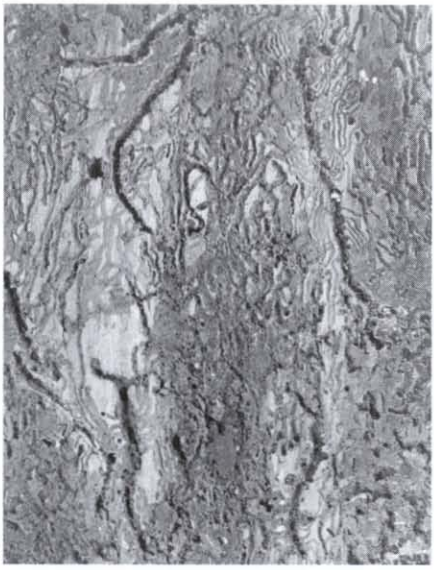
Biology: Two generations per year. Mature adults construct shallow galleries in the bark where they overwinter; larvae and callow adults overwinter in the brood galleries. On warm, late winter days, adults may emerge sporadically and be seen on the bark, but new egg galleries do

not appear until spring. Stems are reinfested for several generations of beetles, progressively downward in the narrow zone below previously killed phloem. Unsuccessful attacks in live phloem beyond this susceptible zone seem to pave the way for successful attacks in a later year, perhaps involving a transmitted fungus.

Reference: Borden 1969.



A



B

Figure 27. *Alniphagus aspericollis.* (A) Adult. (B) Galleries in alder. (A: Borden 1969.)

Alniphagus hirsutus **Schedl**

Distribution: Canada: B.C.; USA: Calif., Mont., Ore. In Idaho: Clearwater, Latah counties.

Hosts: ***Alnus sinuata*** and *A. tenuifolia*. Infests basal part of stems 4-8 cm in diameter.

Adult: 2.1-2.8 mm; similar to *A. aspericollis* but with much smaller crenulations on elytra, and the seta of each crenulation is at least three times longer than the height of the crenulation.

Gallery: Length 1.0-2.0 cm. Unbranched; orientation varies from vertical to across the grain, but most have a strong horizontal component.

Biology: Probably similar to *A. aspericollis*.

Carphoborus

Polygamous. Dull, blackish. Most species with elevated ridges (interstriae) on elytral declivity; eye deeply emarginate. Frons dimorphic: female with abundant setae, male with sparse setae and a bituberculate elevation between upper level of eyes. Antennal club flattened and truncate (Fig. 28D). Three to eight galleries radiate from the nuptial chamber, deeply etching wood. They infest small, shaded-out branches of live trees or stems of small, suppressed trees and inhabit bark that is very dry. Adult broods remain in

the host, etching the wood, for a long period of time before emerging. Larval frass consists of shiny, reddish, segmented excrement as opposed to frass of most other scolytids, which consists mainly of fragments of phloem or wood.

Key to Species of Carphoborus

1.	In *Pinus*	2
—	In *Picea*	3
2(1)	In *Pinus flexilis* and *P. monophylla* (Cassia Co.)	***pinicolens*** **Wood**
—	In *Pinus contorta* and *P. ponderosa*	***ponderosae*** **Swaine**
3(1).	Interstriae 1 and 3 on elytral declivity more highly elevated; interstriae 3 rather coarsely serrate	***sansoni*** **Swaine**
—	Interstriae 1 and 3 on elytral declivity less elevated; interstriae 3 finely serrate	***carri*** **Swaine**

Carphoborus carri Swaine

Distribution: Canada: Alta., Man., N.B., N.W.T., Y.T.; USA: Mont., S.Dak., Wyo. In Idaho: North shore of Henrys Lake, Fremont County.

Hosts: *Picea* spp. The Idaho specimens came from lower branches of a recently killed, standing natural hybrid of ***P. glauca* x *engelmannii.***

Adult: 1.4-2.1 mm; dull dark brown to almost black (Fig. 28A). Interstriae 1, 3, and 9 elevated and serrate (Fig. 28B); teeth on interstriae 3 shorter than its height.

Gallery radiate; biology not studied.

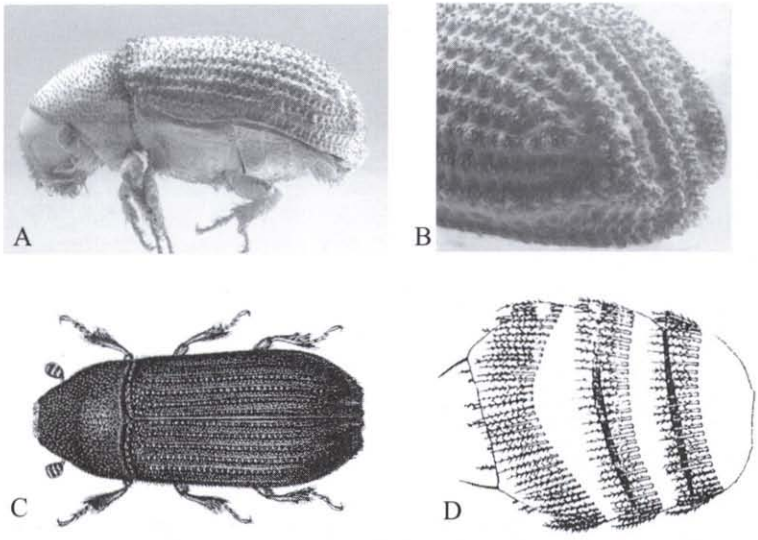


Figure 28. *Carphoborus carri*: (A) adult and (B) elytral declivity. *C. pinicolens*: (C) adult and (D) antennal club. (A, B: Bright 1976; C: Bright and Stark 1973; D: Wood 1982.)

Carphoborus pinicolens Wood

Distribution: USA: Ariz., Calif., Colo., Nev., N.Mex., Ore., Utah, Wyo. In Idaho: Craters of the Moon National Monument, Butte County; City of Rocks, Cassia County; north of Leadore, Lemhi County.

Hosts: ***P. flexilis***, ***P. monophylla***, and *Pinus* spp.

Adult: 1.7-2.5 mm; dull dark brown to black (Fig. 28C). Female frons encircled with setae. Male frons with a bituberculate, median elevation at upper level of eyes. Interstriae 1, 3, and 9 moderately elevated, teeth not longer than height of interstriae.

Gallery radiate; biology not studied.

Carphoborus ponderosae Swaine

Distribution: Canada: B.C.; USA: Calif., Mont., Ore., Utah. In Idaho: Franklin Basin Road, Franklin County.

Hosts: ***Pinus contorta***, *P. ponderosa*.

Adult: 1.8-2.1 mm; dull dark brown to black. Interstriae 1, 3, and 9 elevated and serrate; teeth on interstriae 3 longer than its height.

Gallery radiate; biology not studied.

Carphoborus sansoni Swaine

Distribution: Canada: Alta.; USA: Colo., Ore., Utah, Wyo. In Idaho: Emigration Campground, 25 km west of Montpelier, Bear Lake County.

Hosts: ***Picea engelmannii***, *P. glauca*, *P. pungens*.

Adult: 1.8-2.1 mm; dull almost black. Declivital interstriae 1 and 3 elevated, 3 more so and coarsely serrate; interstriae 9 not elevated or serrate.

Gallery radiate; biology not studied.

Chaetophloeus

Monogamous. Represented in Idaho by a single species, most commonly infesting curlleaf mountain-mahogany (*Cercocarpus ledifolius*). Less common hosts are fruit trees (*Malus*, *Prunus*, *Pyrus*) that are, however, infested more frequently by *Scolytus rugulosus* (Müller). *Chaetophloeus* differs from *Scolytus* in having prominent crenulations on the bases of the elytra whereas *Scolytus* have no such crenulations. Also, *Chaetophloeus* has the underside of the abdomen extending straight back rather than being concave as in *Scolytus* species.

Chaetophloeus heterodoxus (Casey), mountain mahogany bark beetle

Distribution: Canada: B.C., Man., Sask.; USA: Ariz., Calif., Colo., Mont., Nev., N.Mex., N.Dak., Tex., Utah, Wash., Wyo. In Idaho: Butte, Cassia, Custer, Fremont, Idaho, Lemhi, Owyhee, Teton counties.

Hosts: Most commonly on ***Cercocarpus ledifolius***, also on ***Amelanchier***

***alnifolia*, *Prunus emarginata*, *P. avium*, *Malus* spp.**, *Prunus virginiana*, and *Pyrus* spp. Infests bark of branches and trunks of trees injured by sapsuckers, defoliators, or other agents.

Adult: 1.6-2.2 mm; very stout, dull black with whitish scales (Fig. 29A). Dense, yellowish setae around mouth; short, darker setae on front of head. Shoulders of elytra with strongly elevated crenulations as seen in side profile.

Gallery: Consists of an enlarged central chamber with three to six short, fingerlike projections from which larval mines extend (Fig. 29B). Adult galleries and larval mines deeply etch the wood and are often conspicuous due to removal of overlying bark by predacious birds.

Biology: Adults apparently overwinter in their galleries and deposit eggs there in spring. Their progeny mature and may construct new chambers in the same host, or in a new host, in July.

Figure 29. *Chaetophloeus heterodoxus*. (A) Adult. (B) Galleries (arrows) and larval mines in mountain-mahogany. (A: Bright 1976.)

Dendroctonus

Monogamous. Species of *Dendroctonus* (meaning "tree killer") are the most destructive bark beetles in North American conifers. Several species have evolved the ability to aggregate on trees by releasing strong attractants (pheromones). Some also carry fungi that kill trees. Six species are native to Idaho. They infest pines, spruces, Douglas-fir, and felled western larch. The galleries of four of these species run generally parallel with the tree trunk. The others crisscross (*D. brevicomis*) or incline (*D. punctatus*).

The adults range from 2 to 9 mm long, *D. brevicomis* being the smallest and *D. valens* the largest. When mature, they range in color from brown or reddish brown to black; some have reddish brown elytra and are otherwise black. Most have one generation per year in Idaho, but *D. valens* and *D. rufipennis* may require two years to complete a generation at some locations.

Key to Species of Dendroctonus

1. Smaller (2.0-4.7 mm); frons with a median groove (elevated at sides in males); adult galleries crisscrossed; in *Pinus ponderosa* ..... ***brevicomis*** **LeConte**

— Larger (3.5-9.0 mm); frons without a median groove or pair of lateral elevations; adult galleries longitudinal (variable in *punctatus*), not interconnected 2

2(1). Infesting *Pseudotsuga* and felled *Larix* ..... ***pseudotsugae pseudotsugae*** **Hopkins**

— Infesting *Picea* 3

— Infesting *Pinus* 5

3(2). Infests throughout stem; adult galleries longitudinal, 15-20 cm long; larvae mine together when young, separately when older ..... ***rufipennis*** **(Kirby)**

— Infests basal trunk and roots; larvae mine en masse to maturity 4

4(3). Larger (5.0-9.0 mm); uniformly reddish; more or less glabrous; adult tunnels are longitudinal, oriented downward into roots, variable in length to 40 cm or more; massive, smooth pitch tubes on outer bark from ground to 1-2 m height..... ***valens*** **LeConte**

— Smaller (4.9-7.0 mm); brown to brownish black; moderately clothed in yellowish setae; adult tunnel often inclined or curving against wood grain, directed upward or downward, 3-8 cm long; somewhat smaller, granular pitch tubes on outer bark restricted to near ground (< 30 cm height) ..... ***punctatus*** **LeConte**

5(2). Larger (5.0-9.0 mm); reddish or dark brown; adult tunnels in base of trunk and roots, directed downward; larvae mine together 6

— Smaller (3.5-6.8 mm); black at maturity; adult tunnels throughout trunk, directed upward; larvae mine separately .. ***ponderosae*** **Hopkins**

6(5). Averaging larger (5.0-9.0 mm); uniformly reddish brown, more or less glabrous; in most species of *Pinus* ..... ***valens*** **LeConte**

— Averaging smaller (5.0-7.3 mm); body dark brown, elytra commonly reddish brown; moderately clothed in yellowish setae; in *Pinus contorta* ..... ***murrayanae*** **Hopkins**

Dendroctonus brevicomis **LeConte**, western pine beetle

Distribution: Canada: B.C.; Mexico: Chih.; USA: Ariz., Calif., Colo., Mont., Nev., N.Mex., Ore., Tex., Utah, Wash. In Idaho: Ada, Adams, Benewah, Boise, Bonner, Boundary, Clearwater, Elmore, Idaho, Kootenai, Latah, Valley counties.

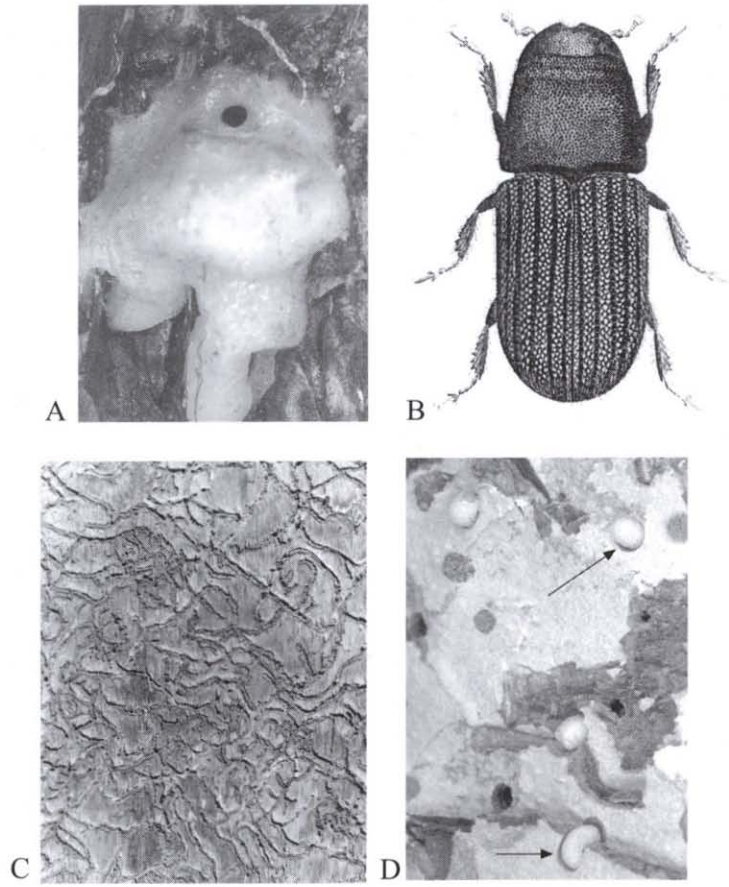


Figure 30. *Dendroctonus brevicomis*. (A) Pitch tube on attacked ponderosa pine. (B) Adult male. (C) Egg galleries. (D) Overwintering larvae (arrows) in bark. (B: Swaine 1918.)

Hosts: ***Pinus ponderosa***, *P. coulteri* (Calif.). Infests the stem, especially of mature trees. Pitch tubes often form at gallery entrances (Fig. 30A).

Adult: 2.0-4.7 mm; dark brown. The male frons has two elevations separated by a groove located midway between the eyes (Fig. 30B). No other pine-infesting Idaho bark beetle has a similar feature.

Gallery: Parent egg galleries are unique in being crisscrossed (Fig. 30C). Newly hatched larvae mine only a few millimeters on the phloem inner face, then tunnel outward in the dead bark where they overwinter (Fig. 30D). Larvae of other *Dendroctonus* species remain in the phloem to transform into pupae and adults. Woodpeckers flake away the outer bark to feed on larvae in winter. Such flaking gives the trunk an orangish-yellow color, helping to identify infested trees that may still have green foliage and otherwise appear normal.

Biology: In southern Idaho (Centerville, Smiths Ferry) two overlapping gen-

erations were reported (Webb 1906). The first generation evidently emerged to infest new host trees between late June and early August. A second generation may have resulted from eggs laid during late August-early September by some early developing first generation adults. Whatever the case, the primary overwintering stage appears to be larvae. Multiple generations occur in warmer climates such as California and Arizona.

References: Miller and Keen 1960, Stark et al. 1970, Webb 1906.

Dendroctonus murrayanae **Hopkins**, lodgepole pine beetle

Distribution: Canada: Alta., B.C., Ont; USA: Colo., Mich., Minn., Mont., Utah, Wyo. In Idaho: west of Pass Creek Summit, Custer County; Wind Lake, Idaho County; southwest of Bannock Pass, Lemhi County.

Hosts: ***Pinus contorta***, *P. banksiana*, *P. strobus*. Infests the basal trunk and roots of individual trees (not groups) such as those girdled by porcupines, struck by lightening, and otherwise outwardly ailing.

Adult: 5.0-7.3 mm; dark brown with reddish brown elytra. Similar in appearance to the spruce beetle, *D. rufipennis*, but differing in host and habit. Differs from *D. punctatus* by host.

Gallery: Variable shape, often with short branches that may be used for turning around. Directed upward or downward, often somewhat slantwise. Eggs are laid in masses along the egg gallery. Larvae feed en masse in a common chamber.

Biology: Mature larvae were collected on July 19 at approximately 2,440 meters elevation (near Bannock Pass). They transformed to adults a few weeks later.

Dendroctonus ponderosae **Hopkins**, mountain pine beetle

Distribution: Canada: B.C.; Mexico: B.C.; USA: Ariz., Calif., Colo., Mont., Nev., N.Mex., Ore., S.Dak., Utah, Wash., Wyo. In Idaho: Benewah, Boise, Bonner, Boundary, Camas, Clearwater, Custer, Elmore, Idaho, Kootenai, Latah, Shoshone, Valley, Washington counties.

Hosts: ***Pinus albicaulis***, ***P. contorta***, ***P. monticola***, ***P. ponderosa***; exotics in the University of Idaho Shattuck Arboretum: ***P. banksiana***, ***P. nigra***, ***P. resinosa***, ***P. strobus***, ***P. sylvestris***, ***Picea abies***; *Pinus balfouriana*, *P. coulteri*, *P. edulis*, *P. lambertiana*, *P. monophylla*, *P. strobiformis*. Infests main trunks of immature and mature trees. Pitch tubes are formed at the gallery entrances.

Adult: 3.5-6.8 mm; black when mature. Sides of pronotum almost straight and parallel on basal two-thirds, then sharply constricted on the anterior one-third (Fig. 31A).

Gallery: Vertical; slanting for about 2 1/2 cm, then almost straight, 30-90 cm long (Fig. 31B). Eggs are deposited in small groups, each in its own

niche, alternately on one side of the gallery, then on the other, sometimes opposite each other. Larvae mine at right angle to the gallery, often for only 3 cm or less, before maturing and constructing pupal chambers.

Biology: One generation per year, overwintering as larvae and adults.

Reference: Evenden et al. 1943.

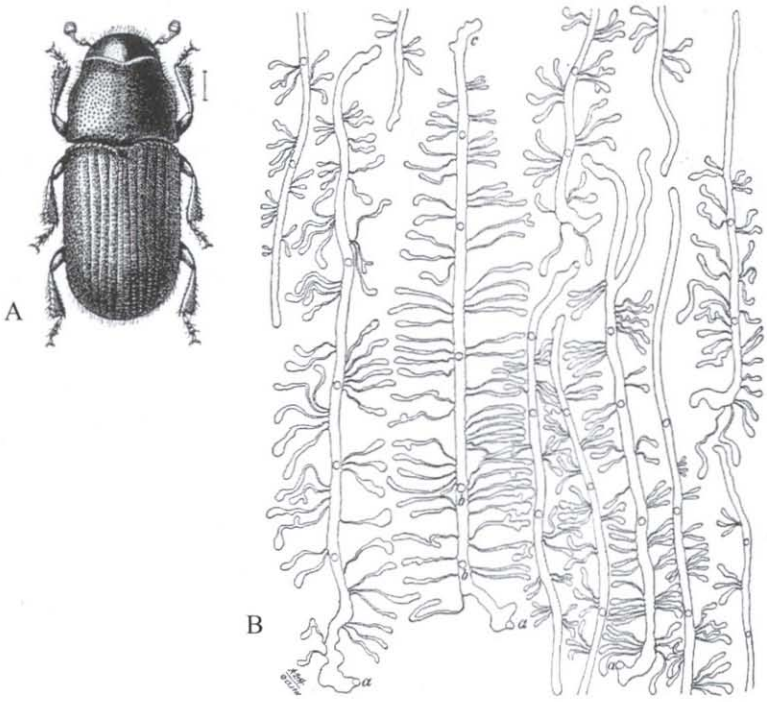


Figure 31. *Dendroctonus ponderosae*. (A) Adult. (B) Galleries in ponderosa pine. (Hopkins 1909.)

***Dendroctonus pseudotsugae pseudotsugae* Hopkins**, Douglas-fir beetle

Distribution: Canada: Alta., B.C.; Mexico: Chih., Dgo., Coah.; USA: all western states including Tex. but not Nev. In Idaho: Blaine, Boise, Bonner, Boundary, Clark, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce, Shoshone, Valley counties.

Hosts: Infests mature, live or freshly downed ***Pseudotsuga menziesii*** and downed (only) ***Larix occidentalis***. Overly dense stands of mature Douglas-fir (Fig. 32A) are susceptible to group killing (Fig. 32B).

Adult: 4-6 mm (Fig. 33A). At full maturity, head and prothorax black, elytra variable from reddish brown to black but never reddish in its southern limit (Mexico). Female with small tubercles on elytral declivity; male declivity smooth, shiny.

Gallery: Unbranched; constructed upward in phloem, parallel with trunk (Fig. 33B). Average length in standing trees about 20 cm. Downed trees

Figure 32. Dense stands of Douglas-fir (A) are susceptible to killing by the Douglas-fir beetle (B).

are attacked less densely resulting in greater distance between attacks and longer galleries (averaging 30-45 cm). Eggs are deposited in variably sized groups, each in its own niche, alternately on one side of the gallery, then on the other, never opposite each other.

Biology: Monogamous, one generation per year. Flight begins in early May after a few days above 20°C. Larvae are present until August, when pupation occurs. Transformation to adults is completed in late August-

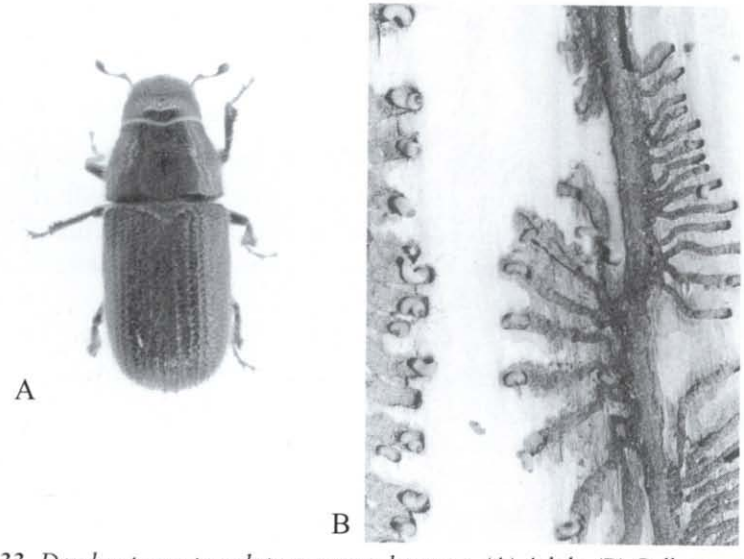


Figure 33. *Dendroctonus pseudotsugae pseudotsugae.* (A) Adult. (B) Gallery and larvae in windfelled Douglas-fir. Eggs are laid alternately on opposite sides of the vertical parental gallery. After hatching, larvae mine sidewise of the parental gallery.

September. Adults overwinter in their brood trees and require exposure to winter temperatures before becoming sexually mature and capable of flying.

References: Furniss and Orr 1978 (general), Furniss 1979 (bibliography), Furniss et al. 1981 (comprehensive), Marsden et al. 1981 (parasites, predators). Note: The subspecies *D. pseudotsugae barragani* Furniss has recently been described from Mexico (Furniss 2001), necessitating the use herein of the subspecies name, *D. pseudotsugae pseudotsugae*, for the Idaho (and USA) population.

***Dendroctonus punctatus* LeConte**, boreal spruce beetle

Distribution: Canada: Alta., B.C., N.B., Nfld., N.W.T., Ont., Que., Y.T.; USA: Alaska, Mont., Pa., N.Y., S.Dak., W.Va., Wyo. In Idaho: Henrys Lake, Fremont County. Undoubtedly, Idaho's rarest scolytid.

Hosts: ***Picea glauca* x *engelmannii*** (natural hybrid, not in pure *engelmannii*), *P. glauca*, *P. mariana*, *P. rubens*. Infests basal trunk and roots. May reinfest same tree for more than one generation without killing it.

Adult: 4.9-7.2 mm; commonly brown to dark brown becoming brownish black with increased maturity (head more so). Separated by host from *D. murrayanae*, which infests *Pinus contorta*. It differs from *D. rufipennis* by subtle characters, e.g., the more angular outline of its antennal club, the somewhat larger punctures on the pronotum and declivity, and the pronotum that is more gradually constricted (Fig. 34A).

Gallery: Variable and difficult to characterize, but inclined moderately to horizontal and shorter (3-8 cm) than *D. rufipennis* galleries. Short "turn-around" spurs may be constructed occasionally along the gallery. Uppermost galleries are more horizontal; those below them are more nearly vertical. Eggs laid in a mass, invariably along lower side of gallery (Fig. 34B). Larvae feed communally (Fig. 34C). Granular pitch tubes form

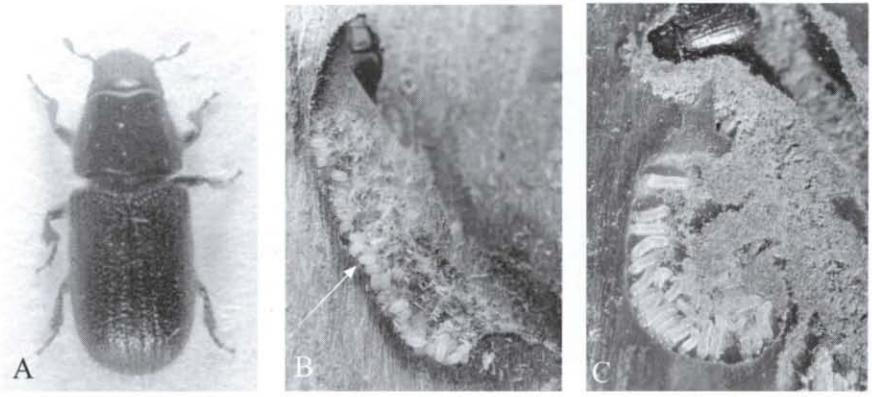


Figure 34. *Dendroctonus punctatus*. (A) Adult. (B) Eggs (arrow) deposited in a mass along side of gallery. (C) Aggregated larvae feeding on phloem. In Idaho, this bark beetle occurs only near Henrys Lake.

on outer bark at entrances to parent tunnels. The granules bleach in color and gradually sluff off and accumulate on the ground below.

Biology: Mature larvae and adult progeny overwinter as separate broods (different galleries), resulting in oviposition and different developmental stages occurring throughout summer. One generation per year is indicated, but development may be slower in northern locations.

References: Furniss 1995, 1996.

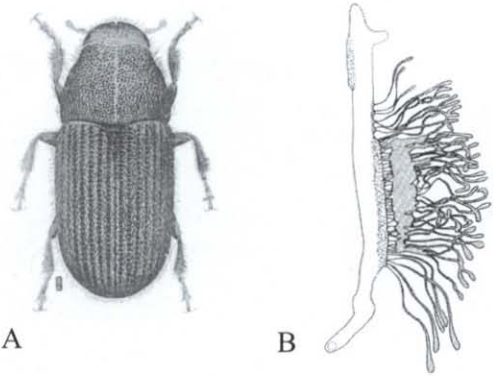


Figure 35. *Dendroctonus rufipennis*. (A) Adult. (B) Egg gallery with larval mines on right. Eggs are laid in rows alternately on one side of the gallery, then the other. Larvae feed communally during a period of development and then separate into individual mines where they pupate and become adult beetles. (A: Swaine 1918; B: Wood 1982.)

***Dendroctonus rufipennis* (Kirby)**, spruce beetle

Distribution: Canada: Alta., B.C., Man., N.B., Sask., N.W.T., N.S., Ont., Que., Y.T.; USA: Alaska, Ariz., Calif., Colo., Maine, Mich., Mont., N.H., Minn., N.Mex., N.Y., Ore., Pa., S.Dak., Utah, Wash., Wyo. In Idaho: Bear Lake, Blaine, Bonner, Boundary, Clearwater, Fremont, Idaho, Kootenai, Latah, Lemhi, Shoshone, Valley counties.

Hosts: ***Picea engelmannii***, *Picea* spp. Infests stems of mature standing and windthrown trees. Woodpeckers often remove outer bark to feed on larvae in winter.

Adult: 4.4-7.0 mm; very dark brown with reddish brown elytra, some individuals becoming entirely black with age. In contrast to *D. punctatus*, the antennal club is round in lateral outline, the punctures on the elytral declivity are smaller than the diameter of tubercles on the interstriae, and the pronotum is rather abruptly constricted anteriorly (Fig. 35A).

Gallery: Inclined for 3 cm, then straight, parallel to trunk, about 15-20 cm long. Eggs are laid in groups alternately on one side of the gallery, then on the other side, but not opposite each other (Fig. 35B). Larvae mine side by side outward from the gallery until they are one-third grown, when they mine separately.

Biology: Varies with climate in consequence of the wide range of elevation and latitude within the distribution of the beetle. In Idaho, a one-year cycle seems normal at lower elevations; a two-year cycle is possible at higher or colder locations where larvae may overwinter the first year, adults the second year.

References: Massey and Wygant 1954 (as *D. engelmannii* Hopkins), Schmid and Frye 1977.

Dendroctonus valens **LeConte**, red turpentine beetle

Distribution: Apparently the most widely distributed bark beetle in N.A. Canada: Alta., B.C., N.W.T., N.S., Ont., Que.; Mexico: B.C., Chih., D.F., Dgo., Hgo., Edo. de Méx., Mor., Pue.; Guatemala; Honduras; USA: Ariz., Calif., Colo., Ill., Kans., Maine, Mass., Mich., Minn., Mont., Nev., N.H., N.J., N.Mex., N.Y., N.C., Ohio, Ore., Pa., S.Dak., Utah, Va., Vt., Wash., W.Va., Wisc., Wyo. In Idaho: Adams, Benewah, Boise, Bonner, Bonneville, Boundary, Butte, Canyon, Cassia, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce, Shoshone, Valley counties.

Hosts: ***Pinus contorta***, ***P. monophylla***, ***P. monticola***, ***P. ponderosa***, ***Picea engelmannii***, other pines and spruces. Infests bases of standing trees and freshly cut stumps. Its presence is symptomatic of exceptional physiological stress or injury (this beetle in particular is attracted to resin odor). Infested trees may survive if growth conditions improve; otherwise, they may succumb to a combination of other beetles, fungi, etc.

Adult: 5.0-9.0 mm, uniformly reddish brown (Fig. 36A). Our largest scolytid. Besides the color and large size of adults, the presence of massive pitch tubes on the bark at the base of infested trees will distinguish this species.

Gallery: More or less parallel with wood grain, sometimes upward at first then downward for 30 cm or more in roots; resinous, plugged with frass; very wide (1 cm). Large masses of solidified resin (pitch tubes) form on outer bark at tunnel entrances on lower trunk (Fig. 36B).

Biology: One- or two-year life cycle in Idaho (not studied). Eggs are laid in masses (not niches) along a side of the gallery (Fig. 36C). Larvae feed side by side, excavating a common chamber as they proceed. Aggregation of larvae (Fig. 36D) is an adaptation to overcome the host at the rather low attack densities typical of this species and of *D. murrayanae* and *D. punctatus*.

Reference: Smith 1961.

Hylastes

Monogamous. Six species occur in Idaho, one of which (*H. tenuis*) is known from a single specimen and will be encountered rarely. Adults vary from blackish to reddish. They are similar in appearance and habits to *Hylurgops*, and to weevils of the genus *Rhyncolus* (Fig. 21), infesting the lower bole and roots of freshly cut stumps and dying trees. They differ consistently from *Hylurgops* in having pronotal pits of uniform size (Fig. 37) versus uneven size (Fig. 38) and, in part, in having the pronotum more uniformly rounded anteriorly (not so constricted) and in having setae on

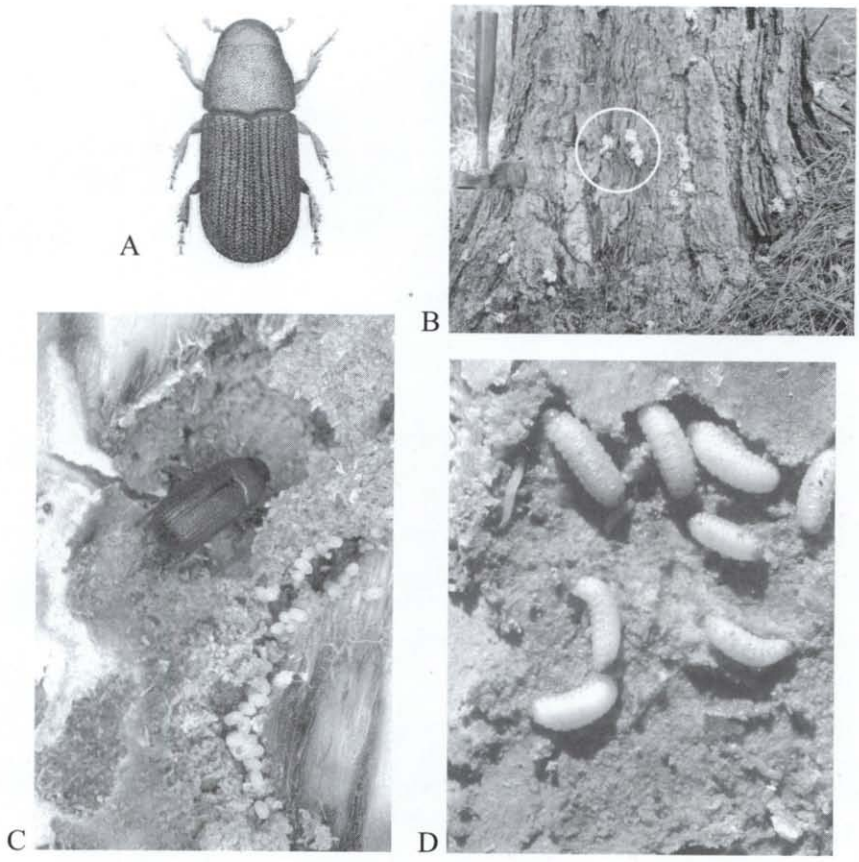


Figure 36. *Dendroctonus valens.* (A) Adult. (B) Pitch masses (circled) on ponderosa pine at beetle entrances. (C) Egg masses and female beetle in gallery. (D) Aggregated larvae. (A: Swaine 1918; B: Furniss and Carolin 1977.)

the elytral declivity that are shorter and arranged in more than one row on an interstriae (ridge) when present. When in doubt, we have entered "*Hylastes* or *Hylurgops*" in our field notes pending mounting of questionable specimens on pins and microscopic examination of their diagnostic features.

The galleries have not been studied or described in a systematic way. They are generally irregularly longitudinal and unbranched, and larval mines may interconnect with others, eventually obscuring the parental galleries.

Key to Species of Hylastes

1. Uniformly reddish brown; 4.8-5.2 mm ..... ***ruber*** **Swaine**
— Black; 3.8-6.0 mm 2
— Dark brown, elytra sometimes dark reddish brown; 2.1-4.0 mm 3
2(1). Elytra and pronotum dull, finely reticulate; 5.1-6.0 mm .. ***macer*** **LeConte**
— Elytra and pronotum shiny, not reticulate; 3.8-4.9 mm ..... ***nigrinus*** **(Mannerheim)**

3(1). Smaller (2.1-2.7 mm); lacking a median carina on lower frons ..... ***tenuis*** **Eichhoff**

— Larger (3.0-4.0 mm); median carina usually present on lower frons 4

4(3). Strial pits on wing (elytron) subrectangular, longer than wide; middle row of setae on declivital interstriae (ridges) longer ..... ***longicollis*** **Swaine**

— Strial pits on wing oval; setae on declivital interstriae uniform in length ..... ***gracilis*** **LeConte**

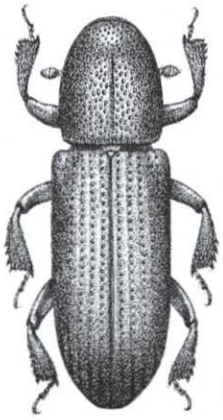


Figure 37. *Hylastes gracilis.* (Bright and Stark 1973.)

Hylastes gracilis LeConte

Distribution: Canada: B.C.; Mexico: B.C., Chis., Dgo., Hgo.; Guatemala; USA: Ariz., Calif., Colo., Mont., Nebr., Nev., N.Mex., Ore., S.Dak.,Utah, Wash. In Idaho: Benewah, Boise, Kootenai, Latah, Valley counties.

Hosts: ***Pinus ponderosa***, ***Pseudotsuga menziesii*** (Valley Co.), *Pinus edulis*, *P. monophylla, P. jeffreyi, P. pseudostrobus*. Infests bases and roots of dying trees and stumps, where phloem is moist.

Adult: 3.3-4.0 mm; dark brown (Fig. 37). Lower frons usually with a median longitudinal carina, short or obscure in some specimens. Pits on elytra oval. Setae on interstriae of declivity short, uniform in length.

Gallery: Not described.

Biology: Not studied; probably one generation annually.

Hylastes longicollis Swaine

Distribution: Canada: Alta., B.C.; USA: Calif., Mont., Ore., S.Dak., Wash. In Idaho: Adams, Boise, Clearwater, Kootenai, Latah, Valley counties.

Hosts: ***Pinus contorta***, ***P. monticola***, ***P. ponderosa***. Infests bases and roots of dying trees and stumps.

Adult: 3.0-3.9 mm; dark brown. Lower frons with a fine median longitudinal carina. Pits on elytra longer than wide (subrectangular). Middle row of setae on interstriae of declivity longer than others.

Gallery: Not described.

Biology: Not studied; presumed to have one generation annually.

Hylastes macer **LeConte**

Distribution: Canada: B.C.; USA: western states except Wyo., N.Mex. In Idaho: Benewah, Boise, Bonner, Clearwater, Idaho, Kootenai, Latah, Shoshone, Valley counties.

Hosts: ***Pinus ponderosa*** (Latah Co.), ***Pseudotsuga menziesii*** (Valley Co.), *Pinus* spp. Infests stumps, lower stem, and roots of dying trees.

Adult: 5.1-6.0 mm; black. Lower frons with a median longitudinal carina. Surface of elytra and pronotum minutely reticulate, dull (versus shiny in *nigrinus*).

Gallery: Not described.

Biology: Not studied.

Hylastes nigrinus **(Mannerheim)**

Distribution: Canada: Alta., B.C., N.W.T., Y.T.; USA: Calif., Mont., Ore., Wash. In Idaho: Benewah, Boise, Bonner, Clearwater, Kootenai, Latah, Valley counties.

Hosts: ***Pseudotsuga menziesii***, other Pinaceae. Infests root crown and roots of stumps and dying trees.

Adult: 3.8-4.9 mm; black. Carina on lower frons variable, evident to absent. Differing from *H. macer* by being stouter, smaller, and having shiny elytra.

Gallery: 3-12 cm long; generally longitudinal, often at an angle at first. Commonly with short, irregular branches. Larval mines often cross each other, and larvae may feed together.

Biology: One generation per year, flying in spring, particularly in late afternoon. Females initiate galleries. Larvae and callow (immature) adults overwinter.

Reference: Zethner-Møller and Rudinsky 1967.

Hylastes ruber **Swaine**

Distribution: Canada: Alta., B.C., N.W.T.; USA: Ariz., Ore., Mont., Wash. In Idaho: Benewah, Boise, Clearwater, Kootenai, Latah, Valley counties.

Hosts: ***Pseudotsuga menziesii***, rarely in ***Pinus ponderosa***. Infests bases and roots of dying trees.

Adult: 4.8-5.2 mm; reddish brown. Lower frons with a median longitudinal carina; strial punctures circular, deep.

Gallery: Not described.

Biology: Not studied.

Hylastes tenuis Eichhoff

Distribution: USA: eastern and southern states, Ariz., Calif., Nev., N.Mex., Tex., Utah. In Idaho: 15 km north of Nezperce, Lewis County, one specimen, host unknown.

Hosts: *Pinus* spp., rarely *Pseudotsuga menziesii.*

Adult: Our smallest *Hylastes*, 2.1-2.7 mm; dark brown to almost black. Frons lacking a median longitudinal carina.

Gallery: Unknown.

Biology: Not studied.

Hylurgops

Monogamous. Four species of *Hylurgops* are native to Idaho, of which *H. subcostulatus* differs from all others in North America by having every other interstriae strongly raised on the posterior of the elytra (declivity). These beetles are similar to *Hylastes* in their appearance and habits. They infest bases and roots of dying trees and stumps. They differ from *Hylastes* in having pronotal pits of varying size (Fig. 38) versus uniform size (Fig. 37), the pronotum generally more constricted anteriorly, and longer setae on the elytral declivity.

Key to Species of Hylurgops

1.	Elytral declivity with every other interstriae strongly ridged ..... ***subcostulatus subcostulatus*** **(Mannerheim)**
—	Elytral declivity with all interstriae of nearly equal height 2
2(1).	Surface of elytra and pronotum dull, reticulate at high magnification ..... ***reticulatus*** **Wood**
—	Surface of elytra and pronotum shiny between punctures, not reticulate 3
3(2).	Reddish brown above, darker beneath; pronotum distinctly constricted on anterior one-fourth ..... ***rugipennis pinifex*** **(Fitch)**
—	Black; pronotum gradually narrowed, not sharply constricted on anterior one-fourth ..... ***porosus*** **(LeConte)**

Hylurgops porosus (LeConte)

Distribution: Canada: Alta., B.C., Sask.; USA: all western states. In Idaho: Benewah, Blaine, Boise, Bonner, Boundary, Cassia, Clearwater, Elmore, Idaho, Kootenai, Latah, Shoshone, Valley counties.

Hosts: ***P. contorta***, ***P. monophylla***, ***P. ponderosa***, one specimen from ***Pseudotsuga menziesii*** (Valley Co.), *Pinus* spp., less common in *Picea.*

Adult: 3.6-5.3 mm; black. Elytral surface smooth, shiny. Median carina evident low on frons (indistinct in *H. reticulatus*). Pronotum gradually narrowed (Fig. 38A).

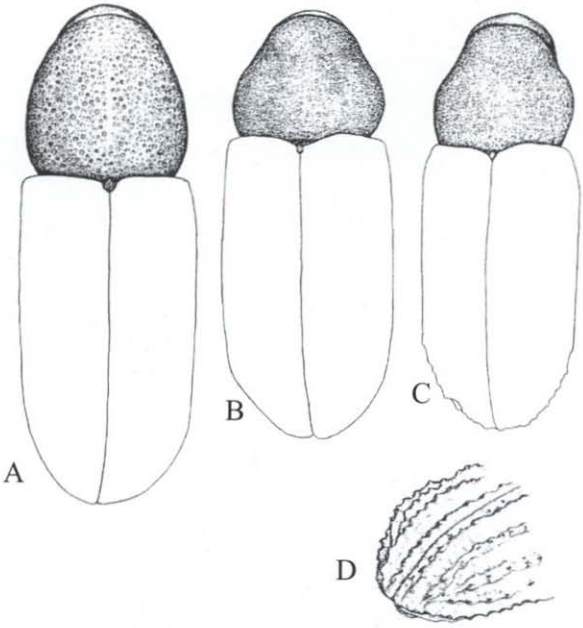


Figure 38. *Hylurgops* species. (A) *H. porosus* adult. (B) *H. rugipennis pinifex* adult. (C) *H. subcostulatus subcostulatus* adult. (D) Declivity. (Wood 1982.)

Gallery: Not described.

Biology: Not studied.

Hylurgops reticulatus **Wood**

Distribution: Canada: B.C., N.W.T.; USA: western states. In Idaho: Benewah, Bonner, Boise, Clearwater, Kootenai, Latah, Lewis counties.

Hosts: ***P. contorta, P. ponderosa, Pseudotsuga menziesii, Tsuga heterophylla,*** *Pinus* spp.

Adult: 3.7-5.0 mm; black with whitish hairs. The surface of the prothorax and elytra is dull and finely reticulate at high magnification, and the frons lacks a distinct carina. These characteristics distinguish it from *H. porosus*.

Gallery: Not described.

Biology: Not studied.

Hylurgops rugipennis pinifex **(Fitch)**

Distribution: Canada: Alta., B.C., Man., N.B., N.S., Ont., Que.; USA: Ala., Ariz., Calif., Colo., Conn., D.C., Maine, Mass., Mich., Minn., Mont., N.H., N.J., N.Mex., N.Y., N.C., Ohio, Ore., Pa., Utah, Va., W.Va., Wisc., Wyo. In Idaho: Ada, Boise, Bonner, Boundary, Caribou, Clearwater, Kootenai, Latah, Valley counties.

Hosts: ***Larix occidentalis, Picea engelmannii, Pinus albicaulis, P. monticola, P. ponderosa,*** *Abies* spp., *Picea* spp., *Pinus contorta, P. flexilis, Pseudotsuga menziesii.* Infests bases of stumps and dying standing trees.

Adult: 3.7-5.2 mm; reddish brown above, black beneath. Pronotum distinctly constricted on anterior one-fourth (Fig. 38B).

Gallery: Enters trunk just above ground level. Gallery extends several centimeters above and below entrance hole. Young larvae mine downward in the roots in a group, gradually separating into individual mines or groups of two to six.

Biology: Life cycle varies from one to two years. Galleries are initiated in spring and early summer. New broods overwinter mostly as larvae and a few callow adults. Some emerge late the second season; others remain another winter as larvae and mature in the third season (Alberta on *P. contorta*).

References: Blackman 1919, Reid 1955.

***Hylurgops subcostulatus subcostulatus* (Mannerheim)**

Distribution: Canada: B.C.; USA: western states except Nev. In Idaho: Ada, Adams, Benewah, Boise, Bonner, Boundary, Idaho, Kootenai, Latah, Nez Perce, Valley counties.

Hosts: ***Pinus contorta*, *P. monticola*, *P. ponderosa*, *Pseudotsuga menziesii***, other pines, *Picea*. Infests bases of dying trees, especially the wet inner bark of trees infested above by *Dendroctonus* species.

Adult: 3.3-4.4 mm; dark reddish to rusty brown; black beneath; adorned with small, stout scales. Pronotum strongly constricted (Fig. 38C). Declivity strongly ridged (every other interstriae raised), armed with rather large tubercles (Fig. 38D), and often encrusted with hardened resin.

Gallery: Short, slightly irregular, usually longitudinal. Larvae mine in all directions without any evident pattern, eventually consuming the entire phloem in localized areas of heavy infestation.

Biology: Trees are infested in early spring and summer; resulting broods emerge in fall and reattack the same host or a new one. Probably one generation annually in Idaho.

Phloeosinus

Monogamous. Six species occur in Idaho infesting junipers, western redcedar, and *Picea glauca* x *engelmannii*. Identification is based mainly on the number and size of teeth on the elytral declivity of males (teeth greatly reduced in females). Their longitudinal galleries are keyhole shaped and deeply engrave the wood. Adults are stout, 1.5-4.1 mm long, dark brown to black, commonly with reddish elytra. The frons is dimorphic, impressed in males, convex in females. They readily infest felled trees and occasionally standing trees that are dying or severely moisture stressed. Some species feed on twigs before becoming sexually mature.

Key to Species of Phloeosinus

1.	In *Picea glauca* x *engelmannii*	***pini*** **Swaine**
—	In *Thuja, Juniperus*	2
2(1).	Teeth on declivital interstriae 1, 3 not larger in male	***punctatus*** **LeConte**
—	Teeth on declivital interstriae 1, 3 larger in male	3
3(2).	Larger (2.0-3.7 mm)	4
—	Smaller (1.7-2.8 mm)	5
4(3).	Declivity of male with six moderately large, recurved, stout teeth on interstriae 1; seven or eight such teeth on interstriae 3	***scopulorum neomexicanus*** **Blackman**
—	Declivity of male with 7 to 11 coarse teeth on interstriae 1; 11 to 16 such teeth on interstriae 3	***serratus*** **(LeConte)**
5(3).	Declivity of male with 11 and 13 coarse teeth on interstriae 1 and 3, respectively; frons with a median carina	***keeni*** **Blackman**
—	Declivity of male with nine coarse teeth on interstriae 1 and 3; frons without a carina	***hoferi*** **Blackman**

Phloeosinus hoferi Blackman

Distribution: Canada: B.C.; USA: western states except Ore., Wash. In Idaho: Bonneville, Cassia, Twin Falls counties.

Hosts: ***Juniperus osteosperma***, *J. scopulorum*, *J. deppeana*. Usually in small branches.

Adult: 1.7-2.4 mm; dark brown to black; elytra lighter brown. Male declivity with nine coarse teeth on first and third interstriae (ridges) of declivity (11 and 13 teeth on *P. keeni*), teeth stouter in middle (Fig. 39A)

Gallery: Not described.

Biology: Not studied.

Phloeosinus keeni Blackman

Distribution: Canada: B.C.; USA: Wash. In Idaho: Bonner, Clearwater, Latah, Oneida counties.

Hosts: ***Juniperus osteosperma*** (Oneida Co., one specimen), ***Thuja plicata***, *Chamaecyparis nootkatensis* (Wash.).

Adult: 2.1-2.8 mm; very dark brown; part or all of elytra usually lighter brown. Male declivity with 11 and 13 coarse teeth on interstriae 1 and 3, respectively (nine on interstriae 1 and 3 on *P. hoferi*).

Gallery: Not described.

Biology: Not studied.

Phloeosinus pini Swaine

Distribution: Canada: Man., N.W.T., Que.; USA: Alaska, Mich. In Idaho: Henrys Lake, Fremont County.

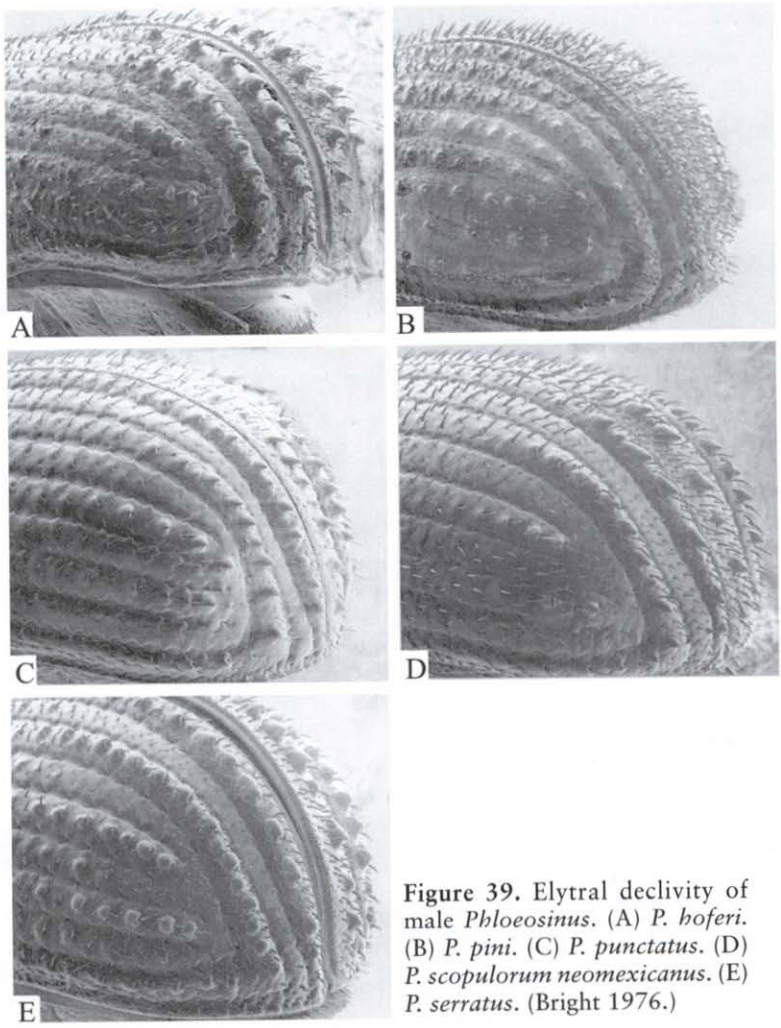


Figure 39. Elytral declivity of male *Phloeosinus*. (A) *P. hoferi*. (B) *P. pini*. (C) *P. punctatus*. (D) *P. scopulorum neomexicanus*. (E) *P. serratus*. (Bright 1976.)

Hosts: ***Picea glauca* x *engelmannii***, *P. glauca*, *Pinus banksiana*. Infests suppressed small trees and branches of mature, recently killed standing trees.

Adult: 1.8-2.5 mm; black. Eye emarginate; club diagonally segmented; declivity finely tuberculate (without prominent teeth) in both sexes (Fig. 39B). Distinguished by host, this being our only *Phloeosinus* species infesting a species of Pinaceae.

Gallery: Vertical; 3-6 cm long, with large, off-center nuptial chamber 2-3 mm above entrance. Twenty-five to 40 eggs laid equally on opposite sides of gallery in large, well-separated niches.

Biology: Overwinters as larvae.

Phloeosinus punctatus **LeConte**, western cedar bark beetle

Distribution: Canada: B.C.; USA: Southeast Alaska, Calif., Ore., Nev., Wash. In Idaho: Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Shoshone counties.

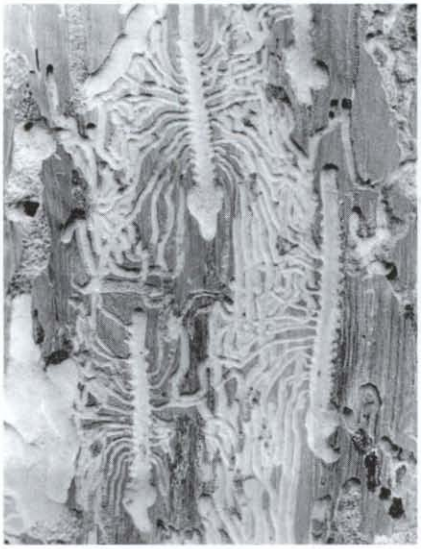
Hosts: ***Juniperus occidentalis***, ***Thuja plicata***, *Chamaecyparis nootkatensis*, *Libocedrus decurrens*, *Sequoiadendron gigantea*, *Sequoia sempervirons*. Infests boles and limbs of felled and dying trees or stressed standing trees.

Adult: 1.9-3.4 mm; very dark brown to black; elytra reddish brown. Declivity of male with six conical teeth on interstriae 1 and about seven conical teeth on interstriae 3 (Fig. 39C). Teeth of female not smaller than male.

Gallery: Longitudinal, 3-7 cm long (Fig. 40A); etches wood; keyhole shape typical of the genus, with nuptial chamber at bottom. Larval mines often cross others.

Biology: Flies in early spring. Up to three generations per year reported but probably fewer in Idaho. Adults apparently require feeding on green twigs before maturing sexually.

Reference: Burke 1966.



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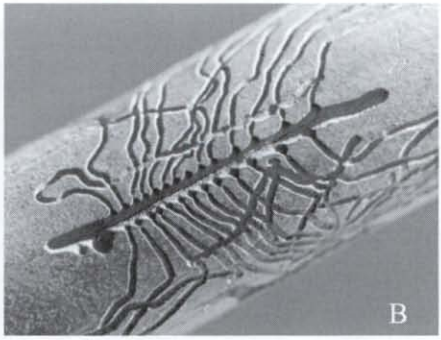

Figure 40. Galleries of *Phloeosinus punctatus* (A) and *P. scopulorum neomexicanus* (B) engraved on sapwood. The enlarged chamber at one end provides space for beetles to turn around during activities involving tunnel construction and oviposition.

Phloeosinus scopulorum neomexicanus **Blackman**

Distribution: USA: Ariz., Colo., Nev., Tex., Utah. In Idaho: Franklin, Butte, Boundary counties.

Hosts: ***Juniperus osteosperma***, *J. deppeana*, *J. monosperma*, *Cupressus arizonica*. Infests limbs and stems of felled or stressed trees.

Adult: 2.2-3.7 mm; very dark brown to black; elytra reddish brown. Declivity of male with six moderately large, recurved, stout teeth on interstriae

1 and seven or eight teeth on interstriae 3 (Fig. 39D). Teeth of female smaller.

Gallery: Longitudinal, about 4-5 cm long; etches wood; nuptial chamber at bottom bulges somewhat to one side (Fig. 40B). About 30 eggs are laid per gallery.

Biology: Not studied. Mature larvae tend to mine into xylem.

Phloeosinus serratus (LeConte)

Distribution: Mexico: Chih. to Hgo.; Jamaica; USA: Ariz., Calif., N.Mex., Ore., Utah. In Idaho: Cassia, Oneida counties.

Hosts: ***Juniperus osteosperma***, *J. deppeana*, *J. monosperma*, *J. occidentalis*, *J. scopulorum*. Infests stems and larger limbs of felled and stressed trees.

Adult: 2.0-3.7 mm; very dark brown; elytra often reddish brown. Declivity coarsely serrate (Fig. 39E), interstriae 1 with 7 to 11 teeth, interstriae 3 with 11 to 16 teeth, interstriae 5 and 7 with 5 or 6 teeth. Teeth of female much smaller.

Gallery: Not described; apparently typical of the genus.

Biology: Not studied.

Phloeotribus

Monogamous. One species in Idaho. Unique among Idaho scolytids in having segments of the antennal club off-center and lamellate. Galleries deeply score the wood.

Phloeotribus lecontei Schedl

Distribution: Canada: Alta., B.C.; USA: Ariz., Calif., Colo., Mont., N.Mex., Ore., Utah. In Idaho: Bonner, Custer, Franklin, Latah, Lemhi, Shoshone counties.

Hosts: ***Pseudotsuga menziesii***, ***Picea engelmannii***, ***Pinus monticola***, *Abies lasiocarpa*, *Picea pungens*. Infests shaded out branches of live trees.

Adults: 1.6-2.4 mm long; black (Fig. 41A). Antennal club has three loosely joined segments that are off-center (Fig. 41B). Frons concave in males, convex in females. A short, hornlike projection is located inward of, and adjacent to, each antenna. Body and elytra clothed in short, stiff, yellowish setae; eltryal declivity with short, stout teeth on all interstriae.

Gallery: Deeply scores wood; gull-wing shape consists of two branches, each 1-2 cm long, oriented diagonally across wood grain from the central nuptial chamber (Fig. 41C). The only biramous egg gallery in *Pseudotsuga menziesii* that is not oriented along the wood grain (i.e., not parallel with long axis of branch or trunk).

Biology: Larvae and adults occur throughout year but overwinter mainly as new adults and some mature larvae. Possibly two generations per year in warmer areas.

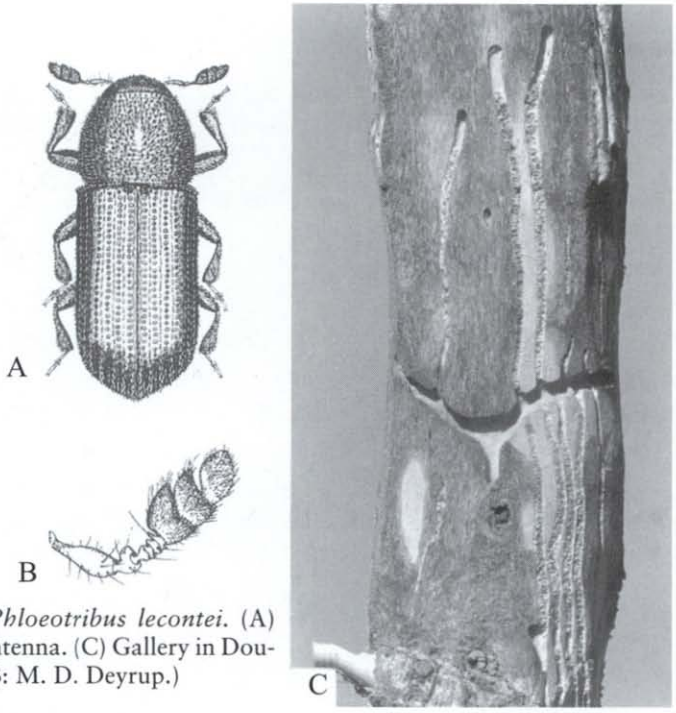

Figure 41. *Phloeotribus lecontei.* (A) Adult. (B) Antenna. (C) Gallery in Douglas-fir. (A, B: M. D. Deyrup.)

Polygraphus

Polygamous. One species known from Idaho, mainly infesting *Picea*. It is most easily recognized as our only bark beetle having the eye almost divided (however, ambrosia beetles of the genus *Trypodendron* also have divided eyes). Also, the club is not segmented, differentiating it from other Idaho Hylesininae.

***Polygraphus rufipennis* (Kirby)**, foureyed spruce beetle

Distribution: Widely distributed. Canada: all provinces; USA: Alaska, Lake States and New England to N.C. and Tenn. All western states except Calif., Nev. In Idaho: Bear Lake, Benewah, Bonner, Boundary, Caribou, Clearwater, Fremont, Idaho, Kootenai, Latah, Shoshone, Valley counties.

Hosts: ***Picea engelmannii*, *P. glauca* x *engelmannii*, *Pinus contorta***, *Picea glauca*, *P. pungens*, *P. rubra*, *Abies fraseri*, *Pinus strobus*. Infests branches and stems of felled or dying trees.

Adult: 1.8-3.1 mm; very dark brown to black; clothed in contrasting, pale vestiture (Fig. 42A). Antennal club not segmented (Fig. 42B). Unique among Idaho bark beetles in having each eye almost divided (Fig. 42C), hence the common name.

Gallery: Variable. Male-initiated galleries have two to six branches radiating from a central nuptial chamber in any direction. Female-initiated galleries are uniramous (Fig. 42D).

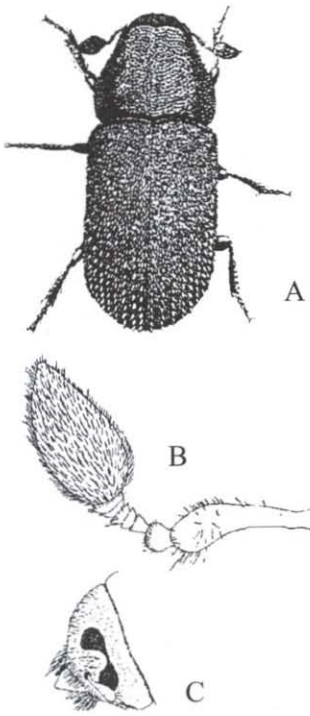

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Figure 42. *Polygraphus rufipennis.* (A) Adult. (B) Antenna. (C) Divided eye. (D) Galleries in spruce. (A: Swaine 1918; B: Balachowski 1949; C: Hilton 1968.)

Biology: Overwinter as adults and larvae. Females may produce several successive galleries during a season, often in the same tree, resulting in overlapping of broods. One generation per year is probably the rule.

References: Hilton 1968, Rudinsky et al. 1978.

Pseudohylesinus

Monogamous. Four species occur in Idaho, three in grand fir and one, *P. nebulosus nebulosus*, in Douglas-fir. Unlike most Idaho scolytids, they are clothed with minute "scales" (flattened setae) that form light and dark areas on the prothorax and elytra.

Key to Species of Pseudohylesinus

1.	In *Pseudotsuga*	***nebulosus nebulosus*** **(LeConte)**
—	In *Abies*	2
2(1).	Larger (4.0-5.4 mm)	***granulatus*** **(LeConte)**
—	Smaller (2.3-3.7 mm)	3
3(2).	Dark brown; front of head more elongate; distance from mouth to top of eyes greater than width between eyes	***sericeus*** **(Mannerheim)**
—	Light brown; front of head less elongate; distance from mouth to top of eyes equal to width between eyes	***dispar pullatus*** **Blackman**

Pseudohylesinus dispar pullatus **Blackman**

Distribution: Canada: B.C.; USA: Ore., Wash. In Idaho: Benewah, Clearwater, Kootenai, Latah, Valley counties.

Hosts: ***Abies grandis***, *A. amabilis*, *A. concolor*, *A. procera*. Infests main stem and larger branches of felled or dying trees.

Adult: 2.6-3.7 mm; light brown with scattered patches of ash-gray scales. Distinguished from *sericeus* by characteristics in the key above.

Gallery: Transverse (across grain); 5-12 cm long, consisting of two straight arms extending from the entrance chamber, which is located toward the middle (easily confused with gallery of *Scolytus ventralis*).

Biology: Apparently one generation per year with broods maturing at different times.

Reference: Bright 1969.

Pseudohylesinus granulatus **(LeConte)**, fir root bark beetle

Distribution: Canada: B.C.; USA: Alaska, Calif., Ore., Wash. In Idaho: Clearwater, Kootenai, Latah, Valley counties.

Hosts: ***Abies grandis***, *A. amabilis*, *A. lasiocarpa*, *A. magnifica*, *A. procera*, *Tsuga heterophylla*. Infests unthrifty standing trees and fallen trees.

Adult: 4.0-5.4 mm; dark brown with sparse covering of light and dark scales (Fig. 43D). Distinguished from other species of *Pseudohylesinus* by its larger size.

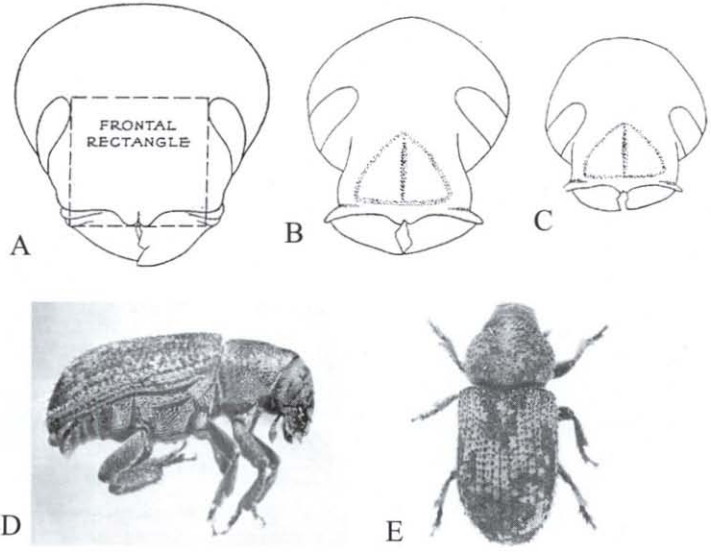


Figure 43. *Pseudohylesinus* species. The relative elongation of the front of the head, as indicated by the frontal rectangle (A) is greater in *P. sericeus* (B) than in *P. nebulosus nebulosus* (C). (D) *P. granulatus* adult. (E) *P. sericeus* adult. (A: Blackman 1942; B, C: Bright 1969; D, E: Furniss and Carolin 1977.)

Gallery: Irregularly transverse; 2-18 cm long; at base of trunk below ground to about 5 m above ground. Expelled reddish brown boring dust may be visible around tree base. Larvae mine at right angle to the gallery.

Biology: Overwintered beetles emerge and construct egg galleries in late May-June. Some of these reemerge in late July-August to construct more egg galleries and lay a second batch of eggs. In August, some adult progeny from the May-June galleries emerge and excavate hibernation tunnels 6-15 mm long in the bark, not in the cambium. Several adults may enter a hibernation tunnel and make separate niches in which to overwinter. Larvae resulting from eggs laid in summer do not mature until a year later, thus hibernating adults of one generation and larvae of another may be present at the same time.

Reference: Bright 1969.

***Pseudohylesinus nebulosus nebulosus* (LeConte)**, Douglas fir pole beetle

Distribution: Canada: Alta., B.C.; Mexico: Chih.; USA: Ariz., Calif., Colo., Mont., N.Mex., Ore., Utah, Wash. In Idaho: Bannock, Blaine, Boise, Bonner, Clearwater, Franklin, Idaho, Kootenai, Latah, Valley counties.

Host: ***Pseudotsuga menziesii***. Infests tops of standing trees killed by Douglas-fir beetle (*Dendroctonus pseudotsugae pseudotsugae*) and throughout stems of downed trees.

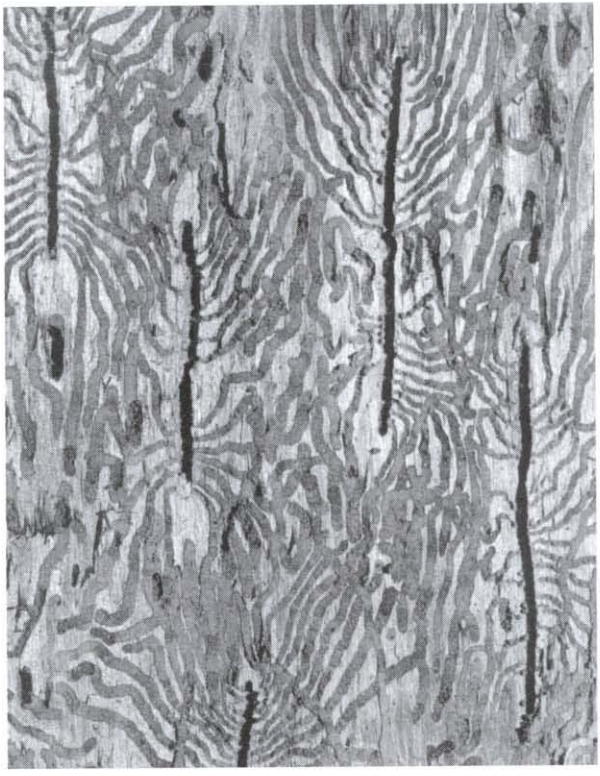


Figure 44. Galleries of *Pseudohylesinus nebulosus nebulosus* in bark of Douglas-fir. Note how well the larval mines avoid each other, allowing maximum utilization of phloem (space and food), and thereby enhancing larval survival.

Adult: 2.3-3.1 mm; very dark brown with variegated surface pattern formed by dark and light scales and hair. Distinguished from other species of *Pseudohylesinus* by host and the vertical alignment of its gallery and from *P. sericeus* by its less elongated head (Fig. 43C).

Gallery: Vertical (parallel with wood grain); 2-3 cm long; often at very high density; entrance at middle (Fig. 44).

Biology: Flies very early in spring, infesting felled Douglas-fir before other scolytids. Interior areas, including Idaho, have one generation per year. New adults bore into fresh host material in late summer where they overwinter.

Reference: Walters and McMullen 1956.

***Pseudohylesinus sericeus* (Mannerheim)**, silver fir beetle

Distribution: Canada: B.C.; USA: Alaska, Calif., Ore., Wash. In Idaho: Clearwater, Idaho counties.

Hosts: ***Abies grandis***, *A. amabilis*, *A. procera*, *Pseudotsuga menziesii*, *Tsuga heterophylla*. Infests limbs and stems of unthrifty or felled trees.

Adult: 2.4-3.3 mm; elytra and pronotum with variegated pattern of dark brown and pale brown scales (Fig. 43E). Distinguished from *P. dispar pullatus* by characteristics in the key above and from *P. nebulosus nebulosus* by its more elongated head (Fig. 43B).

Gallery: Transverse; 4-12 cm long.

Biology: Not studied.

Reference: Bright 1969.

Scierus

Monogamous. Two Idaho species, both infesting Engelmann spruce. Similar to *Hylurgops*, from which they differ by lacking any scales on the elytra and by having widely separated sockets of the front legs and uniformly large pits on the pronotum.

Key to Species of Scierus

1. Smaller (2.7-3.7 mm); setae on elytral declivity shorter, not exceeding half the width of interstriae; tubercles on elytral declivity larger ..... ***annectens* LeConte**

— Larger (3.8-4.3 mm); setae on elytral declivity longer, about equal to width of interstriae; tubercles on elytral declivity smaller (inconspicuous) ..... ***pubescens* Swaine**

***Scierus annectens* LeConte**

Distribution: Canada: Alta., B.C., Nfld., Ont., Que.; USA: Alaska., Ariz., Calif., Colo., Maine, Mont., N.H., N.Mex., Ore., Utah. In Idaho: Bonner, Kootenai, Latah, Valley counties.

Figure 45. *Scierus annectens* adult. (Bright 1976.)

Hosts: ***Picea engelmannii***, other spruces. Infests bases of dying trees, stumps, and underside of trunks of felled trees.

Adult: 2.7-3.7 mm; yellowish to reddish brown with yellowish pubescence (Fig. 45). Distinguished from *S. pubescens* by smaller size, shorter setae, and larger tubercles on declivity.

Gallery: Longitudinal; 3-4 cm long; slightly curved, varying from parallel to about 45 degrees to the wood grain. This species usually gains entry to the phloem via a gallery of the spruce beetle, *Dendroctonus rufipennis*, from which it extends its own gallery. A niche in which to turn around is made near the entrance.

Biology: Beetles fly and infest new hosts from mid-June to mid-August (Colorado). Broods overwinter as larvae and mature in the following spring.

Reference: Stewart 1965.

Scierus pubescens **Swaine**

Distribution: Canada: Alta., B.C.; USA: Alaska, Colo., Mont. In Idaho: Valley County (host unknown).

Hosts: *Picea engelmannii*, *P. glauca*, *Abies lasiocarpa*, *Pinus contorta*. Idaho specimens were caught in flight traps containing natural attractant (frass) of female *Dendroctonus rufipennis*.

Adult: 3.8-4.3 mm; reddish brown with pale yellow vestiture. Differing from *S. annectens* by larger size, longer setae, and inconspicuous tubercles on declivity.

Gallery: Not described.

Biology: Not studied.

Xylechinus

Monogamous. One Idaho species, infesting Engelmann spruce.

Xylechinus montanus **Blackman**

Distribution: Canada: Alta., B.C., Sask.; USA: Alaska, Colo., Mont., Nev., Ore., Utah. In Idaho: Clearwater, Shoshone, Valley counties.

Hosts: ***Picea engelmannii***. Usually infests main stems of small, suppressed trees, sometimes shaded-out branches.

Adult: 2.3-2.7 mm; dark brown; clothed with gray scales and setae. Elytra with deep grooves (striae) having coarse punctures (Fig. 46A). Antennal club is conical and pointed (Fig. 46B), which distinguishes it from *Carphoborus* (flat, truncate) and *Phloeotribus* (sublamellate).

Gallery: Transverse; biramous; extending left and right from the entrance chamber, deeply scoring wood.

Biology: Not studied.

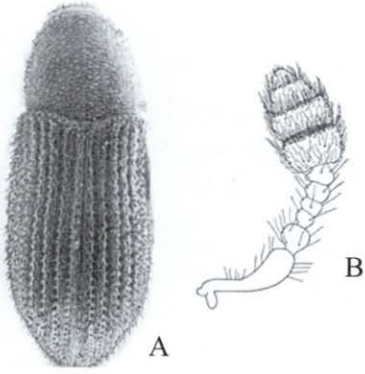


Figure 46. *Xylechinus montanus*. (A) Adult. (B) Antenna. (A: Bright 1976; B: Blackman 1940.)

SPECIES OF THE SUBFAMILY SCOLYTINAE

Bark Beetles

Cryphalus

Monogamous. Represented in Idaho by a single species, most commonly infesting true firs (*Abies*). It may be accompanied by *Pityophthorus* species in small trees but differs from them by its hunchbacked side profile and duller surface.

Cryphalus ruficollis Hopkins

Distribution: Canada: Alta., B.C., Man., N.B., P.E.I., Nfld., N.S., Ont., Que.; Mexico: N.L.; USA: Alaska, Ariz., Calif., Colo., Maine, Mont., N.Mex., N.Y., Ore., Utah, Wash. In Idaho: Bonneville, Boundary, Custer, Idaho, Kootenai, Latah, Lemhi counties.

Hosts: ***Abies grandis***, ***A. lasiocarpa***, ***Pinus albicaulis***, ***P. contorta***, ***P. flexilis***, *Picea* spp. Usually infests immature standing trees, occurring in the bark of the stem and branches of 1 cm diameter or larger.

Adult: 1.7-1.8 mm; rather dull, brownish black (Fig. 47). In side profile, has hunchbacked appearance due to short body, gradually sloping elytral declivity, and head directed downward.

Gallery: Transverse; 1-2 cm long; in phloem. Becomes obscure after larvae have mined the phloem.

Biology: Probably one generation per year, overwintering as young adults in the brood tree.

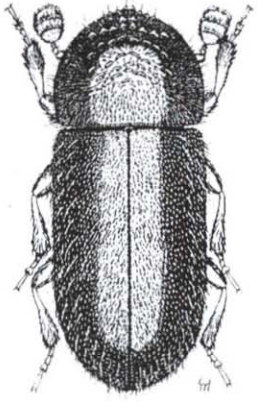


Figure 47. *Cryphalus ruficollis* adult. (M. D. Deyrup.)

Crypturgus

Monogamous. Represented in Idaho by a single species that has the unusual habit of entering trees via galleries of other bark beetles from which it extends a network of fine galleries. Recognized in the field by this trait and its small size, being the smallest of our scolytids, and by microscopic features mentioned below.

Crypturgus borealis Swaine

Distribution: Canada: Alta., B.C., Man., N.B., N.W.T., N.S., Ont., Que., Sask.; USA: Alaska, Ariz., Colo., Maine, Mich., Mo., N.Mex., N.Y., Mont., Ore., Pa., S.Dak., Utah. In Idaho: Bear Lake, Fremont, Latah, Shoshone counties.

Hosts: ***Abies grandis*** (Latah Co.), ***Abies lasiocarpa*** (Bear Lake Co.), ***Picea glauca* x *engelmannii*** (Henrys Lake, Fremont Co.), *Abies* spp., *Picea* spp., *Pinus* spp.

Adult: Our smallest bark beetle, 1.0-1.2 mm; rather dull brownish black (Figs. 48A, 48B). Antenna four-segmented (fewer than those of other Idaho scolytids). The club itself appears unsegmented (Fig. 48C). The elytral declivity of females has a dull patch composed of minute setae.

Gallery: This small beetle is adapted to entering galleries of other bark beetles from which it extends its own very fine galleries for a distance of 1-3 cm in no distinctive manner.

Biology: Thought to have one generation per year, overwintering as adults in the brood galleries.

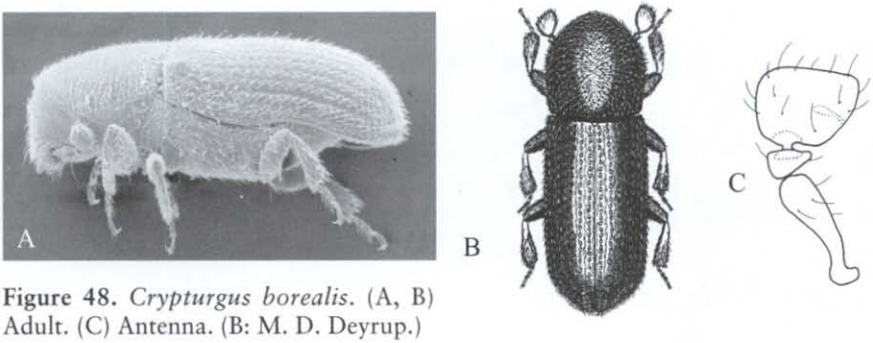


Figure 48. *Crypturgus borealis*. (A, B) Adult. (C) Antenna. (B: M. D. Deyrup.)

Dryocoetes

Polygamous. Five Idaho species, one, *D. betulae*, in paper birch, the others commonly in Engelmann spruce or subalpine fir. Adults are moderately shiny and dark reddish brown, except *D. affaber*, which is yellowish to reddish brown. The frons of females of several species has moderate to dense hairs; those on frons of males are less dense. The antennal club is obliquely truncate (Fig. 49E).

Key to Species of Dryocoetes

1.	In *Betula*	***betulae*** **Hopkins**
—	In *Abies lasiocarpa*	2
—	In *Picea* or less commonly *Pinus*	3
2(1).	Larger (3.2-4.3 mm); female frons with dense brush of hair	***confusus*** **Swaine**
—	Smaller (1.6-2.2 mm); female frons rather sparsely pubescent	***sechelti*** **Swaine**
3(1).	Larger (2.8-4.4 mm); female frons with sparse hair	***autographus*** **(Ratzeburg)**
—	Smaller (2.3-3.1 mm); female frons with moderately dense brush of hair	***affaber*** **(Mannerheim)**

Dryocoetes affaber (Mannerheim)

Distribution: Canada: Alta., B.C., Man., Nfld., N.B., Ont., Que., Sask., Y.T.; USA: Alaska, Ariz., Colo., Maine, Mich., Minn., N.H., N.Mex., N.Y., N.C., Ore., Pa., S.Dak., Tenn., Utah, Wash., W.Va., Wisc. In Idaho: Ada, Benewah, Bonner, Clearwater, Custer, Fremont, Idaho, Kootenai, Latah, Shoshone, Valley counties.

Hosts: ***Picea glauca* x *engelmannii***, ***Picea engelmannii***, less commonly ***Pinus monticola***. Infests lower bole, sometimes limbs, of fallen or dying trees.

Adult: 2.3-3.1 mm, yellowish to reddish brown (Fig. 49A). Female frons with moderately dense setal brush; male frons with sparse setal brush. Body clothed with abundant yellow hairs.

Gallery: Radiate type.

Biology: Not studied, presumed to have one generation per year.

Dryocoetes autographus (Ratzeburg)

Distribution: Europe; Asia; Canada: Alta., B.C., Lab., Man., N.B., Nfld., N.W.T., Que., Sask., Y.T.; USA: Alaska, Calif., Colo., Maine, Mich., Minn., Mont., Nev., N.H., N.Mex., N.Y., N.C., Ore., Pa., S.Dak., Tenn., Utah, Va., Wash., W.Va., Wisc., Wyo. In Idaho: Clearwater, Fremont, Latah, Valley counties.

Hosts: ***Picea glauca* x *engelmannii*** (Fremont Co.), ***P. engelmannii***. Infests lower trunk and roots of dying trees.

Adult: 2.8-4.4 mm; dark reddish brown (Figs. 49B, 49C). Frons with sparse, long hair (more sparse in male). Distinguished from *D. affaber* by greater size and less dense setal brush on female frons.

Gallery: Radiate type. Larval mines rather short, lacking a definite pattern.

Biology: Believed to have one generation per year in Idaho, overwintering as callow adults.

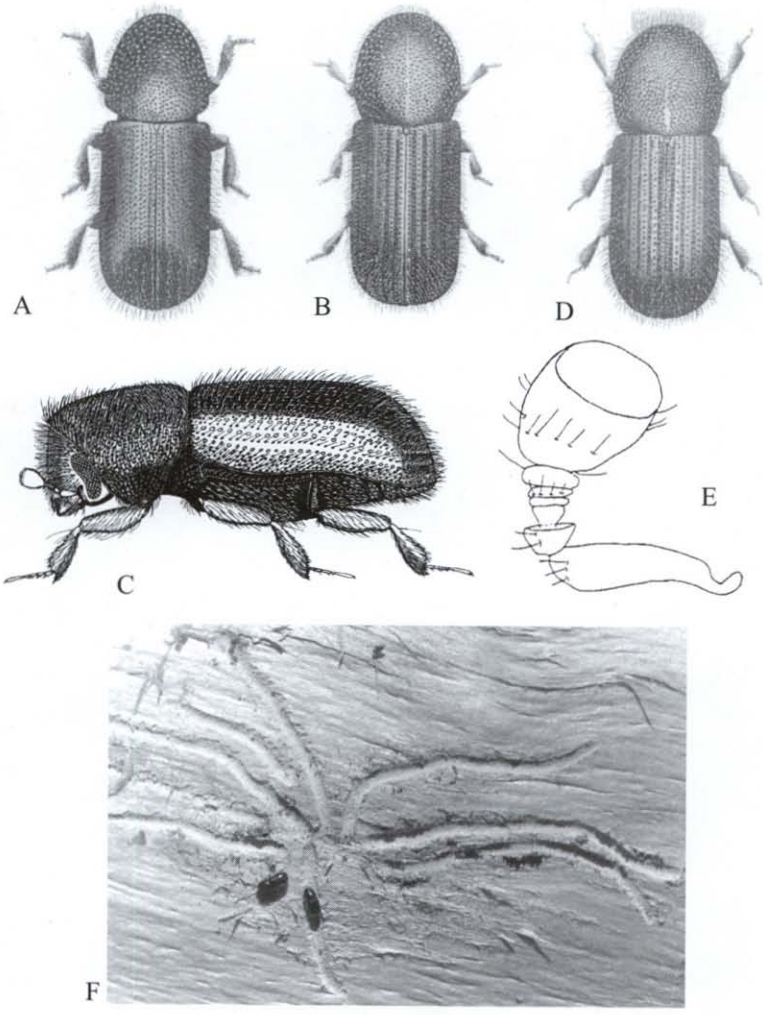


Figure 49. *Dryocoetes* species. (A) *D. affaber* adult. (B, C) *D. autographus* adult. (D) *D. betulae* adult. (E) Generalized antenna. (F) Fresh galleries of *D. confusus* engraved on sapwood of subalpine fir. Here, nine branches radiate from a central chamber, each constructed by a separate female, two of which remain after the overlying bark was removed. (A, B, D: Swaine 1918; C: M. D. Deyrup; E: Bright 1963.)

Dryocoetes betulae **Hopkins**, birch bark beetle

Distribution: Canada: Alta., B.C., Nfld., N.B., Ont., Que.; USA: D.C., Fla., La., Maine, Mich., Miss., Mont., N.H., N.J., N.Y., N.C., Pa., Va., Vt., W.Va., Wash. In Idaho: Willow Creek, Priest Lake, Bonner County.

Hosts: ***Betula papyrifera***, *B. lenta*, *B. lutea*. Infests phloem of decadent trees dying from crowding by conifers and by infection with rot fungi.

Adult: 2.8-3.8 mm; dark reddish brown (Fig. 49D). Female frons with moderately dense setae; those on male sparse. Distinguished by host.

Gallery: Asymmetrical, with many interconnecting branches. May be extended by adult progeny in the year following initiation of the parent gallery.

Biology: Overwinters as larvae of all instars and as adults. Reinfests larger trees for several generations, progressing downward.

Dryocoetes confusus **Swaine**, western balsam bark beetle

Distribution: Canada: Alta., B.C.; USA: Ariz., Colo., Mont., N.Mex., Ore., Utah, Wyo. In Idaho: Bear Lake, Bonner, Boundary, Clearwater, Idaho, Kootenai, Valley counties.

Host: ***Abies lasiocarpa***. Infests stems of mature trees and felled trees.

Adult: 3.2-4.3 mm; dark reddish brown. Female frons with dense brush of reddish hair, more sparse on male frons. Distinguished from *D. sechelti* by its larger size and dense, reddish setal brush on the female frons.

Gallery: Radiate type (Fig. 49F).

Biology: Two-year life cycle: overwintering the first year as eggs and larvae and the second year as callow adults. Adults carry a tree-pathogenic fungus (Molnar 1965).

References: Bright 1963, Mathers 1931.

Dryocoetes sechelti **Swaine**

Distribution: Canada: B.C.; USA: Colo., Mont., Ore. In Idaho: Custer County.

Host: ***Abies lasiocarpa***.

Adult: 1.6-2.2 mm; reddish brown. Distinguished from *D. confusus* by its smaller size and sparse hair on the female frons.

Gallery: Radiate type; in lower bole.

Biology: Not studied.

Ips, pine engraver beetles

Polygamous. Eleven species occur in Idaho, all in pines except *I. hunteri, I. tridens engelmanni,* and *I. pilifrons utahensis*, which infest spruce. Our most destructive species is the pine engraver, *I. pini*, which kills dense groups of young ponderosa pines especially in droughty growing seasons.

All species are polygamous and, therefore, the galleries are of the radiate type. Adult length varies from 2.3 mm (*I. latidens*) to 6.9 mm (*I. emarginatus*). The rear end (declivity) of the wings (elytra) is deeply concave and armed with three to five prominent spines on each side of the concavity. The number and shape of these spines differ by species; the third spine is usually larger in males. *Orthotomicus caelatus* is similar but has an obliquely truncated antennal club with concentric sutures, whereas the club of *Ips* is round in its anterior outline with the sutures procurved or bisinuate, and the third

spine of *O. caelatus* is situated inward of the edge of the elytral concavity rather than marginally as in *Ips* species.

Key to Species of Ips

1. In *Picea* 2
— In *Pinus* 4
2(1). Smaller (3.3-4.3 mm); frons of female protuberant or not 3
— Larger (4.4-5.0 mm); frons of female weakly, if at all, protuberant ..... ***pilifrons utahensis*** **Wood**
3(2). Frons of both sexes not protuberant, vestiture of rather sparse setae ..... ***hunteri*** **Swaine**
— Female frons moderately to profoundly protuberant below upper level of eyes (male less so), glabrous to densely pilose ..... ***tridens engelmanni*** **Swaine**
4(1). Sides of elytral concavity three-spined 5
— Sides of elytral concavity four or five-spined 6
5(4). Smaller (2.3-3.6 mm); third spine pointed; sutures on antennal club gently curved (obtuse) ..... ***latidens*** **(LeConte)**
— Larger (3.6-5.0 mm); third spine stouter, subcapitate; sutures on antennal club acutely curved ..... ***mexicanus*** **(Hopkins)**
6(4). Sides of elytral concavity four-spined (spine 4 obsolete in *emarginatus*) 8
— Sides of elytral concavity five-spined 7
7(6). In *Pinus monticola* (northern Idaho) ..... ***montanus*** **(Eichhoff)**
— In *Pinus monophylla* (Cassia Co., bordering Utah) .... ***confusus*** **(LeConte)**
8(6). Larger (5.5-6.9 mm); third spine emarginate (notched) at its tip ..... ***emarginatus*** **(LeConte)**
— Smaller (3.3-5.7); third spine not emarginate at its tip 9
9(8). Smaller (3.3-4.3 mm); sutures on antennal club curved obtusely ..... ***pini*** **Say**
— Larger (4.0-5.7 mm); sutures on antennal club curved acutely 10
10(9). Frons with a fine median longitudinal carina (ridge) ..... ***integer*** **(Eichhoff)**
— Frons without a median longitudinal carina ..... ***plastographus plastographus*** **(LeConte)**

Ips confusus **(LeConte)**, pinyon ips

Distribution: Mexico: B.C., Chih; USA: Ariz., Calif., Colo., Nev., N.Mex., Utah. In Idaho: City of Rocks, Cassia County.

Hosts: ***Pinus monophylla***, *P. edulis*.

Adult: 3.5-4.2 mm; five spines on each side of elytral declivity (Fig. 50A). The only other five-spined Idaho species (*I. montanus*) occurs in western white pine, *P. monticola*, in northern Idaho.

Gallery: Longitudinal; three to five branches forming a broad tuning fork pattern.

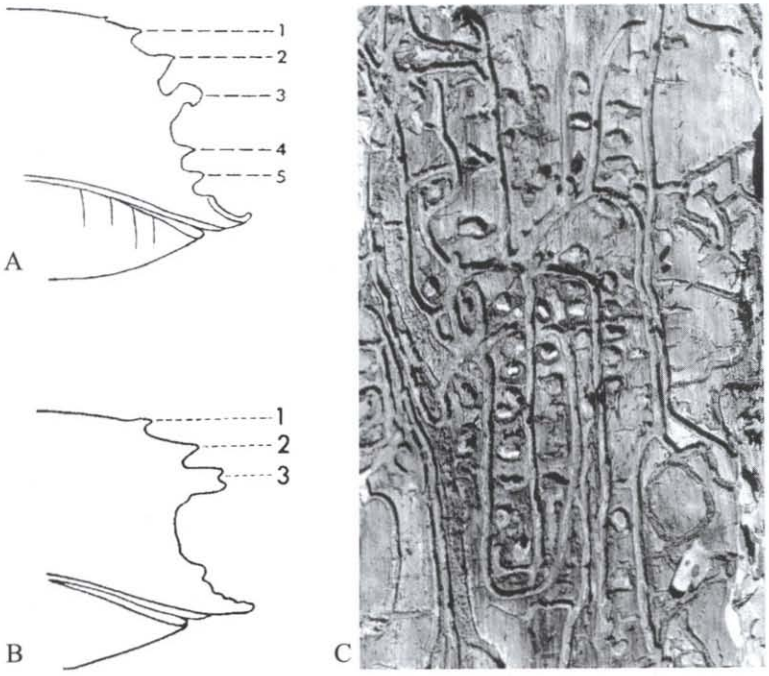


Figure 50. (A) *Ips confusus* declivital spines. (B) *I. emarginatus* spines. (C) *I. emarginatus* galleries in ponderosa pine. (A, B: Hopping 1963b, 1963c; C: Furniss and Carolin 1977.)

Biology: Three to four generations per year in Arizona and New Mexico, probably two in Idaho. Hibernate in dense aggregations under bark in winter where they totally consume the inner bark and score the xylem.

Reference: Massey 1971.

Ips emarginatus (LeConte), emarginate ips

Distribution: Canada: B.C.; Mexico: B.C.; USA: Calif., Mont., Ore., Wash. In Idaho: Ada, Boise, Bonner, Clearwater, Idaho, Kootenai, Latah, Valley counties.

Hosts: ***Pinus ponderosa*** (common), ***P. contorta*** (rare), *P. monticola*, *P. jeffreyi*. Infests bases of mature, dying trees, particularly those infested above with *Dendroctonus ponderosae* Hopkins.

Adult: Our largest *Ips*, 5.5-6.9 mm; very dark brown. Four spines on declivity, the third spine emarginate at its tip, the fourth spine usually obsolete (Fig. 50B).

Gallery: Longitudinal; long (0.6-1.2 m); interconnected laterally; ladder-like (Fig. 50C). Larval mines short; pupal cells large, well defined.

Biology: Not studied. Perhaps two generations per year at the latitude of Idaho, more generations and overlapping of broods possible southward.

Ips hunteri Swaine

Distribution: USA: Ariz., Colo., Utah. In Idaho: Indian Cr., Bonneville County.

Hosts: ***Picea pungens* x *engelmannii***, *P. pungens*. Infests stems of unthrifty or felled trees.

Adult: 3.3-4.0 mm; very dark brown to almost black. Elytra arched in lateral perspective (Fig. 51A); declivity with four spines, spine 3 subcapitate (blunt); antennal sutures bisinuate, center of suture 2 acutely angulate. Frons with a transverse pair of small tubercles near center. Elytral interstriae punctured.

Gallery: Not described.

Biology: Not studied.

Ips integer (Eichhoff)

Distribution: Canada: B.C.; Mexico; Guatemala; USA: western states, except Nev., Wyo. In Idaho: Adams, Benewah, Boise, Boundary, Clearwater, Kootenai, Latah, Lewis, Valley counties.

Hosts: ***Pinus contorta*, *P. ponderosa***, other pines. Tends to infest larger diameter portions of felled or dying trees, tops of which may be infested with *I. pini*.

Adult: 4.6-5.7 mm; brown to almost black. Declivity with four spines, the third spine larger, capitate in male (Fig. 51B) not larger in female (Fig. 51C). Distinguished from *I. pini* by acutely angulate sutures 1 and 2 on antennal club (Fig. 51D) and from *I. plastographus* by having a median longitudinal carina on the frons.

Gallery: One to five elongate egg galleries extend more or less longitudinally from the nuptial chamber. Egg niches closer together than in *I. plastographus*, and larval mines are contiguous.

Biology: Not reported in detail. Young adults do not tunnel into the sapwood near the pupal cells as do those of *I. plastographus*.

Reference: Lanier 1970.

Ips latidens (LeConte)

Distribution: Canada: Alta., B.C., Ont., Que., Sask.; Mexico: Chih.; USA: Ariz., Calif., Colo., Mass., Mont., N.H., N.Mex., N.Y., Ore., Pa., Utah, Wash., W.Va., Wyo. In Idaho: Ada, Benewah, Bonner, Boise, Butte, Cassia, Clearwater, Kootenai, Latah, Valley counties.

Hosts: ***Pinus flexilis*, *P. monophylla*, *P. monticola*, *P. ponderosa*, *P. sylvestris*** (exotic), other pines. Infests slash and tops and limbs of dying trees.

Adult: 2.3-3.6 mm; dark reddish brown; three spines on each side of declivity (Fig. 51E), the lower one being longest in males and rather pointed (*I. mexicanus*, our other three-spined species, is larger and has a

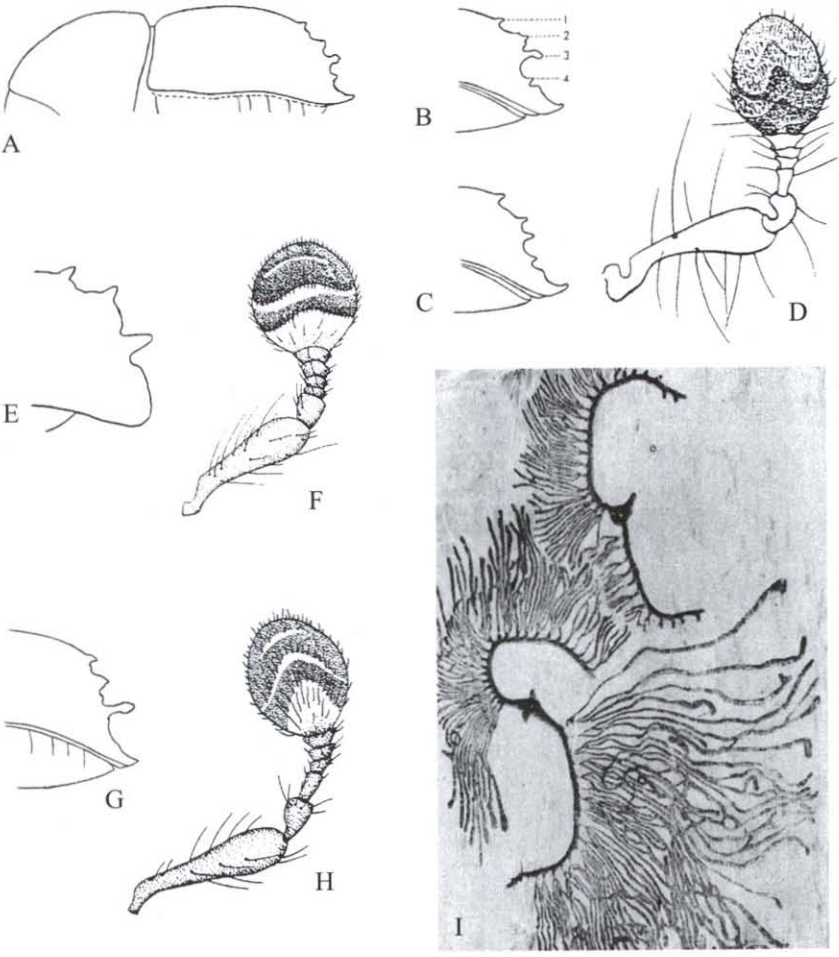


Figure 51. (A) *Ips hunteri* side profile. (B) *I. integer* spines, male. (C) *I. integer* spines, female. (D) *I. integer* antenna. (E) *I. latidens* spines. (F) *I. latidens* antenna. (G) *I. mexicanus* spines. (H) *I. mexicanus* antenna. (I) *I. mexicanus* galleries. (A, E, F, H, I: D. R. Lauck; B, C: Hopping 1963d; G, I: Hopping 1963c; D: Swain 1918.)

subcapitate lowest, or third, spine). Sutures on antennal club gently curved (Fig. 51F).

Gallery: Radiate with two to five short (2-5 cm) egg galleries extending from a rather large central chamber.

Biology: Apparently one generation per year. Flight is most intense in late May to early July. Females lay an average of 64 eggs. Larvae have three instars. Broods consist of an equal number of males and females.

Reference: Miller and Borden 1985.

***Ips mexicanus* (Hopkins)**, Monterey pine ips

Distribution: Canada: Alta., B.C.; USA: Alaska (Douglas Island), western

states except Wash., Nev., N.Mex. In Idaho: Blaine, Bonner, Caribou, Kootenai, Payette, Valley counties.

Hosts: ***Pinus contorta***, ***P. ponderosa***, other pines. Infests the stems of dying and recently felled trees.

Adult: 3.6-5.0 mm; dark reddish brown. Declivity with three spines, the third one large, cylindrical, and subcapitate (Fig. 51G) as opposed to *I. latidens*, which is smaller and has a more pointed third spine. Sutures on antennel club acutely curved (Fig. 51H).

Gallery: One or two strongly curved egg galleries extend from nuptial chamber, often forming an incurved or S-shaped pattern (Fig. 51I). Egg niches large, located on outer curve; galleries deeply etch sapwood. Two to four larval mines originate from each egg niche.

Biology: Probably one generation per year in Idaho.

Reference: Struble 1961 (as *radiatae* Hopkins). Note: Cognato (2000) transferred *I. mexicanus* to a new genus, *Pseudips*.

Ips montanus (Eichhoff)

Distribution: Canada: B.C.; USA: Calif., Mont., Ore., Wash. In Idaho: Benewah, Bonner, Clearwater, Kootenai, Latah, Shoshone counties.

Hosts: ***Pinus monticola***, *P. albicaulis*, *P. balfouriana*, *P. contorta*. Infests dying or felled western white pine, commonly in association with *Dendroctonus ponderosae*.

Adult 4.6-5.4 mm long; very dark brown. Lower male frons (Fig. 52A) with a prominent median tubercle. Declivity with five spines on each lateral edge, similar to *I. confusus* (Fig. 50A), but the latter is confined to *Pinus monophylla* in Cassia County, next to Utah.

Gallery: Robust, with three to six branches (Fig. 52B), each up to 18 cm long, extending from a large nuptial chamber that may also have one or two short (1 cm) spurs. Gallery branches spread wide apart, turning or ending to avoid neighboring galleries. Eggs are laid in niches, spaced less than 3 per cm, often on one side if another gallery is nearby.

Biology: Not studied.

Ips pilifrons utahensis Wood

Distribution: USA: Ariz., Colo., Utah, Wyo. In Idaho: Bonner, Franklin, Latah counties.

Host: ***Picea engelmannii***.

Adult: 4.4-5.0 mm; very dark brown. Sides of elytral declivity four-spined, spine 3 longer and capitate in both sexes. Larger than *I. tridens engelmanni* and with generally less protuberant frons on females.

Gallery: Not described.

Biology: Not studied.

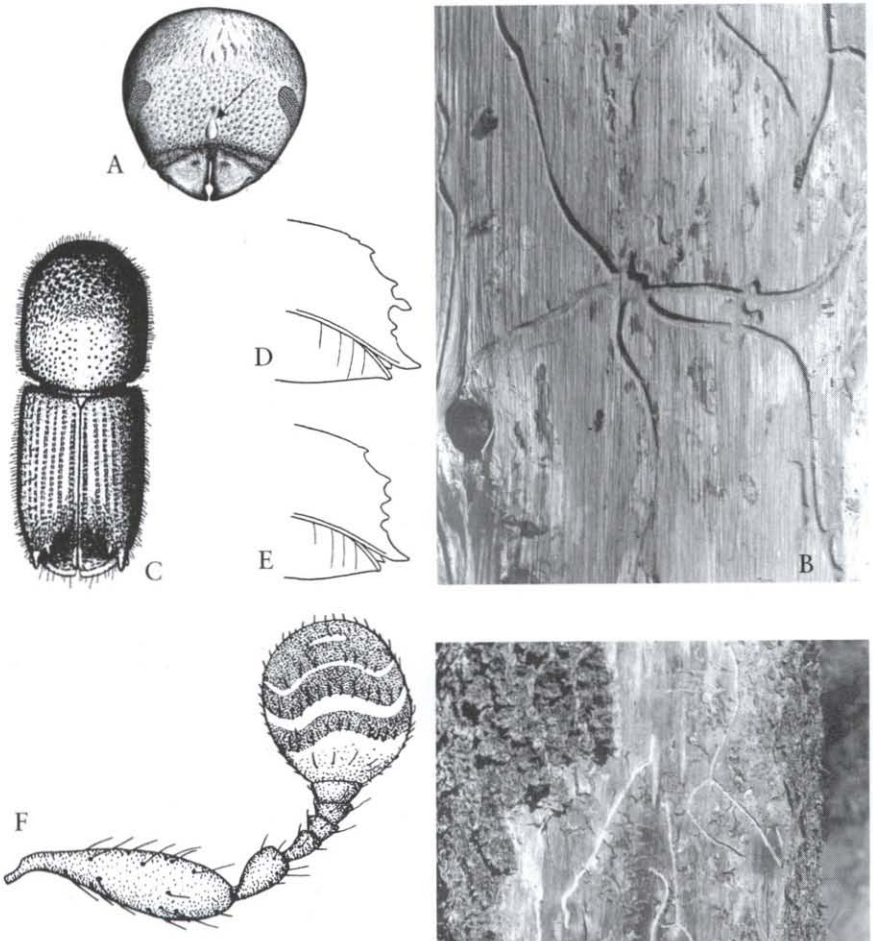


Figure 52. (A) *Ips montanus* head with median tubercle (arrow) above mouth. (B) *Ips montanus* weathered galleries in western white pine. (C) *I. pini* adult. (D) *I. pini* spines on male. (E) *I. pini* spines on female. (F) *I. pini* antenna. (G) *I. pini* galleries in lodgepole pine. (A: Hopping 1965b; C-E: Hopping 1964; F: D. R. Lauck.)

Ips pini **(Say)**, pine engraver

Distribution: Widely distributed. Canada: all provinces except N.W.T.; Mexico: Chih.; USA: northeastern and lake states to N.C., all western states. In Idaho: Adams, Benewah, Boise, Bonneville, Bonner, Boundary, Cassia, Clearwater, Custer, Idaho, Kootenai, Latah, Lemhi, Lewis, Power, Valley counties.

Hosts: ***Pinus ponderosa***, ***P. contorta***, *P. banksiana*, *P. jeffreyi*, *P. strobus*. Infests fresh logging slash, tops of snow-broken trees, and dense groups of immature trees.

Adult: 3.3-4.3 mm; dark reddish brown to almost black (Fig. 52C). Declivity with four teeth on each elytron, the third tooth larger, capitate in male (Fig. 52D), but equal to second in female (Fig. 52E). Frons with a median tubercle; other tubercles are aligned forward of it along the anterior edge. Basal segments of antennal club obtuse (Fig. 52F), not acutely angular in their middles as they are in *I. plastographus plastographus*.

Gallery: One to five branches, each of which may extend 3-12 cm longitudinally from the nuptial chamber, often in the shape of a tuning fork at higher densities of attack but sprawling more at low density (Fig. 52G).

Biology: Two generations per year in Idaho, more in warmer parts of its range. Most progeny of the second generation drop to the ground in fall and overwinter in the litter. They fly in late April-May to infest slash (live pines are not susceptible then). Their progeny mature and fly to infest standing trees and slash in late June-July. Severe outbreaks have occurred in unthinned, immature, ponderosa pine following severe drought. Outbreaks are short lived.

Reference: Sartwell et al. 1971.

Ips plastographus plastographus (LeConte)

Distribution: Canada: B.C.; USA: Calif., Mont., Ore., Wyo. In Idaho: Fremont, Idaho, Kootenai, Shoshone, Valley counties.

Hosts: ***Pinus contorta***, ***P. ponderosa*** (one record, Valley Co.), ***P. albicaulis*** (one record, Seven Devils Mountains, Idaho Co.). Infests upper side of felled trees.

Adult: 4.0-5.2 mm; brown to almost black. Declivity of each elytron armed with four spines. In males (Fig. 53A), the third spine is larger, capitate, and bent slightly downward at its tip; that of females (Fig. 53B) is smaller and pointed. Differs from *I. pini* by its larger size and acutely angular basal segments of the antennal club (Fig. 53C), and from *I. integer* by the lack of a carina on the frons.

Gallery: Two or three egg galleries run longitudinally from the nuptial chamber, often shaped like a tuning fork with parallel arms. Egg niches usually not as close to each other as those of *I. integer*, and larval mines are not contiguous.

Biology: Not reported in detail. Young adults tend to deeply score the wood surface and may bore 1 cm into the sapwood prior to emerging through the bark.

Reference: Lanier 1970.

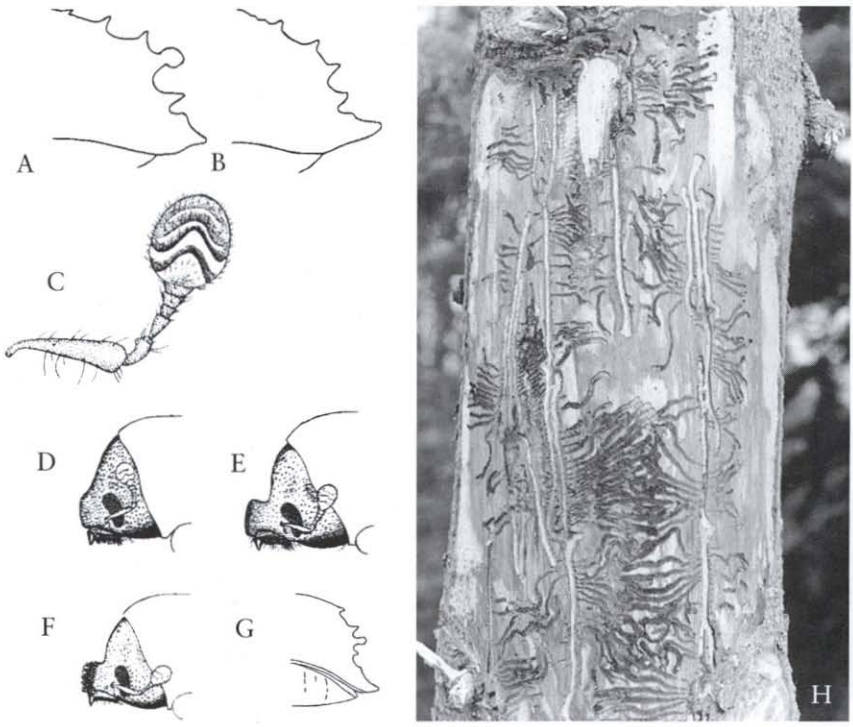


Figure 53. (A) *Ips plastographus plastographus* male spines. (B) *I. plastographus plastographus* female spines. (C) *I. plastographus plastographus* antenna. (D-F) *I. tridens engelmanni* variations in protuberance and pubescence of frons. (G) *I. tridens engelmanni* spines. (H) *I. tridens engelmanni* galleries in Engelmann spruce. (A-C: D. R. Lauck; D-G: Hopping 1965a.)

Ips tridens engelmanni Swaine

Distribution: Canada: Alta., B.C., N.W.T., Yuk.; USA: Alaska, Calif., Mont., Ore., Wash., Wyo. In Idaho: Idaho, Kootenai, Valley counties.

Hosts: ***Picea engelmannii***, *P. glauca*, *P. sitchensis*. Infests stems of unthrifty, cut or fallen trees.

Adults: 3.3-4.3 mm long; dark brown to blackish. Declivity with four spines on each elytron (Fig. 53G), which are slightly longer on males. Frons of females varies greatly in protuberance (Figs. 53D-F). Some females reproduce by gynogenic parthenogenesis (mating with a male but without incorporation of DNA from the male), creating all-female broods with frons like the mother (protuberant or not). Consequently, broods in the same tree may differ in this character. Differs from *I. pilifrons utahensis* by its smaller size and more protuberant frons.

Gallery: Consists of an entrance chamber and two to five branches parallel to the stem, often close together and up to 25-30 cm long (Fig. 53H).

Biology: Presumed to have one generation per year.

Reference: Lanier and Oliver 1966 (gynogenesis).

Orthotomicus

Polygamous. Represented in North America by *O. caelatus*. Allied to *Ips* (declivity concave, armed with spines).

Orthotomicus caelatus (Eichhoff)

Distribution: Canada: All provinces; USA: All states in which *Pinus*, *Picea*, or *Larix* occur naturally. In Idaho: Benewah, Blaine, Boise, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Shoshone, Valley counties.

Hosts: ***Pinus contorta***, ***P. monticola***, ***P. ponderosa***, other pines, ***Picea engelmannii***, *P. glauca, P. sitchensis, Larix occidentalis.* Infests fresh stumps and lower stems of dying standing trees.

Adult: 2.4-3.3 mm; very dark reddish brown (Figs. 54A, 54B). Antennal club truncate (Fig. 54C). Declivity abrupt, very steep, armed with three spines (larger in male), the upper two situated on the edge of the declivity and the third inward from the edge (Fig. 54D).

Gallery: Radiate type. The gallery and pupal cells deeply score sapwood.

Biology: One to two generations per year reported for Alberta, overwintering in all stages.

Reference: Reid 1955.

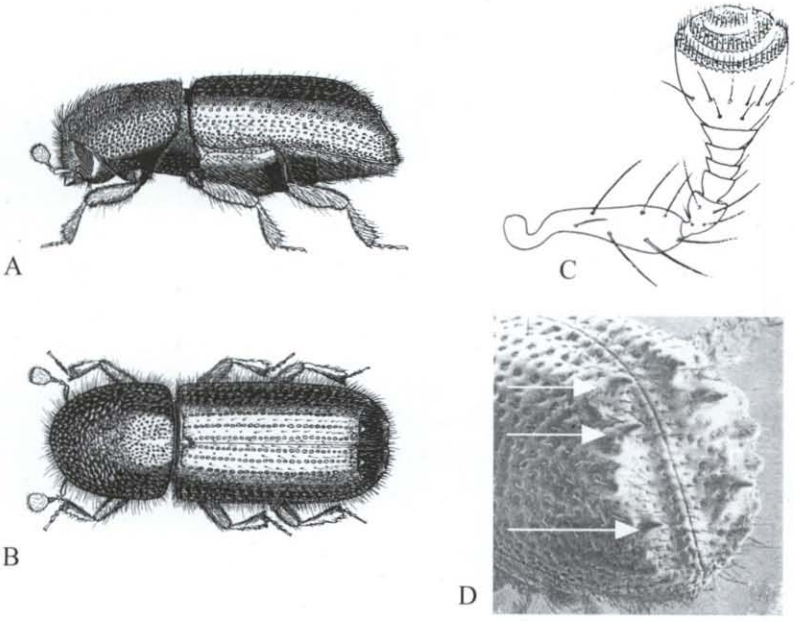


Figure 54. *Orthotomicus caelatus*. (A, B) Adult. (C) Antenna. (D) Declivity with spines. (A, B: M. D. Deyrup; C: Hopping 1963a; D: Bright 1976.)

Pityogenes

Polygamous. Three species occur in Idaho, infesting pines and spruce. The elytral declivity is almost concave in males, sulcate in females, and armed with two or three spines that are larger in males. Females are unique among Idaho scolytids in having a large fossa (cavity) on the front of their head.

Key to Species of Pityogenes

1. Female frons with a large, cone-shaped cavity (fossa) extending above eyes; male declivity with three pairs of broad-based teeth; infesting five-needle pines (*Pinus monticola*, *P. albicaulis*, *P. flexilis*) ..... ***fossifrons*** **(LeConte)**

— Female fossa either large and suboval or small and divided; male declivity with two pairs of slender teeth, upper pair long and hooked downward; infesting two- or three-needle pines (*Pinus contorta*, *P. ponderosa*) 2

2(1). Larger (2.3-3.7 mm); female fossa large, not divided, extending above eyes; infesting *Pinus ponderosa* ..... ***carinulatus*** **(LeConte)**

— Smaller (1.9-2.9 mm); female fossa small, divided (sometimes plugged with host material); infesting *Pinus contorta* ..... ***knechteli*** **Swaine**

Pityogenes carinulatus (LeConte)

Distribution: Canada: B.C.; Mexico: Chih.; USA: All western states and Nebr., S.Dak. In Idaho: Adams, Benewah, Boise, Boundary, Butte, Kootenai, Latah, Lewis, Valley counties.

Hosts: ***Pinus ponderosa***, *P. jeffreyi,* less common in other pines. Infests stems and tops of stressed or dying young trees, and slash.

Adult: 2.3-2.7 mm; dark brown. Male with two spines on each side of the elytral declivity, the upper one long and hooked downward at the end (Fig. 55A). Female with a very large, half-oval, frontal fossa (Fig. 55B) and two small spines on each side of the declivity.

Gallery: Radiate, often with four to seven branches extending from the nuptial chamber.

Biology: Not studied.

Pityogenes fossifrons (LeConte)

Distribution: Canada: B.C., USA: western states except N.Mex. In Idaho: Benewah, Bonner, Boundary, Clearwater, Franklin, Idaho, Kootenai, Shoshone, Valley counties.

Hosts: ***Pinus monticola***, less commonly ***P. flexilis***, ***P. albicaulis***. Infests stems of young standing trees.

Adult: 1.8-2.5 mm; very dark brown, almost black. Each side of male declivity armed with three equally spaced, pointed teeth, none of which is hooked; female's teeth smaller. Female with a deep, cone-shaped fossa on central third of frons, extending above upper level of eyes (Fig. 55C).

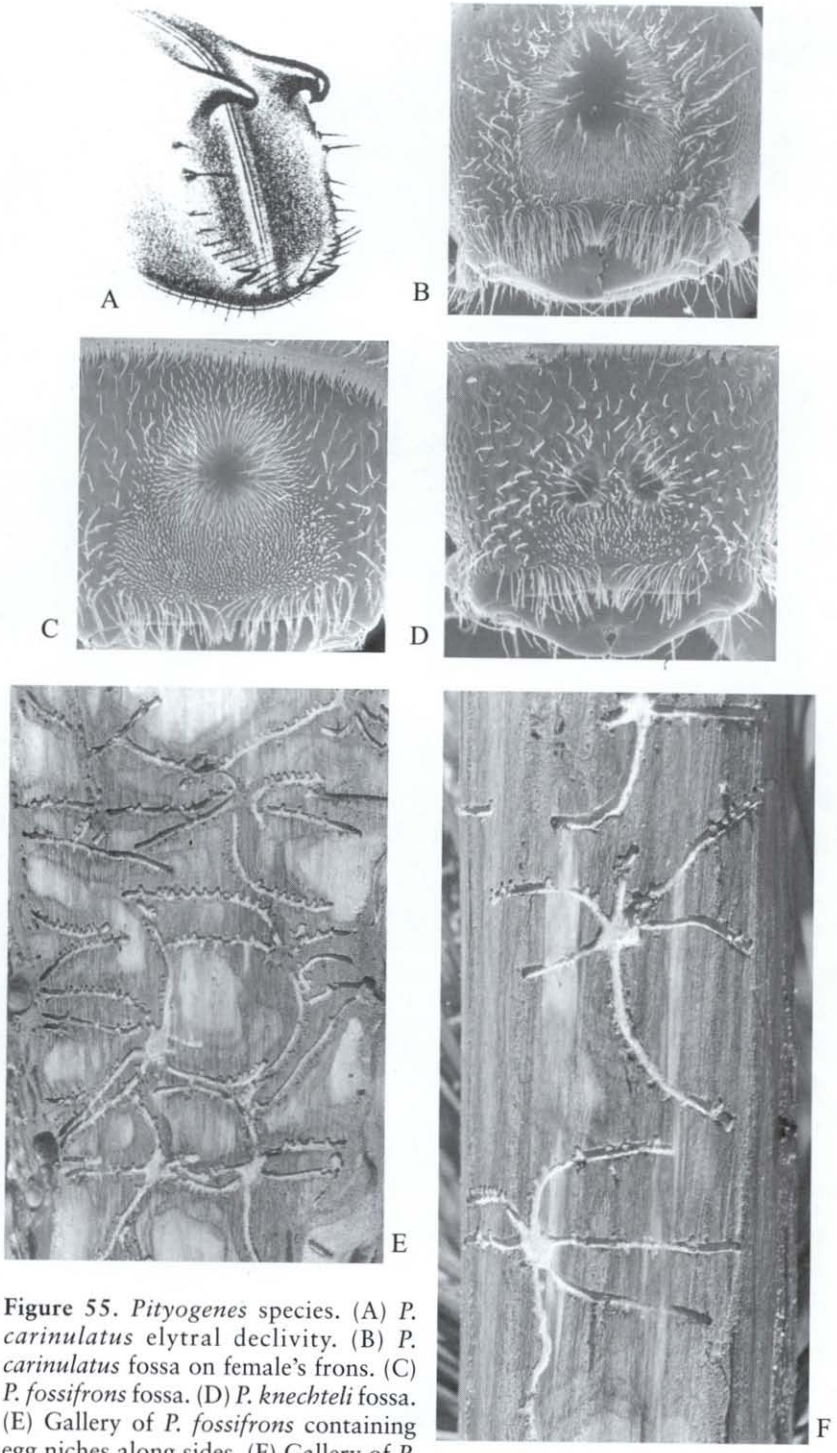


Figure 55. *Pityogenes* species. (A) *P. carinulatus* elytral declivity. (B) *P. carinulatus* fossa on female's frons. (C) *P. fossifrons* fossa. (D) *P. knechteli* fossa. (E) Gallery of *P. fossifrons* containing egg niches along sides. (F) Gallery of *P. knechteli* containing egg niches along sides. (A: Swaine 1918.)

Gallery: Radiate with several parental galleries extending from the nuptial chamber (Fig. 55E). The parental galleries tend to turn across grain as though avoiding galleries located above and below.

Biology: Not studied.

Pityogenes knechteli **Swaine**

Distribution: Canada: Alta., B.C., Sask. (Cypress Hills); USA: Calif., Colo., Mont., Ore., Utah, Wyo. In Idaho: Blaine, Boundary, Caribou, Cassia, Custer, Gooding, Idaho, Valley counties.

Host: ***Pinus contorta***.

Adult: 1.9-2.9 mm; brown to almost black. Male declivity with two spines on each side, the upper one of which is larger and hooked downward at its end. Female with a divided fossa (two cavities) on frons (Fig. 55D) sometimes obscured by resinous aggregate.

Gallery: Radiate, commonly with six branches each made by a separate female (Fig. 55F).

Biology: Not studied.

Pityokteines

Polygamous. Four Idaho species; infesting *Abies* except *P. ornatus* in *Pinus*. They are small (1.6-2.9 mm), dark brown beetles, similar to *Pityophthorus* except for their obliquely truncated antennal club (Fig. 56A) and three pairs of spines of varying size on the elytral declivity.

Key to Species of Pityokteines

1.	In *Pinus;* male elytral spines prominent	***ornatus*** **(Swaine)**
—	In *Abies*, rarely *Pinus contorta*; male elytral spines small	2
2(1).	In *Abies grandis*	***elegans*** **Swaine**
—	In *Abies lasiocarpa*; rarely *Pinus contorta*	3
3(2).	Smaller (1.6-1.9 mm); somewhat stouter; frons of female with sparse, short setae; elytral declivity armed on each side with three small, pointed teeth	***lasiocarpi*** **(Swaine)**
—	Larger (1.7-2.3 mm); more slender; frons of female with abundant, very long setae; elytral declivity with three minute tubercles on each side, sometimes absent	***minutus*** **(Swaine)**

Pityokteines elegans **Swaine**

Distribution: Canada: B.C.; USA: Calif., Wash., Ore. In Idaho: Benewah, Clearwater, Kootenai, Latah counties.

Hosts: ***Abies grandis***, *A. concolor*, *A. magnifica*.

Adult: 1.9-2.6 mm; dark brown. Female with dense setal brush on frons; that of male shorter, less dense. Declivity with three small spines on each side, slightly larger in males.

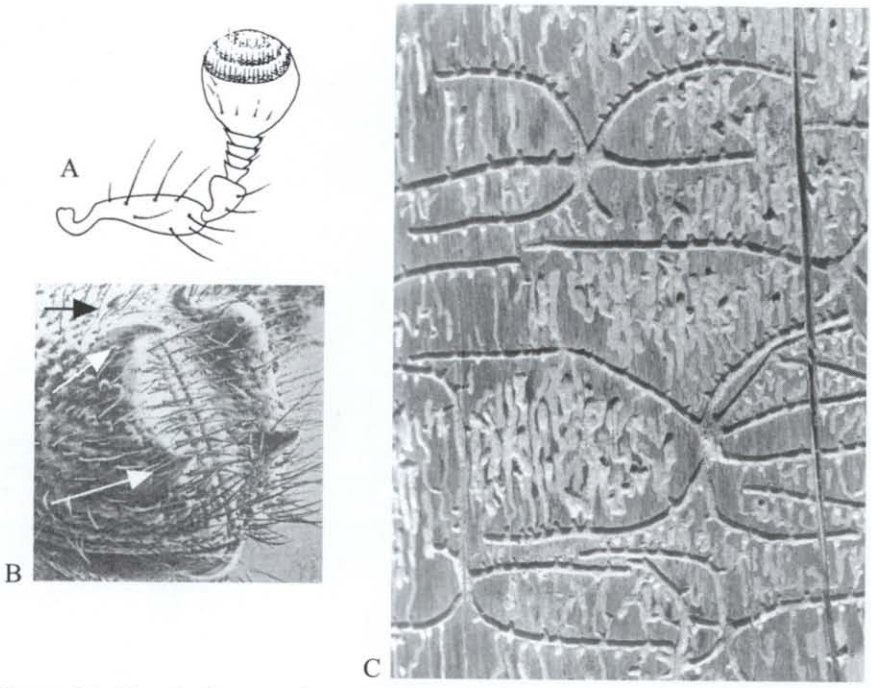


Figure 56. *Pityokteines* species. (A) Generalized antennal club of *P. ornatus*. (B) Declivity and spines of *P. ornatus*. (C) Weathered galleries of *P. elegans* on sapwood of grand fir. (A: Hopping 1963a; B: Bright 1976.)

Gallery: Radiate type, consisting typically of four to six branches that turn across grain etching the wood surface (Fig. 56C). Eggs tend to be laid only along one side of gallery.

Biology: One to one and a half generations per year may occur, overwintering as larvae, pupae, and adults. Flight to new hosts extends through summer, peaking in August.

Reference: Kirtibutr 1974.

Pityokteines lasiocarpi (Swaine)

Distribution: Canada: Alta., B.C.; USA: Mont., Ore., Utah , Wash. In Idaho: Bear Lake, Boise, Bonner, Boundary, Franklin, Idaho, Kootenai, Shoshone, Twin Falls counties.

Hosts: ***Abies lasiocarpa***, rarely ***Pinus contorta***, *A. amabilis*, *Picea engelmannii*, *Pseudotsuga menziesii*. Infests stems of dying standing trees.

Adult: 1.6-1.9 mm; dark brown. Frons of both sexes with fine, rather sparse, short hair. Margins of declivity rounded, armed on each side with three small, pointed teeth.

Gallery: Radiate, faintly etching wood.

Biology: Not studied.

Pityokteines minutus (Swaine)

Distribution: Canada: Alta., B.C.; USA: Ariz., Colo., Mont., N.Mex., Ore., Utah, Wash., Wyo. In Idaho: Bear Lake, Boundary, Clearwater, Kootenai, Twin Falls, Valley counties.

Host: ***Abies lasiocarpa.***

Adult: 1.7-2.3 mm; dark brown. More slender than our other species. Frons of females has a dense setal brush; the brush of males is shorter and less dense. Sides of male declivity with three minute tubercles, equal in size, reduced to inconspicuous granules in female.

Gallery: Radiate.

Biology: Not studied.

Pityokteines ornatus (Swaine)

Distribution: Canada: B.C.; USA: Ariz., Calif., Colo., Mont., N.Mex., Ore., S.Dak., Utah. In Idaho: Bear Lake, Bonner, Clearwater, Idaho, Kootenai, Twin Falls, Valley counties.

Hosts: ***Pinus ponderosa***, *P. attenuata*, *P. contorta*, *P. edulis*, *P. jeffreyi*, *Picea pungens*. Infests stems of dying or felled trees often in association with *Ips* species.

Adult: 2.1-2.9 mm; very dark reddish brown. Female frons with less dense setae than our other species; male frons similar to the female. Elytral declivity with three spines, the middle spine of male larger, with inflated base; spines of female smaller (Fig. 56B).

Gallery: Radiate; may be entirely hidden in phloem.

Biology: Not studied.

Pityophthorus

Polygamous. Idaho has 21 species of *Pityophthorus*, more than any other genus. They are small (1.3-3.1 mm), shiny brown or black beetles. Frons of females vary from densely setiferous (Fig. 57C) to glabrous; frons of males are usually glabrous or nearly so (Fig. 57D), sometimes with a carina (fine ridge). The elytral declivity (Figs. 57E, 57F) is sulcate or bisulcate (grooved), usually with minute tubercles aligned in a row on interstriae 1, 3, or both. They typically infest branches and twigs of live trees and branches and stems of trees killed by other bark beetles. Galleries are usually radiate (Fig. 58F).

Pityophthorus species are extremely difficult to identify specifically, except *P. alpinensis*, because it is the only species in subalpine larch, *Larix lyallii*. They may be confused with *Pityokteines* but have a round or oval antennal club (Figs. 57A, 57B) instead of the obliquely truncated club of *Pityokteines*. Few species of *Pityophthorus* have been studied biologically, and we have not found it possible to construct a practical key suited to the anticipated users of this field guide. Outdoor adventurers will do well to take solace in identifying them to genus. Those who wish to delve deeper

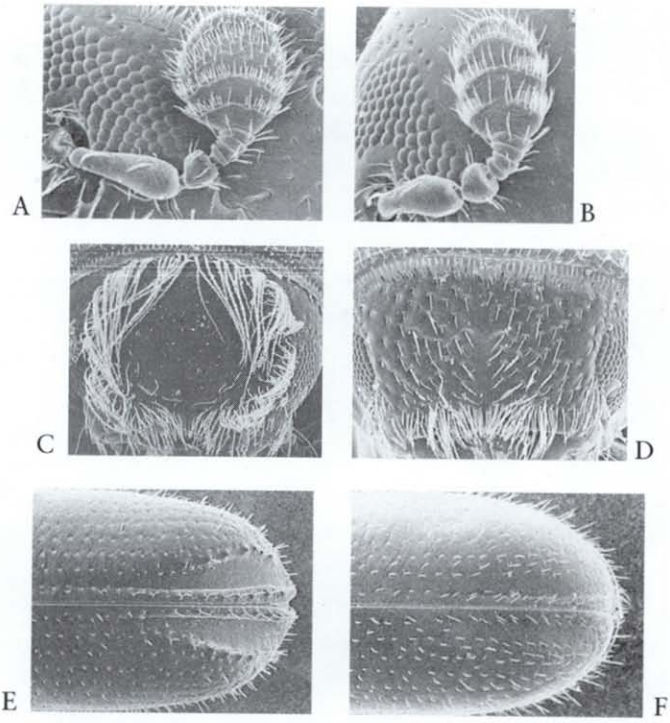


Figure 57. *Pityophthorus* species differ in the shape of the antennal club, being round (A) or oval (B); in the pubescence of the frons, females generally being pubescent (C) and males more glabrous (D); and in the elytral declivity that varies from sulcate (E) to convex (F). (Bright 1981.)

should consult Bright (1981) and Wood (1982). The classification of subspecies followed here is arbitrarily that of Bright.

Pityophthorus absonus Blackman

Distribution: Canada: Alta., B.C.; USA: Calif., Colo., Mont., Nev., Utah. In Idaho: Boundary, Caribou, Cassia counties. Most often found at higher elevation.

Hosts: ***Abies lasiocarpa***, ***Pinus contorta***, ***P. ponderosa***, *P. albicaulis*, *P. monticola*, *P. aristata*, *P. flexilis*. Infests small shaded-out branches and suppressed saplings.

Adult: 1.7-2.4 mm; very dark brown. Female with dense brush on frons; male frons glabrous with a small, rather toothlike, longitudinal carina (ridge) on lower portion. Declivity convex, steep. Interstriae 1 weakly elevated, with or without a row of very fine granules; interstriae 3 with a row of fine granules.

Gallery: Not described.

Biology: Not studied.

Pityophthorus alpinensis **G. Hopping**

Distribution: Canada: Alta.; USA: Mont. In Idaho: Grave Peak and Salmon Mountain, Idaho County.

Host: ***Larix lyallii***. Infests broken-off branches of 1 cm diameter and larger.

Adult: 2.3-2.7 mm; almost black (Fig. 58A). Frons of female concave, finely punctured, encircled by a row of long setae (Fig. 58B). Male frons convex, coarsely punctured, bare of setae, with a median longitudinal carina (Fig. 58C).

Gallery: Not described.

Biology: Not studied.

Pityophthorus aquilus **Blackman**

Distribution: Canada: Alta., B.C., Sask.; USA: Ariz., Calif., Colo., Mont., N.Mex., S.Dak., Utah, Wyo. In Idaho: Cassia County, east of Bostetler Guard Station, Sawtooth National Forest.

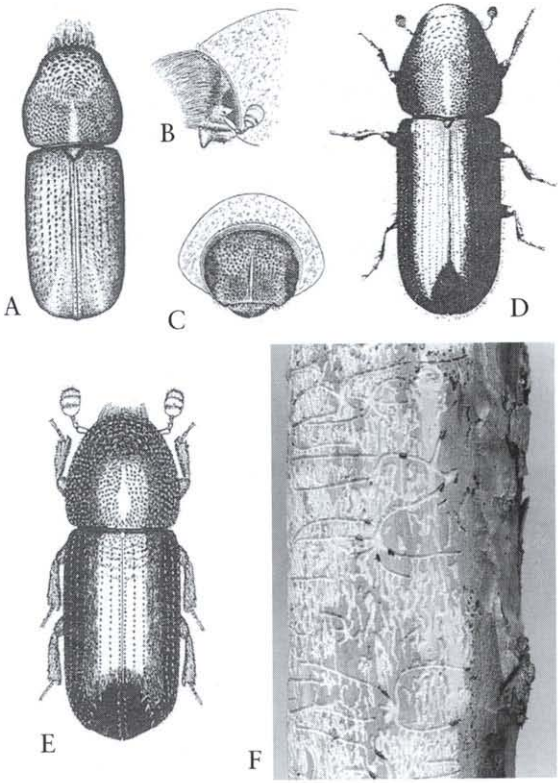


Figure 58. (A) *Pityophthorus alpinensis* adult. (B) *P. alpinensis* setiferous female frons. (C) *P. alpinensis* glabrous male frons with median ridge. (D) *P. nitidus* adult. (E) *P. pulchellus tuberculatus* adult. (F) Radiate galleries of *P. pseudotsugae* exposed by shaving bark. (A-C: Hopping 1960; D: Swaine 1918; E: M. D. Deyrup; F: U.S. Forest Service.)

Hosts: ***Abies lasiocarpa***, ***Pinus contorta***, *P. aristata*, *P. flexilis*, *P. ponderosa*. Infests small branches of dying trees.

Adult: 1.9-2.2 mm; very dark brown. Female frons sparsely pubescent; male frons glabrous with sharply elevated median carina from mouth to upper level of eyes. Elytral declivity evenly convex, weakly bisulcate; interstriae 1 and 3 with fine to moderate granules.

Gallery: Not described.

Biology: Apparently has one-year life cycle, emerging and ovipositing in new hosts in mid-summer.

Reference: Stevens 1973 (as *P. opimus* Blackman).

Pityophthorus barberi **Blackman**

Distribution: Mexico: Dgo., N.L.; USA: Ariz., Colo., N.Mex., Utah. In Idaho: McCall, Valley County.

Hosts: ***Pinus ponderosa***, *P. cembroides*, *P. edulis*, *P. leiophylla*. Infests shaded-out branches of living trees.

Adult: 1.7-2.2 mm; very dark reddish brown. Frons of both sexes with sparse setae and a curved, transverse carina between upper level of eyes. Declivity: interstriae 1 and 3 weakly elevated, each with a row of fine granules; interstriae 2 widened, flat.

Gallery: Not described.

Biology: Not studied.

Pityophthorus blandus **Blackman**

Distribution: USA: Ariz., Calif., Colo., Nev., Utah. In Idaho: City of Rocks, Cassia County.

Hosts: ***Pinus monophylla***, *P. edulis*. Infests branches.

Adult: 2.0-2.8 mm; very dark brown. Female frons densely covered with yellowish setae, longer and incurved on periphery. Male frons glabrous with a short, weakly elevated median carina. Declivity bisulcate; interstriae 1 with a row of fine granules; interstriae 3 with a row of larger, rounded granules.

Gallery: Not described.

Biology: Not studied.

Pityophthorus boycei **Swaine**

Distribution: Canada: Alta., B.C., Y.T.; USA: Calif., Colo., Mont., Ore., S.Dak., Wyo. In Idaho: Clark Fork, Bonner County (one specimen, 1912).

Hosts: **Idaho host unknown**, *Pinus contorta*, *P. ponderosa*, *P. monticola*, *P. aristata*. Tunnels in pith of small twigs that may then break and fall while still green.

Adult: 2.0-3.1 mm; very dark brown. Antennal club broadly oval in female, narrower in male. Frons with a median, longitudinal carina; lacking conspicuous setae in both sexes. Declivity convex; interstriae 1 and 3 with row of fine granules.

Gallery: Not described.

Biology: Not studied.

Pityophthorus confertus confertus Swaine

Distribution: Canada: B.C.; USA: Calif., Colo., Mont., Ore., Utah. In Idaho: Bear Lake, Benewah, Bonner, Boundary, Cassia, Idaho, Kootenai, Latah, Shoshone, Valley counties.

Hosts: ***Pinus contorta***, ***P. ponderosa***, ***P. monophylla***, ***P. mugo*** (exotic), *P. jeffreyi*, *P. lambertiana*, *P. coulteri*, *P. attenuata*, *P. flexilis*, *P. monticola*. Infests branches and stems, sometimes alone but often in trees infested by *Ips* and *Dendroctonus*.

Adult: 1.8-2.6 mm; very dark brown. Female frons densely covered with setae that are longer and curved inwardly on the periphery. Male frons not pubescent; distinctly impressed from mouth to upper level of eyes, median area at top of impression raised. Declivity steep, bisulcate; six or more fine granules on interstriae 1 and 3.

Gallery: Radiate; egg galleries average 4 cm long. Eggs spaced about 3 mm apart, closer toward end of gallery.

Biology: Adult stage attained in about two months.

Reference: Amman et al. 1974.

Pityophthorus confinis (LeConte)

Distribution: Canada: B.C.; USA: Ariz., Calif., Colo., Mont., Nev., N.Mex., Ore., Utah, Wash., Wyo. In Idaho: Benewah, Boise, Kootenai, Latah counties.

Hosts: ***Pinus ponderosa***, *P. albicaulis, P. contorta*, *P. coulteri*, *P. lambertiana*, *P. monophylla*, *P. sabiniana*, *P. strobiformis*. Infests needle-bearing (terminal) portion of small branches and tops of immature trees.

Adult: 2.5-3.1 mm; dark brown to dark reddish brown. Frons of female densely pubescent, setae longer toward periphery; male frons glabrous with distinct longitudinal carina, more strongly elevated near midpoint or near upper level of eyes. Declivity bisulcate with a row of fine tubercles on interstriae 1 and 3.

Gallery: Radiate.

Biology: Not studied.

Pityophthorus deletus LeConte

Distribution: Mexico: Coah., Dgo.; USA: Ariz., Calif., Colo., N.Mex., S.Dak.,

Tex., Utah, Wyo. In Idaho: Bear Lake, Cassia counties.

Hosts: ***Pinus contorta***, ***P. flexilis***, ***P. monophylla***, *P. cembroides*, *P. edulis*, *P. strobiformis*, *Picea engelmannii*. Infests small branches.

Adult: 1.4-2.0 mm; very dark brown. Extremely variable. Female frons may vary from weakly concave to weakly convex, with scattered to dense setae. Male frons glabrous with a longitudinal carina varying from short to long, weakly elevated to toothlike. Biological studies may reveal that more than one species is involved (Bright 1981).

Gallery: Not described.

Biology: Not studied.

Pityophthorus digestus **(LeConte)**

Distribution: Canada: B.C.; Mexico: Dgo.; USA: Ariz., Calif., Nev., N.Mex., Ore., Wash., Wyo. In Idaho: Boise, Kootenai, Latah, Lemhi counties.

Hosts: ***Pinus ponderosa***, ***P. contorta***, *P. jeffreyi*. Infests small branches.

Adult: 1.5-2.0 mm; very dark brown. Frons convex, with a low longitudinal carina in both sexes; vestiture sparse, short. Declivity convex, flattened to very weakly sulcate; interstriae 1 and 3 with a row of fine granules.

Gallery: Not described.

Biology: Not studied.

Pityophthorus grandis **Blackman**

Distribution: Canada: B.C.; USA: Ariz., Calif., Colo., Nebr., N.Mex., S.Dak., Tex., Utah. In Idaho: Snow Creek, Boundary County.

Hosts: ***Pinus ponderosa***, *P. flexilis*, *P. leiophylla*, *P. monophylla*.

Adult: 2.4-2.9 mm; dark reddish brown. Female frons strongly impressed on lower half, raised on upper half. Impressed area of female frons with moderately dense setae; male frons with sparse setae. Declivity sloping, bisulcate; interstriae 1 and 3 with a row of fine granules that are closer together on upper half. Interstrial punctures each with a moderately long seta. Apex of elytra distinctly pointed.

Gallery: Not described.

Biology: Not studied.

Pityophthorus murrayanae murrayanae **Blackman**

Distribution: Canada: Alta., B.C., Man., N.B., N.W.T., Ont.; USA: Alaska, Ariz., Calif., Colo., Mont., Nev., Ore., Utah, Wyo. In Idaho: Benewah, Latah, Lemhi, Valley counties.

Hosts: ***Pinus flexilis***, ***Abies grandis***, ***Pseudotsuga menziesii***, *Pinus albicaulis*, *P. contorta*, *P. ponderosa*, *Picea engelmannii*, *Abies lasiocarpa*.

Adult: 1.9-2.5 mm; reddish brown. Female extremely variable (polymor-

phic), with frons varying from glabrous to pubescent and setae from short to long. Male frons glabrous, deeply impressed, with raised callus above. Declivity moderately bisulcate; interstriae 1 with a row of five or more fine granules; interstriae 3 with about four or five very small granules, each with a long, stout seta arising from posterior margin.

Gallery: Not described.

Biology: Not studied.

Pityophthorus nitidulus (Mannerheim)

Distribution: Canada: Alta., B.C.; USA: Alaska, Ariz., Calif., Ore., Nev., Utah, Wash., Wyo. In Idaho: Benewah, Bonner, Boundary, Franklin counties.

Hosts: ***Picea engelmannii***, ***Pinus monticola***, *Picea glauca*, *P. breweriana*, *P. sitchensis*, *Pinus aristata*, *P. contorta*, *P. flexilis*, *P. lambertiana*, *P. muricata*, *P. ponderosa*, *P. radiata*. Infests limbs and stems.

Adult: 1.7-2.7 mm; very dark reddish brown. Female frons with flattened, abundant, long, yellow setae, longer and incurved on the periphery. Male stouter; frons glabrous with a more prominent lateral and a less prominent longitudinal carina. Declivity moderately bisulcate; interstriae 1 with a row of very fine granules; interstriae 3 with a row of fine, acute, larger granules and a row of long setae.

Gallery: Radiate; three or four egg galleries extend from an irregularly shaped nuptial chamber.

Biology: Larvae mine away from egg galleries in all directions and pupate in the bark. Callow adults may feed in the phloem before leaving the tree.

Pityophthorus nitidus (Swaine)

Distribution: Throughout Canada; USA: Colo., Maine, Mont., Ore. In Idaho: Salmon Mountain, Idaho County.

Hosts: ***Pinus albicaulis***, ***Picea engelmannii***, *Pinus contorta*, *P. resinosa*, *P. strobus*, *P. flexilis*, *Picea glauca*, *P. mariana*.

Adult: 1.8-2.3 mm; very dark reddish brown (Fig. 58D). Female frons concave; setae variable, short to long. Male frons convex, glabrous, with a weak longitudinal carina. Declivity sloping; interstriae 1 and 3 with a row of fine granules, which are larger in the male.

Gallery: Not described.

Biology: Not studied.

Pityophthorus opaculus LeConte

Distribution: Throughout Canada; USA: northeastern states and Ariz., Calif., Colo., Mich., Minn., Nev., N.Mex., S.Dak., Utah, Wyo. In Idaho: Latah County (one specimen).

Hosts: **Idaho host unknown,** *Abies balsamea, A. concolor, A. lasiocarpa, Larix laricina, Picea engelmannii, P. glauca, P. mariana, P. rubens, Pinus contorta, P. flexilis, Pseudotsuga menziesii.*

Adult: 1.3-1.8 mm; brown to dark brown. Frons convex with faint longitudinal carina in both sexes, vestiture sparse. Declivity convex; interstriae 1 with a row of extremely fine granules; none on interstriae 3.

Gallery: Not described.

Biology: Not studied.

Pityophthorus pseudotsugae Swaine

Distribution: Canada: B.C.; USA: Ariz., Calif., Colo., Mont., Nev., Ore., Utah, Wash., Wyo. In Idaho: Bonner, Bonneville, Boundary, Cassia, Idaho, Kootenai, Latah, Shoshone, Twin Falls counties.

Hosts: ***Abies lasiocarpa, A. grandis, Pseudotsuga menziesii, Pinus contorta, P. monophylla,*** *A. concolor, A. amabilis, A. magnifica, A. nobilis, A. procera, Picea engelmannii, Pinus lambertiana.* Infests twigs and branches.

Adult: 1.8-2.3 mm; very dark brown. Female frons with abundant setae that are longer and incurved around periphery. Male frons convex, glabrous, with a prominent transverse carina at upper level of eyes. Declivity convex, weakly bisulcate. Interstriae 1 with a row of very fine granules; interstriae 3 with a row of setiferous, larger granules.

Gallery: Radiate; four to seven egg galleries originate from the nuptial chamber (Fig. 58F).

Biology: Not studied.

Pityophthorus pulchellus tuberculatus Eichhoff

Distribution: Canada: Alta., B.C., Y.T.; Mexico: N.L.; USA: Alaska, all western states including Nebr., S.Dak., Tex. In Idaho: Bear Lake, Bonner, Bonneville, Boundary, Caribou, Cassia, Clearwater, Fremont, Idaho, Kootenai, Latah, Valley counties.

Hosts: ***Pinus contorta, P. flexilis, P. monophylla, P. ponderosa,*** most species of pines. Infests 2-10 cm diameter branches of slash and standing trees.

Adult: 1.5-2.3 mm; very dark brown (Fig. 58E). Female frons glabrous in center, encircled by long, incurved, yellowish setae. Male frons glabrous, impressed, with transverse carina at upper level of eyes. Declivity somewhat flattened (broadly, shallowly sulcate); interstriae 1 with a row of fine, setiferous granules; interstriae 3 with a row of distinct, setiferous, acute granules.

Gallery: Radiate; two to five egg galleries originate from the nuptial chamber.

Biology: Not studied.

Pityophthorus scalptor Blackman

Distribution: USA: Calif., Ore. In Idaho: Benewah, Latah counties.

Hosts: ***Pinus ponderosa***, *P. coulteri*, *P. jeffreyi*. Infests small branches of young trees.

Adult: 2.2-2.7 mm; dark reddish brown. Female frons deeply concave, with a fringe of very long, incurved, yellowish setae around periphery and shorter, sparser setae in concavity. Male frons glabrous, convex, with a fine, longitudinal carina. Declivity convex; interstriae 1 and 3 with a row of fine granules.

Gallery: Not described.

Biology: Not studied.

Pityophthorus serratus Swaine

Distribution: Canada: B.C.; USA: McCloud, Calif. In Idaho: Viola and Moscow Mountain, Latah County (two specimens). Very rare.

Hosts: ***Pinus ponderosa***.

Adult: 2.1-2.3 mm; reddish brown. Female frons flattened, densely covered with setae that are longer and curved inwardly along periphery; male frons with a transverse carina and short, erect setae. Elytral declivity sloping, deeply bisulcate. Interstriae 1 with a row of very small granules. Interstriae 3 of female with 7 to 10 larger granules each with a long, fine seta; that of male with about 10 large, acute granules.

Gallery: Not described.

Biology: Not studied.

Pityophthorus sierraensis Bright

Distribution: Canada: B.C.; USA: Calif., Colo., Nev., Wyo. In Idaho: Salmon Mountain, Idaho County.

Hosts: ***Pinus albicaulis***, *P. aristata*, *P. balfouriana*, *P. flexilis*.

Adult: 2.4-2.7 mm; very dark brown. Female frons densely covered with long, yellowish setae; those on periphery longer and incurved. Male frons with sparse, short setae and a weakly elevated longitudinal carina. Interstriae 1 and 3 weakly elevated, bearing a row of small granules; interstriae 2 widened, weakly sulcate.

Gallery: Not described.

Biology: Not studied.

Pityophthorus toralis Wood

Distribution: Canada: Alta., B.C.; USA: Calif., Ore., Utah, Wyo. In Idaho: Bannock Pass, Lemhi County.

Hosts: ***Pinus albicaulis***, *P. contorta* , *P. flexilis*, *P. monticola*.

Adult: 2.1-2.8 mm; very dark brown, almost black. Female frons flattened, shallowly concave in center, with abundant long, incurved yellowish setae on periphery and shorter setae toward center. Male frons glabrous, convex above eyes, impressed below eyes with a longitudinal carina. Declivity convex; interstriae 1 granulate.

Gallery: Radiate.

Biology: Idaho collection, July 19: parents and young larvae in galleries that were 2-3 cm long.

Procryphalus

Monogamous. Two species are known from Idaho, one on *Salix scouleriana* (Scouler willow), the other on *Populus tremuloides* (quaking aspen). They are small (1.5-2.2 mm), dull, blackish beetles. The elytral declivity is steeper (more blunt) and the body is of normal length compared with *Trypophloeus* species, which have a more gently sloping (slanting) declivity and proportionately shorter body and infest the same hosts.

Key to Species of Procryphalus

1. In *Populus* ..... ***mucronatus*** **(LeConte)**
— In *Salix* ..... ***utahensis*** **Hopkins**

Procryphalus mucronatus (LeConte)

Distribution: Canada: Alta., B.C.; USA: Alaska, Colo., Nev., N.Mex., Utah. In Idaho: Boundary, Caribou, Franklin, Fremont, Kootenai, Latah, Oneida, Teton counties.

Host: ***Populus tremuloides***. Infests dying or freshly dead standing trees (Fig. 59B).

Adult: 1.8-2.2 mm; black. It differs from the associated *Trypophloeus populi* by its steeper declivity and proportionately longer body (Fig. 59A).

Gallery: Consists of shallow tunnels in dead bark on the main stem, which are not visible on interface of bark and wood. In winter the bark of heavily infested trees has a pinkish color; uninfested trees have white bark.

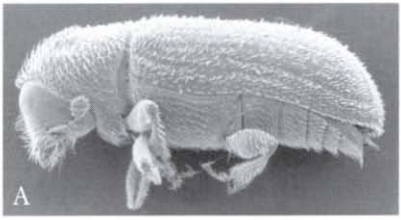
Biology: One to two generations per year, overwintering as larvae and adults.

Reference: Petty 1977.

Procryphalus utahensis Hopkins

Distribution: Canada: Alta., B.C., Que.; USA: Alaska, Calif., Colo., Mont., Ore., S.Dak., Utah. In Idaho: Latah County and "Minidoka N.F." (southeastern Idaho).

Host: ***Salix scouleriana***. Infests unthrifty, mature stems of living trees; may progressively infest same stem for several generations, gradually killing it.



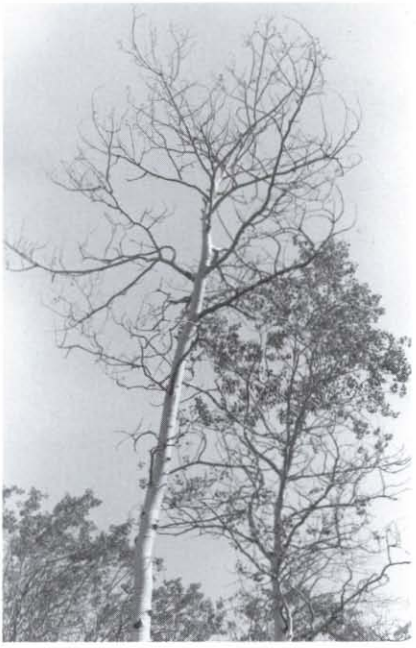


Figure 59. (A) *Procryphalus* adult. (B) Aspen with symptoms of infestation. The bare tree in foreground has just died; the background tree is dying (note dead lower branches), apparently from some combination of this beetle and microorganisms.

Adult: 1.5-1.7 mm; dark brown to black. Differs from *Trypophloeus striatulus*, which also infests willow, in its smaller average size and steeper declivity.

Gallery: In outer bark, lacking a discrete pattern.

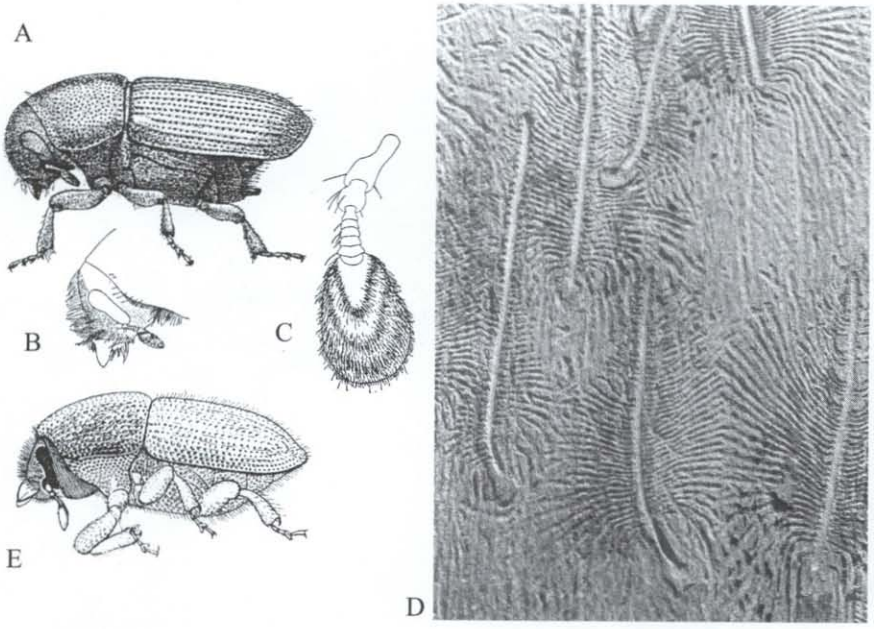
Biology: Not studied.

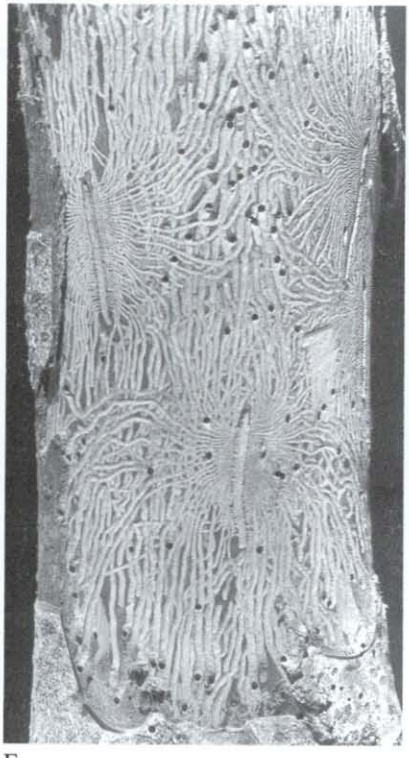
Scolytus, fir engravers

Monogamous. Eleven species occur in Idaho on diverse hosts. Two European species have reached Idaho from earlier accidental introductions in the eastern USA; they infest elms and fruit trees. Native species are restricted to conifers: *Abies*, *Pseudotsuga*, *Larix*, *Tsuga*, and *Picea* (none on *Pinus*). Those in conifers were reviewed and illustrated by Edson (1967).

Adults are very shiny, dark brown to black. The frons of males is concave and adorned with dense, brushlike setae (Fig. 60B); that of females is convex and sparsely setiferous (Fig. 60A). Males of some species have a carina or spine on the basal (largest) segment of the abdominal concavity (Figs. 61G-J), the appearance and location of which help to identify species. Fir engravers are distinct from other genera by having a "sawed-off," or concave, rear end of the abdomen (Figs. 61C-J), which is less so in *S. rugulosus*.

Scolytus species construct transverse, oblique, or vertical egg galleries that engrave the wood and the overlying phloem. Dead adults are often found head inward, plugging the entrances to their galleries, presumably an adaptation to prevent invasion by other insects. When mature, larvae of some species tunnel a short distance into the wood.





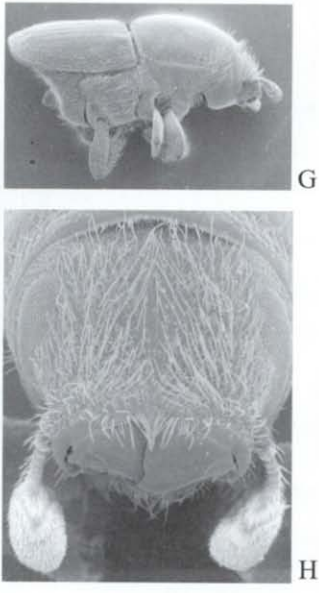


Figure 60. (A) *Scolytus multistriatus* adult female. (B) *S. multistriatus* adult male. (C) *S. multistriatus* antenna. (D) *S. multistriatus* galleries in American elm. (E) *S. rugulosus* adult. (F) *S. rugulosus* galleries in cherry (note the tendency for larvae to tunnel into wood at ends of their mines). (G) *S. laricis* adult. (H) Pubescent frons typical of male *Scolytus* species. (A-C: Kaston 1936, E: Balachowski 1949.)

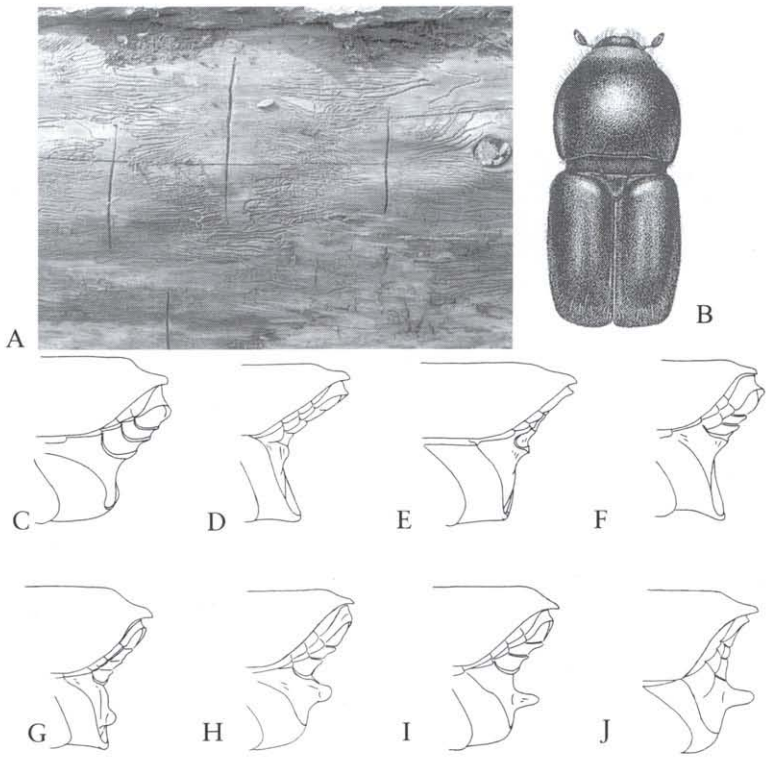


Figure 61. (A) Weathered galleries of *Scolytus ventralis* on sapwood of a fallen grand fir. (B) Adult *S. ventralis*. Characteristic truncated abdomens: (C) *S. monticolae*, (D) *S. praeceps*, (E) *S. ventralis*, (F) *S. subscaber*, (G) *S. opacus*, (H) *S. laricis*, (I) *S. piceae*, (J) *S. unispinosus*. (K) Venter of *S. subscaber*. Note the U-shape of the largest (lower) declivital segment of *S. subscaber*; this segment is more V-shape in *S. ventralis*. (B: Bright and Stark 1973; C-J: Edson 1967; K: Bright 1976.)

Key to Species of Scolytus

1. In angiosperms (deciduous trees) 2
— In gymnosperms (conifers) 3
2(1). In *Ulmus*; spine on sternite 2 of abdominal concavity of both sexes ..... ***multistriatus*** **(Marsham)**
— In *Prunus*, *Malus*, *Pyrus* (fruit trees); no spine on abdominal concavity ..... ***rugulosus*** **(Müller)**
3(1). In *Larix* ..... ***laricis*** **Blackman**
— In other Pinaceae 4
4(3). In *Picea* ..... ***piceae*** **(Swaine)**
— In other Pinaceae 5

5(4).	In *Tsuga*	***tsugae*** **Swaine**
—	In *Pseudotsuga* or *Abies*	6
6(5).	Male with prominent spine on sternite 2 of abdominal concavity	7
—	Male without projecting spine on sternite 2 of abdominal concavity	8
7(6).	In *Pseudotsuga*	***unispinosus*** **LeConte**
—	In *Abies*	***opacus*** **Blackman**
8(6).	Larger (2.5-4.4 mm); in *Abies*	9
—	Smaller (2.0-3.0 mm); in *Abies* or *Pseudotsuga*	10
9(8).	Adult tunnel (egg gallery) horizontal, long (8-30 cm), usually not very resinous; larval mines connected to egg gallery on inner phloem surface; infesting stems	***ventralis*** **LeConte**
—	Egg gallery ε-shaped, short (2 cm), very resinous; larval mines hidden at first, appearing on inner phloem surface a few millimeters from the egg gallery; infesting branches	***subscaber*** **LeConte**
10(8).	In *Pseudotsuga*; egg gallery vertical (with grain)	***monticolae*** **Swaine**
—	In *Abies grandis*; egg gallery horizontal (across grain)	***praeceps*** **LeConte**

Scolytus laricis **Blackman**, western-larch beetle

Distribution: Canada: B.C.; USA: Mont., Ore., Wash. In Idaho: Benewah, Boundary, Clearwater, Idaho, Kootenai, Latah, Shoshone counties.

Host: ***Larix occidentalis***, ***L. lyallii***. Infests trunks of small diameter, suppressed trees, tops of larger felled trees, and larger broken-off branches.

Adult: 2.4-3.0 mm; very dark reddish brown; elytra slightly lighter. Male sternite 2 has a stout spine that is rounded at its apex (Fig. 61H).

Gallery: Vertical; average length 5 cm (Fig. 62A). Woodpeckers often peck away bark, exposing galleries. In *L. lyallii*, galleries are aberrant, being shorter, less uniform, and with the entrance chamber often extended a short distance to the sides of the gallery.

Biology: Not studied but evidently one generation per year, overwintering as larvae.

Scolytus monticolae **Swaine**

Distribution: Canada: B.C.; USA: Calif., Mont., Ore., Utah, Wash., Wyo. In Idaho: Ada, Benewah, Boise, Cassia, Clearwater, Franklin, Kootenai, Latah, Valley counties.

Host: ***Pseudotsuga menziesii***. Infests tops of mature trees killed by Douglas-fir beetle, *Dendroctonus pseudotsugae*, and felled trees.

Adult: 2.2-3.0 mm; very dark brown; elytra distinctly lighter. Male declivity without a spine (Fig. 61C), which separates it from *S. unispinosus*.

Gallery: Vertical; average length 5 cm, maximum 9 cm (Fig. 62B).

Biology: Beetles fly and infest trees in July. Broods overwinter as mature larvae and emerge the following summer. Entrance holes are often

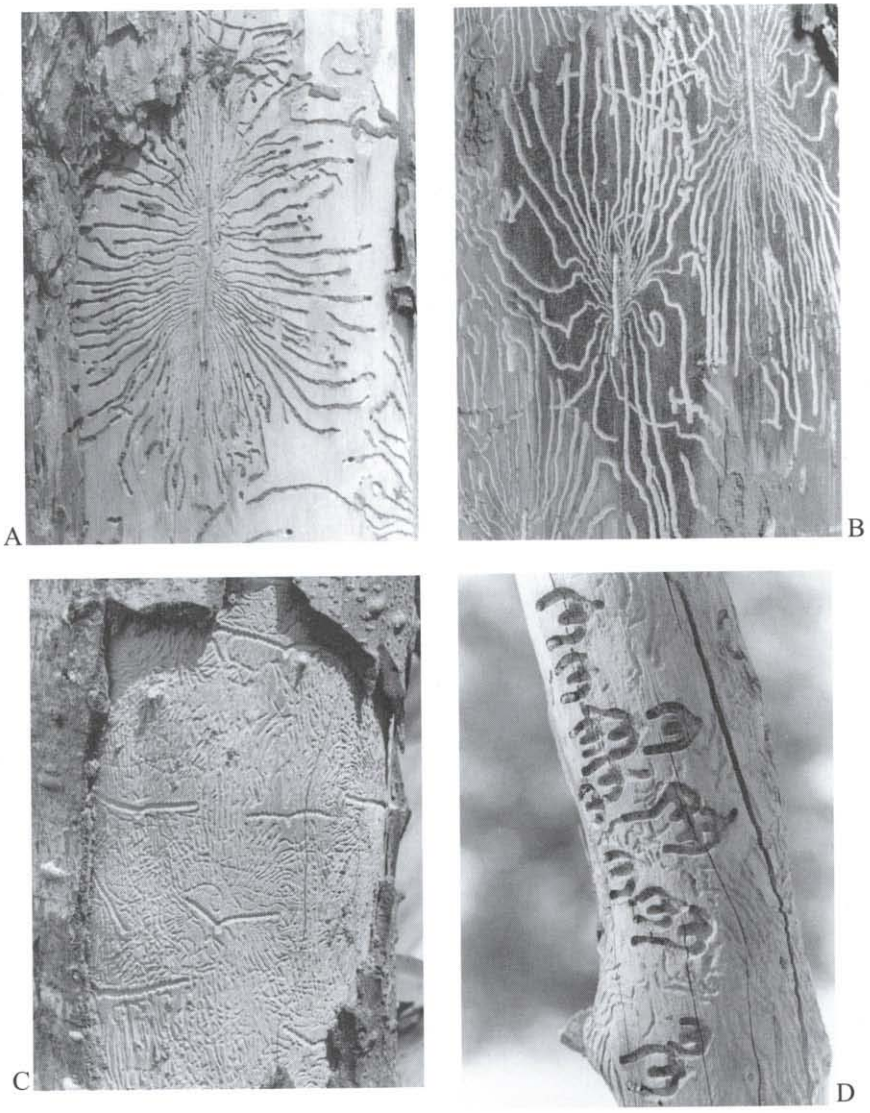


Figure 62. Galleries of *Scolytus* species. (A) *Scolytus laricis* in western larch. (B) *S. monticolae* in Douglas-fir. (C) *S. opacus* in grand fir trunk. (D) *S. subscaber* in grand fir limb.

plugged by a dead parent, apparently an adaptation to prevent other insects from entering.

Reference: McMullen and Atkins 1959 (as *S. tsugae*).

***Scolytus multistriatus* (Marsham)**, smaller European elm bark beetle

Distribution: Europe; N. Asia; Canada: Southern provinces from B.C. to N.S.; USA: All states. In Idaho: Ada, Bannock, Bonneville, Canyon, Cassia, Latah, Twin Falls counties. Native of Eurasia, discovered in

USA (Mass.) in 1909 and now occurs in all states. First collected in Idaho in 1964 in Canyon County. Found in Latah County 1967.

Hosts: ***Ulmus americana*** and other elms.

Adult: 1.9-3.1 mm; dark reddish brown; elytra often slightly lighter. Abdominal concavity of both sexes with a prominent cylindrical spine located on lower (anterior) half of sternite 2 (Fig. 60A).

Gallery: Vertical; 2.5-5 cm long (Fig. 60D).

Biology: Number of generations per year: one and one-half (Canada) to three (southern states). In Idaho, broods overwinter as larvae. Adults emerge in late spring and feed in twigs before constructing egg galleries in cut or diseased branches and stems. They introduce a fungus that gradually kills the infected tree (Dutch elm disease). American elm (*Ulmus americana*) is especially susceptible.

Scolytus opacus **Blackman**, keelspined fir beetle

Distribution: USA: Ariz., Calif., Colo., Mont., Ore., Utah, Wash., Wyo. In Idaho: Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Lewis, Shoshone, Valley counties.

Hosts: ***Abies grandis***, ***A. lasiocarpa***, *A. concolor*. Tends to infest branches and stems of trees of less than 30 cm in diameter.

Adult: 2.0-3.4 mm; very dark brown; elytra slightly lighter. Abdominal concavity of male with a keel-shaped spine, its base extending three-quarters the length of sternite 2 (Fig. 61G).

Gallery: Oblique to transverse; 2-5 cm long; gull-wing shaped, with branches extending at an obtuse angle from the central nuptial chamber (Fig. 62C).

Biology: One generation per year, overwintering as larvae. Entrance holes commonly plugged by a dead parent.

Remarks: Originally described as two species, the larger one, *S. opacus* (2.5-3.4 mm), occurring on *A. lasiocarpa*, the smaller one, *S. abietis* Blackman (2.0-2.8 mm), on *A. grandis*.

Scolytus piceae **(Swaine)**, spruce engraver

Distribution: Canada: Alta., B.C., Man., N.W.T., Ont., Que.; USA: Alaska, Calif., Colo., Maine, Mass., Mich., Mont., N.Mex., N.Y., N.Dak., S.Dak., Utah, Wash., Wisc., Wyo. In Idaho: Bonneville, Clearwater, Kootenai, Latah, Shoshone counties.

Hosts: ***Picea engelmannii***, ***P. glauca* x *engelmannii***, ***P. pungens* x *engelmannii***, other *Picea* species. Infests shaded-out branches.

Adult: 2.2-2.8 mm; dark reddish brown; pronotum often almost black. Abdominal concavity of male with a rather long conical spine on upper third of sternite 2 (Fig. 61I); that of female smaller.

Gallery: Vertical; 5.0-7.5 cm long; bayonet shaped due to one branch being offset from the nuptial chamber.

Biology: Not studied; apparently one generation per year, overwintering as larvae.

Scolytus praeceps LeConte

Distribution: Canada: B.C., USA: Calif., Ore., Wash. In Idaho: Bonner, Clearwater, Kootenai, Latah counties.

Hosts: ***Abies grandis***, *A. concolor*, *A. magnifica*. Infests smaller limbs and tops of dying and felled trees.

Adult: 2.0-2.7 mm; dark brown; elytra usually lighter. Male abdominal concavity with a carina (ridge), not a spine, on the upper third of sternite 2 (Fig. 61D); carina barely discernible on the female.

Gallery: Horizontal; 2.5-6.0 cm long; commonly with one branch across grain, the other at a 45-degree angle from the central nuptial chamber.

Biology: Not studied. Apparently one generation per year, overwintering as larvae.

Scolytus rugulosus (Müller), shothole borer

Distribution: Europe; Canada: Southern provinces; Mexico: Chih., N.L.; USA: wherever hosts grow. In Idaho: Ada, Cassia, Franklin, Fremont, Gem, Idaho, Kootenai, Latah, Teton, Twin Falls counties.

Hosts: Stone and pome fruits. ***Prunus avium***, ***P. emarginata***, ***P. virginiana***, ***Malus* spp.**, and probably ***Pyrus* spp.** Infests unthrifty, moisture-stressed, or sun-scalded trunks and branches of live or felled trees.

Adult: 1.5-2.7 mm; dark brown. The abdominal concavity ascends posteriorly at a much shallower angle (Fig. 60E) than our other *Scolytus* species and lacks a spine on sternite 2.

Gallery: Vertical; 1-5 cm long; extending upward from the base without a nuptial chamber (Fig. 60F). Larvae of later broods mine into the xylem where they overwinter. Earlier broods may pupate in the bark instead of the xylem before emerging to fly. The dense pattern of emergence holes explains the common name.

Biology: Adults begin to infest trees in spring but may be active on bark throughout summer. The same stem may be infested progressively by several generations. Up to three generations per year are produced in California; the number in Idaho is unknown.

Reference: Smith 1932.

Scolytus subscaber LeConte, ε-engraver

Distribution: Canada: B.C.; USA: Calif., Ore., Mont., Wash. In Idaho: Latah, Clearwater, Idaho counties.

Hosts: ***Abies grandis***, *A. concolor*, *A. magnifica*. Infests and kills branches of mature trees without killing the tree.

Adult: 2.9-4.4 mm; black. Abdominal concavity of male with only a faintly raised median carina at posterior of sternite 2 (Fig. 61F). Distinguished from *S. ventralis* by its more highly polished pronotum and elytra (finer punctures), proportionately broader pronotum, more aciculate (scratched) female frons, more U-shaped sternite 2 (Fig. 61K), and unique gallery.

Gallery: "ε" shape (Fig. 62D); 2 cm long; formed by two gallery branches curving inwardly around a central chamber. Due to the unique gallery shape, the Idaho County record is based only on finding a limb with abandoned galleries. Parent galleries become very resinous, which is a defensive wound response. Larvae mine a short distance out of sight in phloem, then their mines appear on the phloem innerface next to the wood.

Biology: One generation per year, overwintering as larvae.

Reference: Bright and Stark 1973.

Scolytus tsugae **Swaine**, hemlock engraver

Distribution: Canada: B.C.; USA: Calif., Mont., Ore., Wash. In Idaho: Boise, Bonner, Clearwater, Idaho, Kootenai, Latah counties.

Hosts: ***Tsuga heterophylla***, ***T. mertensiana***. Infests shaded-out limbs as well as stems of standing or felled trees.

Adult: 2.2-3.5 mm; dark brown. Declivity without a spine. Similar to *S. monticolae* but distinguished by its hosts and horizontal, rather than vertical, gallery.

Gallery: Horizontal; 4-10 cm long with a central nuptial chamber; scores the sapwood.

Biology: One generation per year, overwintering as larvae.

Scolytus unispinosus **LeConte**, Douglas-fir engraver

Distribution: Canada: Alta., B.C.; USA: Ariz., Calif., Colo., Mont., Nev., N.Mex., Ore., Utah, Wash., Wyo. In Idaho: Adams, Boise, Boundary, Clearwater, Custer, Kootenai, Latah, Lemhi, Nez Perce counties.

Host: ***Pseudotsuga menziesii***. Infests stems of young trees that are weakened or dying.

Adult: 3.4-7.0 cm; very dark brown; elytra usually slightly lighter. Declivity of male with a prominent spine located high (posteriorly) on sternite 2 (Fig. 61J). Spine of female smaller.

Gallery: Vertical; 3-5 cm long; lightly scoring sapwood; similar to that of *S. monticolae*. Nuptial chamber distinct, usually located toward middle of gallery, occasionally at bottom end. Larval mines extend at right angle to the egg gallery for 3-5 cm.

Biology: One generation per year in Idaho. Broods overwinter as mature larvae. Adults fly to infest new hosts from mid-May through July.

Reference: McMullen and Atkins 1962.

Scolytus ventralis **LeConte**, fir engraver

Distribution: Canada: B.C.; USA: Ariz., Calif., Colo., Mont., Nev., N.Mex., Ore., Utah, Wash., Wyo. In Idaho: Benewah, Bonner, Boundary, Clearwater, Kootenai, Latah, Shoshone, Valley counties.

Hosts: ***Abies grandis***, *A. concolor*, *A. magnifica*. Infests stems of merchantable-size trees, particularly during droughty years; also infests stems of felled trees.

Adult: 2.5-3.8 mm; black; elytra very dark reddish brown (Fig. 61B). Declivity of male with only a faintly raised carina on posterior of sternite 2 (Fig. 61E). Distinguished from *S. subscaber* by the slightly less polished appearance of pronotum and elytra, slightly narrower pronotum, more acutely shaped sternite 2 on the abdominal concavity, and, especially, by the straight, horizontal gallery.

Gallery: Horizontal; 8-30 cm long, with entrance at middle; deeply scoring the sapwood. Larval mines extend upward and downward at right angle from egg gallery, more or less parallel with each other. These galleries are commonly seen on downed trees in the forest, after they have lost their bark (Fig. 61A).

Biology: One generation per year, overwintering as larvae and pupating in June-July. Flight of adults to new hosts is most intense in July.

References: Struble 1957, Ashraf and Berryman 1969.

Trypophloeus

Monogamous. Three Idaho species, infesting *Salix scouleriana* (Scouler willow) and *Populus tremuloides* (quaking aspen). Adults are black, 1.5-2.1 mm long, and hunchbacked in side profile due to their short body and gradually sloping elytral declivity. Their galleries are hidden in the bark and are difficult to trace.

Key to Species of Trypophloeus

1.	In *Salix*	***striatulus*** **(Mannerheim)**
—	In *Populus*	2
2(1).	Posterior end of interstriae 4 with one to five small, slender teeth (requires high magnification); northern Idaho	***thatcheri*** **Wood**
—	Posterior end of interstriae 4 without teeth; southern Idaho	***populi*** **Hopkins**

Trypophloeus populi **Hopkins**

Distribution: Canada: Man., N.S., Sask.; USA: Ariz., Colo., Nev., Utah. In

Idaho: Bonneville, Oneida, Owyhee, Teton counties.

Hosts: ***Populus tremuloides***, *P. acuminata*, *P. angustifolia*, *P. trichocarpa*. Infests smooth, green bark of limbs or stems of standing dying trees.

Adult: 1.7-2.1 mm; black (Fig. 63A). Differs minutely from *T. thatcheri* in the absence of small, slender teeth posteriorly on interstriae 4 of the elytra. Differs from *Procryphalus mucronatus* by its shorter body and less steep elytral declivity.

Biology: One to one and one-half generations per year (Utah), overwintering as larvae. Eggs appear by mid-July.

Galleries: Parent galleries short, inconspicuous, located very shallowly beneath outer bark. Larvae feed communally, and their mines penetrate more deeply into the thick bark.

Reference: Petty 1977.

Trypophloeus striatulus **(Mannerheim)**, willow bark beetle

Distribution: Canada: Newf., N.S., Que., Y.T.; USA: Alaska, Colo., Minn., Ore., Utah. In Idaho: Kootenai, Owyhee counties.

Hosts: ***Salix scouleriana***, *Salix alaxensis* (Alaska), *Alnus crispa*, *A. rugosa*. Infests unthrifty stems (Figs. 63B, 63C). Fungus infection and damage caused by moose browsing are often associated with infestation by this beetle in Alaska.

Adult: 1.6-2.4 mm; black. Appears hunchbacked in side profile, head pointing downward. Body stout and short; elytral declivity sloping gradually.

Gallery: Short, cave-like cavity, generally not visible on inner face of phloem. Phloem around cavity is stained black. Eggs are laid in a mass. Larval mines extend for up to 6 cm shallowly beneath bark surface (Fig. 63D). Many galleries are vacated without brood being produced.

Biology: One generation per year, overwintering as mature larvae and solitary adults. Stems are reinfested by several beetle generations before dying.

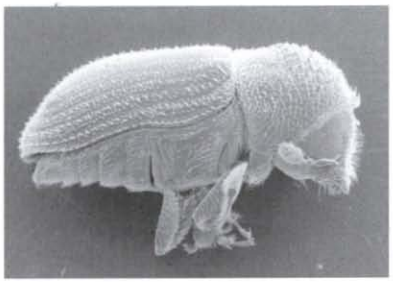
Trypophloeus thatcheri **Wood**

Distribution: Canada: B.C.; USA: Calif. In Idaho: Kootenai, Latah counties.

Hosts: ***Populus tremuloides***, *P. trichocarpa*. Idaho specimens reared from a section of main stem and a 5-cm-diameter broken branch still attached to tree.

Adult: 1.5-1.9 mm; black. Similar to *T. populi* but has a row of one to five microscopic, slender teeth on the posterior of interstriae 4 of the elytra.

Remarks: *T. thatcheri* and *T. populi* may be subspecies (Wood 1982). Their galleries and biology are probably similar.



A

B

C

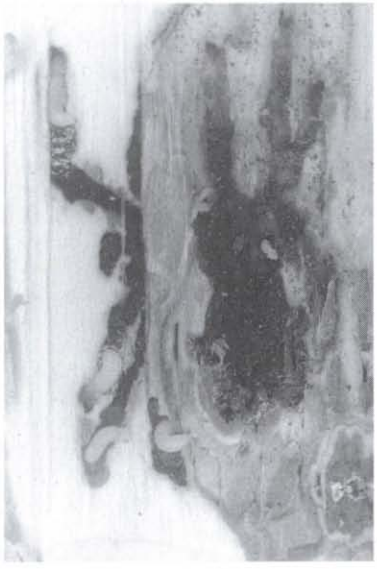


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Figure 63. (A) *Trypophloeus populi* adult. (B) Dying willow infested by *T. striatulus*. (C) Holes on stem infested with *T. striatulus*. (D) Gallery and mature larvae of *T. striatulus*.

Cone Beetles

Conophthorus

Monogamous. These shiny, brown to black beetles bore into the stalk (peduncle) or base of pine cones and tunnel along the cone axis where they lay eggs. Larvae mine throughout the cones and are an important cause of seed loss in some years, especially in seed orchards. Adults are similar in appearance to *Pityophthorus*, but they infest cones rather than branches and stems and our two *Conophthorus* species are larger than *Pityophthorus* species that occur in Idaho.

Key to Species of Conophthorus

1. In cones of *Pinus monophylla* (Cassia Co.) ..... ***monophyllae*** **Hopkins**
— In cones of other *Pinus* species ..... ***ponderosae*** **Hopkins**

Conophthorus monophyllae **Hopkins**, singleleaf pinyon cone beetle

Distribution: USA: Calif., Nev., Utah. In Idaho: City of Rocks, Cassia County.

Host: ***Pinus monophylla***. Beetles enter cones via their stalks or bases, causing cones to cease growing and turn brown. Pitch exudes from the entrance and attacks are often unsuccessful.

Adult: 2.7-3.1 mm; shiny; almost black.

Gallery: Lengthwise through the center (axis) of the cone. Larvae mine throughout the cone, feeding on the seeds and scales.

Biology: Cones are infested in spring during their second year of growth. Broods mature during summer and overwinter in the stunted cones.

Conophthorus ponderosae **Hopkins**, ponderosa pine cone beetle

Distribution: Canada: B.C; Mexico: Dgo., Edo. de Méx, Mich.; USA: Ariz., Calif., Colo., Mont., Nebr., Nev., N.Mex., Ore., Utah, Wash., Wyo. In Idaho: Bear Lake, Benewah, Boise, Bonner, Clearwater, Kootenai, Latah, Nez Perce, Shoshone counties.

Hosts: ***Pinus flexilis***, ***P. monticola***, ***P. ponderosa***, rarely ***P. contorta*** and ***P. albicaulis***. Infested cones become stunted, turn brown, and remain unopened.

Adult: 2.5-4.0 mm; shiny; dark brown; elytra often lighter brown. The only scolytid in cones of these pines.

Gallery: An adult female enters the stalk or base of a cone, then tunnels lengthwise through the cone center. Her resulting brood mine throughout the cone (Fig. 64).

Biology: Second-year conelets (young, still-small cones) are infested early in their development in late spring. Broods mature in late summer, and overwinter in the dwarfed cones that may drop to the ground.

Reference: Williamson et al. 1966 (under the synonym *C. monticolae* Hopkins).

Ambrosia Beetles

Ambrosia beetles share certain behaviors. They expel conspicuous white powdery wood "flour" from their tunnels, whereas bark beetles expel coarser fragments that are yellowish orange or reddish. They also differ from bark beetles in that their emerging adult progeny leave the brood tree through the parent entrance hole, rather than through bark at locations away from

the adult gallery. Ambrosia beetles tend to infest the rather moist basal portions of stems of trees that are dying or were recently killed by bark beetles or broken by wind or snow. Many species are attracted to the odor of ethyl alcohol, a metabolic product present in dying trees. As such, our Idaho species are not technically primary tree killers.

Gnathotrichus

Monogamous. Two species occur in Idaho, of which *G. retusus* is much more common, infesting most conifers and paper birch. Adults are shiny, dark brown. They differ from *Trypodendron* in being more elongate (slender), lacking stripes or markings on the elytra or prothorax, and having a frons that is not sexually dimorphic. The diameter of their entrance holes is smaller (1.3 mm) than that of *Trypodendron lineatum* (1.5 mm). They tunnel radially through bark, into sapwood, then left and right along a growth ring. Eggs are laid in niches above and below the tunnel. Larvae feed on fungus, the spores of which are carried into the tunnel by their parents.

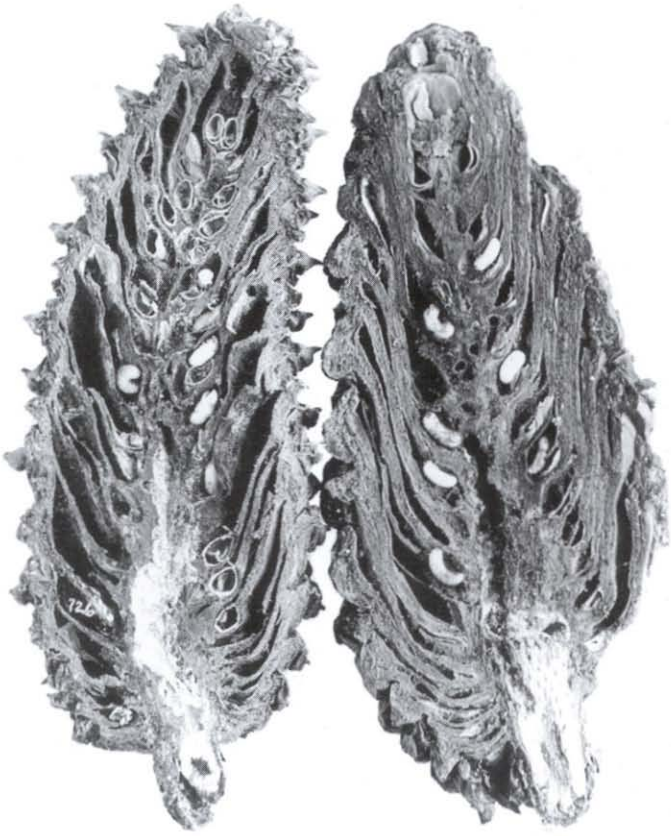

Figure 64. Ponderosa pine cone infested by *Conophthorus ponderosae*. (Keen 1958.)

Key to Species of Gnathotrichus

1. Underside of head with a small median anterior projection (Fig. 65B) at edge of the oral cavity; common ..... ***retusus*** (LeConte)

— Underside of head lacking a median anterior projection; uncommon ..... ***sulcatus*** (LeConte)

Gnathotrichus retusus (LeConte)

Distribution: Canada: B.C.; Mexico: B.C.; USA: Calif., Mont., Nev., Ore., Wash. In Idaho: Benewah, Boise, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Valley counties.

Hosts: ***Pinus contorta***, ***P. monticola***, ***P. ponderosa***, ***Picea engelmannii***, ***Pseudotsuga menziesii***, ***Larix occidentalis***, ***Tsuga heterophylla***, ***Abies grandis***, ***Betula papyrifera***. Infests bases of standing trees killed by bark beetles, freshly felled merchantable trees, and stumps.

Adult: 3.3-3.7 mm; shiny dark brown; slender and elongate; elytral declivity rather deeply sulcate; distinguished from *G. sulcatus* by a small median anterior projection on the underside of its head (Fig. 65B).

Gallery: The main gallery is constructed radially into the sapwood, then it branches up to six times to form brood galleries that curve along the annual growth rings. All branches are in the same horizontal plane. Larvae develop in short cradles that are oriented above and below the parent tunnels.

Biology: One generation per year, overwintering in the brood tree in all developmental stages. Flight begins in spring and continues to fall. Larvae feed primarily on ambrosia fungi.

Reference: Prebble and Graham 1957.

Gnathotrichus sulcatus (LeConte)

Distribution: Canada: B.C.; Mexico: D.F., Dgo., Hgo., Mich., Oax., Pue., Tlax., Ver.; Guatemala; Honduras; USA: Ariz., Calif., Colo., Nev., N.Mex., Ore., S.Dak., Utah, Wash. In Idaho: Ada, Clearwater, Kootenai, Latah, Valley counties.

Hosts: ***Pseudotsuga menziesii***, ***Abies grandis***, *Abies* spp., *Pinus* spp., *Tsuga heterophylla*.

Adult: 2.8-3.5 mm; shiny; dark brown; slender and elongate (Fig. 65A); elytral declivity weakly, rather narrowly sulcate. Similar to *G. retusus* but without a median anterior projection on the underside of the head.

Gallery: Radially in sapwood, then branching alternately left or right, curving with growth rings (Fig. 65C). Broods develop in cradles aligned above and below the egg gallery (Fig. 65D).

Biology: Believed to be the same as *G. retusus*.

Reference: Prebble and Graham 1957.

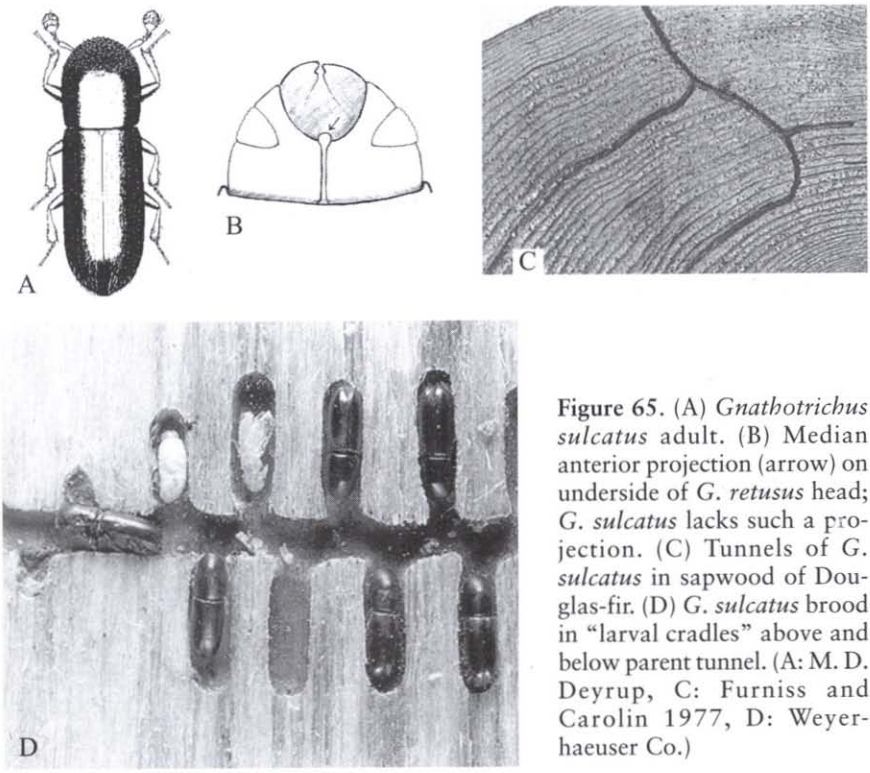

Figure 65. (A) *Gnathotrichus sulcatus* adult. (B) Median anterior projection (arrow) on underside of *G. retusus* head; *G. sulcatus* lacks such a projection. (C) Tunnels of *G. sulcatus* in sapwood of Douglas-fir. (D) *G. sulcatus* brood in "larval cradles" above and below parent tunnel. (A: M. D. Deyrup, C: Furniss and Carolin 1977, D: Weyerhaeuser Co.)

Trypodendron

Monogamous. Four Idaho species: *T. lineatum* and *T. rufitarsis* in conifers, *T. retusum* in quaking aspen, and *T. betulae* in paper birch. All tunnel radially into sapwood, then construct side branches. Larvae develop in short cradles aligned above and below branch tunnels and feed on ambrosia fungi carried into the galleries by their mothers. Adult broods leave their tree via the parents' tunnels. Adults are medium size (3.0-4.6 mm), shiny, dark brown to black, often with lighter markings on the elytra or prothorax. The frons of females is convex (Fig. 66C), and that of males is deeply concave (Fig. 66D).

Key to Species of Trypodendron

1. In angiosperms (*Betula*, *Populus*) 2
— In gymnosperms (Pinaceae and *Thuja*) 3

2(1). In *Populus*; larger (3.8-4.6 mm); black when mature ..... ***retusum*** **(LeConte)**
— In *Betula*; smaller (3.1-3.5 mm); dark brown to black with pale yellow area lengthwise on each elytron ..... ***betulae*** **Swaine**

3(1). Posterior of elytra rounded; body dark brown to black except for a lighter area on posterior of pronotum and two light stripes lengthwise on each elytron ..... ***lineatum*** **(Olivier)**

— Posterior of elytra pointed; body brown, darker on front and sides of pronotum and elytra ..... ***rufitarsis*** **(Kirby)**

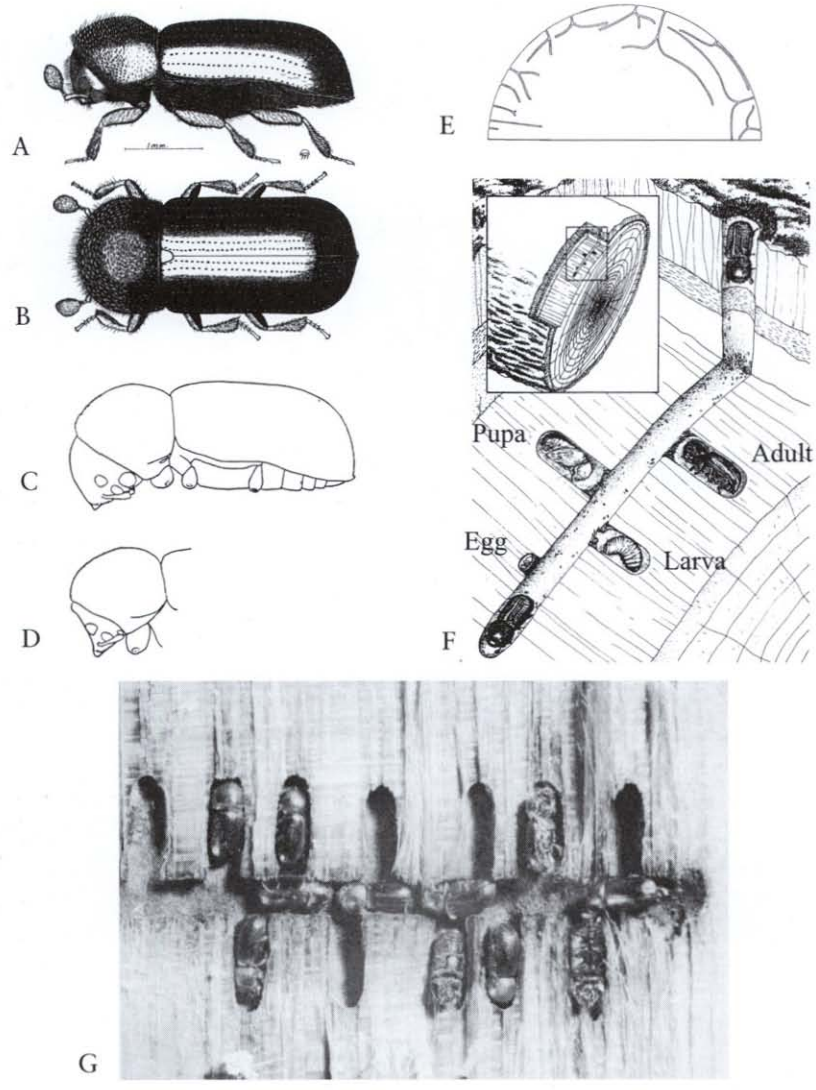

Figure 66. *Trypodendron lineatum*. (A, B) Adult. (C) Female profile. (D) Male profile. (E) Galleries in cross-section of tree trunk. (F) Schematic of tunnel in sapwood including four brood stages from egg (in niche) to adult (in "cradle" chewed during its larval stage). (G) Cradles oriented above and below parental tunnel. Brood mature with their heads toward the tunnel. These adults had crawled back into cradles and died when the log was cut into boards and heat-dried. (A, B: M. D. Deyrup; C, D: Wood 1982; E: Prebble and Graham 1957; F: Borden 1988; G: McLean and Borden 1977.)

Trypodendron betulae **Swaine**, birch ambrosia beetle

Distribution: Canada: Alta., B.C., Man., N.B., N.S., N.W.T., Ont., Que.; USA: Alaska, Maine, Mass., Minn., Mont., N.H., N.J., N.Y., S.Dak., Wis. In Idaho: Bonner, Boundary, Latah counties.

Hosts: ***Betula papyrifera***, *B. lenta*, *Alnus* sp. (rarely). Infests stems of dying trees, sometimes in association with *Dryocoetes betulae*.

Adult: 3.1-3.5 mm; dark brown to black with pale yellow area lengthwise on each elytron (Figs. 67A, 67B). Distinguished from *Xyleborus dispar* by having males of normal size (not dwarfed) with concave rather than convex frons and by the uniformly oval antennal club (obliquely truncate in *dispar*).

Gallery: Radially into sapwood, then branching Y-like, in a horizontal plane.

Biology: Not studied, apparently one generation per year.

Reference: Wood 1957.

Trypodendron lineatum **(Olivier)**, striped ambrosia beetle

Distribution: Europe; N. Asia; Canada: All southern provinces; USA: Alaska, Ariz., Calif., Colo., Conn., D.C., Maine, Mich., Minn., Mont., Nev., N.H., N.Mex., N.Y., N.C., Ore., Pa., S.Dak., Tenn., Utah, Wash., W.Va., Wyo. In Idaho: Ada, Benewah, Blaine, Boise, Bonner, Boundary, Cassia, Clearwater, Custer, Fremont, Idaho, Kootenai, Latah, Shoshone, Valley counties.

Hosts: Virtually all Idaho conifers of merchantable size, except *Juniperus*. Infests stumps, felled trees, and bases of standing trees killed by other agents. Recently felled trees are less attractive than those down overwinter.

Adult: (Figs. 66A, 66B) 3.0-3.5 mm; very dark brown to black except posterior of pronotum, which is lighter; each elytron usually with two lengthwise stripes (Figs. 67C, 67D). Distinguished from *T. rufitarsis* by the rounded, versus pointed, posterior of elytra and by the pattern of coloration.

Gallery: Radially into sapwood, then branching (Figs. 66E, 66F), usually following an annual growth ring and always in a horizontal plane.

Biology: (Based on studies in B.C., Canada.) Flight extends from onset of warm spring weather through August, with peaks in April-May and July-August. Later attacks are mainly by reemerged parents. Larvae develop to adults in cradles aligned above and below the galleries (Fig. 66G). They feed on ambrosia fungi. Broods transform to adults and emerge by way of the parent tunnel during July-September and overwinter in the forest litter. One generation per year with two or more broods (i.e., originating at different dates).

Reference: Borden 1988.

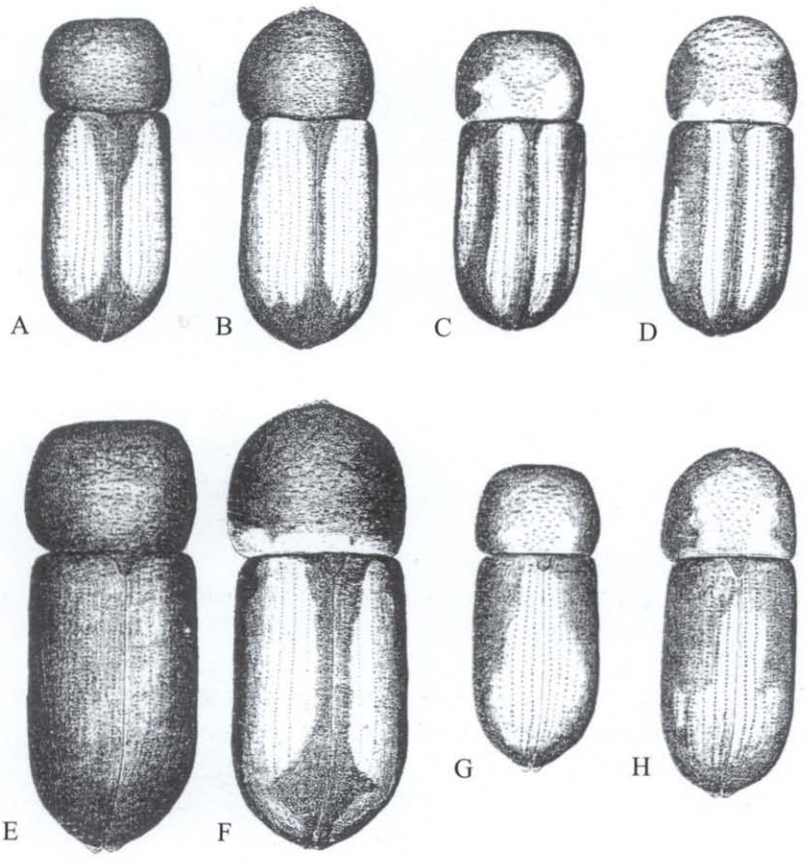

Figure 67. Color patterns in *Trypodendron*. (A) *T. betulae* male. (B) *T. betulae* female. (C) *T. lineatum* male. (D) *T. lineatum* female. (E) Mature *T. retusum* male. (F) Young *T. retusum* female. (G) *T. rufitarsis* male. (H) *T. rufitarsis* female. (Wood 1982.)

***Trypodendron retusum* (LeConte)**, aspen ambrosia beetle

Distribution: Canada: Alta., B.C., Man., N.B., Ont., Que., Sask., Y.T.; USA: Alaska, Ariz., Calif., Colo., Conn., Mich., Minn., Nev., N.H., N.Mex., N.Y., Ore., Pa., S.Dak., Utah, Vt., Wash., W.Va., Wis. In Idaho: Blaine, Bonner, Bonneville, Boundary, Fremont, Kootenai, Oneida, Owyhee, Teton, Twin Falls counties.

Hosts: ***Populus tremuloides***, *P. deltoides*, *P. grandidentata*. Infests dying standing trees larger than approximately 10 cm in diameter.

Adult: 3.8-4.6 mm; uniformly black when fully mature; young adults with pale yellowish-brown areas on base of pronotum and lengthwise on elytra (Figs. 67E, 67F). Similar to *Xyleborus dispar* (both may occur in *Populus tremuloides*), but *T. retusum* has normal-appearing males, with concave frons, and both sexes have a more flattened antennal club, which is not truncated. In contrast, *X. dispar* males are dwarfed, with a convex frons, and both sexes have a cylindrical, truncated antennal club.

Gallery: Consists of an entrance tunnel and two to five lateral branches in sapwood. Entrance tunnel extends radially into trunk, then curves to one side, following a growth ring. Then, a similar side branch is tunneled opposite the first side branch. Thereafter, one to three lateral branches may be constructed inwardly by the same procedure. These combined tunnels extend for 2.5-11.0 cm.

Biology: One generation per year, overwintering as brood adults outside the tree, presumably in litter. Adults infest new trees in spring. Eggs are laid singly in short cradles, averaging 12 per gallery, with a range of 3 to 34. Parents inoculate cradles with a yellowish ambrosia fungus on which larvae feed. Larvae are present beginning one week after a gallery is begun. Cradles are enlarged to 4.8 mm by larvae as they grow in size. Pupae appear after four to six weeks and adults one week later. Adults emerge during late June-July.

Reference: Brewer et al. 1988.

Trypodendron rufitarsis (Kirby)

Distribution: Canada: Alta., B.C., Man., N.B., Ont., Y.T.; USA: Ariz., Calif., Colo., Minn., Mont., Ore., Utah, Wash. In Idaho: Benewah, Boise, Bonner, Caribou counties.

Hosts: ***Pinus contorta***, ***P. monticola***, ***P. ponderosa***, ***Picea engelmannii***, *Pinus banksiana*, *P. jeffreyi*. Infests bases of dying trees.

Adult: 3.4-3.7 mm; brown; darker on front and sides of prothorax and sides of elytra (Figs. 67G, 67H), transition from light to dark color gradual. Distinguished from *T. lineatum* by the color pattern and duller surface and by having the posterior end of elytra pointed rather than rounded.

Gallery: Not described; probably similar to *T. lineatum*.

Biology: Not studied.

References: French and Roeper 1972 (fungus), Wood 1957.

Xyleborinus

Polygamous; however, females may produce male offspring parthenogenetically. One small species in Idaho, originally from Europe, infests a wide range of host species. Inhabits sapwood and feeds on introduced fungi. Its gallery differs from our other ambrosia beetles in having a communal larval chamber rather than larvae being in separate cradles.

Xyleborinus saxeseni (Ratzeburg)

Distribution: Eurasia; Australia; South America; Canada: B.C., Ont.; Mexico: B.C., Hgo.; USA: 34 states, including in the West: Ariz., Calif., Ore., Tex., Utah, Wash. In Idaho: Boundary, Idaho, Latah, Kootenai, Nez Perce counties.

Hosts: ***Alnus rhombifolia*, *Betula occidentalis*, *Populus tremuloides*, *Abies grandis*** (one record), nearly all genera of deciduous trees and rarely in conifers. Infests dying or recently cut trees of all sizes.

Adult: Female 1.9-2.4 mm; dark brown (Figs. 68A, 68B); antennal club truncate (Fig. 68C); interstriae 1 and 3 feebly elevated, each bearing about five to seven pointed tubercles; body thinly clothed with hairs. Male dwarfed; 1.6-1.8 mm; flightless; much rarer than females (ratio 1 to 7 or less).

Gallery: Radially into sapwood for 3-5 cm, the end enlarged into a cavity in which eggs are laid. Hatched larvae excavate a narrow chamber as they grow in size (Figs. 68D, 68E). Sometimes, adults gain entrance to the host via galleries of other scolytids (e.g., *Trypodendron retusum*, *Alniphagus aspericollis*, and *Gnathotrichus* spp.).

Biology: Eggs are laid prolifically (up to 100). Larvae feed communally, evidently on an ambrosia fungus introduced into the gallery by the par-

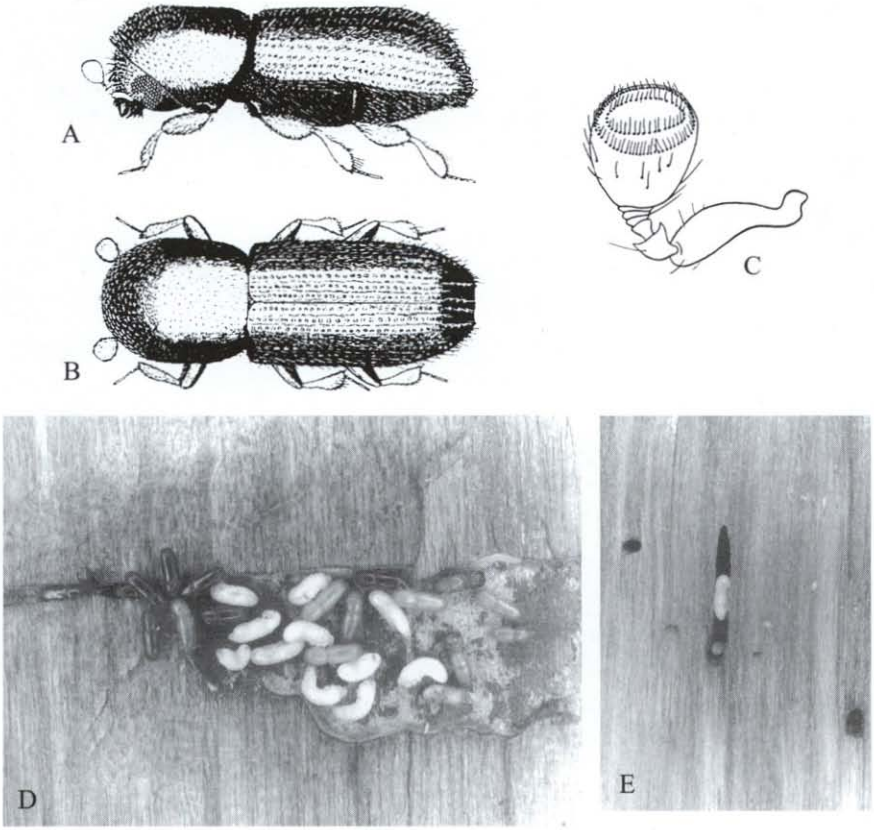

Figure 68. *Xyleborinus saxeseni*. (A, B) Adult. (C) Antenna. (D) Radial section through entry tunnel at left and chamber packed with larvae, pupae, and newly transformed adult brood. (E) Cross-section of brood chamber showing its narrowness and a pupa within it. (A, B: M. D. Deyrup; C: Balachowski 1949.)

ents. In warmer areas a generation develops in one to two months; the number of generations in Idaho is unstudied.

References: Bright 1968, Hosking 1973.

Xyleborus

Polygamous. Two very different species occur in Idaho. One is native (*X. intrusus*), infesting decaying stumps of Douglas-fir and rarely found. The other, *X. dispar*, is larger and infests a wide range of angiosperm hosts that are dying. Only the females can fly. The male of *X. dispar* is dwarfed, and the male of *X. intrusus* has not been described. Species of *Xyleborus* produce many more female than male offspring. Inbreeding is normal due to the dwarfed males being flightless. In a species not found in Idaho (*X. compactus* (Eichhoff)), males are haploid, females diploid, and an unmated female produces only male offspring with which she then mates to produce female offspring (Entwistle 1964).

Key to Species of Xyleborus

1. Smaller (2.2-2.7 mm); slender; dark reddish brown; declivity with several pointed tubercles, vestiture of sparse setae, and inconspicuous punctures; in *Pinus, Pseudotsuga* ..... female ***intrusus* Blandford**

— Larger (2.8-3.5 mm); stouter; blackish; declivity lacking evident tubercles or setae but with relatively large diameter punctures; in deciduous trees ..... female ***dispar* (Fabricius)**

Xyleborus dispar (Fabricius)

Distribution: Europe; Canada: B.C., N.S., Ont.; USA: Several eastern states; In the West: Ore., Utah, Wash. In Idaho: Adams, Benewah, Boise, Bonner, Boundary, Clearwater, Gem, Idaho, Kootenai, Latah, Nez Perce counties.

Hosts: ***Alnus rhombifolia*, *Betula papyrifera*, *Cornus* sp., *Juglans nigra*, *Malus* sp., *Populus tremuloides*, *Prunus* spp., *Salix scouleriana*, *Ulmus pumila***, *Castanea*, *Corylus*, *Quercus*, *Vitis*, and other woody plants. Infests unthrifty or injured stems.

Adult: Female 2.8-3.5 mm; dark brown to black (Figs. 69A, 69B); similar to *Trypodendron retusum* (both may occur in *P. tremuloides*), but the antennal club of *X. dispar* is cylindrical and obliquely truncated (Fig. 69D) whereas that of *T. retusum* is flattened and rather oval. Males rare; 1.5-1.8 mm; dwarfed in appearance due to the declivity beginning almost at the prothorax (Fig. 69C). *Trypodendron* males are of normal size and have a deeply concave frons (convex in *X. dispar*).

Gallery: Radially into sapwood for 1-3 cm, then branching in a horizontal plane (Fig. 69E). Each branch may branch again. The female parent transmits a nutritious ambrosia fungus that grows on the wall of the gallery and is fed upon by her brood.

Biology: One generation per year (B.C., Canada), infesting trees in mid-April. Broods overwinter as new adults before emerging in March-April. A sex ratio of 2.2 females per male is reported. Related species have the capability of producing diploid female progeny sexually or haploid males parthenogenetically (Entwistle 1964).

References: French and Roeper 1975, Mathers 1940 (under the synonym *Anisandrus pyri* (Peck)).

Xyleborus intrusus Blandford

Distribution: Mexico: Chih., D.F., Dgo., Jal., Mor., Oax., Pue.; Guatemala; Honduras; Canada: B.C.; USA: Mid-Atlantic states; In the West: Ariz., Calif., Colo., Mont., N.Mex., Ore., S.Dak., Utah. In Idaho: Ada, Butte, Latah, Washington counties (very rare).

Hosts: ***Pseudotsuga menziesii***, *Pinus contorta*, *P. coulteri*, *P. jeffreyi*, *P. leiophylla*, *P. mexicanus*, *P. ponderosa*. Infests bases of trees in which decay is advanced (differing from all other Idaho scolytids, which require fresher material).

Adult: Female: 2.2-2.7 mm; dark reddish brown; declivity very steep and rather convex; interstriae 1 and 3 each with three to six pointed tubercles; vestiture of sparse hair. Male undescribed.

Gallery: Not described, but in related species, the gallery penetrates sapwood deeply and branches repeatedly. Possibly more than one generation may inhabit and extend a gallery system.

Biology: Not studied.

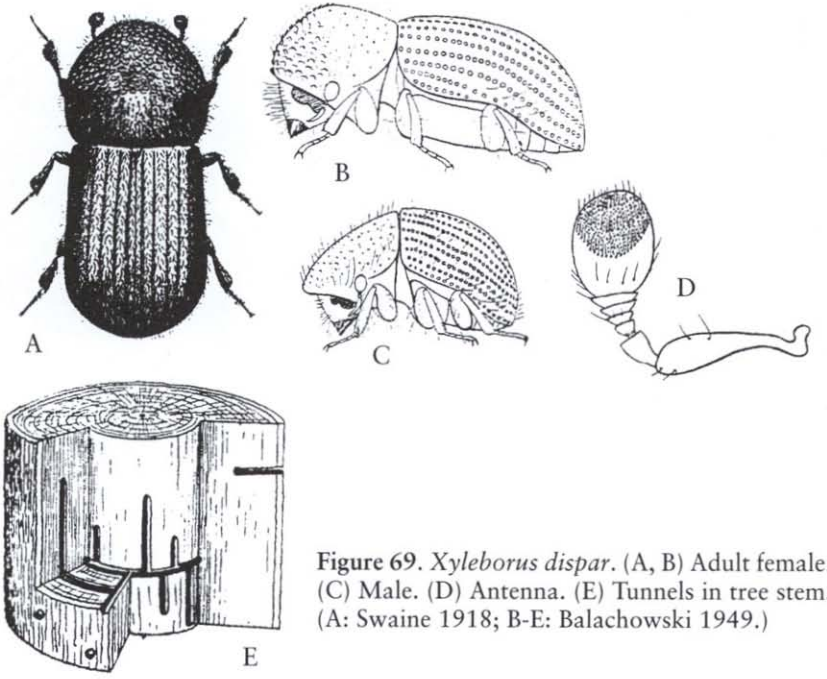

Figure 69. *Xyleborus dispar*. (A, B) Adult female. (C) Male. (D) Antenna. (E) Tunnels in tree stem. (A: Swaine 1918; B-E: Balachowski 1949.)

GLOSSARY

Antennal suture – the junction of two antennal segments.

Asperites – coarse surface elevations such as on the pronotum of *Alniphagus aspericollis*.

Biramous – two-branched egg gallery, each branch extending opposite the other from the nuptial chamber.

Bisinuate – having the shape of two sinuous undulations.

Bisulcate – having two parallel grooves.

Brood – all of the individuals that hatch from eggs laid by one female and that normally mature at about the same time.

Callow adult – a recently transformed adult that is uniformly light yellowish brown (lacking the darker color of mature adults).

Carina – herein applying to a narrow ridge or keel on the head (frons) oriented longitudinally or transversely or a ridge or keel on the second abdominal sternite (segment) of some *Scolytus* species.

Club – the enlarged terminal part of the antenna consisting of one to four segments, fused except in *Phloeotribus lecontei*.

Crenulations – acutely elevated, broad surface projections, especially on the base of each elytron or on the ridges (interstriae) that run lengthwise on the elytra; rounded teeth.

Declivity – herein applying to the sloping, sometimes concave, rear end of the elytra.

Dimorphism – having two distinct forms in the same species, often involving the frons or elytral declivity and differing usually between males and females.

Egg gallery – tunnel made by adult females in which they lay eggs. For brevity, may appear as "gallery" herein.

Egg niche – a notch created on the side of an egg gallery by a female beetle in which to deposit an egg.

Elytra (sing., elytron) – shell-like forewings of a beetle that cover and protect the folded-up membranous hindwings that are used to power flight.

Emarginate – having a notched margin.

Fossa – a deep cavity on the frons, herein referring especially to that of female *Pityogenes*.

Frass – fragments of phloem or wood chewed by adults while tunneling and often expelled from the entrance of their tunnel.

Frons – front of the head between the eyes, extending from the mouth to above the eyes.

Glabrous – having a surface without hairs, generally smooth.

Host – the plant in which a bark beetle may reproduce or in which it develops.

Interstriae – the interspace between rows of punctures or grooves (striae) on the elytra, sometimes raised to form ridges. By its definition, this term has no singular form. Interstriae (and striae) are numbered laterally from the elytral suture.

Larva (pl., larvae) – the legless, white, immature stage, having a tender, flexible body and a hardened, usually brownish, head capsule. Usually curled, C-like, in lateral view.

Larval mine – a tunnel made by a larva, emanating from an egg gallery.

Mycangium (pl., mycangia) – pouchlike structures or pits for storing mutualistic fungi in all ambrosia beetles and some bark beetles.

Nuptial chamber – a cavelike chamber made by bark beetles in the inner bark beneath the entrance hole, from which the egg galleries originate. So named because some species mate there, but used also for turning around to reverse direction during oviposition.

Parthenogenesis – asexual reproduction without fertilization by a male, common among *Xyleborus* species.

Pheromones – insect-produced chemicals that stimulate a specific reaction such as aggregation on a host tree. Usually enhanced by odor of the host tree.

Pitch tube – an accumulation of solidified, coniferous-tree resin on the outside of the bark around a bark beetle entrance hole. Created by some *Dendroctonus* species.

Polymorphism – having several different forms in the same species.

Procurved – curved with the convexity in front.

Pronotum – upper surface of the segment behind the head (prothorax).

Prothorax – first segment behind the head; it bears the first pair of legs but no wings.

Punctures – pits on body parts, herein mainly on the pronotum (see especially *Hylurgops* and *Hylastes*) and on the striae of the elytra.

Pupa (pl., pupae) – the brief, immobile life stage between the larva and the adult. It is white, lacks any hardened part, and does not feed but has rudimentary adult features.

Reticulate – marked with a network of fine, impressed or elevated lines.

Serrate – notched like the teeth of a saw.

Seta (pl., setae) – hair, usually long and slender or bristlelike, but broad (scalelike) in some Hylesininae, especially *Pseudohylesinus*.

Sternite – referring herein to the ventral segments of the abdomen, especially of *Scolytus* species, where sternite 2 (numbered backward from the rear-most leg-bearing body segment) may contain a spine.

Stria (pl., striae) – longitudinal grooves on the elytra, usually containing punctures aligned in a row.

Subcapitate – elytral spine with the tip slightly enlarged.

Sublamellate – herein, the antennal club of *Phloeotribus*, in which the segments are laterally produced and not fused.

Subspecies – geographically separated populations that differ in appearance or biology but which interbreed when brought together.

Sulcate – broadly grooved, e.g., the elytral declivity of some species of *Pityophthorus* and *Gnathotrichus*.

Truncate – herein, an antennal club having its tip cut off rather squarely, not rounded or pointed.

Tubercle – a small rounded projection from a surface.

Uniramous – unbranched; an egg gallery that extends from the nuptial chamber in only one direction.

Vestiture – the hair-like or scale-like covering of the body or elytra.

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DIAGNOSTIC HOST INDEX

(Idaho records)

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Alnus **spp. (alder)**
- Trunk, in bark
  - *Alniphagus aspericollis*, 29–30
  - *Alniphagus hirsutus*, 30
- Trunk, in wood
  - *Xyleborinus saxeseni*, 105–107
  - *Xyleborus dispar*, 107–108

Amelanchier alnifolia **Nuttall (serviceberry)**
- Trunk and branches, in bark
  - *Chaetophloeus heterodoxus*, 32

Betula occidentalis **Hook. (water birch)**
- Trunk, in Bark
  - *Xyleborinus saxeseni*, 105-107

Betula papyrifera **Marshall (paper birch)**
- Trunk, in bark
  - *Dryocoetes betulae*, 62–63
- Trunk, in wood
  - *Gnathotrichus retusus*, 100
  - *Trypodendron betulae*, 103
  - *Xyleborus dispar*, 107–108

Cercocarpus ledifolius **Nuttall (curlleaf mountain-mahogany)**
- Trunk and branches, in bark
  - *Chaetophloeus heterodoxus*, 32

Cornus **sp. (dogwood)**
- Trunk, in wood
  - *Xyleborus dispar*, 107-108

Juglans nigra **L. (black walnut)**
- Trunk, in wood
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SPECIES INDEX

Page numbers in **bold** indicate pages with illustrations.

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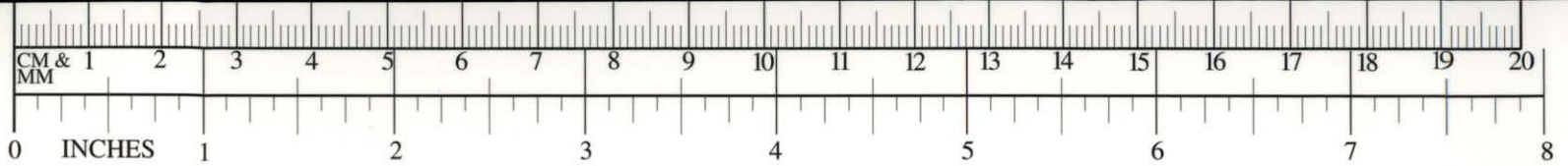
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Field Guide to the Bark Beetles of Idaho and Adjacent Regions

Aided by this field guide, anyone familiar with Idaho trees can seek out and identify any of Idaho's more than 100 species of bark beetles and their close relatives.

Rather than rely on beetle anatomy for identifications, this guide makes primary use of host trees and the beetles' distinctive and intricate gallery patterns in the bark.

Book Highlights

- This first guide to the bark beetles of Idaho includes many recent records of species found there by the authors.
- More than 100 photographs and illustrations depict beetle galleries and identifying anatomical features of the beetles themselves.
- A host tree index lists Idaho trees and shrubs and the bark beetles that infest them.
- Detailed information on each species includes distribution by county, host trees, gallery pattern, and a description of the adult beetle.
- Simplified keys make primary use of host trees and gallery patterns to identify beetles to genus and species.

The Authors

Malcolm Furniss, an outdoorsman and authority on bark beetles of western North America, passes on the practical knowledge he has gained during many years in the field. James "Ding" Johnson, a skilled taxonomist and gifted field biologist, is head of the Idaho Insect Survey and curator of the William F. Barr Entomological Museum at the University of Idaho.

"This book would benefit anyone curious about the natural world. It is a 'must have' for those interested in discovering these fascinating and often overlooked inhabitants of Northwest trees as well as for forest entomologists who routinely work with bark beetles. I highly recommend it."

—Sandra Kegley, forest entomologist, USDA Forest Service, Coeur d'Alene, Idaho

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