Management of black army cutworm

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Summary

Newly planted seedlings are more likely to be severely damaged by the black army cutworm if they have been planted in certain biogeoclimatic zones on dry sites burned within the 12 months prior to moth flight. Defoliation inhibits root growth and reduces the establishment of new roots into the soil. This causes moisture stress in the seedlings; mortality or prolonged growth loss can result especially if the moisture stress is compounded by other factors such as a summer drought, the planting of seedlings in ash or rotten wood, or deformation of the roots during planting.

Significant damage can be avoided through proper management by careful monitoring and planning. Susceptible sites can be identified and mapped in advance. New populations can be detected by pheromone traps deployed on newly burned susceptible sites. Some sites with moderate cutworm populations may require on-site inspection to accurately assess the risk of severe damage to seedlings. Final plans and commitments for planting can then be adjusted to avoid or minimize long-term damage.

Seedlings should not be planted on infested sites if those sites are prone to drought. If feasible, planting should be delayed until after pupation, which usually occurs about June 15 at low elevations, and up to 3 weeks later at higher elevations. If delay of a few weeks is not feasible, planting should be delayed a year. A third choice is to continue planting and assess seedling damage after bud flush one year later. Dead seedlings, seedlings with dead terminals, and seedlings defoliated more than 60% should be replaced.

No precautions are necessary if seedlings are planted on good moist sites not prone to drought, or if the site is burned after September 15 and planting is completed the following spring. Even if the seedlings are subsequently defoliated, the long-term effect of defoliation on these sites is usually slight.

Résumé

Les semis nouvellement plantés sont plus susceptibles d'être gravement endommagés par la légionnaire noire s'ils sont plantés dans certaines zones biogéoclimatiques d'endroits secs brûlés dans les 12 mois précédant le vol des adultes. La défoliation inhibe la croissance des racines et réduit l'implantation de nouvelles racines dans le sol. Cette situation cause un stress hydrique chez les semis; la mortalité et la perte de croissance prolongée peuvent en résulter surtout si le stress hydrique est combiné à d'autres facteurs comme une sécheresse estivale, la plantation des semis dans la cendre ou dans du bois en putréfaction, ou la déformation des racines au cours de la plantation.

Il est possible d'éviter une bonne partie des dommages grâce à une gestion appropriée découlant d'une surveillance et d'une planification soigneuses. Il est aussi possible de reconnaître d'avance les endroits où les dommages sont le plus susceptibles de survenir et indiquer leur position sur une carte, et de déceler la présence des nouvelles populations par l'installation de pièges à phéromone dans les endroits à risque nouvellement brûlés. Certains endroits où la population de légionnaires est modérée pourraient nécessiter une inspection sur place pour permettre une évaluation plus exacte du risque de dommages graves causés aux semis. Les plans et les engagements définitifs pour la plantation peuvent alors être adaptés de manière à éviter ou à réduire le plus possible les dommages à long terme.

Les semis ne devraient pas être plantés dans les endroits infestés si ces derniers sont sujets à la sécheresse. Si la chose est possible, la plantation devrait être reportée à une période ultérieure à la pupaison, qui survient habituellement vers le 15 juin dans les endroits de faible élévation et jusqu'à 3 semaines plus tard dans les endroits de plus grande élévation. Sinon, il faudrait attendre l'année suivante. Une troisième possibilité consisterait à continuer la plantation et à évaluer les dommages causés aux semis après le débourrement un an plus tard. Il faudrait remplacer les semis morts de même que ceux dont les pousses terminales sont mortes et la défoliation dépasse 60 p. 100.

Les précautions ne sont pas nécessaires si les semis sont plantés dans des endroits humides non sujets à la sécheresse ou si l'endroit est brulé après le 15 septembre et que la plantation est terminée le printemps suivant. Même si les semis sont défoliés plus tard, les effets à long terme de la defoliation dans ces endroits sont habituellement peu prononcés.

The problem

Early in the spring, black army cutworm caterpillars begin feeding on herbs and shrubs growing in recently burned areas (Figure 1a, b, c). If conifer seedlings are present, they will be defoliated as well (Figure 1d, e, f). The first evidence of a problem with black army cutworm is "shot-hole" feeding damage on vegetation shortly after snow melt. Often, the damage is first noticed by planting crews at a time when adjustments to the planting program can be difficult and costly. Larval feeding is usually completed within six weeks of spring emergence.

Most of the damage is done during the first year the caterpillars appear. Occasionally some defoliation occurs in subsequent years, but usually this results in only minor damage. Feeding is usually patchy, and seedlings within the patches are attacked to varying degrees. Usually, only small areas are depleted of all vegetation, but sometimes entire cut blocks are defoliated.

Height growth of seedlings is greatly reduced in the first year of larval feeding if more than 60% of the foliage is lost (Figure 2). If the terminal is killed (Figure 1g, h), there is often a noticeable dieback down to the subordinant latent bud which is stimulated to develop, flush, and subsequently become dominant (Figure 1i). On moist sites, height growth of seedlings recovers rapidly, and is close to normal by the second year after defoliation (Figure 3). On dry sites, height growth of seedlings recovers only partially, and there is no further improvement in the third year. Thus, on sites which are prone to drought, it is important to prevent seedlings from being defoliated more than 60%.

The impact of defoliation on seedlings depends not only on the amount of feeding and bud damage, but also on other factors which affect root growth and establishment. Roots normally grow into the soil, permitting the root hairs to establish close contact with soil particles to absorb water and nutrients. However, after defoliation, root growth is inhibited and the seedling depends on moisture that incidentally comes into contact with existing roots. If the soil around the existing roots dries out in the first year after planting, the effects of defoliation are compounded and there can be significant mortality and growth loss (Figure 4). Causes of moisture stress are usually summer drought, poor planting techniques (which cause defects such as "J" roots), or placement into rotten wood, dry organic soil, or other droughty microsites.

Figure 1. *Damage caused by the black army cutworm: a –early "shot-hole" feeding damage; b –feeding damage on false hellebore; c –feeding damage on fireweed; d –defoliated and debudded Douglas-fir; e –defoliated lodgepole pine; f –defoliated Engelmann spruce; g –debudded Engelmann spruce; h –dieback of Douglas-fir; i –dieback and regrowth from a subsidiary latent bud.*

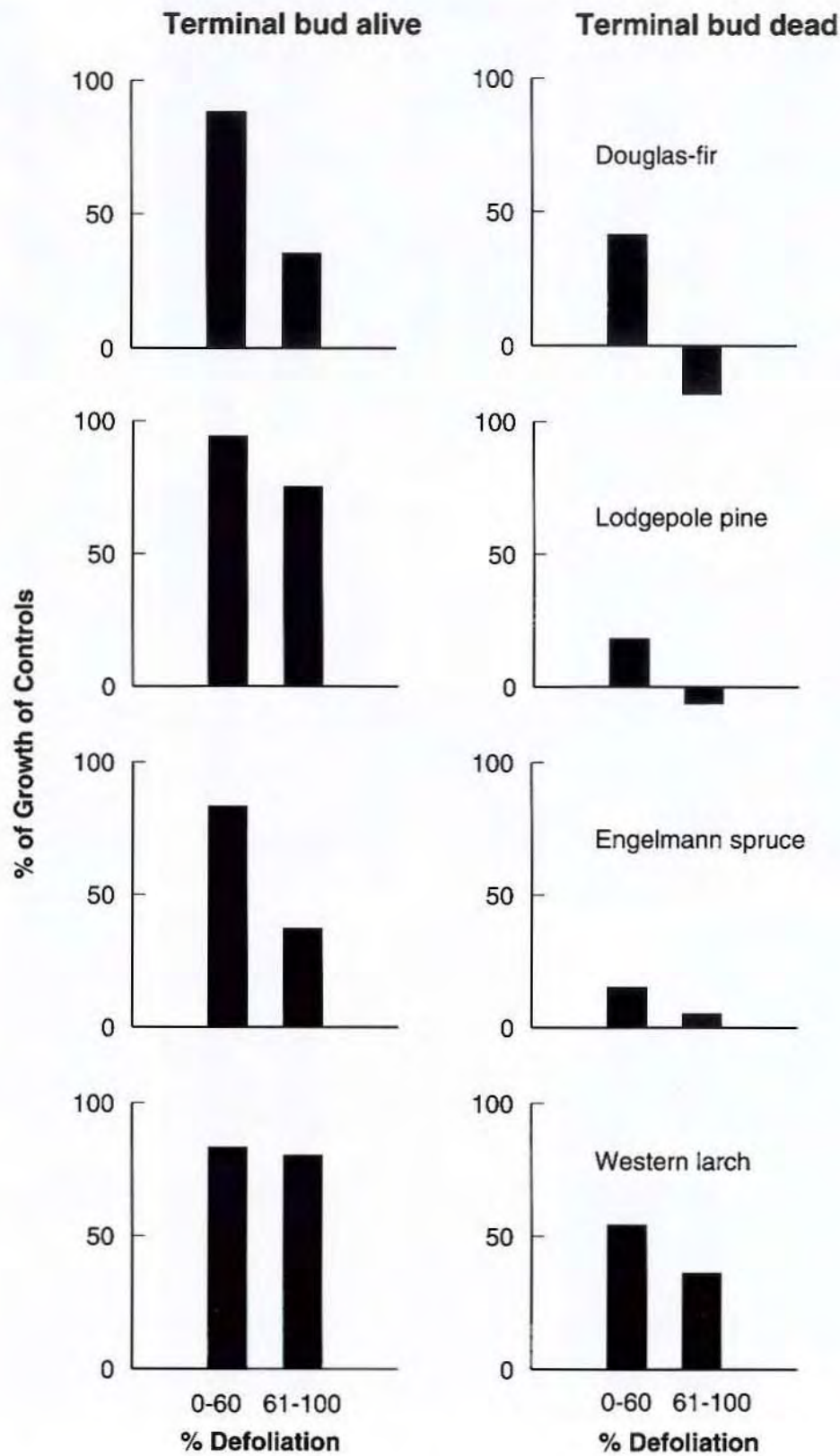

Figure 2. *Average height growth of seedlings during the year of defoliation by the black army cutworm expressed as a percentage of the height growth of non-defoliated seedlings. Defoliation greater than 60% greatly reduces height growth, especially if the terminal is killed.*

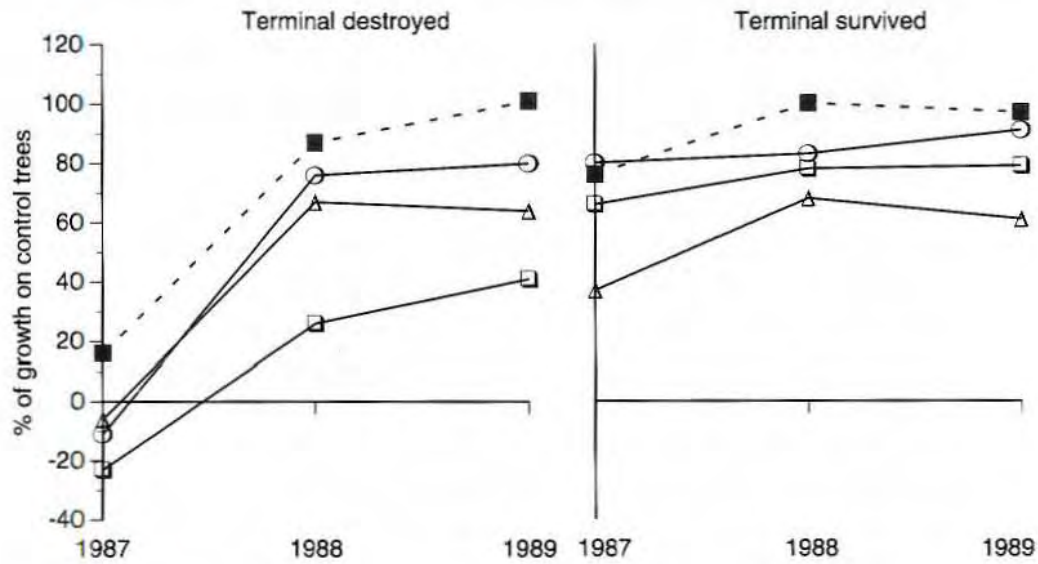

Figure 3. *Recovery of height growth of trees defoliated 61 to 100% in 1987 and during two subsequent years expressed as a percent of growth on non-defoliated trees. Lodgepole pine seedlings on moist sites recovered faster and more completely than those on dry sites; terminal destruction severely reduced growth during the year of defoliation.*

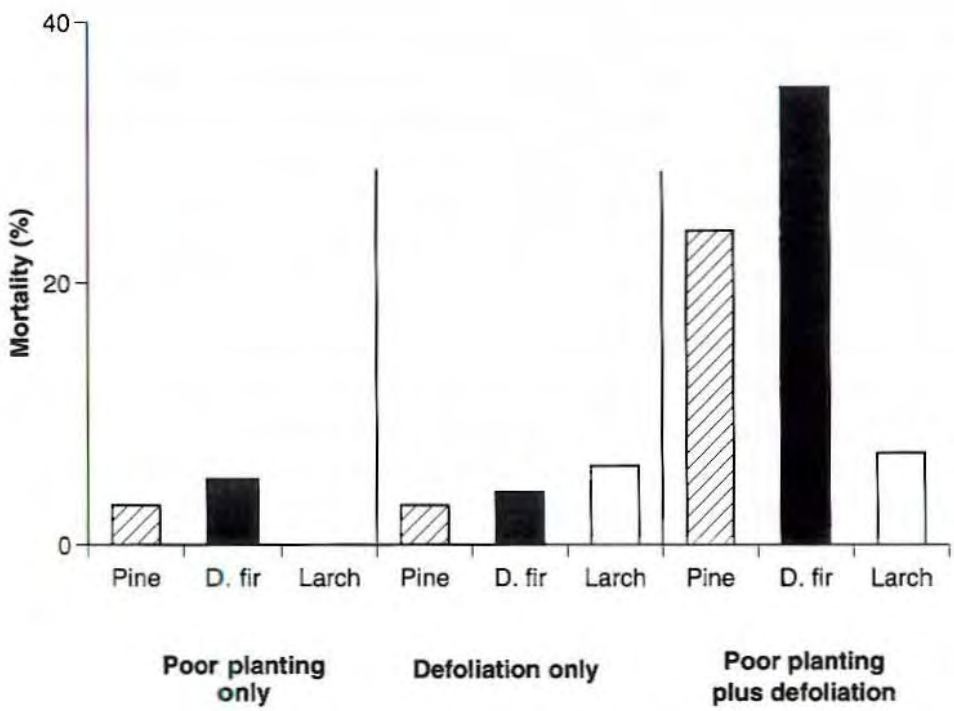

Figure 4. *Percent mortality by species on a dry site due to poor planting, defoliation by black army cutworm, and the combined effect of poor planting plus defoliation. The combined effect was more pronounced with lodgepole pine and Douglas-fir.*

Description and life cycle of the black army cutworm

The life history of the black army cutworm is depicted in Figure 5. As the caterpillars (Figure 6a) finish feeding for the year, they burrow 3 to 7 cm into loose soil to pupate where temperatures are cooler. These soil conditions are frequently found near upturned stumps and adjacent to roads and skid trails. The pupae, about 2.5 cm long, are initially light brown and then turn black a few days before adult emergence (Figure 6b). The adults, also about 2.5 cm long, emerge 2 to 3 weeks later and are dark colored (Figure 6c, d), but the male has a buff stripe on the inner edge of the forewing. During the day the moths hide, becoming active at dusk. They are strong, fast fliers and they congregate in recently burned areas. After two weeks, the females produce a sex attractant, or pheromone, which can stimulate male moths hundreds of metres away to fly upwind. The male finds the female by following this scent plume and then mates with her. Shortly thereafter, the female lays eggs singly or in clusters (Figure 6e) in loose sandy soil or in ash. The eggs take about 2 months to hatch and the small caterpillars overwinter in the soil.

It is the caterpillars of the cutworm that defoliate the seedlings. They are black and velvety with multiple white stripes running the length of the body (Figure 6a). The color pattern is similar at all stages of growth. They go through six growth stages, or instars. At the change of instars, the caterpillar sheds its old skin and head capsule and develops a larger one.

No noticeable damage is caused by the young overwintering larvae, but older larvae can consume significant amounts of foliage. Most damage is done by caterpillars in the final three stages (Figure 7), and those in the sixth instar are the most damaging of all; large caterpillars can consume a seedling in one or two nights.

It is useful to distinguish the average instar of the caterpillars feeding at a particular site; this provides a basis for estimating the feeding time left during the current season. As there is no obvious difference in color pattern or body form between instars, the easiest way to distinguish different stages of development is by comparing the size of the caterpillar with the accompanying pictures of caterpillars at different stages of development (Figure 7). The average number (and range) of feeding days left from the mid-point of each of the last three instars before pupation is as follows: IV instar –18 (range 11-25) days; V instar –15 (range 8-22) days; VI instar –6 (range 0-13) days. These figures should be interpreted with some caution, since not all of the cutworm larvae at a particular site are at the same stage of development at any given time. For example, even if sampling reveals that most of the insects are in the sixth (final) instar on a particular date, some feeding damage may continue for more than 13 days since some of the cutworms were likely still in the fifth instar when the sample was taken.

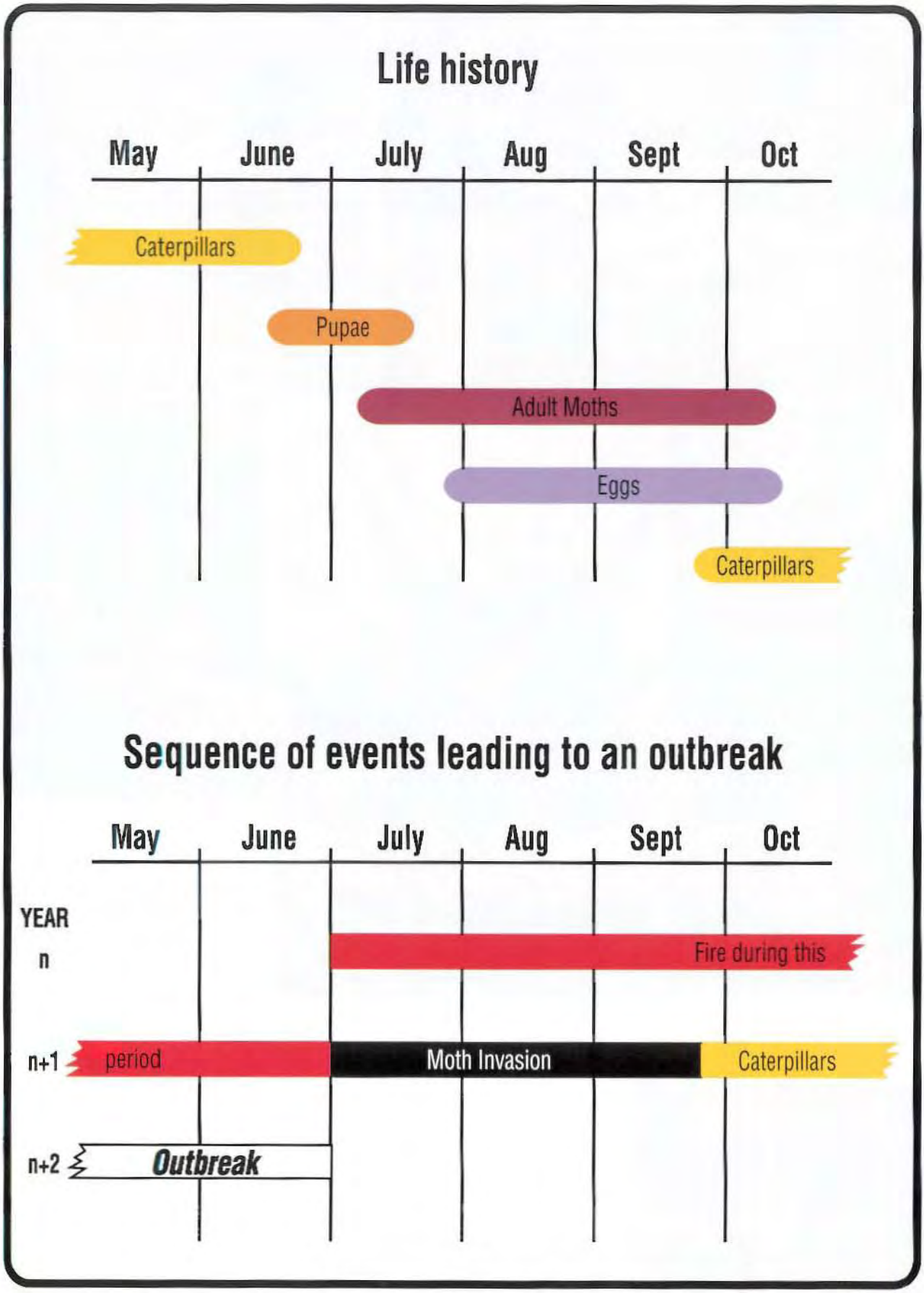

Figure 5. *Life history of black army cutworm and sequence of events leading to an outbreak*

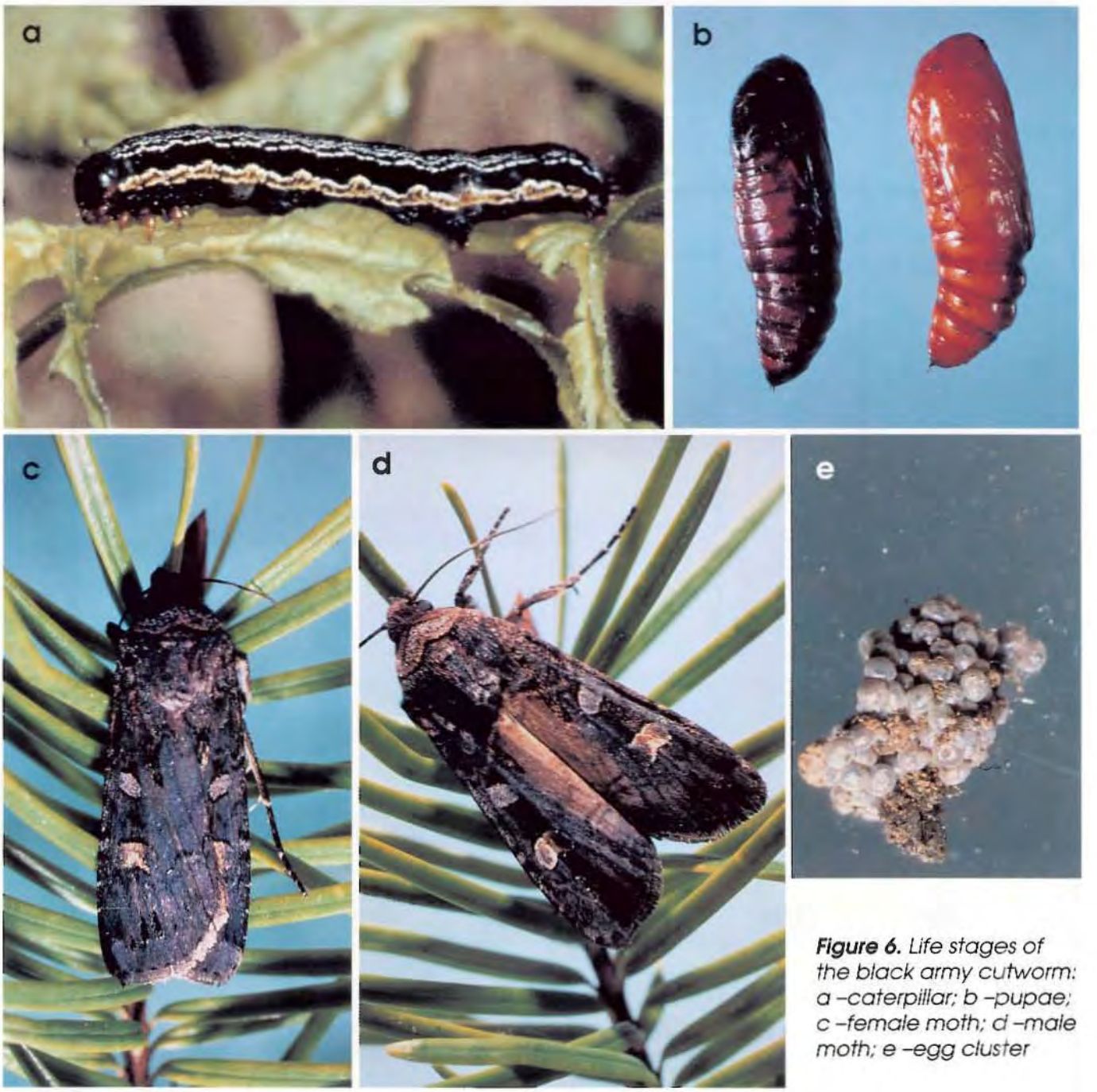

Figure 6. *Life stages of the black army cutworm: a –caterpillar; b –pupae; c –female moth; d –male moth; e –egg cluster*

Figure 7. *The final three caterpillar stages—instars IV, V, and VI (actual size)*

During daylight hours, caterpillars usually hide in the soil adjacent to damaged vegetation; specimens should be collected and identified to confirm that the damage is, in fact, caused by black army cutworm.

Like cutworm larvae, caterpillars of a sphinx moth, called hornworms, also feed on fireweed. Their color patterns are similar to those of black army cutworm, but they pose no risk to seedlings. Unlike the cutworms, hornworms have a red head, spots, and a horn on the last body segment (Figure 8), and they occur later in the season.

Sometimes damage due to Rhizina root rot disease is mistaken for cutworm damage. Rhizina root rot also damages conifer seedlings in burned areas, but damage from Rhizina is easily distinguished from cutworm damage. Damage from Rhizina first becomes noticeable as patches of discolored and dying conifer seedlings associated with large, chestnut-brown to blackish, irregularly shaped fruiting bodies on the surface of the soil. All the needles remain whole, and they change color to yellow and then red before falling off. Other vegetation is not affected. In contrast, damage by the black army cutworm is typified by missing and chewed needles. Whole seedlings do not become discolored unless the main stem is girdled. Where conifer seedlings are damaged by the cutworm, adjacent vegetation is also badly damaged.

Figure 8. *The caterpillar of the sphinx moth, called a hornworm, which feeds on fireweed only and does not present a danger to conifer seedlings*

Characteristics of outbreaks

A wild or prescribed fire is the triggering mechanism for an outbreak (Figure 5). Moths fly throughout July, August, and September and congregate on sites that have been burned earlier that spring or during the previous autumn. Fires that occur in July or August can be invaded the same year. The moths lay their eggs in burned soil; this results in large numbers of caterpillars the following spring. Although moths are attracted to burned sites in large numbers, there is no close relationship between the size of a population in a region one year and that in the next year.

Some areas are more prone to outbreaks than others. Since 1948, caterpillars of the black army cutworm have been collected from over 100 sites in British Columbia (Figure 9). At most of these locations vegetation was damaged, and seedlings were damaged at some of these locations. The biogeoclimatic zones that are prone to outbreaks of the cutworm have been identified as the Engelmann Spruce-Subalpine Fir (ESSF), Montane Spruce (MS), Sub-boreal Spruce (SBS), and Interior Cedar-Hemlock (ICH). The locations of the infestations were not known in sufficient detail to determine whether some biogeoclimatic sub-zones are more susceptible than others.

The cutworm caterpillars prefer certain species of plants over others, and the preferred plants usually become severely damaged before other species are eaten. A good many plant species are preferred by the cutworm over most conifer seedlings (Table 1); the exception is western larch (*Larix occidentalis*), which ranks about the same as saskatoon (*Amelanchier alnifolia*) in preference. When populations are low, the caterpillars feed only on preferred plant species; when populations are moderate, damage to seedlings depends to some extent on the abundance of other plant species preferred by the cutworm; when populations are high, most conifers and deciduous plants are consumed. Some species of plants are not palatable to the cutworm, and these remain relatively undamaged even when the insects are starving.

There can be wide variations in the number of caterpillars encountered. Patches of vegetation up to a few hundred metres across can be eaten clean in a few days (Figure 10). Between patches, a few caterpillars may be present, but there will be no obvious signs of feeding. As the season progresses, each defoliated patch will enlarge as hungry caterpillars consume new plants along the periphery.

As noted previously, caterpillars emerge from the soil to feed at dusk. By day they usually bury themselves in the top layers of the soil and ash and considerable searching may be required to find them. If night temperatures are too low to permit feeding, or if palatable food becomes scarce, caterpillars may remain on the surface during the day searching for food.

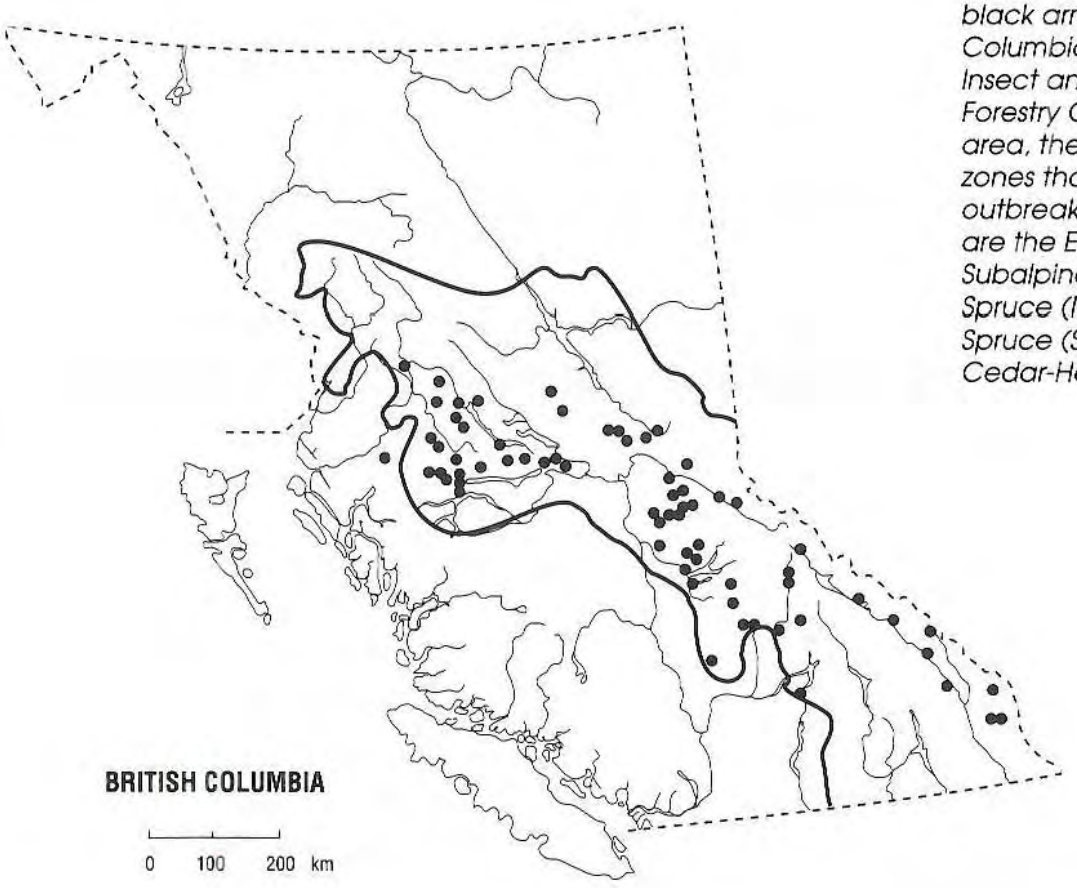

Figure 9. *Location of all known outbreaks of the black army cutworm in British Columbia (Courtesy of Forest Insect and Disease Survey, Forestry Canada). Within this area, the biogeoclimatic zones that are prone to outbreaks of the cutworm are the Engelmann Spruce-Subalpine Fir (ESSF), Montane Spruce (MS), Sub-boreal Spruce (SBS), and Interior Cedar-Hemlock (ICH) zones.*

Figure 10. *A bare patch defoliated by black army cutworm within an otherwise green area that has been clearcut and burned*

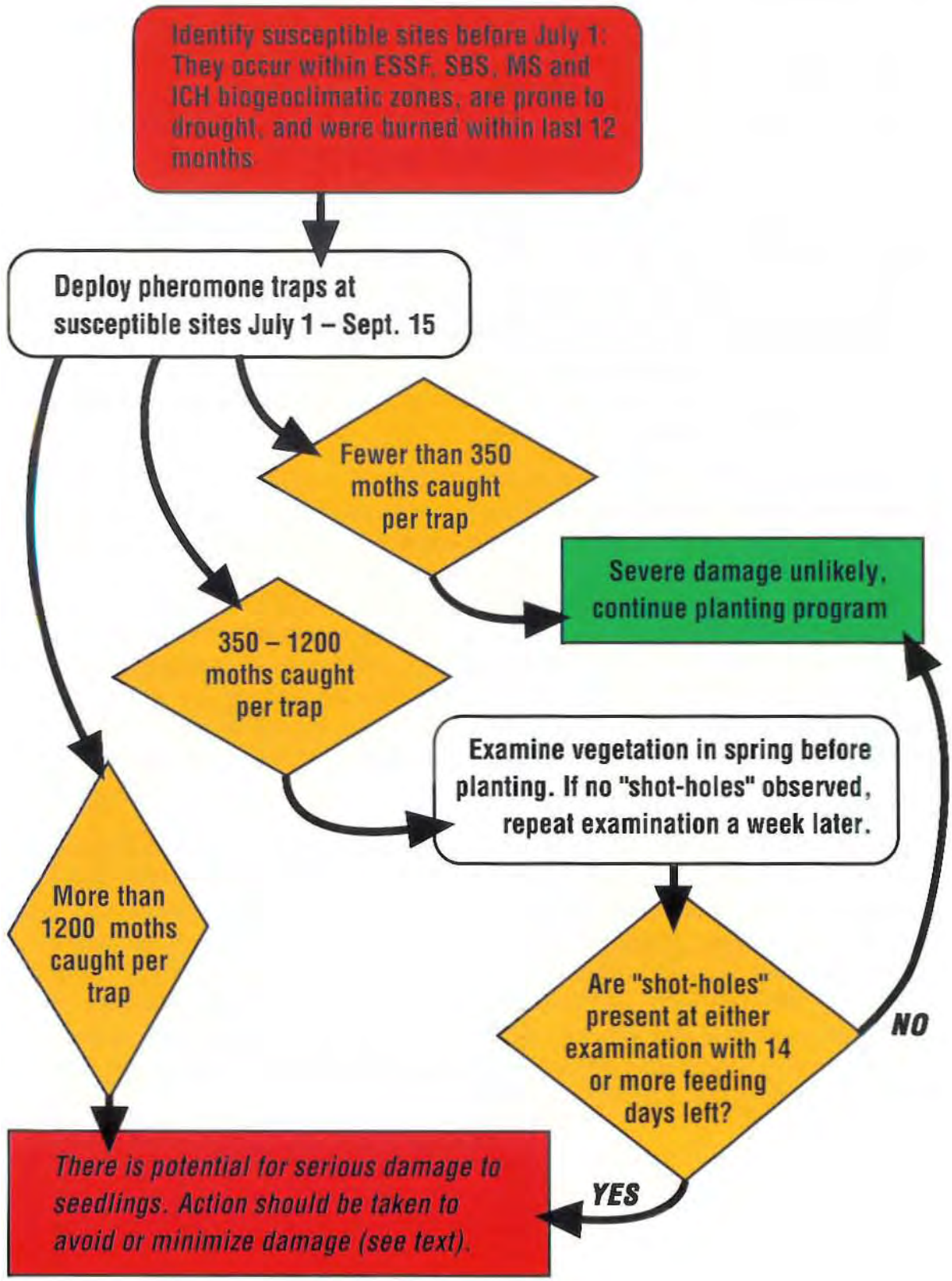

***Figure** 11. Management procedures to detect threatening populations of black army cutworm early enough to avoid significant damage (ESSF –Engelmann Spruce- Subalpine Fir; SBS –Sub-boreal Spruce; MS –Montane Spruce: ICH –Interior Cedar-Hemlock).*

Detecting infestations at susceptible sites with pheromone traps

Pheromone traps should be placed in position early in July just before moth flight on burned susceptible sites.

Each trap consists of the following:

- a green Multi-Pher Trap, model MP-1 (distributed by Bio-Contrôle Services, 2949, Chemin Ste-Foy, Ste-Foy, Quebec, G1X 1P3),
- a 2.5-cm^2 piece of "Vapona" insecticide strip placed in the bottom to immobilize the moths,
- a rubber stopper containing the pheromone [1000 µg of (Z)-7-dodecenyl acetate and (Z)-11-tetradecenyl acetate at a ratio of 1:20] pinned under the lid.

Traps should be placed at a height of 0.5 to 1.0 m on south-facing slopes of the burn (Figure 12). One trap is sufficient for a small site of 1 km^2 or less, provided it is checked every week or two to make sure it is intact, functioning, and that rodents are not feeding on the catch. Traps should not be placed within 100 m of another trap, or the catch rate in individual traps will be affected. Traps should be left in position from July 1 to September 15, and the total number of moths caught during that period should be determined.

If fewer than 350 moths are caught per trap, caterpillar populations the following spring should be low, significant damage to conifer seedlings is unlikely, and planting should proceed the next spring.

If more than 1200 moths are caught per trap, caterpillar populations the following spring will be high, and there is a high risk of an outbreak that will result in severe defoliation of seedlings.

If more than 350 but fewer than 1200 moths are caught per trap, the risk of infestation is moderate and some sites will experience significant defoliation and some will not. Vegetation on such sites should be checked in the spring before planting proceeds. Usually, only a few sites will fall into this category.

Surveying vegetation damage at moderately infested sites

Moderately infested susceptible sites should be visited as soon as the snow has melted, and the leaves of preferred plants should be inspected for feeding damage. Plants which are preferred by the black army cutworm over conifer seedlings during the early feeding stages are listed in Table 1. Twenty to thirty individual plants of the preferred species should be randomly inspected. This may include many individuals of the same species, but at least five different species should be checked.

If most of the plants show evidence of feeding, such as "shot holes" in the leaves, then significant damage to seedlings is likely, and measures should be taken to avoid damage.

If there is little or no damage, the plants should be flagged and inspected again seven days later. Again, if there is evidence of feeding on most preferred plants,

Figure 12. *Pheromone trap monitoring a burned site*

and if there is at least 14 days of feeding time left (i.e. before the end of May at low elevations), significant damage to seedlings is likely, and measures should be taken to avoid damage.

If damage to preferred plants is not obvious by the time of the second observation, then significant damage to the seedlings is unlikely.

Avoiding damage if an outbreak occurs

Established plantations: When an outbreak occurs in a year-old plantation, growth losses and mortality will be minimal as seedlings with an established root system will rapidly grow a new complement of needles. Areas of severe feeding should be delineated at the peak of feeding and surveyed after bud flush the following year. Replanting may be required in some areas.

New plantations: Where outbreaks occur on good growing sites that are not prone to subsequent summer drought, planting should proceed normally, but special care should be taken to place the roots properly. Even if the seedlings on moist sites are defoliated, they generally survive, set new buds, and regain their growth rates the next year.

On sites that will dry out if a summer drought occurs, seedlings are most vulnerable. If more than 60% of the foliage is lost or if terminal buds are killed, significant mortality and height growth loss will occur. If site conditions and seedling availability permit, it is best to delay planting in infested areas on dry sites. Damage will be minimal if planting can be delayed until the middle of June at low elevations or later at higher elevations. On these sites, it is especially important that planters place roots properly into the soil; poor planting technique will result in poor root growth, and this will worsen the impacts of any defoliation. If planting cannot be delayed for a few weeks, then postponement for a year should be considered. A year's delay would be preferable to planting immediately, since mortality could be significant and growth rates will remain depressed for several years.

If feeding on newly planted seedlings does unexpectedly occur on a dry site, areas of severe feeding should be delineated and assessed after bud flush the following year. Dead trees, trees defoliated more than 60%, and trees with dead terminals should be replaced. Surveys of sites where replanting may be necessary or sites where planting has been postponed will provide information necessary to organize planting stock re-allocations and to estimate future sowing needs.

If you require further information or wish to discuss a particular situation, contact one of the following agencies:

Forestry Canada
Forest Insect and Disease Survey
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Victoria, B.C., V8Z 1M5
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British Columbia Ministry of Forests
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