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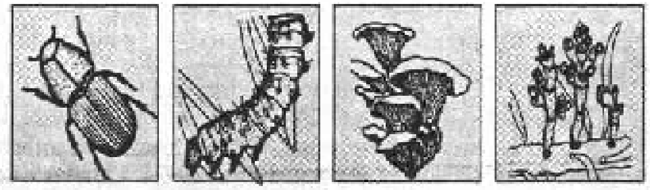

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WESTERN BALSAM BARK BEETLE ACTIVITY AND FLIGHT PERIODICITY IN THE NORTHERN REGION

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INTRODUCTION

The western balsam bark beetle (WBBB), *Dryocoetes confusus* Swaine, is the most conspicuous of a complex of pests responsible for large amounts of tree mortality in subalpine fir stands throughout western North America. Infestations are chronic in some areas. In 1996, more than 53,000 acres were infested in the Northern Region, and an estimated 51,000 subalpine fir were killed.

Primarily a killer of subalpine fir in high-elevation spruce/fir stands, WBBB is widely found throughout the range of its host. Rarely grand fir, Engelmann spruce, and lodgepole pine may also be attacked. It is commonly found throughout the range of subalpine fir--from Colorado on the east, Arizona and New Mexico on the south, Oregon to the west and northward into the interior of British Columbia and Alberta (Furniss and Carolin 1977).

Low populations of the beetle maintain themselves in trees weakened by old age and root disease, storm-damaged trees, or logging slash. During periods of drought or other environmental stress, infestations may build and spread to less-susceptible stands. Groups of up to 1,000 trees, generally of larger diameters, may be killed. Data collected by Doidge (1981) showed an estimated 35 percent of subalpine fir mortality is due directly to attack by beetles. The remainder is attributed to a combination of partial attacks ("strip" attacks) and/or a beetle-introduced lesion-causing fungus, *Ceratocystis dryocoetidis*, and other unidentified fungi. Coalescing lesions may kill trees without further beetle activity. Often, other secondary bark beetles become a part of this tree-killing association (Doidge 1981).

In the Northern Region each year, several thousand acres of subalpine fir mortality are attributed to balsam woolly adelgid (BWA) (*Adelges piceae* [Ratzburg]). In some areas, it may be difficult to distinguish between mortality caused by BWA and WBBB, from the air. Both may be part of a larger complex of pests responsible for a general decline in subalpine fir throughout its range. Not all of that complex has been identified, nor are their associations completely understood.

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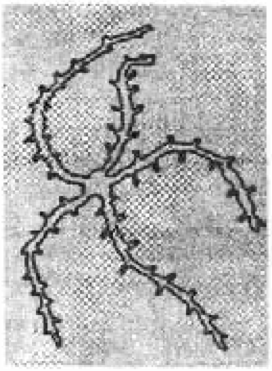

Figure 1. Typical egg gallery pattern

BIOLOGY

Little has been published on the biology of this species. Stock (1991) and Hansen (1996) have shown a 2-year life cycle exists in much of the beetles' range. Our trap-catch data suggest that is likely in most of the Northern Region as well. Beetles overwinter mostly as larvae under the bark the first year, continue development during spring and early summer, and over-winter the second year as nearly mature adults. Beetles fly throughout the summer, beginning in early June. Males make initial attacks on susceptible hosts, bore into the phloem, excavate a nuptial chamber, then attract and mate with several females. Egg galleries radiate from the central nuptial chamber in a random pattern (Figure 1). Larvae extend their mines from the main egg galleries until freezing weather, then become dormant (Stock 1991).

External evidence of attack on the boles of standing trees is hard to detect. Entrance holes and boring dust on the bark may be visible; however, boring dust is quickly washed away by rain or snow. Pitch flow is evident on some successfully attacked trees, but not all. Attacked trees generally turn yellowish-red within a year. Adults are shiny, dark brown, cylindrical beetles ranging from 3.4 mm to 4.2 mm long. Their thorax is evenly convex above; their posterior is abruptly rounded and without spines. The front of their head is covered with distinct bristles. Females have a denser patch of these "hairs" than do males (Figure 2).

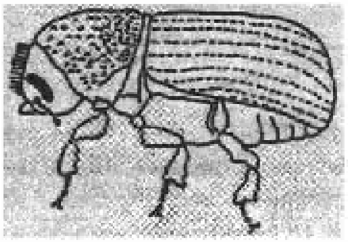

Figure 2. Adult female beetle

FLIGHT PERIODICITY

During the years 1993-1995, we monitored beetle flight periodicity using Lindgren funnel traps baited with the male-produced attractant pheromone, *exo*-brevicomin. Trapping was conducted at sites in northern Idaho (Bonners Ferry Ranger District [RD], Idaho Panhandle National Forests [NF]), at elevations ranging from 6,000 to 6,300 feet; and western Montana (Sula RD, Bitterroot NF), where elevational range was 7,000 to 7,800 feet. Ten traps spaced at varying intervals, but at least several hundred yards apart, were hung at each site.

In all 3 years, traps were installed during late May or early June and removed about October 1. We had assumed that would result in reliably seasonal consistency from year to year. However, while the traps were hung during similar calendar periods, weather in the 3 years was quite dissimilar. An unusually cool and wet season in 1993 was followed by an abnormally warm and dry one in 1994. We are not suggesting a relationship to the preceding 2 years of atypical weather, but beetle populations declined markely in 1995.

Trap counts, though variable from year to year and site to site, indicate initial flights take place in late June to early July. There apparently is more than one flight each year. Our data indicate the initital flight has typically a male dominance, while the latter flight is predominately female. Data collected in northern Utah for the period 1992-1994 suggests similar flight patterns and behavior in that part of the beetles' range (Hansen 1996). Following is a compilation of the data collected during the years 1993-1995 in northern Idaho and west-central Montana (data are presented graphically in the Appendix).

BEETLES CAUGHT IN FLIGHT-MONITORING TRAPS, 1993-1995

	1993		1994		1995	
Date	Idaho	Montana	Idaho	Montana	Idaho	Montana
June 1st wk	45	0	0	1	2	*
2nd wk	10	0	0	0	0	*
3rd wk	*1889*	6	0	155	16	0
4th wk	1079	102	*1965*	*744*	0	0
July 1st wk	39	0	315	259	*365*	5
2nd wk	5	0	322	211	313	0
3rd wk	177	376	164	172	0	*658*
4th wk	*1783*	0	153	397	9	409
Aug 1st wk	1406	*1700*	182	133	12	242
2nd we	343	294	154	96	9	5
3rd wk	104	67	263	55	1	0
4th wk	130	187	300	56	15	23
Sep 1st wk	0	0	76	31	29	7
2nd wk	264	*	0	15	19	0
3rd wk	10	*	38	0	3	3
4th wk	3	*	17	0	1	0
TOTAL	7287	2732	3932	2325	794	1352

* Traps not in place. Italics type indicates seasonal peaks.

MANAGEMENT

Because of the high elevation and sensitive sites on which subalpine fir typically grows, silvicultural control is seldom feasible. There is, however, a gradual tendency to bring more and more of these formerly inaccessible stands under management--both in the United States and Canada. In addition, more concern is generated for the health of these stands, purely from the perspective of safeguarding wildlife habitat and watershed sources, than there previously has been. All of this present awareness is bringing into focus increasing mortality in subalpine fir stands, a need to identify the complex of causes, and a desire to reverse those trends where possible.

Stock (1991) has shown that WBBB are attracted to recent windthrow, logging slash, or root disease-weakened trees. One method available, to keep epidemics from developing, is to salvage blowdown as quickly and completely as possible, and to treat logging slash as judiciously as practicable. Where and when feasible, weakened (weakened from any of a number of sources: root disease, defoliation, drought, fire) and beetle-infested trees should be salvage logged in a timely manner.

Recently, aggregative pheromones for WBBB have been identified, synthesized, tested, and shown to be effective in helping to manipulate beetle populations to our advantage (Stock, et al, 1994). Commercially available pheromone tree baits, containing the male-produced *exo*-brevicomin, can effectively concentrate beetles into stands scheduled for harvest. At present, these are most ideally suited for stands which are to be regenerated. Silvicultural guidelines suitable for partial cutting in these stands--relative to reducing hazard of bark beetle depredations--have yet to be developed.

CONCLUSION

While much remains to be learned about WBBB and the complex of pests of which it is a part, we are beginning to understand more fully its life cycle and behavior in our Region. These series of flight-monitoring studies were but a beginning in that process. Additional observations, studies, and demonstrations will be required to develop an effective management program for subalpine fir stands infested or threatened by WBBB. Only then will we be able to provide information which will assist the land manager in protecting the health of these valuable forest stands.

ACKNOWLEDGEMENTS

We gratefully acknowledge the assistance of both District and FHP personnel, without whose efforts in trap collection and data compilation, this study might never have been completed. On the Bonners Ferry RD, Mike Anderson made numerous trap collections, while on the Sula RD, George Regan helped install and take down traps in addition to making weekly collections. Others who helped at various times were Nena Bloom and Jana Jones, FHP, Missoula. Finally, Carol Bell Randall, FHP, Coeur d'Alene, provided assistance throughout the entire project. To each of these we extend our sincere thanks.

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APPENDIX

Trap-catch patterns for the years 1993-95 in Montana and Idaho:

WBBB TOTAL CATCH