Pine engraver (*Ips pini*)

Insect and Disease Management Guide – Northern and Intermountain Regions, Chapter 4.10 (Revised 2025)

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INTRODUCTION

Pine engraver beetle (*Ips pini*) is a native bark beetle that is widely distributed throughout North America and can infest any pine species. In the Northern and Intermountain Regions, pine engraver is most often a management concern in ponderosa pine and sometimes in lodgepole pine. There is an exception, in northern Idaho, where lodgepole pine and ponderosa pine are both important host species. Problematic pine engraver infestations often last just one year and can last two, or more years when plentiful breeding material is available and when optimal weather conditions exist. Pine engraver maintains populations in trees with limited defense responses, i.e., wind-, storm-, or fire-damaged trees, trees weakened or recently killed by other damage agents, or trees stressed by heat or reduced soil moisture, and logging slash. Most frequent damage is in second-growth ponderosa pine stands where overstocked sapling to pole-size trees (2-10 inches DBH) are killed. Multiple generations per year facilitate additional tree mortality due to a rapid increase in beetle populations over the growing season. If these stands are thinned, consideration should be given to slash management to avoid increased mortality of residual trees. Pine engraver typically kills small clusters (<10) of trees but can kill large pockets (50 - 500) of trees during outbreaks (Kegley et al. 1997).

LIFE HISTORY

Overwintering adults become active early in the spring (i.e., late April to early May) when daytime temperatures exceed 63° F, infesting slash or winter-damaged trees with moist phloem. Attacks are initiated by male beetles that construct nuptial chambers beneath the bark. Each male then attracts several females using attractant pheromones. After mating, females construct egg

galleries radiating from the nuptial chamber, resulting in star-, H-, or Y-shaped egg galleries (Figure 1).

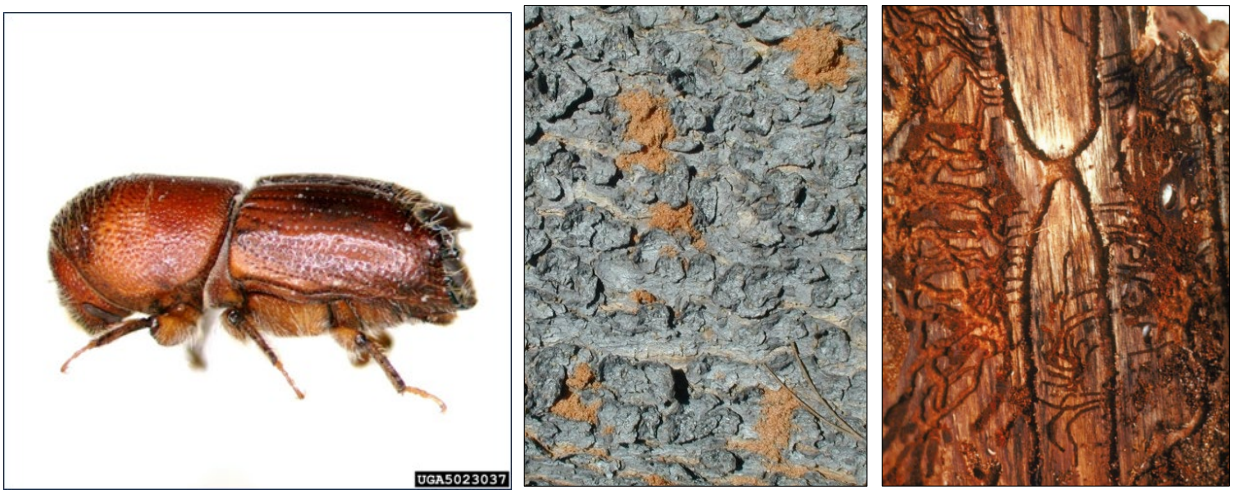

Figure 1— Pine engraver beetle and signs. (Left) Adult beetles are cylindrical, dark reddish-brown to black and 1/8 to 3/16 inch long. All members of the genus *Ips* are characterized by an elytral declivity – a dish-shaped depression at their posterior end. On each side of this depression, there are four small spines. (Center) Boring dust produced where beetles enter the host. (Right) Each male attracts several females which, after mating, construct egg galleries radiating from the nuptial chamber. (Courtesy photos by Pennsylvania Department of Conservation and Natural Resources - Forestry Archive, Bugwood.org (left); Brytten Steed, USDA Forest Service (center); Ladd Livingston, Idaho Department of Lands (right)).

Egg galleries are kept free of boring dust and frass, unlike those of many other bark beetles. During this time fungi are introduced that clog the tree's vascular tissues. Eggs hatch in four to 14 days. The larvae mine laterally (across the wood grain), feeding on phloem tissue for 10 to 20 days. A pupal cell is formed at the end of each larval gallery. The first-generation adults emerge in about 10 days after initiating pupation, completing their development from egg to adult in 40 to 55 days, around June. First-generation adults fly, usually less than a quarter of a mile, to seek new material to infest, preferring slash but attacking nearby trees if beetle numbers are high enough and residual live pines have reduced vigor. The second generation is typically completed from late-summer to early-fall. Warm, dry temperatures shorten beetle development time (30 to 40 days) and may allow additional full or partial generations to develop within the growing season (Figure 2).

Pine engraver can have one to five generations depending on climatic conditions across its range. Across the Northern and Intermountain Regions two generations are most common, with a third likely in warmer years and in southern locations. Microsites, weather, and elevation can also cause variability in pine engraver emergence and development (Williams et al. 2008). When there are two generations per year, adults emerging late-summer or early-fall and seek sheltered places (e.g., beneath the duff on the forest floor or within infested material) to overwinter. This generation can make feeding attacks prior to overwintering where no new brood is produced, but phloem is consumed by the adult beetles. There is evidence that warmer, drier conditions in more northern portions of pine engraver range (e.g., northern Idaho) contribute to a partial third generation in which these beetles seek new host material and lay eggs, which then overwinter as larvae or pupae

(Eckberg and Kegley 2017). Pine engraver that overwinters as adults have greater survival than overwintering as larvae and pupae (Livingston 1979). More information is needed to fully understand voltinism and phenology of pine engraver under a changing climate across the range of ponderosa pine in the Intermountain and Northern Regions.

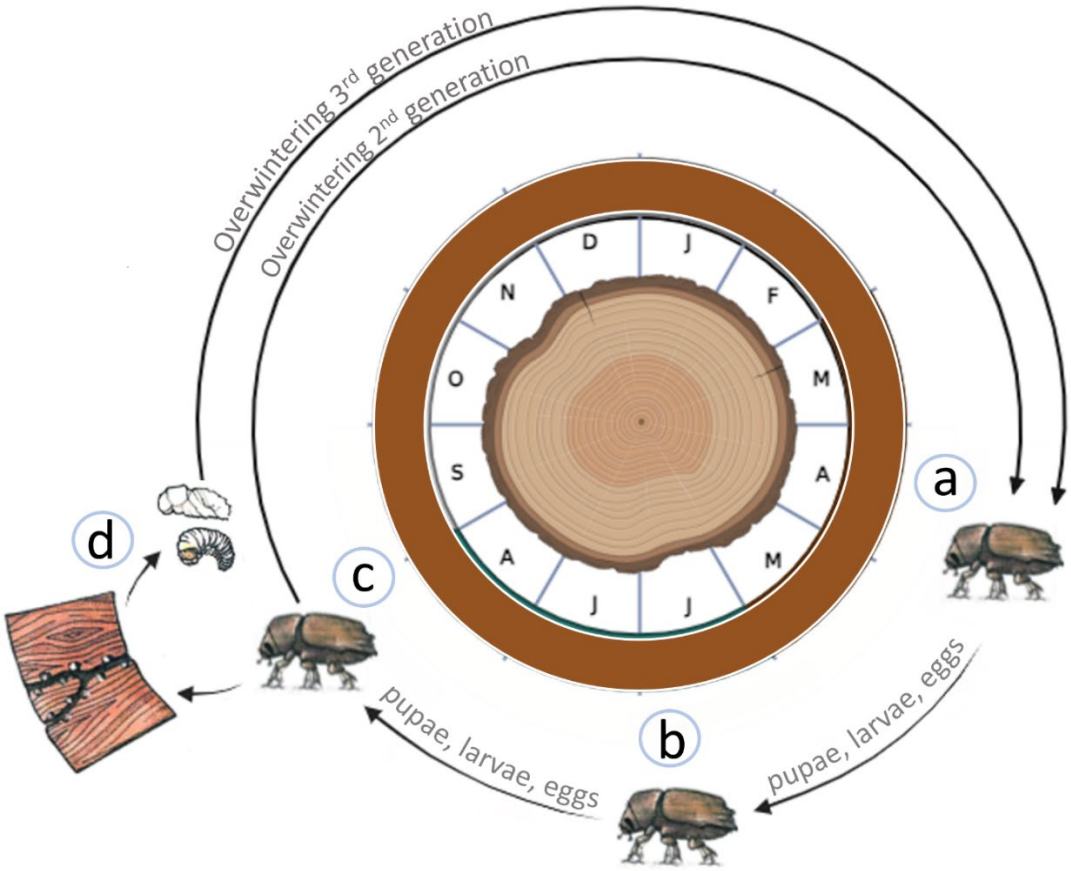

Figure 2 — Life cycle of the pine engraver. Adult beetles represent approximate emergence and mating period relative to the calendar year. Pine engraver beetles in the Northern and Intermountain Regions have two to three generations per year: (a) overwintering adults emerge in spring, infest suitable host material, mate and lay eggs, producing (b) the first-generation of adults that emerges in late spring. The first generation infests slash or host trees, produces (c) the second generation that will overwinter as adults, or mate and produce a (d) third generation that overwinters as larvae or pupae.

DAMAGE

The first indication of a pine engraver attack in slash or standing trees is the characteristic reddish-orange boring dust at the beetle's point of entry into the host. In slash or logs, this boring dust appears as mounds around entrance holes on the upper surface of the host material or on the underside of the log. On standing trees, the dust is most notable in bark crevices, branch junctions, and around the base of the infested tree where boring dust can accumulate. Removing the bark reveals a Y-, H-, or star-shaped gallery pattern usually aligned with the grain of the wood and free of boring dust. From a distance, stand-level damage may be seen as small pockets of pole-size trees or tops of larger pines with light green or yellow crowns within months of attack. Crowns eventually

fade to red later that year or the following spring, depending on weather conditions.
The number of trees damaged by pine engraver is typically small, but during outbreaks, groups of pines may be killed, impacting up to hundreds of trees. Smaller trees (2-10 inches DBH) are often killed outright. For larger trees, top kill may be more common (Figure 3), but mortality can also occur during drought or other periods of high stress or in conjunction with other damage agents (Negrón et al. 2016). Fire-scorched trees are highly attractive to pine engraver and have compromised vigor, making them ideal host material (Fettig et al. 2010). Attacks are often associated in the same tree with western pine beetles, mountain pine beetles, red turpentine beetles, and woodborers (Figure 3).

The percentage of normal precipitation between April and July has been used to predict the intensity of beetle outbreaks in California (Hall 1956, *Ips confusus*) and Oregon (Dolph 1965, *Ips pini*) with about 75 to 50 percent accuracy, respectively. If precipitation is 75 percent of normal or less, moderate to heavy tree mortality can be expected in overstocked, second-growth ponderosa pine stands (McGregor et al. 1977). Damage may continue for two to three years. Under conditions of extreme drought, large groups of young sawtimber have been attacked and killed (Livingston 1979).

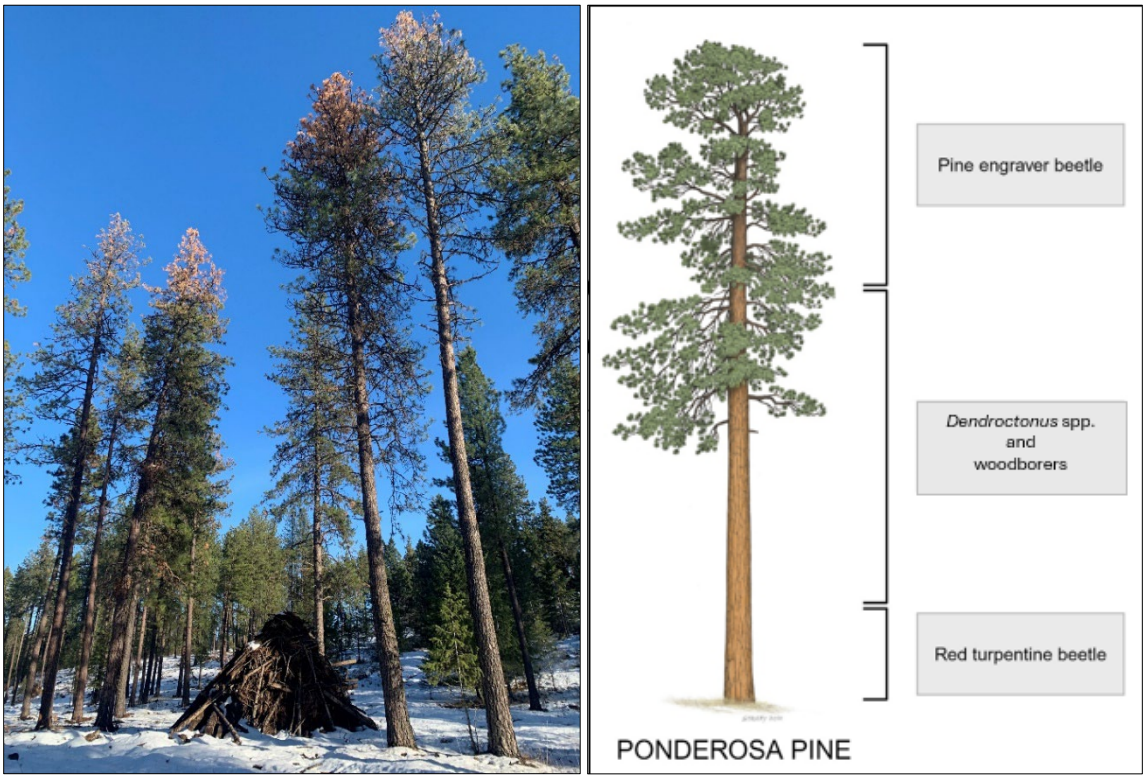

Figure 3 — Pine engraver damage in ponderosa pine. (Left) A cluster of large ponderosa pine trees with signature pine engraver top kill adjacent to a slash pile. (Right) Typical resource partitioning of bark beetles in large ponderosa pines with multiple-species infestations.

MANAGEMENT

Pine engraver management is often a combination of prevention and suppression tactics that depend on various factors such as stand structure, site condition, weather, and timing of harvest operations or vegetation treatments. Outbreaks are often associated with improper slash management, so proper removal and/or destruction of breeding material is critical for pine engraver prevention and management. Other practices for minimizing pine engraver infestation include thinning to improve tree vigor and proper timing and execution of prescribed burns.

Slash Management

Green pine slash, greater than two inches diameter, generated during logging and thinning operations and pines weakened by abiotic disturbances (e.g., windthrow, ice breakage, drought, harvest, fires, soil compaction) provide ideal habitat for pine engraver attack and population buildup (Livingston 1979). This highly suitable breeding material requires proper slash management, which generally includes proper timing and spacing of slash creation (Table 1).

- Avoid creating pine slash unless it can be properly managed prior to pine engraver emerging in the spring.
- Avoid creating new slash within a half mile of locations where slash was produced the previous year.
- Clean up or treat storm damaged pine, where possible.
- Do not stack slash or fresh pine logs or green pine firewood against live, desirable pines.

Table 1 — Timing of green pine slash creation and treatment based on pine engraver biology and habitat suitability

Slash created	Likelihood of pine engraver infestation*	Treatment timing+
December – March	High: Slash covered by moderate-heavy snow, or remains frozen, will contain enough moisture to attract and be suitable habitat for pine engraver beetles in the spring.	April – June 1
April – July	Extreme: Pine engraver is active, seeking suitable, freshly created habitat.	As slash is created
August – November	Low - Moderate: Slash has time to dry, becoming less habitable for pine engraver when produced before fall freeze.	April – June 1

* Varies based on temperature and precipitation patterns that regulate drying of slash.
+ If there is evidence of pine engraver in slash when temps reach 60°F (often between March and May), then treat slash before the second-generation beetles emerge (within four to six weeks from when slash was initially infested).

Several management tactics can be used to minimize the risk of pine engraver infestation. Effectiveness of these tactics depends on the time of year, amount of slash created, precipitation patterns, and resources available and may fail during exceptionally hot, dry years (DeGomez et al. 2008). Slash management can occur before pine engraver infests the slash or after slash has been infested, which is also called sanitation. Tactics can be used independently or in combination with one another with the goal to (1) reduce suitability of the slash prior to emergence of overwintering adults, (2) sanitize infested slash before the offspring of overwintering adults emerge to attack live

pines, or (3) provide suitable slash throughout the growing season so that each generation of pine engraver remain in slash and do not attack green trees. Tactics include:

- **Slash removal** to physically remove material from the site or burn slash piles on site. Physical removal may only be practical for small operations where limited slash is generated. If all slash cannot be removed, concentrate on larger diameter pieces, up to eight inches, because reproductive success can be higher in larger diameters (Steed and Wagner 2004). If burning, create smaller piles and avoid scorching residual trees.
- **Bark removal** by dozer trampling or other large equipment, or manually (draw knife, ax, or chainsaw adaptors, such as log wizard©) to destroy suitable habitat by exposing phloem tissues.
- **Lop and scatter** to increase drying rate and reduce suitability for brood development. Where slash removal is impractical, lopping slash into smaller pieces (< 12 inches length) and scattering them into openings is often effective. Exposing the slash to higher intensity or direct sunlight dries slash faster than being shaded (Villa-Castillo and Wagner 1996, Hayes et al. 2008). Timing and amount of precipitation (especially snow) after lop and scatter also influence slash drying times.
- **Chipping or mastication** to manipulate slash and/or reduce fuels makes the material uninhabitable for pine engraver breeding. These treatments create abundant volatiles that may attract pine engraver beetles up to two weeks after creation, so treatments should be avoided prior to and during beetle flight in the spring to avoid attacks of standing pines (Fettig et al. 2006b).
- **Green chaining** aims to keep beetles in slash and out of standing green trees by providing fresh pine slash for emerging beetles to infest throughout the growing season (Livingston 1979). Close monitoring is critical to properly time new slash for each generation of emerging adults. Throughout the season, create a new supply of fresh slash for each generation of flying adults just as those beetles enter the pupal stage. This tactic may be difficult to maintain due to timing issues and may fail if a stand is already drought-stressed. This tactic is an option when timber operations occur in late spring through early fall and pine engraver beetle populations are present.
- **Large slash piles** (minimum 20 foot long and 10 foot deep) to contain subsequent generations by acting as a population sink (Kegley et al. 1997). When slash piles are large enough that interior pieces do not dry before beetles from later generations emerge, new beetles are attracted deeper into the pile rather than infesting standing green trees. These slash piles must be created prior to the emergence of the overwintering beetles in the spring, and larger logs should be placed at the bottom of the pile to retain moisture and act as breeding material for subsequent generations (Knopf 1982). Drier, hotter summers require larger piles to provide sufficient moisture (e.g., 80 foot by 30 foot by 15 foot high, or larger).

Preventative Thinning

Thinned, vigorous stands of pine are less attractive to pine engraver beetles and can help reduce risk of future outbreaks by promoting tree defenses. These defense reserves are especially needed during drought years to reduce successful bark beetle attacks. Recently thinned stands may temporarily be more attractive to pine engraver because soil disturbance, mechanical damage to

leave trees, and other abiotic factors may reduce vigor of trees initially, so care should be taken to minimize stress and damage of residual trees.

- Reduce pure pine stand density to 60 – 80 square feet of basal area per acre or 100 – 150 stand density index (Fettig et al. 2022; Long and Shaw 2005).
- Consider the proportion of pine in mixed composition stands when determining density reduction.
- Avoid damaging residual trees and promptly remove heavily damaged trees.

Suppression and Sanitation

Timely thinning and slash disposal is critical to avoid pine engraver outbreaks, which are easier to prevent than to control. If pine engraver populations do build up, there are options for sanitation and suppression, though depending on management objectives, direct suppression may not be warranted because infestations are likely to be brief.

Some of the above-described tactics for slash management will also be effective for brood destruction in infested trees; all must be conducted before adult beetles emerge, so the window for sanitation tactics is short. These tactics include chipping, piling and burning, or harvest.

Prescribed Burns

Prescribed burns are a management strategy that can improve residual stand vigor and serve other management objectives like removing smaller trees and reducing fuel loads. However, pine engraver beetles are highly attracted to trees scorched by fire because this scorching destroys the cambium and weakens tree defenses. If possible, planning the timing and intensity of prescribed burns to reduce scorch to residual trees can minimize the likelihood and extent of subsequent pine engraver-induced mortality in scorched stands, if that is a management concern. The likelihood of pine engraver infestation in scorched trees is most prevalent within two years of burning, then tapers off in the third year.

- Conducting prescribed burns in spring can result in less pine engraver-induced mortality than burns conducted in late fall (Fettig et al. 2010).
- Raking excessively deep (>12 inches) ground fuels and duff from the bases of high-value and desired leave trees limits bole scorch that can minimize the chance of beetle infestation (Hood et al. 2007).
- When burning slash piles, avoid scorching nearby standing, desired green pines.

Developed Settings

In developed environments, such as recreation and administrative sites or homesites, avoid disturbing roots of ornamental pines. Excessive damage typically weakens trees, rendering them more susceptible to beetle attack; weakened or badly damaged trees should be removed. Pine slash created near housing developments should be disposed of as soon as possible and should not be left near live pine trees. Avoid backfilling or paving over root areas, including the root flare. More than four inches of soil or mulch over roots stresses trees, making them attractive to attacking beetles.

Insecticides

High value trees that have not yet been attacked can be protected from future attacks by bark beetle species, including pine engraver, using broad-spectrum insecticides, like carbaryl, permethrin or other products labeled for bark beetles by treating the bark surfaces. Spray heights for insecticide applications are limited with ground-based, pressurized equipment (usually to 50 feet or less) and may not sufficiently protect taller trees. All portions of the tree greater than four inches diameter should be treated for full protection. The use of bucket trucks or other equipment greatly increases treatment costs and usually precludes this practice. Alternative application methods and insecticide formulation may be delivered systemically by stem or soil injections. Properly applied insecticide treatments can be effective for one to two years (Fettig et al. 2006a) and sometimes longer with systemic treatments. Insecticides are not recommended for protecting slash piles from being infested nor killing beetles in slash. Consult with a forest entomologist for current information.

Semiochemicals

There are currently no semiochemicals available to protect standing trees or slash from pine engraver infestation. However, anti-attractant pheromones are being tested and may provide valuable tools to aid slash management in the future (Gaylord et al. 2020). One challenge to any future anti-aggregation pheromone is the frequent presence of other bark beetle species with pine engraver in pines.

Attractant pheromones of pine engraver have been identified, synthesized, and are commercially available. Attractants may be used to monitor pine engraver populations or for mass trapping within a stand or around infested slash piles in isolated scenarios. Trapping with attractant pheromones is only recommended in consultation with an entomologist. Spillover attacks of live pines near the traps are likely to occur when using attractants for pine engraver.

NATURAL CONTROLS

Competition among developing brood often reduces adult emergence from small-diameter host material. In larger material, competition with other bark beetles and woodborers often reduces food available for pine engraver broods. Predation by woodpeckers, beetles, flies and mites is common, as is parasitism by wasps and nematodes.

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