Young Stand Thinning and Diversity Study: Post-treatment Assessment of Ground-dwelling Vertebrates

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The goal of the Young Stand Thinning and Diversity Study is to evaluate the effects of thinning regimes of young managed, Douglas-fir stands on various ecosystem properties. Pre- and post-treatment assessments of vegetation and avian species have been reported, or are in progress. This interim report documents results from the first year of post-treatment sampling of ground-dwelling vertebrate species. Descriptions of study sites, silvicultural treatments, and pre-treatment analyses of ground-dwelling vertebrates are presented in Hagar (1996).

Methods

Field Sampling

A new sampling design was established for post-treatment sampling. In the pre-treatment (1991-92) sampling effort, a 10x10 grid of Sherman live-traps with an inter-trap distance of 20-m was approximately centered in each stand. Additionally, a separate 5x5 pitfall-trap grid with similar spacing among stations was located away from the live-trap grid. To better handle the spatial variability of treatments, especially the light thin with gap treatments, the regular grid design was replaced by variable length transects. The number of transects in a stand varies with stand shape and size; however, each stand has a total of 100 trapping stations. Transects were spaced 30-m apart and >50-m from a stand edge. Trapping stations on a transect were originally to be spaced 30-m apart. However, to avoid permanent vegetation and mushroom sampling plots, inter-station distances on a transect varied from this spacing by $\pm$ 5-10m. Pitfall traps constructed of two #10 cans were located at every other station on a transect, for a total of 50 pitfall stations per stand. Trap stations were marked with numbered, wire-flags. Hand-drawn maps of transect orientation and approximate trap-station locations were produced for future reference.

During a trapping period, one Sherman live-trap was placed at every trapping station, and pitfall traps were cleared of debris and made functional. All traps were baited with a standard mixture of peanut butter, rolled oats, and sunflower seeds. Polyfiber batting was placed inside each trap for insolation. Sherman traps were placed inside a half-gallon milk cartons for added insolation and to reduce exposure of traps and potential captures to rain water. A pint-sized juice carton was inserted into each pitfall trap for similar reasons. Traps were checked every day. Captures were

identified to species, ear-tagged or toe clipped, weighed, sexed, then released immediately at the site of capture. Dead specimens were removed from the site and stored. Upon termination of a trapping period, Sherman traps were removed; pitfall traps were filled with sticks and rocks.

Trapping of ground-dwelling vertebrates was conducted from 21 September to 10 November 1998. The four stands constituting a geographic block were simultaneously trapped for six consecutive nights.

Data Analysis

Capture rates (number of individuals/100 undisturbed trap nights) of frequently recorded species (i.e., species with >30 recorded individuals across all stands) were qualitatively compared between pre- and post-treatment. A randomized-block ANOVA determined significant differences in mean capture rates of frequently recorded species among treatments in 1998. Statistical differences were interpreted as a treatment effect because pre-treatment mean capture rates were not significantly different for any species among stands assigned to the different thinning treatments. Comparisons of species' capture rates among different habitats can be confounded by age structure and residency status of individuals. For instance, source and sink habitats can have similar densities of a species but the latter would be comprised of primarily younger individuals. Also, habitats used primarily for dispersal would have lower recapture rates of a species compared to primary habitat. To evaluate differences in age structure of a species and residency characteristics in 1998, mean weight of captures (a surrogate for age) and mean recapture rates were compared among treatments with a fixed-effects ANOVA. Weights of individuals suspected of being gravid or that were infested with bot-fly larva were not used. When ANOVA comparisons indicated a significant difference among means, pairwise comparisons were performed using the Least Significant Difference (LSD) method.

Results/Discussion

Ten mammal and five amphibian species were recorded in 1998 (Table 1). This compares with 17 identified mammal and seven amphibian species in 1991-92. Only four mammal and one amphibian species were recorded often enough (>30 recorded individuals) for meaningful assessment of treatment effects in 1998. These same species plus the western red-backed vole and the northern flying squirrel had >30 recorded individuals in the pre-treatment sampling. More individuals were recorded in 1998 than in either of the pre-treatment sampling periods (1654 - 1998, 892- 1991, 1214 - 1992). Of the seven most commonly captured species among all three years, mean capture rates for five species (Pema, Tato, Sosp, Sotr, Glsa) were higher in control plots in 1998 compared to 1991-92 combined (Table 2). Ensatina and western red-backed vole exhibited an opposite trend. Differences in capture rates on the control plots likely reflects natural, inter-annual variability in population levels with possibly one exception. Pre-treatment sampling was conducted in late Fall (10 October - 27 November), and thus may have sampled stands when chipmunks were beginning to hibernate or after a significant portion of the local population had hibernated (M. Hunter, pers. comm.). Sampling in 1998 was purposely conducted

earlier to avoid this potential problem. The 10-fold increase in mean capture rate of this species in control plots and generally higher mean capture rates in the thinned stands in 1998 likely reflects seasonal differences between the pre- and post-treatment sampling efforts.

Data from the first year of post-treatment sampling suggests that thinning treatments had a limited effect on ground-dwelling vertebrates. Compared to control plots, capture rates tended to be higher in the thinned stands for the deer mouse (Pema), chipmunk (Tato), and Ensatina (Enes), and lower for shrew species (Sotr, Sosp) (Table 3). However, only the deer mouse exhibited a statistically significant ($P<0.05$) response to thinning treatments. Mean capture rates of the deer mouse were about three times as high for thinned stands as for the control plots. A numeric response of the deer mouse to more open conditions would be expected given its preference for shrub and herbaceous vegetation. Although mean capture rate of this species did increase with thinning intensity, rates were statistically similar ($P>0.05$) among thinning treatments. Based on the 1998 results, it appears that removing at least one-half of the initial overstory density is sufficient for a numerical increase in the deer mouse, but additional overstory thinning does little to enhance habitat conditions for this species.

Analyses of mean weights and recapture rates suggest that the numerical response (or lack of a statistically significant response) of individual species to thinning treatments was not confounded by sink/source habitat or differential dispersal effects. For all species for which samples sizes were sufficient for analysis, mean weights (Table 4) and recapture rates (Table 5) were statistically similar ($P>0.05$) among treatments.

Future Efforts

Trapping will be conducted Fall 1999. A more extensive analysis of stand-level pre-, post-treatment trends and treatment effects on capture rates of ground-dwelling vertebrates will be conducted after collecting the second year of post-treatment data. Additionally, micro-habitat assessment will be conducted using the post-treatment capture data. This assessment will consist of correlating capture data from every other station, every other transect with habitat features of the corresponding trap stations, which will be collected during Summer/Fall 1999. Habitat features will include tree and snag density, log density, shrub and herbaceous cover, and other ground cover (e.g., percent rock and bareground). The sub-sampling of trapping stations for the micro-habitat assessment is to minimize spatial autocorrelation. Redundancy Analysis is proposed as the primary statistical method for the micro-habitat analysis. The combination of stand-level and micro-habitat assessments will provide a hierarchical analysis of species' habitat use; stand-level responses will indicate general response of species to the gradient of thinning treatments, micro-habitat analysis will indicate the proximate habitat features for individual species. Micro-habitat assessments will potentially aid in explaining numerical responses (or lack of) of species among treatments by more closely examining their affinities with small-scale habitat features and thinning-treatment effects on the dispersion of these features.

The post-treatment ground-dwelling vertebrate data base was documented following the OSU Forest Science Data Base (FSDB) protocol (Appendix B). The pre-treatment data currently residing in the FSDB (StudyId WE0081) will be reformatted to match the 1998 data base design. The updated WE0081 data base will be permanently stored in the FSDB prior to Fall 1999 sampling.

Literature Cited

Hagar, J. 1996. Pre-treatment analysis of wildlife-habitat relationships in young managed stands in the Oregon Cascade Range. Report to Cascade Center for Ecosystem Management, Blue River Ranger District, Willamette National Forest. 35p.

Table 1. Numbers of individuals/100 undisturbed trap nights for ground-dwelling vertebrates, 1998. TAC = Treatment Area Code. See Appendix A for definition of species acronyms.

Block/ Treatment (TAC)	Species				
	Pema	Tato	Sosp	Sotr	Enes
Cougar Reservoir					
Control (1)	1.04	1.22	0.80	5.14	0.33
Heavy Thin (2)	4.55	1.85	0.56	3.47	0.00
Light Thin (3)	6.84	2.70	1.40	7.94	1.67
Light Thin/gaps (4)	5.44	2.04	0.90	3.38	0.33
Mill Creek					
Control (5)	5.32	0.51	1.48	3.99	0.00
Heavy Thin (6)	12.03	2.65	0.23	2.09	2.01
Light Thin (7)	17.42	3.99	0.82	3.99	1.67
Light Thin/gaps (8)	16.26	5.96	1.01	4.03	0.44
Christy Flats					
Control (9)	3.60	7.19	1.17	3.39	0.33
Heavy Thin (10)	7.13	4.24	0.34	2.25	1.33
Light Thin (11)	6.87	7.90	0.23	2.49	2.00
Light Thin/gaps (12)	10.65	3.84	0.23	2.40	1.33
Sidewalk Creek					
Control (13)	2.69	2.02	0.45	3.91	0.00
Heavy Thin (14)	8.26	3.20	0.67	1.90	0.00
Light Thin (15)	10.41	0.00	1.02	1.69	0.67
Light Thin/gaps (16)	9.78	1.71	0.57	2.72	3.33

Incidental captures (No. of individuals): Clca (15), Glsa (3), Negi (10), Mior (15), Scor (2), Tado (1), Amgr (2), Astr (1), Dite (3), Tagr (2)

Table 2. Mean (1 se) number of individuals/100 undisturbed trap nights by thinning treatment for frequently captured ground-dwelling vertebrates. First row for a treatment corresponds to pre-treatment sampling (1991,1992 combined), second row is first year (1998) of post-treatment sampling. See Appendix A for definition of species acronyms.

	Species						
Treatment	Pema	Tato	Sosp	Sotr	Enes	Clca	Glsa
Control	2.00 (0.62)	0.28 (0.21)	0.51 (0.12)	1.38 (0.38)	0.81 (0.22)	0.55 (0.22)	0.05 (0.05)
	3.16 (1.03)	2.74 (1.75)	0.97 (0.26)	4.11 (0.43)	0.17 (0.11)	0.11 (0.05)	0.09 (0.10)
Heavy Thin	4.30 (1.25)	0.84 (0.45)	0.28 (0.14)	1.90 (0.53)	0.63 (0.24)	0.89 (0.31)	0.13 (0.10)
	8.00 (1.79)	2.99 (0.58)	0.45 (0.12)	2.43 (0.41)	0.84 (0.58)	0.14 (0.10)	0.00 (0.00)
Light Thin	4.03 (0.72)	0.59 (0.34)	0.45 (0.14)	1.69 (0.41)	0.88 (0.47)	0.83 (0.37)	0.42 (0.26)
	10.39 (2.88)	3.65 (1.90)	0.87 (0.28)	4.03 (1.60)	1.50 (0.33)	0.03 (0.03)	0.04 (0.05)
Light Thin with gaps	4.02 (0.99)	1.27 (0.65)	0.40 (0.13)	1.36 (0.48)	0.37 (0.17)	1.00 (0.59)	0.25 (0.16)
	10.53 (2.57)	3.39 (1.13)	0.68 (0.20)	3.13 (0.42)	1.36 (0.80)	0.09 (0.06)	0.00 (0.00)

Table 3. Results of ANOVA comparison of mean capture rates (1 se) of frequently captured ground-dwelling vertebrates among thinning treatments in 1998. Means with same letter in column are not significantly ($P>0.05$) different. See Appendix A for definition of species acronyms.

	Species				
Treatment	Pema	Tato	Sosp	Sotr	Enes
Control	3.16^{A} (1.03)	2.74^{A} (1.75)	0.97^{A} (0.26)	4.11^{A} (0.43)	0.17^{A} (0.11)
Heavy Thin	8.00^{B} (1.79)	2.99^{A} (0.58)	0.45^{A} (0.12)	2.43^{A} (0.41)	0.84^{A} (0.58)
Light Thin	10.39^{B} (2.88)	3.65^{A} (1.90)	0.87^{A} (0.28)	4.03^{A} (1.60)	1.50^{A} (0.33)
Light Thin with gaps	10.53^{B} (2.57)	3.39^{A} (1.13)	0.68^{A} (0.20)	3.13^{A} (0.42)	1.36^{A} (0.80)

Table 4. Mean (1 se) weight (g) of individuals by thinning treatment, 1998. Means with same letter in column are not significantly different ($P>0.05$). See Appendix A for definition of species acronyms.

	Species			
Treatment	Pema	Tato	Sosp	Sotr
Control	15.9 (0.37) ^{A}	82.8 (1.79)^{A}	6.5 (0.25)^{A}	5.6 (0.77)^{A}
Heavy Thin	14.6 (0.21) ^{A}	82.9 (1.25)^{A}	6.0 (0.30)^{A}	4.9 (0.08)^{A}
Light Thin	15.9 (0.19) ^{A}	82.2 (0.87)^{A}	6.1 (0.27)^{A}	4.9 (0.09)^{A}
Light Thin/gaps	15.3 (0.19) ^{A}	82.6 (0.88)^{A}	6.8 (0.76)^{A}	4.7 (0.11)^{A}

Table 5. Mean (1 se) recapture rate of the deer mouse (Pema) and Townsend's chipmunk (Tato) by thinning treatment, 1998. Means with same letter in column are not significantly different ($P>0.05$).

	Species	
Treatment	Pema	Tato
Control	0.49 (0.039)^{A}	0.31 (0.132)^{A}
Heavy Thin	0.54 (0.056)^{A}	0.38 (0.164)^{A}
Light Thin	0.54 (0.038)^{A}	0.31 (0.154)^{A}
Light Thin/gaps	0.47 (0.082)^{A}	0.43 (0.066)^{A}

Appendix A. Definition of species acronyms.

Amgr	*Ambystoma gracile*	northwestern salamander
Astr	*Ascaphus truei*	tailed frog
Clca	*Clethrionomys californicus*	western red-backed vole
Dite	*Dicamptodon tenebrosus*	Pacific Giant Salamander
Enes	*Ensatina eschscholtzii*	Ensatina
Glsa	*Glaucomys sabrinus*	northern flying squirrel
Mior	*Microtus oregoni*	oregon vole
Negi	*Neurotrichus gibbsii*	shrew-mole
Pema	*Peromyscus maniculatus*	deer mouse
Scor	*Scapanus orarius*	coast mole
Sosp	*Sorex spp.*	*pacificus, sonoma* complex
Sotr	*Sorex trowbridgii*	Trowbridge's shrew
Tado	*Tamiasciurus douglasii*	Douglas squirrel
Tagr	*Taricha granulosa*	rough-skinned newt
Tato	*Tamias townsendii*	Townsend's chipmunk

Appendix B - Meta-data for Yound Stand Thining and Diversity Study ground-dwelling vertebrate data base.

Variable Format and Definitions WE81TEST 12/27/98

Format 1

Small Vertebrate Captures

Variable	Coded	Null	Format	Unit	Definition
MONTH			I2		Month
DAY			I2		Day
YEAR			I4		Year
JULIAN			I3		Julian Date
TAC	Y		I2		Treatment Area Code
BLOCK	Y		I2		Block Code
TREATMENT	Y		I1		Treatment Code
TRANSECT			I2		Transect Number (1998-99)
STATION			I2		Trap Station Number (1998-99)
PLOT			A3		Transect/Station Code (1991-92)
TRAPTYPE	Y		A2		Trap Type
SPECIES	Y		A4		Species
CAPSTAT	Y		A2		Capture Status
TAG1			I4		Tag #1 Number
EAR1	Y		A2		Ear for Tag#1
TAG2			I4		Tag#2 Number
EAR2	Y		A2		Ear for Tag#2
TOENUM1			I4		Toe Number Assigned in Field
TOENUM2			I4		Re-assigned Toe Number (1991-92)
BODYL			F5.1	cm	Body Length
TAILL			F5.1	cm	Tail Length
WEIGHT			F5.1	g	Weight
SEX	Y		A2		Gender
REPROSTAT	Y		A3		Reproductive Status
LIVE	Y		I1		Live Status
DEAD	Y		I1		Dead Status
DEADNUM			A5		Bag Number of Dead Specimen
NOTENUM			I5		Note Number (1998-99)
NOTES			A45		Comments

Appendix B Cont'd

Variable Format and Definitions WE82TEST 12/27/98

Format 2

Trap Status

Variable	Coded	Null	Format	Unit	Definition
MONTH			I2		Month
DAY			I2		Day
YEAR			I4		Year
JULIAN			I3		Julian Date
TAC	Y		I2		Treatment Area Code
BLOCK	Y		I2		Block Code
TREATMENT	Y		I1		Treatment Code
TRANSECT			I2		Transect Number
STATION			I2		Trapping Station Number
TRAPTYPE	Y		A2		Trap Type
STATUS	Y		A10		Trap Status

Appendix B Cont'd

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                                Variable Code Definitions                    WE81,2TEST   12/27/98
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Variable:  BLOCK
1          Cougar Reservoir (Blue River RD)
2          Mill Creek (McKenzie RD)
3          Christy Flats (Oakridge RD)
4          Sidewalk Creek (Oakridge RD)

Variable:  CAPSTAT
N          New Capture
NE         New Capture/escaped prior to tagging/toe-clipping
R          Recapture
RE         Recapture/escaped prior to recording tag/toe number
E          Escaped/capture status unknown
P          Torn ear(s) indicative of tag loss
RT         Retagged due to problems with existing ear tag

Variable:  DEAD
1          Dead

Variable:  EAR1, EAR2
           EAR1 corresponds to TAG1, EAR2 corresponds to TAG2
R          Right Ear Tagged
L          Left Ear Tagged

Variable:  LIVE
1          Live

Variable:  REPROSTAT
TD         Testes Descended
TR         Testes Recessed
L          Lactating
NL         Not Lactating
U/0        Unknown

Variable:  SEX
M          Male
F          Female
U/0        Unknown

Variable:  SPECIES
AMGR       Ambystoma gracile              northwestern salamander
ANFE       Aneides ferreus                clouded salamander
ASTR       Ascaphus truei                 tailed frog
CLCA       Clethrionomys californicus     western red-backed vole
DITE/DIEN  Dicamptodon tenebrosus         Pacific giant salamander
ENES       Ensatina eschscholtzii         Ensatina
GLSA       Glaucomys sabrinus             northern flying squirrel
MILO       Microtus longicaudus           long-tailed vole
MIOR       Microtus oregoni               oregon vole
MIRI       Microtus richardsoni           Richardson's vole
MUER       Mustela erminea                ermine
NEGI       Neurotrichus gibbsii           shrew-mole
PEMA       Peromyscus maniculatus         deer mouse
SCOR       Scapanus orarius               coast mole
SOBE       Sorex bendirii                 marsh shrew
SOSP       Sorex spp.                     pacificus, sonoma complex
SOTR       Sorex trowbridgii              Trowbridge's shrew
SPGR       Spliogale putorius             spotted skunk
TADO       Tamiasciurus douglasii         Douglas squirrel
TAGR       Taricha granulosa              rough-skinned newt
TATO       Tamias townsendii              Townsend's chipmunk
U/UNKN                                    Unknown
VOLE                                      Unknown vole species
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Appendix B Cont'd

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*****************************************************************************************************
                                Variable Code Definitions                    WE81,2TEST   12/27/98
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Variable:   STATUS
SPRUNG      Sprung
MISSING     Missing trap
NOTSET      Trap not activated
DESTROYED   Trap present, but broken

Variable:   TRAPTYPE
P           Pitfall Trap
S           Sherman Trap
T       Tomahawk

Variable:   TREATMENT
1           Control
2           Heavy Thin
3           Light Thin
4           Light Thin/gaps

Variable:   TAC
            Cougar Reservoir
1           Control
2           Heavy Thin
3           Light Thin
4           Light Thin/gaps

            Mill Creek
5           Control
6           Heavy Thin
7           Light Thin
8           Light Thin/gaps

            Christy Flats
9           Control
10          Heavy Thin
11          Light Thin
12          Light Thin/gaps

            Sidewalk Creek
13          Control
14          Heavy Thin
15          Light Thin
16          Light Thin/gaps
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