Appendix I

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Appendix II

Insect, Disease, and Animal Damage

Stephen Fitzgerald

Insects

The most common insect pests of aspen include defoliators, which consume entire leaves or portions of leaves; leafminers; scale insects; and wood borers.

Examples of defoliating insects include satin moth, fall webworm, various species of tent caterpillars, and the large aspen tortrix. Of these, satin moth (a nonnative insect) and large aspen tortrix are the most serious, as they can defoliate entire trees and stands (Schmitt 2000). Satin moth outbreaks have been observed periodically in northeast Oregon (Schmitt 2000). Although outbreaks of large aspen tortrix have not been observed in Oregon, this insect has a broad range that includes all western states.

Two species of leafminers, the aspen blotchminer and the aspen leafminer, are the most common in aspen. Adult moths of both species lay eggs on leaves when foliage is unfolding in the spring. Larvae feed and pupate inside the leaf. Adult moths emerge in late summer and overwinter in bark crevices. Aspen blotchminer creates brown blotches between leaf veins. The aspen leafminer creates winding or meandering tunnels inside the leaf, which are quite striking in appearance.

The oystershell scale is a sucking insect that attaches itself to branches and to the main stem (trunk) of aspen trees. The insect inside the tiny oyster-like scale pierces the aspen's thin bark and sucks or extracts food from the tree's sap stream. Adult scale insects mate and lay eggs in the spring. After hatching, the young insects are briefly mobile (crawler stage) and can move to other portions of the tree. Once stationary, they develop the characteristic thick oystershell that protects them from predators and insecticide sprays.

Common wood borers that attack aspen include the poplar borer and the bronze poplar borer. Adults feed on the foliage or tender shoots in early spring and then mate. Females lay eggs in bark crevices or areas of rough or wounded bark. Within a few weeks, larvae hatch and bore into the tree to complete their life cycle, which takes 1 to 2 years. Aspen trees with injuries caused by other insects, animals, or wind are more likely to become infested with wood borers. These wounds also facilitate entry of decay and canker diseases (Schmitt 2000).

Figure 63. Slight weeping from a wood borer entrance hole in aspen. (Photo: Stephen Fitzgerald)

Other wood borers commonly found on ornamental quaking aspen have the potential to infest native aspen stands. These species include the poplar-and-willow borer (an introduced insect), American hornet moth, and western poplar clearwing borer.

All of the borers mentioned above create an entrance hole that weeps or drip sap down the stem (Figure 63). Often there is boring dust (frass) mixed with the sap at the entrance hole.

Diseases

Aspen is subject to a host of leaf and shoot diseases. Most leaf diseases build up over a 2- to 3-year period and cause premature leaf drop and reduced tree vigor. Trees typically rebound when the leaf disease subsides and has run its course. Rarely do trees die.

One of the more common leaf diseases of aspen in Oregon is Marssonina leaf spot/blight. This leaf disease builds up under favorable weather conditions such as moist spring weather. The leaves in heavily infected stands begin to turn yellow and drop in early August. Spores develop in leaves on the ground and infect new leaves as they are flushing and expanding in the spring of the following year.

Another leaf disease is shepherd's crook of aspen. This disease causes twigs (and attached leaves) to die, turn black, and droop, creating the appearance of a "shepherd's crook." Damage is most severe on seedlings and saplings (Schmitt 2000).

Conifer-aspen rust, another important disease, spends part of its life cycle on Douglas-fir, larches, and pines and part on aspen. Orange spots on aspen leaves in the fall help identify this disease. This leaf rust causes premature leaf drop when infection levels are high.

Canker diseases are common in aspen, attacking the stem and leaving a sunken area of dead bark. The canker enlarges over time, killing the tree or predisposing it to damage by other agents and wind. Five common canker diseases in aspen are Cytospora, Hypoxylon, Ceratocystis, Cryptosphaeria, and sooty-bark canker. Cytospora canker is opportunistic; it often attacks weakened trees or bark that has been injured by frost, sunscald, or browsing. Hypoxylon canker kills stems and branches. It can kill small trees within 2 to 4 years. Ceratocystis canker is usually slow growing, taking years to kill individual trees. Cryptosphaeria canker is much more aggressive and can kill trees within a few years (Shepperd et al. 2006). Sooty-bark canker is fairly common in aspen stands of the Blue and Wallowa mountains (Schmitt 2000).

The most common stem decay of aspen in Oregon is aspen trunk rot, which increases over time as stands mature. This disease causes extensive internal decay, which predisposes trees and stands to wind breakage. You know this disease is present when you see the common "shelf fungi" or "conk" protruding from the tree trunk. This stem decay allows wildlife species, such as woodpeckers, to more easily excavate cavities. These cavities are in turn used by other wildlife after the woodpeckers vacate. Another common stem decay is heart rot. This stem decay is difficult to identify, but it causes similar decay as aspen trunk rot.

Aspen is also susceptible to a couple of root and butt rots. In northeast Oregon, Armillaria root disease causes root mortality and decay. White mottled rot has been identified in the Blue and Wallowa mountains. This disease can infect tree roots through wounds and cause root mortality and decay (Schmitt 2000). Trees infected with these root and butt rots are much more susceptible to windthrow.

Animal damage

The most common animal problems are browsing damage by elk, deer, and domestic livestock. Restoration efforts should include strategies to reduce browsing pressure (see Case Study 4 and Chapter 6). In some stands, antler rubbing by deer and elk causes significant damage to sprouts and young trees, allowing entry of stem decays and canker diseases. Elk will also eat aspen bark, damaging the stem and creating points of entry for diseases. Other common problems include sapsucker damage (horizontal holes that encircle or partially encircle the main stem) and beaver damage to aspen adjacent to streams, rivers, and lakes.

Other injuries

Sunscald damage looks similar to that caused by cankers. Young trees with thin, green bark are susceptible to damage when suddenly exposed to direct sunlight (when an adjacent tree dies or blows down). The increased heating on the exposed side kills the bark and creates a longitudinal wound on the south to west side of the tree. Sunscald predisposes aspen trees to canker and stem decays.

Wind can break off all or portions of healthy trees, allowing entry of stem decays that further weaken the tree. Mature and over-mature aspen stands may already contain significant stem rot, such as from trunk rot fungus, which predisposes trees to wind breakage.

Because of its thin bark, aspen is also susceptible to wildfire; above-ground portions of trees are easily killed by fire.

Table A-1. Common insects, diseases, and animal damage of quaking aspen.

Type of Insect	Common Name	Scientific Name
Defoliators	Western tent caterpillar	*Malacasoma californicum*
	Satin moth	*Leucoma salicis*
	Fall webworm	*Hyphantria cunea*
	Large aspen tortrix	*Choristoneura conflictana*
Leafminers	Aspen blotchminer	*Lithocolletis tremuloidiella*
	Aspen leafminer	*Phyllocnistis populiella*
Stem scales	Oystershell scale	*Lepidosaphes ulmi*
Wood borers	Poplar borer	*Saperda calcarata*
	Bronze poplar borer	*Agrilus liragus*
	Poplar-and-willow borer	*Cryptorhynchus lapathi*
	American hornet moth/Cottonwood crown borer	*Sesia tibialis*
	Western poplar clearwing	*Paranthrene robiniae*
Type of Disease	**Common Name**	**Scientific Name**
Leaf	Marssonina leaf spot/blight	*Marssonina populi*
	Shepherd's crook of aspen	*Venturia macularis*
	Conifer-aspen rust	*Melampsora medusa*
Stem cankers	Hypoxylon canker	*Hypoxylon mammatum*
	Cytospora canker	*Cytospora chrysosperma*
	Ceratocystis, Black, or Target canker	*Ceratocystis fimbriata*
	Cryptosphaeria canker	*Cryptosphaeria populina*
	Sooty-bark canker	*Encoelia pruinosa*
Stem decays	Aspen trunk rot	*Phellinus tremulae*
	Heart rot	*Peniophora rufa*
Root rots	Armillaria root disease	*Armillaria sinapina*
	White mottled butt rot	*Ganoderma applanatum*
Type of Damage	**Common Name**	**Scientific Name**
Distinct horizontal holes on tree stem	Red-naped sapsucker Red-breasted sapsucker	*Sphyrapicus nuchalis* *Sphyrapicus ruber*
Tree partially gnawed or tree is completely felled	Beaver	*Castor canadensis*
Sprout tips and branches appear to be clipped or browsed	Mule deer Elk Livestock (cattle and sheep)	*Odocoileus hermionus* *Cervus canadensis nelsoni*
Antler rubbing or shredding of bark on sprouts and young trees	Mule deer Elk	*Odocoileus hermionus* *Cervus canadensis nelsoni*
Bark removed or stripped off	Elk Moose	*Cervus canadensis nelsoni* *Alces alces shirasi*

Appendix III

Glossary

Aspen release—Allowing aspen to grow or thrive by thinning or cutting competing vegetation.

Basal area—The cross-section area of a tree stem in square feet, commonly measured at breast height (4.5 feet above ground) and inclusive of bark, usually computed by using diameter at breast height, or tallied through the use of a basal area factor angle gauge. The basal area factor is the number of units of basal area per acre (or per hectare) represented by each tree. The formula for basal area = (3.1416 x DBH^2)/(4 x 144). This formula simplifies to: basal area = 0.005454 x DBH^2.

Cambium—Layer of cells between the inner bark and the wood of a tree, which repeatedly subdivides to form new wood and bark cells.

Clone—A group of genetically identical cells or organisms derived from a single cell or individual by some kind of asexual reproduction.

Decadent—In terms of trees, refers to old trees in a state of decay.

Diameter at breast height (dbh)—Standard measurement of a tree's diameter, usually taken at 4.5 feet above the ground.

Disturbance—In ecology, a temporary change in average environmental conditions that causes a pronounced change in an ecosystem. Ecological disturbances include fires, flooding, windstorm, and insect outbreaks, as well as human actions such as forest clearing and the introduction of exotic species.

Extirpation—Local extinction of a species in a specific area, although it still exists elsewhere.

Forage—Plant material (mainly plant leaves and stems) eaten by grazing livestock.

Geographic Information System (GIS)—An information processing technology to input, store, manipulate, analyze, and display spatial resource data to support decision making. Generally, an electronic medium for processing map information, typically used with manual processes to make specific decisions about the land base and its resources.

Girdle—A method of killing trees by cutting through the cambium of the stem, thus interrupting the flow of water and nutrients.

Heartwood—The older, inactive central wood of a tree or woody plant; usually darker and denser than the surrounding sapwood.

Herbaceous vegetation—Low-growing, non-woody plants (including wildflowers and ferns) in a forest understory.

Herbivory—The consumption of living plant tissue by animals.

Midstory—The trees that form the middle layer in a forest of more than one vertical layer or canopy.

Monitoring—The act of observing something (and sometimes keeping a record of it). In this case, monitoring refers to observing the effects of treatments on your land to see if you are meeting your goals and objectives.

Overstory or canopy—The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees and other woody growth.

Perched water table—A water table, usually of limited area, maintained above the normal free water elevation by the presence of an intervening impermeable layer.

Pioneer species—The first species to populate an area in the process of primary succession.

Riparian zone or riparian area—The interface between land and a water body, such as a stream, pond, or lake. Plant communities in this area are called riparian vegetation.

Self-thin—The process whereby individual trees within a grove die due to competition for space, sun, and water.

Silviculture—The art and science of growing forest trees.

Species richness—Simple counts of the number of species in a given area.

Succession—The natural replacement of one plant (or animal) community by another over time in the absence of disturbance.

Sucker—Shoot or cane that grows from a bud at the base of a tree or shrub or from its roots.

Terminal leader—Top central branch of a tree, providing straight, uniform growth.

Understory—The level of forest vegetation beneath the canopy.

Uneven-aged management—The application of actions to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products.

Ungulate—A hoofed mammal adapted for running; mostly large herbivores, including deer, cattle, gazelles, horses, elk, and antelope.

Watershed—A region defined by patterns of stream drainage. A watershed includes all of the land that contributes water to a particular stream or river.

Wildlife habitat—The native environment of an animal. Habitats ideally provide all of the elements needed for life and growth: food, water, cover, and space.

Appendix IV

Supplies and Equipment Needed to Complete FULL and RAPID Assessments

Supplies/Equipment	Assessment type	Supplier*
Aluminum tags and wire or zip ties	FULL	Terratech (http://www.terratech.net; 800-321-1037), other suppliers
Aluminum nails	FULL	Hardware store
Tree marking paint	FULL	Terratech, other suppliers
Colorful flagging (orange, pink)	FULL	Terratech, other suppliers
Orange or red spray paint for t-bar posts	FULL	Hardware store
Compass	FULL/RAPID	Terratech, other suppliers
RAPID Aspen Assessment Form (1 page)	RAPID	Aspen manual (page 20)
FULL Aspen Assessment Form (2 pages)	FULL	Aspen manual (pages 14–15)
Instructions for completing assessment	FULL/RAPID	Aspen manual (pages 12–13 or 19)
Clipboard	FULL/RAPID	Many suppliers
Pencil	FULL/RAPID	Many suppliers
GPS (Global Positioning System) and spare batteries	FULL/RAPID (optional)	Many suppliers
6' cattle fence t-bar posts	FULL	Farm supply store
Post pounder or sledgehammer	FULL	Hardware store
Hammer	FULL	Hardware store
Digital camera	FULL/RAPID	Many suppliers
75' measuring tape	FULL	Terratech, other suppliers
Yardstick	FULL	Many suppliers
Dry erase board and marker or notebook paper	FULL (optional)	Many suppliers

**Mention of specific products, services, and suppliers does not imply endorsement by Oregon State University or the OSU Extension Service. No discrimination is intended against products, services, and suppliers not mentioned.*