FOREST HEALTH PROTECTION
USDA Forest Service
State and Private Forestry

OFO-BE-09-04
July, 2009

Forest Health Protection, Ogden Field Office Report on Spruce Beetle-Caused Tree Mortality in Clyde Creek, Uinta-Wasatch-Cache National Forest, June 2009

During the fall of 2006 Shawn Martin, former Silviculturist, Heber Ranger District, Uinta National Forest, contacted Forest Health Protection, Ogden Field Office (FHP-OFO) to report the discovery of spruce beetle-caused tree mortality in the Clyde Creek drainage. Spruce beetle populations had been at epidemic levels in Bryant's Fork and other drainages south of Clyde Creek since 2003. Shawn's discovery indicated that the insects had begun to spread northward along Strawberry Ridge. In February of 2007, Shawn mapped additional tree mortality with pockets ranging in size from 1 to 14 infested trees.

In 2008, the Heber Ranger District proposed to salvage the spruce beetle-killed trees in the Clyde Creek drainage to recover some economic value and prepare the site for tree regeneration. Jim Gibson, Silviculturist, Uinta-Wasatch-Cache National Forest, and Stephen Penny, Forester/Project ID Team Leader, Heber Ranger District, requested a survey from FHP-OFO staff to determine the level of previous spruce beetle-caused tree mortality and to assess current and predict future spruce beetle population trends in the Clyde Creek drainage. Information provided by this survey would be used to help address issues associated with this salvage project and prioritize stands for salvage and restoration. Forest Health Protection staff conducted this survey June 1-9, 2009.

This report discusses the methods used to survey stands within the Clyde Creek drainage project area and our survey results.

Methods

Using ArcMap (V. 9.2), geospatial data were used to systematically overlay 52 sample points across 15 spruce-fir stands identified within the project area. Stand numbers included 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, and 17. Spruce beetle and stand data were collected from the 52 sample points. These points were generally spaced at 10 chain (1 chain = 66 feet) intervals along parallel transects located 10 chains apart to ensure sufficient coverage within each stand.

From each of the 52 sample points, a variable radius plot (basal area factor of 20) was established to determine sample trees. All trees greater than five inches diameter at breast height (dbh) were tallied and measured. Tree mensuration data collected included tree species and dbh. All spruce trees in each plot were examined for evidence of spruce beetle infestation and the type

and year of attack was recorded. Tree regeneration less than five inches dbh, and greater than six inches in height was tallied in a 1/300th acre subplot (radius = 6.8') at plot center.

Data Analyses

Data collected in surveyed spruce-fir stands was summarized using the Forest Insect and Disease Tally (FINDIT) program (Bentz 2000). The FINDIT program calculated the following statistics to determine the level of spruce beetle-caused tree mortality and other stand attributes.

1. Total trees/acre (TPA).
2. Total live and dead basal area (BA ft^2/ac).
3. Quadratic mean diameter (QMD).
4. Live stand density index (SDI).
5. Number of dead and live trees.
6. Percentage of each tree species.
7. Percentage of basal area (BA) comprised of each tree species.
8. Total regeneration/acre of each tree species.
9. Percentage of basal area killed by insects and diseases.

Results and Discussion

Table 1 summarizes FINDIT results from the 52 plots used to determine the current level of spruce beetle-caused tree mortality in each stand and tree mortality trends associated with spruce beetle attacks. The standard errors of means were generally high due to the low number of plots sampled in each stand. Therefore, our interpretation of these results considered this limitation.

Engelmann spruce and subalpine fir generally comprised the majority of trees in recorded our survey plots in the Clyde Creek drainage, although the proportion of these species varied among stands. Aspen was a major component in stands 6, 8, and 15. Minor amounts of aspen were present in several other stands. Single white fir trees were found in both stands 1 and 3. Trees of all conifer species throughout the project area were large. The mean QMDs of Engelmann spruce ranged from 18.7 to 27.6 inches. Subalpine fir regeneration was generally most abundant in the understories of sampled stands, although a fair amount (200-600 tpa) of Engelmann spruce regeneration was present in Stands 5, 6, and 13. No conifer regeneration was recorded in Stands 4, 7, 10, or 17. Aspen regeneration was only found in stands 1 and 6.

At the time of this survey, spruce beetles had killed 70 to 100% of the Engelmann spruce component in sampled stands throughout Clyde Creek.

Table 1. Summary of stand attribute data and percent spruce beetle-caused tree mortality in each stand surveyed

	TA* ES(%)	TA AF(%)	TA AS(%)	ES QMD	%ESB					ES BFV	AF BFV	Regen/ac	
					≥'06	'07	'08	'09	Tot			ES	AF
All	50(42)	60(50)	10(8)	22.4	57	18	5	1	81	21121	7753	104	410
1	11(3)	410(97)	0	25.6	32	68	-	-	100	8995	32392	0	900
2	39(50)	39(50)	0	23.6	10	90	-	-	100	26178	12009	0	300
3	60(43)	78(56)	2(1)	26.7	68	25	5	-	98	26311	11924	43	0
4	27(35)	50(65)	0	23.8	100	-	-	-	100	17599	11418	0	0
5	9(11)	75(89)	0	20.0	100	-	-	-	100	3976	16834	300	0
6	55(30)	49(27)	79(43)	19.2	48	29	-	-	77	22496	4947	600	150
7	0	84(100)	0	20.0	-	-	-	-	-	0	26337	0	0
8	49(51)	18(19)	28(30)	18.7	47	31	22	-	100	17826	964	150	1800
9	44(31)	97(67)	3(2)	20.0	59	22	3	-	84	18074	8284	33	700
10	31(71)	14(29)	0	24.3	87	13	-	-	100	22144	6085	0	0
13	72(68)	32(30)	2(2)	20.9	49	9	11	-	-	24052	5567	214	386
14	38(50)	34(44)	5(6)	23.6	56	18	0	9	83	16196	2709	100	633
15	34(18)	86(46)	66(36)	21.8	62	38	-	-	100	16807	14800	0	150
16	56(88)	8(12)	0	25.6	100	-	-	-	100	44807	3203	0	300
17	34(100)	0	0	27.6	70	-	-	-	70	32060	0	0	0

*TA = trees per acre; ES = Engelmann spruce; AF = subalpine fir; AS = aspen; QMD = quadratic mean diameter; ESB = Engelmann spruce beetle; BFV = board foot volume

The majority of susceptible host trees had been mass attacked and killed by 2006, except in stands 1 and 2 where most of the spruce beetle caused mortality occurred in 2007. The number of spruce beetle-killed trees decreased dramatically in 2008 due to the loss of susceptible host trees. Approximately, 16% of trees were either healthy, unsuccessfully attacked, and 3% were strip attacked. The healthy trees were relatively small with mean diameters less than 9 inches at dbh.

We examined several trees that had been attacked in 2007. The inner bark of all these trees contained numerous brood adults that were constructing exit holes in preparation for flight. We anticipate that emergent adults will infest the remaining susceptible host trees >5 inches dbh in the Clyde Creek drainage in 2009.

Although salvage treatments typically involve the removal of currently infested and dead trees from the stand, spruce beetles will likely kill most of the remaining spruce by the time salvage harvests are implemented (~2010). Spruce beetles will also disperse into other areas susceptible stands in adjacent drainages. Since most of the susceptible spruce component is dead, there is no need to prioritize treating stands based on the number of living or infested trees.

The prioritization of stands for salvage should therefore consider other resource objectives including:

- The potential for regeneration success. With the elimination of local seed sources and lack of advanced regeneration, use appropriate site preparation and artificially regenerate stands to achieve desirable stocking levels of Engelmann spruce

- Planting non-host tree species to enhance species diversity and consequently reduce long-term insect and disease impacts

- Improving fisheries and wildlife habitat

- Recouping the commercial timber value of spruce beetle-killed trees

- Minimizing dead tree hazards near dispersed recreation sites, roads, and other travel corridors

Many (80%) stands also had few or no mature aspen stems and aspen regeneration. The presence of aspen regeneration in some stands, however, provides opportunities for aspen restoration.

Aspen stands in these areas can be managed by a wide variety of silvicultural techniques (Hinds and Sheppard 1987). Regardless of the methods used for aspen management, it is necessary to control the amount of herbivore grazing on aspen regeneration to insure survival of the aspen clone. If an aspen clone loses more than one crop of sucker sprouts the rate of sprouting is greatly reduced and the clonal root system can be killed.

Some techniques that can be used to protect aspen suckers from herbivory include satiating the demand (from herbivores) for sprouts (Crouch 1983), leaving logging slash as a physical barrier to protect sprouts from browsing (Rumble et al. 1996), repellents (Baker et al. 1999), or fencing (Shepperd and Fairweather 1994). Fencing is the only guaranteed means of directly protecting sprouts from browsing animals. Research by Shepperd and Fairweather (1994) has shown that fencing is operationally feasible but must be maintained every 8-10 years (or until dominant stems are ca. 1 inch in diameter) to effectively protect aspen regeneration from animal browse. Wire fences constructed from two widths of 1 m wide field fencing, or one height of 1.4 m wide fencing with one or two high tensile smooth wires strung above, have been found effective (Shepperd et al. 2001).

If you have any questions regarding information in this report please feel to contact us by either by email (lghebertson@fs.fed.us, dblackford@fs.fed.us), or by phone 801-476-9720.

Sincerely,

/s/ *Liz Hebertson* /s/*Darren Blackford*

LIZ HEBERTSON
Forest Health Specialist

DARREN BLACKFORD
Entomologist

Literature Cited

Bentz BJ. 2000. FINDIT, Forest Insect and Disease Tally system. USDA Forest Service, Rocky Mountain Research Station. Logan, UT. pp. 17.

Crouch GL. 1983. Aspen regeneration after commercial clearcutting in southwestern Colorado. *Journal of Forestry* May: 316-319.

Baker DL, Andelt WF, Brunham KP, Shepperd WD. 1999. Effectiveness of Hot Sauce® and Deer Away® repellents for deterring elk browsing of aspen sprouts. *Journal of Wildlife Management* **63**(4): 1327-1336.

Rumble MA, Pella T, Sharps JC, Carter AV, Parrish BJ. 1996. Effects of logging slash on aspen regeneration in grazed clearcuts. *The Prairie Naturalist* **28**(4): 199-210.

Shepperd WD. 2001. Manipulations to Regenerate Aspen Ecosystems. In: Shepperd, Wayne D.; Binkley, Dan; Bartos, Dale L.; Stohlgren, Thomas J.; and Eskew, Lane G., compilers, 2001. Sustaining Aspen in Western Landscapes: Symposium Proceedings, 13-15 June 2000, Grand Junction, CO. RMRS-P-18, Ft. Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. pp 355-365.

Shepperd WD, Fairweather ML. 1994. Impact of large ungulates in restoration of aspen communities in a southwestern ponderosa pine ecosystem. In: CovingtonWS, and DeBano LS (*eds*.), Sustainable ecological systems: Implementing an ecological approach to land management. USDA Forest Service, General Technical Report RM-247: 344-347.