Forest Service
U.S. DEPARTMENT OF AGRICULTURE

State & Private Forestry | FS-1179 | August 2021 (Revised)

Forest Insect and Disease Leaflet 96

Larch Casebearer

Larch casebearer, *Coleophora laricella* Hübner (Lepidoptera: Coleophoridae), is a needle-mining insect that lives most of its larval stage within a hollowed-out needle case (fig. 1). It is native to mountainous regions of Central Europe where it feeds on European larch, *Larix decidua* Mill. In the late 1800s, larch casebearer was discovered defoliating planted European larch near Northampton, MA, and subsequently spread onto eastern larch, *Larix laricina* (Du Roi) K. Koch. Outbreaks in the northeast were reported by 1900, with complete defoliation of eastern larch trees in invaded areas. Spread into the western Great Lakes region occurred through the 1920s and 1930s. Larch casebearer was reported in Ann Arbor, MI, by the early 1920s, northeastern Wisconsin in 1939, and Port Arthur, Ontario, in 1947. In 1957, larch casebearer was discovered defoliating western larch, *Larix occidentalis* Nutt., near St. Maries, ID. Although the exact source of casebearer on western larch remains unknown, it is likely that populations were introduced from those residing on eastern larch.

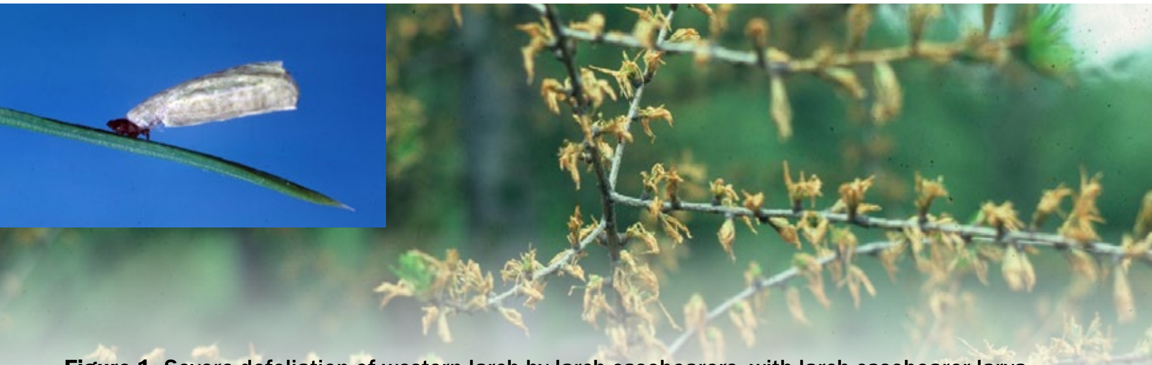

Figure 1. Severe defoliation of western larch by larch casebearers, with larch casebearer larva carrying a case (inset). Photos by Roger Ryan (now retired), USDA Forest Service.

Hosts and Distribution

There are three larch species native to North America: eastern larch (also called tamarack), western larch, and alpine or subalpine larch, *Larix lyallii* (Parl.). As noted above, larch casebearer feeds on eastern and western larch. It has not been detected on alpine larch, which occurs in the same region as western larch but typically at higher elevation. Alpine larch and western larch hybridize in some parts of their range, indicating that alpine larch may be a suitable host. Other hosts in North America include European larch and species of Asian larches, which have been planted in some North American locations.

The distribution of eastern larch extends from the Northeastern United States up to Northeastern Canada, across the Great Lakes region and boreal forest, and into Alaska (fig. 2). The distribution of western larch, which does not overlap with that of eastern larch, includes mountainous regions of Oregon, Washington, Idaho, and Montana in the United States and southern British Columbia and Alberta in Canada (fig. 2). Larch casebearer has spread throughout eastern and western larch forests of the United States, but factors

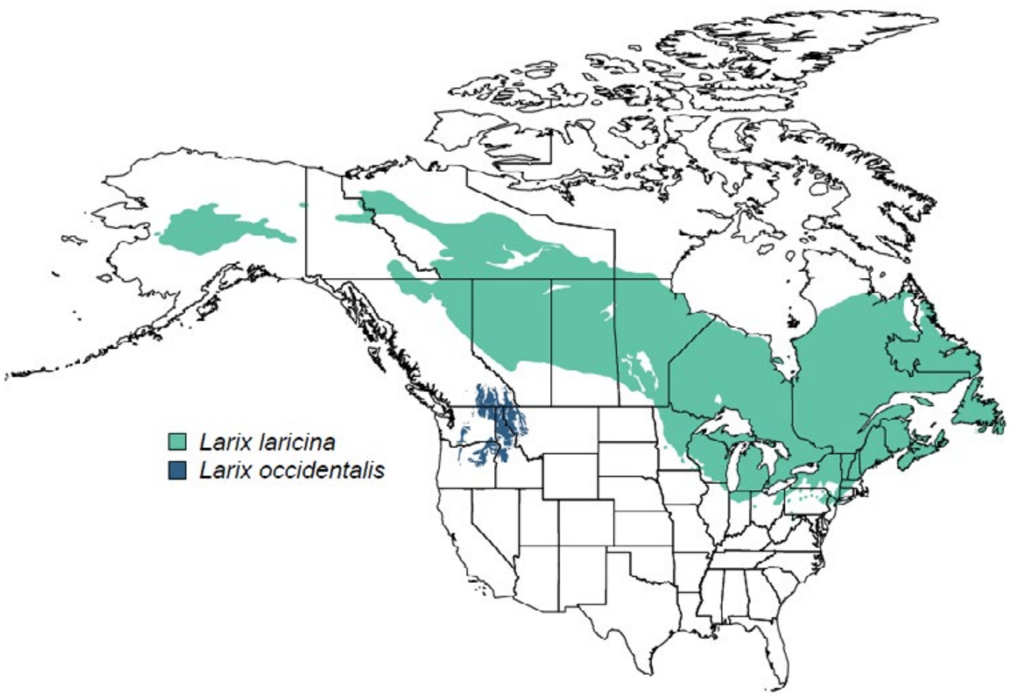

Figure 2. Distributions of eastern and western larch in North America. Western larch and alpine larch occur in the same region, with alpine larch at higher elevations.

influencing the insect's distribution, which may be limited by cold temperatures at higher latitudes and elevations, are not well characterized. For instance, the northern limits of the insect's range in eastern and western larch forests of Canada are unknown, and larch casebearer has never been reported in Alaska.

Description and Life History

Larch casebearer has one generation per year, with an obligate larval diapause during the overwintering stage. It has four life stages (egg, larva, pupa, and adult), but its life cycle is comprised of seven distinct phenological phases: egg, needle miner, autumnal casebearer, overwintering casebearer, spring casebearer, pupa in case, and adult moth (fig. 3). Moths deposit eggs, which resemble inverted jelly molds, individually onto larch needles in mid-summer. First instars hatch through the bases of eggs and then mine into underlying needles where they feed for several weeks. During the second to third instar, larvae construct cases out of mined, hollowed out needles by lining them with silk.

After reaching the casebearing stage in autumn, larvae move between needle fascicles and feed by attaching their cases to needles, puncturing holes, and mining in one or both directions without entirely leaving their cases (fig. 4). Casebearing larvae overwinter as third instars attached near dormant buds, often in clusters. Termination of diapause occurs sometime between mid-winter and spring. Beginning in April or May, larvae molt into the fourth and final instar, detach their cases (termed "activation"), and begin feeding on larch foliage. Larval activation typically occurs 2 to 3 weeks after larch bud break; longer photoperiods and warmer temperatures accelerate diapause termination and subsequent activation.

As they grow, spring feeding larvae enlarge cases with silk and/or construct new cases from hollowed out needles. In spring, larvae consume several needles by mining in the same manner as the previous autumn. Development from activation to the pupal stage takes approximately 6 weeks. Pupation occurs inside cases attached to host needles, often in the base of fascicles. Thus, both larval development and pupation are completed inside cases. Adult emergence and peak flight occur from late June to early July, but regional differences in the timing and duration of the flight period likely exist.

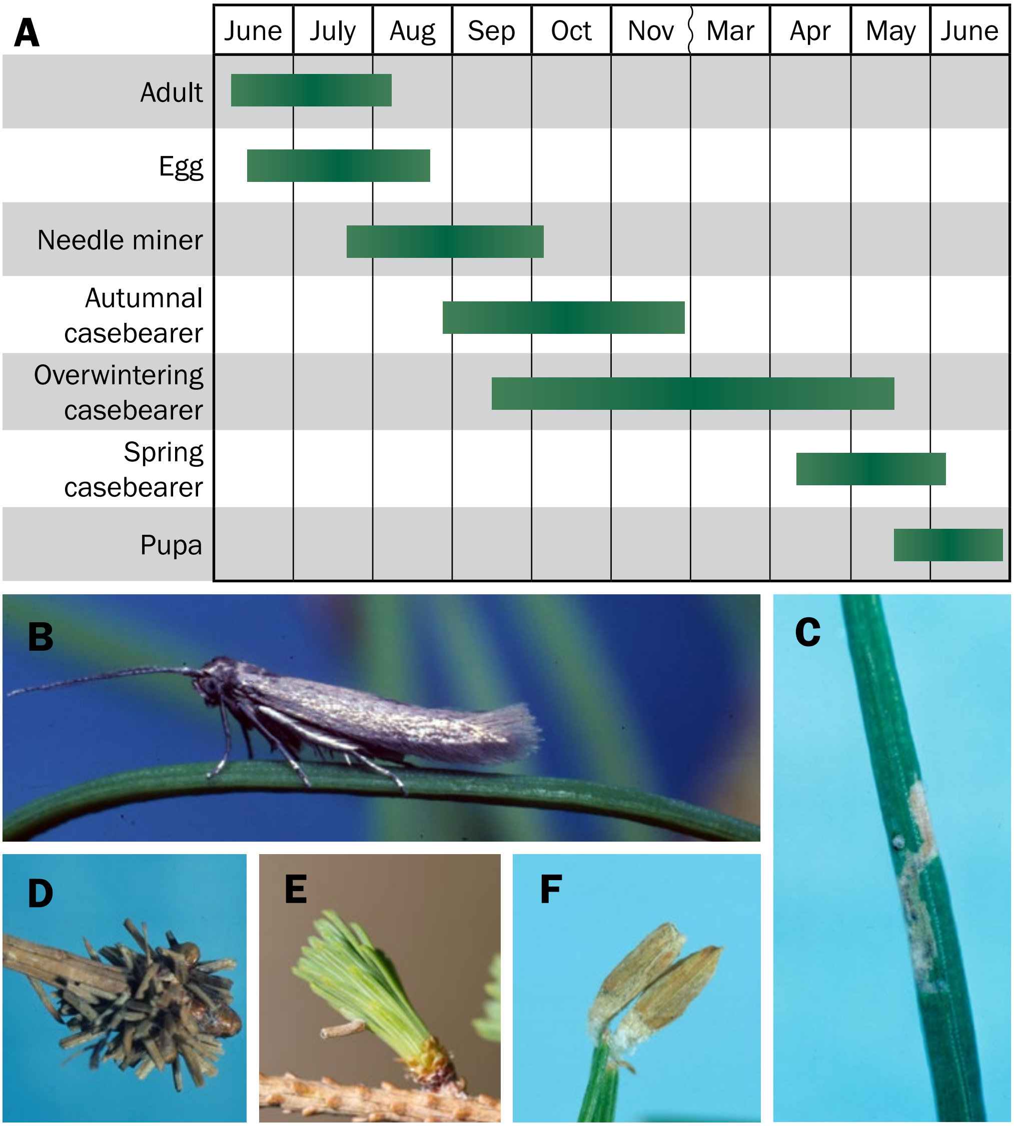

Figure 3. (A) Life cycle for larch casebearer depicting seven phenological phases: (B) adult, (C) egg and needle miner, (D) overwintering casebearer, (E) spring casebearer, and (F) pupae. The larval stage lasts from the needle-mining stage until pupation. The autumnal casebearer is not pictured but is similar in appearance to spring casebearers. Approximate timings of first appearance can vary by location. Photos (B), (C), and (D) by Roger Ryan (now retired), USDA Forest Service; photo (E) by Steven Katovich, USDA Forest Service; and photo (F) by Thérèse Arcand, Natural Resources Canada, Canadian Forest Service.

Evidence and Impacts

Larch casebearers can be found year-round on host trees, but minute eggs and needle-mines are challenging to detect. Larch casebearing larvae and feeding damage can be observed upon close inspection of branches in autumn, but feeding damage by fourth instars in spring is the most damaging part of the life cycle and,

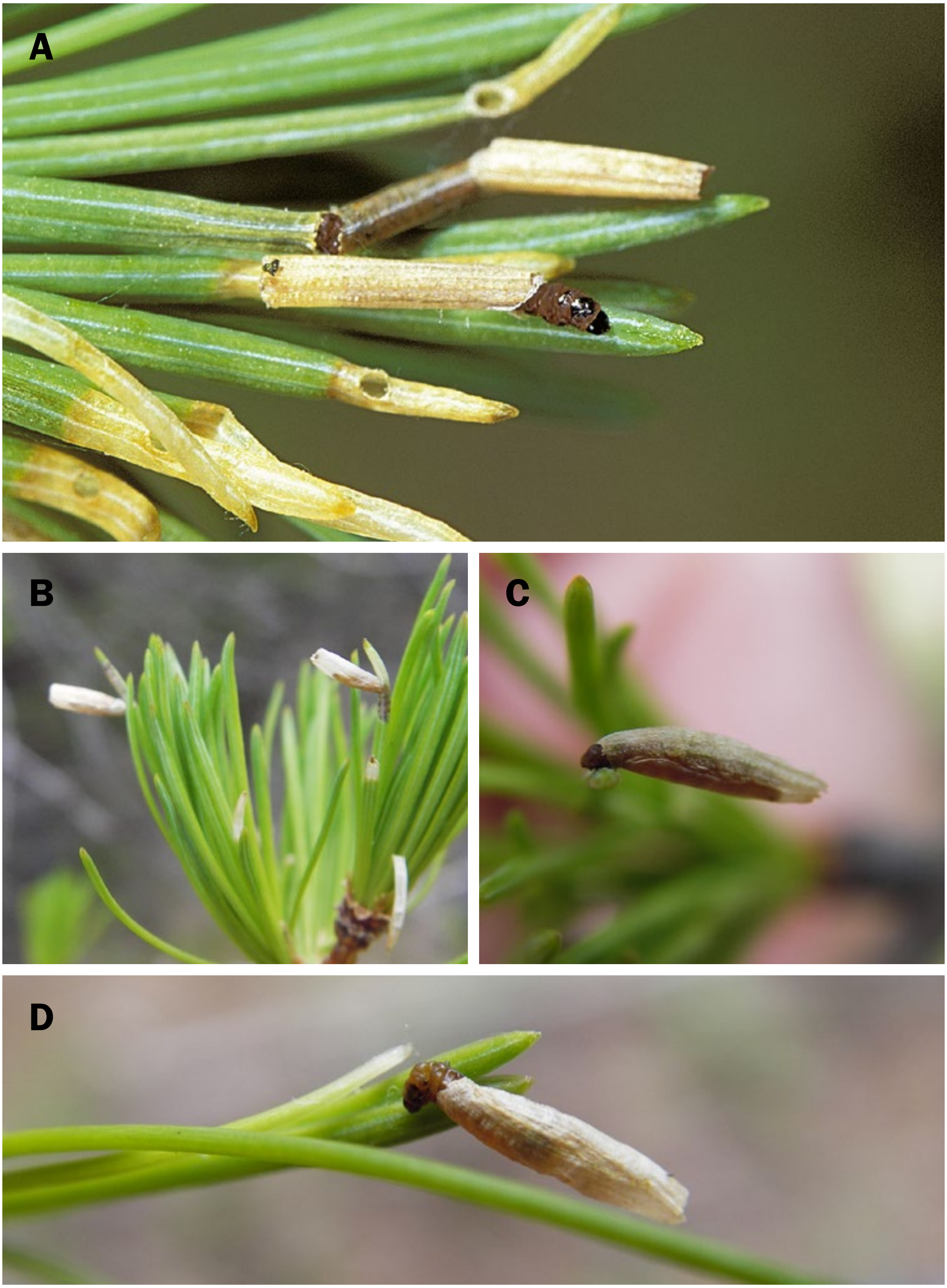

Figure 4. (A) Branch-level feeding damage from larch casebearer larvae in spring/early summer; note small feeding holes on yellow-brown needles. (B) Larvae entering needles to feed. (C, D) Individual larva with case constructed from a hollowed out larch needle. Photo (A) by Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre; photos (B), (C), and (D) by Brytten Steed.

Figure 5. Feeding damage by larch casebearer in spring, Minnesota. Note the light color of damaged foliage. Photo by Samuel Ward, Department of Biochemistry, Molecular Biology, Entomology and Plant Pathology, Mississippi State University.

when larvae are at high densities, render trees with a very conspicuous burnt, reddish-brown appearance (figs. 5, 6). Severe and widespread defoliation can be detected during aerial surveys (fig. 7), whereas low-density populations are not likely to cause conspicuous damage.

Larch is a deciduous conifer, and some trees will refoliate after spring defoliation, depending on their vigor and the history and severity of defoliation. Severe defoliation can decrease tree growth and weaken trees, making them more susceptible to secondary mortality agents. For example, in eastern larch forests, defoliation has been associated with increased susceptibility of eastern larch to eastern larch beetle, *Dendroctonus simplex* LeConte (Coleoptera: Curculionidae),

Figure 6. Stand-level feeding damage by larch casebearer in spring, Oregon. Photo by William M. Ciesla (now retired), USDA Forest Service.

Figure 7. Landscape scale defoliation of eastern larch by larch casebearer in Michigan. Photo by Marc A. Roberts, USDA Forest Service.

whereas in western larch forests, defoliation can be associated with increased incidence of western larch borer, *Tetropium velutinum* LeConte (Coleoptera: Cerambycidae), and Armillaria root disease.

Repeated defoliation from high-density casebearer populations (e.g., exceeding more than two larvae per bud) leads to dieback from the tips of the branches, top kill, epicormic branching, and eventually mortality. At least 5 years of severe, repeated defoliation are typically required to cause significant decline (e.g., more than 95 percent reduction in radial growth) and mortality. Young trees that are open grown or located at stand edges are the most likely to be killed.

Following the introduction of larch casebearer, widespread-severe defoliation of eastern larch was observed by 1900. Outbreaks associated with reduced tree growth and vigor, and occasionally mortality, continued across the Great Lakes region until the importation of natural enemies (parasitic wasps) from the native range (see Natural Control section) reduced casebearer densities below damaging levels beginning in the late 1940s. Since 2000, however, increased casebearer activity has been observed on eastern larch.

Widespread outbreaks on western larch followed the establishment of larch casebearer in Idaho in the late 1950s. Due to their success in eastern larch forests, parasitic wasps were also released in western larch forests. The biological control program was deemed a success in western larch forests and only short-duration (1–2 years) defoliation events were detected via aerial surveys from the early 1970s to 1997, after which some minor outbreaks have been reported.

Natural Control

In eastern larch forests, warm growing seasons (April–November) along with high spring precipitation are associated with increased incidence of defoliation. In western larch forests, casebearer populations are limited by cold spring temperatures (e.g., late frosts) along with high spring precipitation, which increases incidence of two fungal competitors, larch needle cast (*Rhabdocline laricis* (Vuill.) J.K. Stone; basionym: *Meria laricis* Vuillemin) and larch needle blight (*Hypodermella laricis* Tub.) (fig. 8). Low precipitation that results in needle desiccation can negatively impact needle mining casebearers (i.e., early instars). In eastern larch forests, these fungal competitors have historically been less common and are not believed to inhibit casebearer populations. In general, casebearers can survive very cold winters, tolerating brief exposures to temperatures into the -40s °C (-40s °F).

Several natural enemies help regulate casebearer populations. Birds, spiders, and predatory insects, such as ants, consume eggs, larvae, and/or pupae. In response to widespread outbreaks of larch casebearer in the early 1900s in eastern larch forests and 1960s in western larch forests, natural enemies from the native range of larch casebearer were introduced into North America, a strategy

Figure 8. Co-occurrence of larch casebearer and larch needle blight on western larch in summer, Montana. Photo by Laurel Haavik, USDA Forest Service.

known as importation or classical biological control. Several species of parasitic wasps were introduced, and two, *Agathis pumila* Ratzeburg (Hymenoptera: Braconidae) and *Chrysocharis laricinellae* Ratzeburg (Hymenoptera: Eulophidae), became widely established (fig. 9). The program was deemed a success by the late 1940s in eastern larch forests, whereas casebearer populations in western larch forests began to collapse in the 1970s following the release of these two parasitoids. Control in both forest types was mostly attributed to parasitism from *A. pumila.* Despite the persistence of both *A. pumila* and *Ch. laricinellae* as well as parasitism from several native parasitoids, some casebearer outbreaks have been detected since the late 1990s in western larch forests and the early 2000s in eastern larch forests.

Chemical Control

Since larch is tolerant of defoliation and can refoliate, management using pesticides may not be necessary unless repeated defoliation occurs. Chemical control, while not feasible at the stand- or landscape-scales, can be applied to protect high-value trees in seed orchards, recreation areas, and urban areas. Insecticides should be applied in mid-spring shortly after budburst and subsequent larval activation for maximum efficacy. If chemical control is desired, seek advice from tree care professionals and pesticide specialists before applying treatments.

Silvicultural Control

No specific silvicultural methods have been developed to control larch casebearer, in part because it has not been a major pest following biological control efforts. Indeed, since the introduction of parasitic wasps, defoliation has most often been localized, isolated, and of low severity. Larch casebearer prefers open grown, younger trees, but defoliation can occur in stands of a variety of ages and composition. Intensity of western larch defoliation in the

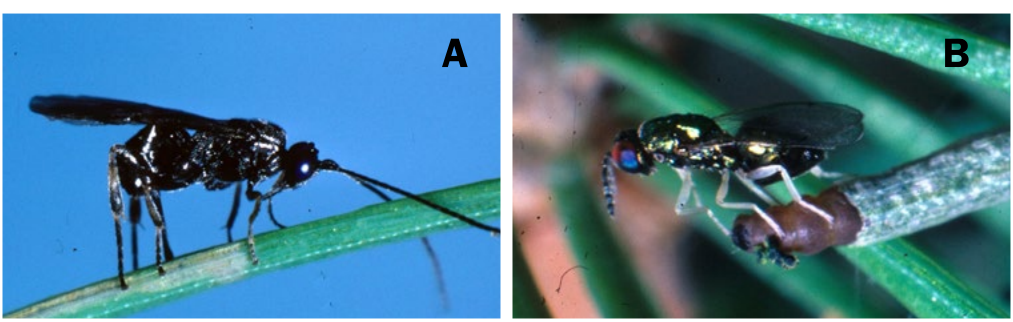

Figure 9. Parasitic wasps, (A) *Agathis pumila* and (B) *Chrysocharis laricinellae,* depositing eggs into larch casebearer larvae. *A. pumila* attacks the needle-mining stage, whereas *Ch. laricinellae* attacks casebearing stages in spring and autumn. Photos by Roger Ryan (now retired), USDA Forest Service.

following season can be estimated by overwintering casebearer densities (fig. 10). This defoliation-casebearer density relationship has not been verified on eastern larch. The importance of host tree condition for susceptibility is unknown because defoliation occurs on both apparently healthy and weakened trees. In eastern larch forests, casebearer populations can persist in the same stand for several years. Although western larch is relatively tolerant to root disease and few insect pests feed on it, it has become less abundant due to fire suppression and selective harvesting.

Managers are encouraging the recolonization of western larch to its historical range. Since defoliation from larch casebearer can significantly damage western and eastern larches, it will be an important insect to monitor as larch regenerates and is recruited into the overstory. Additionally, as temperatures warm, forests above 1,200 m that were historically colonized, but not severely damaged by larch casebearer, may become more vulnerable. Warming temperatures may also increase the risk to alpine larch.

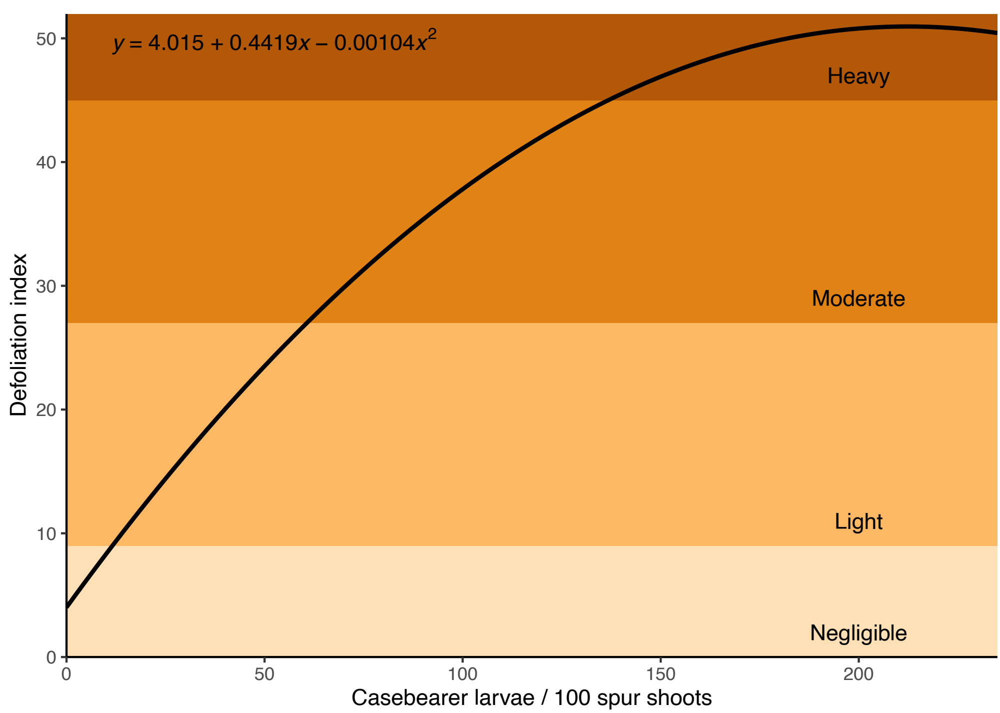

Figure 10. Overwintering density of larch casebearers per 100 spur shoots (dormant buds) can be used to predict intensity of western larch defoliation the following growing season. The defoliation index is divided into levels of predicted intensity (negligible to heavy), as indicated by different fill colors. See Ciesla and Bousfield (1974) for sampling methods and model development.

References

Arno, S.F.; Habeck, J.R. 1972, Ecology of alpine larch (*Larix lyallii* Parl.) in the Pacific Northwest. Ecological Monographs. 42: 417–450.

Benoit, P.; Blais, R. 1988. The effects of defoliation by the larch casebearer on the radial growth of tamarack. The Forestry Chronicle. 64: 190–192.

Ciesla, W.M.; Bousfield, W.E. 1974. Forecasting potential defoliation by larch casebearer in the northern Rocky Mountains. Journal of Economic Entomology. 67: 47–51.

Hagen, H.A. 1886. *Coleophora laricella* Hb. very injurious to *Larix europea*, in Massachusetts. The Canadian Entomologist: 18: 125–126.

Johnston, P.R.; Seifert, K.A.; Stone, J.K.; Rossman, A.Y.; Marvanová, L. 2014. Recommendations on generic names competing for use in *Leotiomycetes (Ascomycota)*. IMA Fungus. 5: 91–120.

Miller-Pierce, M.; Shaw, D.C.; Demarco, A.; Oester, P.T. 2015. Introduced and native parasitoid wasps associated with larch casebearer (Lepidoptera: Coleophoridae) in western larch. Environmental Entomology. 44: 27–33.

Ryan, R.B.; Tunnock, S.; Ebel, F.W. 1987. The larch casebearer in North America. Journal of Forestry. 85: 33–39.

Sloan, N.F.; Coppel, H.C. 1965. The insect parasites of the larch casebearer, *Coleophora laricella* Hubner, (Lepidoptera: Coleophoridae) in Wisconsin with keys to the adults and mature larval remains. Wisconsin Academy of Sciences, Arts and Letters. 54: 125–146.

Thorpe, W.H. 1933. Notes on the natural control of *Coleophora laricella*, the larch case-bearer. Bulletin of Entomological Research. 24: 271–291.

Tunnock, S.; Denton, R.E.; Carlson, C.E.; Janssen, W.W. 1969. Larch casebearer and other factors involved with deterioration of western larch stands in northern Idaho. Res. Pap. INT-68. Ogden, UT: U.S. Department of Agriculture, Forest Service. 10 p.

Ward, S.F.; Aukema, B.H. 2019. Anomalous outbreaks of an invasive defoliator and native bark beetle facilitated by warm temperatures, changes in precipitation and interspecific interactions. Ecography. 42: 1068–1078.

Ward, S.F.; Aukema, B.H. 2019. Climatic synchrony and increased outbreaks in allopatric populations of an invasive defoliator. Biological Invasions. 21: 685–691.

Ward, S.F.; Eidson, E.L.; Kees, A.M.; Venette, R.C.; Aukema, B.H. 2020. Allopatric populations of the invasive larch casebearer differ in cold tolerance and phenology. Ecological Entomology. 45: 56–66.

Ward, S.F.; Moon, R.D.; Herms, D.A.; Aukema, B.H. 2019. Determinants and consequences of plant–insect phenological synchrony for a non-native herbivore on a deciduous conifer: implications for invasion success. Oecologia. 190: 867–878.

Acknowledgments

This publication is a revision of the previous version by Tunnock and Ryan (1985). Their work provided valuable guidance to the preparation of this update. The authors also thank Steven Katovich and Lee Pederson for providing helpful reviews.

Author Credits

Samuel F. Ward, Department of Biochemistry, Molecular Biology, Entomology and Plant Pathology, Mississippi State University.

Laurel J. Haavik, U.S. Department of Agriculture, Forest Service, Forest Health Protection, Missoula, MT.

Brian H. Aukema, Department of Entomology, University of Minnesota, St. Paul, MN.

Pesticide Precautionary Statement

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

Caution: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The Forest Insect and Disease Leaflet (FIDL) series provides information about insects and diseases affecting forest trees in the United States. FIDLs are produced through coordinated efforts of the USDA Forest Service's Forest Health Protection staff and its partners from State forestry, academic, and research organizations.

Learn more at www.fs.fed.us/foresthealth/publications/fidls/index.shtml