Appendices to the Thunder Mountain Fire Research Project

Contents

Appendix A. Detailed description of the Thunder Mountain area

This appendix was developed from a report to the Scientific Panel on Plants for the Interior Columbia Basin Ecosystem Management Project (Wooten, 1994).

Continentally glaciated character

The Thunder fire burned the northern tier of the Okanogan Range in north-central Okanogan County, Washington, a plateau characterized by high-elevation topography with gentle slopes. This topography differs from that typical of the adjacent North Cascades mountains which are more highly dissected by alpine and valley glaciation. Presumably, the final phase of glaciation in the Okanogan Range was the melting of the terminus of the Cordilleran ice sheet, which rounded most of the summits and cirques produced in previous alpine glacier phases (Waite, 1972). The region thus lies just north of the margin of the North American continental glaciation, and is characterized by anomalous topographic including glacial erratics, outwash deposits, drumlins, eskers, terraces, and ice-marginal channels carved by ice and/or water (E.C. Pielou, 1991).

Due to the presence of nearby volcanism and ashfalls, combined with the effects of landform shape wrought by glaciation, undescribed, unusual community types occur here that are more similar to those of the true boreal north, with introgressions of certain southern species. Extensive muskeg-like bogs in this area are dotted with regularly-spaced “earth hummocks” which appear to be linked to pleistocene ashfall in permafrost regions (Scotter and Zoltai, 1992).

The boreal landscape does not extend west into the North Cascade Mountains, nor south of the continental glaciation, nor east onto the Columbia Plateau, nor appreciably north of the international border, as the mountain range loses elevation. Because the wet, cold conditions of glaciated regions are relatively intact here, these boreal meadow complexes represent a disjunct ecological province of unmatched biological diversity. The unusual nature of this boreal province is

documented in this report. What is enigmatic is how it has managed to remain intact.

Wetlands
The northern Okanogan Range is characterized by an extensive wetland network, which still retains many aspects of its the area's glacial character. The wetlands occupy streams and pockets at high elevation, where perhaps because of the low energy gradients and deep glacial colluvium, the soil rarely dries out. Adding to the wetness are severe summer thunderstorms which travel up the Chewuch River's "fire alley", ultimately to precipitate in this area.

Boreal wetlands have a number of features uncommon in low elevation Washington wetlands, including the presence of earth hummocks, boreal (willow-bog birch) flora, late snow melt (mid-July is typical), short growing season, heavy snow packs, dense, but sometimes shallow peat formation underlain by sandy alluvium deposited by continental glaciation. Sphagnum formations are less common here than in the true boreal north, but occasionally they are dominant. Other moss associations are common around bog margins. Typically, herbaceous flora is dominated by *Carex scopulorum* var. *prionophylla*, *Lupinus polyphyllus* var. *burkei* (=*L. arcticus*), *Trollius laxus*, *Epilobium* spp., *Carex disperma*, *Calamagrostis canadensis*, *Valeriana dioica*, and *Valeriana sitchensis*.

Appendix B. Floristic survey - dates, locations and plant list

Floristic records in this report were compiled during the following field surveys:

06/29/95	Dog Creek, lower end, Forest Service TES plant survey - G. Wooten.
07/06/95,07/07/95	Thirtymile-Twentymile Cr. Saddle, Forest Service TES plant survey - G. Wooten.
07/07/95-07/08/95	Wetland Inventory Workshop, near Thirtymile Meadow, G. Wooten, Coordinator.
07/08/95,07/09/95	Thirtymile Cr., Ridge NW of Thirtymile meadow, Forest Service TES plant survey - G. Wooten.
12/28/95-01/01/96	Tripod Peak winter wildlife tracking survey, M. Poss, A. Gaskill.
02/29/96-03/10/96	Thunder Mountain winter wildlife tracking survey, M. Poss, A. Gaskill.
08/17/96-08/19/96	Thunder Mountain Revegetation study, Mary Poss, Coordinator.
09/06/96-09/09/96	Thunder Mountain Revegetation study, Mary Poss, Coordinator.
09/21/96-09/22/96	Thunder Mountain Birding and Ecology Workshop Hikes, Mary Poss, Coordinator.
09/27/96-09/29/96	Thunder Mountain Birding and Ecology Workshop Hikes, Mary Poss, Coordinator.

Collections of herbarium specimens from the area were taken primarily from floristic surveys predating the fire. Dates of collections made by George Wooten are 6/20/90; 8/11-13,27/91; 9/1,2/91; 5/15,28/92; 6/14,27,28/92; 7/13,15,26,28/92; 8/9,10,16,22-25/92. Most of these collections were taken during surveys for a study of the effects of livestock grazing in high elevation wetlands in Horseshoe Basin, close to the Thunder Fire. About 50 of these

collections have been deposited at the University of Washington Herbarium.

Habitat data for the floristic notes follows notes taken in the field. These habitats are coded as follows:

16:4-7 6/29/95 Thunder Timber Survey Dog Creek.
DOG CR. BOTHB Hot burned area, lower end Dog Creek.
DOG CR. BOTSTAND Hot burned area, lower Dog Creek with standing water.
DOG CR. UNBURNED Unburned patch, lower Dog Creek.
DOG CR. WET Large wetland on Dog Creek.
16:15-16 7/6/95 Thunder Timber survey Thirtymile Meadow Area.
DILL CR - U30 Upper 30mile
DILL CR - U30-BOT Upper 30mile saddle with Botrychium spp.
16:18-20 7/8/95 Thunder Weed Wetland Workshop and keyouts.
UPPER 30MILE - BIGDRY Dry aspen meadow above Thirtymile Meadows.
UPPER 30MILE - CLASSBOG Bog 1 mile west of Thirtymile Meadows.
UPPER 30MILE - OTHER Other species seen upper Thirtymile Meadows.
UPPER 30MILE - KEYOUT 7/8/95 Species keyed out from upper Thirtymile Meadows.
17:34-35 6/17/97 Hike to bog & new keyouts.
BOG WEST OF 30MILE MEAD-6/17/97 New species seen.
17:38-39 7/21/97 Thunder keyouts mushroom keyouts.
[NO VASCULAR FLORA INFORMATION]
17:43-45 6/28/97 Thunder with Art Partridge.
DILL CR UNIT 6 - 6/29/97
17:46-50 7/5/97 Thunder keyouts - moss.
[PRIMARILY MOSSES, VASCULAR PLANTS SEEN ALREADY RECORDED]
17:80-81 7/24/97 Boreal ecology workshop. Map of area, surveys.
[PRIMARILY FUNGI, SEE BELOW]
18:79-81 7/13/96 George and Mary into upper Sheep Creek.
20MILE - TWMILE-7-13-96 East side Twentymile Cr. drainage.
20MILE - FOREST7-96 Forest on east side Twentymile Cr. drainage.
20MILE - RIDGE7-96 Dry ridge east side Twentymile Cr. drainage.
20MILE - WETFOR-IN7/96 Wet forest east side Twentymile Cr. drainage.
20MILE - ROCKYBENCH7/96 Rocky bency east side Twentymile Cr. drainage.
20MILE - WETFOR7-96 Wet forest east side Twentymile Cr. drainage.
20MILE - CAMPON.20MILE Forested camp Twentymile Cr. bottom.
20MILE - DRYFOR.20MILE.7.96 Dry forest Twentymile Cr. bottom.
20MILE - INTOFIRE.7/96 Fire margin west side Twentymile Cr. bottom.
20MILE - BACK AT CAMP Dry forest Twentymile Cr. bottom.
20MILE - 20MILE.BOTTOM Twentymile Cr. bottom.
20MILE - OVER.BURNED.RIDG Ridge between Twentymile and Sheep Creeks.
SHEEP CR - TOP.MEADOW Summit between Twentymile and Sheep Creeks.
SHEEP CR - PK.6954.FIRE Burned summit between Twentymile and Sheep Creeks.

SHEEP CR - 6954.DOWN.WEST West face of summit between Twentymile and Sheep Creeks.
18:114 9/2/96 Thunder Keyouts.
20MILE, SHEEP CR KEYOUTS.8.24.96 West face of summit between Twentymile and Sheep Creeks.
18:116-119 9/21/96 Thirtymile Trip No. 1 with birders & keyouts.
30MILE - WKSHP.9.21.96
30MILE - KEYOUTS.9.21.96
18:120-121 9/26/96 Timber Creek GW & MP.
TIMBER CR - TIM.CR.9.27.96 Flora list of Timber Creek.
TIMBER CR - TIM.CR.PLOT Vegetation plot on Timber Creek.
18:122 9/29/96 Thirtymile Trip No. 2.
UPPER 30MILE - 30.MI.9.29.96 Upper Thirtymile Creek.
18:123 9/29/96 Thunder log counts.
[NO FLORA INFORMATION]
[PLOT NOTES] 8/17/96 Ecology plot data collection.
UPPER 30MILE-DILL CONFLUENCE
[PLOT NOTES] 9/7/96 Ecology plot data collection.
[NO FLORA INFORMATION]
[NOTES] 9/97 Thirtymile Meadows FS survey.
UPPER 30MILE MEADOWS - FS SURV Rare plant found on FS survey.
[NOTES] 9/1/97 Dog Creek ecology plot data collection.
DOG CREEK 9/1/97 Dog Creek Keyouts.

Table of 217 vascular plant species found in the Thunder fire perimeter, with alphacode and common name.

ACHMIL	**Achillea millefolium**	common yarrow	Asteraceae
ACOCOL	**Aconitum columbianum**	Columbian monkshood	Ranunculaceae
AGOAUR	**Agoseris aurantiaca**	orange agoseris	Asteraceae
AGOGLAD	**Agoseris glauca** var. **dasycephala**	pale yellow false-dandelion	Asteraceae
AGOLAC	**Agoseris lackschewitzii**	pink agoseris	Asteraceae
AGRSCA	**Agrostis scabra**	rough bentgrass	Poaceae
AGRTHU	**Agrostis thurberiana**	Thurber's bentgrass	Poaceae
ALLCER	**Allium cernuum**	nodding onion	Liliaceae
ALNVIRS2	**Alnus viridis** ssp. **sinuata**	Sitka alder	Betulaceae
ANGARG	**Angelica arguta**	Lyall's angelica	Apiaceae
ANTLAN	**Antennaria lanata**	woolly pussytoes	Asteraceae
ANTLUZ	**Antennaria luzuloides**	woodrush pussytoes	Asteraceae
ANTMIC2	**Antennaria microphylla**	rosy pussytoes	Asteraceae
ANTRAC	**Antennaria racemosa**	raceme pussytoes	Asteraceae
ANTUMB	**Antennaria umbrinella**	umper pussytoes	Asteraceae
AQUFOR	**Aquilegia formosa**	western columbine	Ranunculaceae
ARAGLA	**Arabis glabra**	tower rockcress	Brassicaceae
ARAHOLH	**Arabis holboellii** var. **holboellii**	Holboell's rockcress	Brassicaceae
ARAHOLR	**Arabis holboellii** var. **retrofracta**	Holboell's rockcress	Brassicaceae
ARCUVA	**Arctostaphylos uva-ursi**	bearberry, kinnickinnick	Ericaceae
ARECAP	**Arenaria capillaris**	mountain sandwort	Caryophyllaceae
ARNCOR	**Arnica cordifolia**	heartleaf arnica	Asteraceae
ARTTRIV2	**Artemisia tridentata** ssp. **vaseyana**	mountain big sagebrush	Asteraceae

ASTALP2	**Astragalus alpinus**	alpine milkvetch	Fabaceae
ASTFOL	**Aster foliaceus**	leafy aster	Asteraceae
BETNAN	**Betula nana**	bog birch	Betulaceae
BOTLUN	**Botrychium lunaria**	moonwort	Ophioglossaceae
BOTMIN	**Botrychium minganense**	Victorin's moonwort	Ophioglossaceae
BOTPIN	**Botrychium pinnatum**	pinnate moonwort	Ophioglossaceae
BROANO	**Bromus anomalus**	nodding brome	Poaceae
BROCAR	**Bromus carinatus**	California brome	Poaceae
BROCIL2	**Bromus ciliatus**	fringed brome	Poaceae
BROTEC	**Bromus tectorum**	cheatgrass	Poaceae
CALBIFB	**Caltha biflora** var. **biflora**	elkslip	Ranunculaceae
CALCAN	**Calamagrostis canadensis**	blue reedgrass	Poaceae
CALRUB	**Calamagrostis rubescens**	pinegrass	Poaceae
CARAUR	**Carex aurea**	goldenfruit sedge	Cyperaceae
CARCAN	**Carex canescens**	hoary sedge	Cyperaceae
CARCON	**Carex concinnoides**	northwestern sedge	Cyperaceae
CARDEW	**Carex deweyana**	roundfruit sedge	Cyperaceae
CARDIS	**Carex disperma**	softleaf sedge	Cyperaceae
CARHOO	**Carex hoodii**	Hood's sedge	Cyperaceae
CARNOR	**Carex norvegica**	closedhead sedge	Cyperaceae
CARPET	**Carex petasata**	Liddon sedge	Cyperaceae
CARPHA	**Carex phaeocephala**	dunhead sedge	Cyperaceae
CARRAY	**Carex raynoldsii**	Raynolds' sedge	Cyperaceae
CARROS	**Carex rossii**	Ross' sedge	Cyperaceae
CARSCOP	**Carex scopulorum** var. **prionophylla**	saw-leaved sedge	Cyperaceae
CARVAL2	**Carex vallicola**	valley sedge	Cyperaceae
CASELM	**Castilleja elmeri**	Wenatchee Indian paintbrush	Scrophulariaceae
CASMIN	**Castilleja miniata**	great red Indian paintbrush	Scrophulariaceae
CASTHO	**Castilleja thompsonii**	Thompson's Indian paintbrush	Scrophulariaceae
CERBER	**Cerastium berringianum**	Bering chickweed	Caryophyllaceae
CHASUA	**Chamomilla suaveolens**	pineapple weed	Asteraceae
CHEATR	**Chenopodium atrovirens**	Fremont's goosefoot	Chenopodiaceae
CHECHE2	**Chenopodium chenopodioides**	red goosefoot	Chenopodiaceae
CIRARV	**Cirsium arvense**	Canada thistle	Asteraceae
CIRVUL	**Cirsium vulgare**	bull thistle	Asteraceae
CISUMB	**Cistanthe umbellata**	pussypaws	
CLALAN	**Claytonia lanceolata**	lanceleaf springbeauty	Portulacaceae
CLARUB	**Claytonia rubra**	redstem springbeauty	Portulacaceae
COLPAR	**Collinsia parviflora**	smallflower blue-eyed Mary	Scrophulariaceae
CONCANC	**Conyza canadensis** var. **canadensis**	Canadian horseweed	Asteraceae
CORUNA	**Cornus unalaschkensis**	western cordilleran bunchberry	Cornaceae
CYSFRA	**Cystopteris fragilis**	brittle bladder fern	Polypodiaceae
DANINT	**Danthonia intermedia**	timber oatgrass	Poaceae
DELNUTL2	**Delphinium nuttallianum** var. **lineapetalum**	upland larkspur	Ranunculaceae
DESINCV2	**Descurainia incana** ssp. **viscosa**	mountain tansymustard	Brassicaceae
DESSOP	**Descurainia sophia**	flixweed	Brassicaceae
DODDEN	**Dodecatheon dentatum**	white shootingstar	Primulaceae
DODPULP3	**Dodecatheon pulchellum** ssp. **pulchellum**	birdie-beaks, shootingstar	Primulaceae
DRAALB	**Draba albertina**	slender whitlowgrass	Brassicaceae
ELYALAL	**Elymus alaskanus** ssp. **latiglumis**	cutting wheatgrass	Poaceae
ELYELY	**Elymus elymoides**	bottlebrush squirreltail	Poaceae
EPIANA	**Epilobium anagallidifolium**	alpine willowherb	Onagraceae
EPIANG	**Epilobium angustifolium**	fireweed	Onagraceae
EPICILW	**Epilobium ciliatum** ssp. **watsonii**	Watson's willowherb	Onagraceae
EPIGLA	**Epilobium glaberrimum**	smooth willowherb	Onagraceae
EPIHAL	**Epilobium halleanum**	Hall's willowherb	Onagraceae

EPILAC	**Epilobium lactiflorum**	creamy willowherb	Onagraceae
EQUARV	**Equisetum arvense**	field horsetail	Equisetaceae
ERIAUR	**Erigeron aureus**	alpine yellow fleabane	Asteraceae
ERIPER	**Erigeron peregrinus**	wandering daisy	Asteraceae
ERIUMBM	**Eriogonum umbellatum** var. **majus**	subalpine wild buckwheat	Polygonaceae
FESIDA	**Festuca idahoensis**	Idaho fescue	Poaceae
FESOCC	**Festuca occidentalis**	western fescue	Poaceae
FESOVIB2	**Festuca ovina** var. **brachyphylla**	alpine fescue	Poaceae
FILARV	**Filago arvensis**	field cotton-rose	Asteraceae
FRAVES	**Fragaria vesca**	woodland strawberry	Rosaceae
FRAVIR	**Fragaria virginiana**	Virginia strawberry	Rosaceae
GALTRI3	**Galium trifidum**	three-petal bedstraw	Rubiaceae
GAYDIFP	**Gayophytum diffusum** ssp. **parviflorum**	spreading groundsmoke	Onagraceae
GENAMAA4	**Gentianella amarella** ssp. **acuta**	northern gentian	Gentianaceae
GERPUS	**Geranium pusillum**	small geranium	Geraniaceae
GEUALE	**Geum aleppicum**	yellow avens	Rosaceae
GEUMAC	**Geum macrophyllum**	large-leaf avens	Rosaceae
GEUTRI	**Geum triflorum**	old-man's-whiskers, prairie smoke	Rosaceae
GNAMIC	**Gnaphalium microcephalum**	white cudweed	Asteraceae
GNAPAL	**Gnaphalium palustre**	lowland cudweed	Asteraceae
HACMIC	**Hackelia micrantha**	Jessica's stickseed	Boraginaceae
HIEGRA	**Hieracium gracile**	low alpine hawkweed	Asteraceae
JUNDRU	**Juncus drummondii**	Drummond's rush	Juncaceae
JUNPAR	**Juncus parryi**	Parry's rush	Juncaceae
KOEMAC	**Koeleria macrantha**	prairie junegrass	Poaceae
LEDGLA	**Ledum glandulosum**	false Labrador tea	Ericaceae
LEWPYG	**Lewisia pygmaea**	dwarf, or alpine bitterroot	Portulacaceae
LINBOR	**Linnaea borealis**	twinflower	Caprifoliaceae
LISCOR	**Listera cordata**	heart-leaf twayblade	Orchidaceae
LITTEN	**Lithophragma tenella**	woodlandstar or fringecup	Saxifragaceae
LOMAMB	**Lomatium ambiguum**	streambank desert-parsley	Apiaceae
LONINV	**Lonicera involucrata**	four-line honeysuckle	Caprifoliaceae
LONUTA	**Lonicera utahensis**	Rocky Mountain honeysuckle	Caprifoliaceae
LUPARC	**Lupinus arcticus**	arctic lupine	Fabaceae
LUPWYE	**Lupinus wyethii**	Wyeth's lupine	Fabaceae
LUZPAR	**Luzula parviflora**	smallflowered woodrush	Juncaceae
LUZSPI	**Luzula spicata**	spiked woodrush	Juncaceae
MELBULB	**Melica bulbosa** var. **bulbosa**	oniongrass	Poaceae
MICNUT	**Microseris nutans**	nodding silverpuffs	Asteraceae
MITPEN	**Mitella pentandra**	five-stamen bishop's-cap	Saxifragaceae
ORTSEC	**Orthilia secunda**	sidebells pyrola	Ericaceae
OSMDEP	**Osmorhiza depauperata**	blunt-fruit sweet Cecily	Apiaceae
OSMOCC	**Osmorhiza occidentalis**	western sweet Cecily	Apiaceae
OSMPUR	**Osmorhiza purpurea**	purple sweet Cecily	Apiaceae
PEDBRA	**Pedicularis bracteosa**	greater wood-betony	Scrophulariaceae
PENCON	**Penstemon confertus**	lesser yellow beardtongue	Scrophulariaceae
PENFLO	**Pentaphylloides floribunda**	shrubby cinquefoil, yellow rose	
PENPRO	**Penstemon procerus**	small-flowered penstemon	Scrophulariaceae
PENPROT	**Penstemon procerus** var. **tolmiei**	small-flowered penstemon	Scrophulariaceae
PENWAS	**Penstemon washingtonensis**	Washington penstemon	Scrophulariaceae
PHAHAS	**Phacelia hastata**	silver-leaf scorpion-weed	Hydrophyllaceae
PHLALP	**Phleum alpinum**	alpine fescue	Poaceae
PHLGRAG	**Phlox gracilis** ssp. **gracilis**	annual phlox	Polemoniaceae
PINALB	**Pinus albicaulis**	whitebark pine	Pinaceae
PINPON	**Pinus ponderosa**	ponderosa pine	Pinaceae
PLADIL	**Platanthera dilatata**	scentbottle	Orchidaceae

PLAMAJ	**Plantago major**	great plantain	Plantaginaceae
PLASTR	**Platanthera stricta**	slender bog orchid	Orchidaceae
POAALP2	**Poa alpina**	alpine bluegrass	Poaceae
POAANN	**Poa annua**	annual bluegrass	Poaceae
POALEP	**Poa leptocoma**	bog bluegrass	Poaceae
POAPRA	**Poa pratensis**	Kentucky bluegrass	Poaceae
POASEC	**Poa secunda**	Sandberg's bluegrass	Poaceae
POLAVI	**Polygonum aviculare**	crackweed, jointweed, doorweed	Polygonaceae
POLDOU	**Polygonum douglasii**	Douglas' knotweed	Polygonaceae
POLELE	**Polemonium elegans**	elegant Jacob's-ladder	Polemoniaceae
POLPULP3	**Polemonium pulcherrimum** ssp. **pulcherrimum**	showy polemonium,showy Jacobs ladder	Polemoniaceae
POLVIV	**Polygonum viviparum**	serpent-grass	Polygonaceae
POPTRE	**Populus tremuloides**	quaking aspen	Salicaceae
POTDIVD	**Potentilla diversifolia** var. **diversifolia**	mountain-meadow cinquefoil	Rosaceae
POTDIVP	**Potentilla diversifolia** var. **perdissecta**	mountain-meadow cinquefoil	Rosaceae
POTDRU	**Potentilla drummondii**	Drummond's cinquefoil	Rosaceae
PSESPIS2	**Pseudoroegneria spicata** ssp. **spicata**	bluebunch wheatgrass	Poaceae
PYRASA	**Pyrola asarifolia**	pink wintergreen	Ericaceae
PYRMIN	**Pyrola minor**	lesser wintergreen	Ericaceae
RANESC	**Ranunculus eschscholtzii**	Eschscholtz's buttercup	Ranunculaceae
RANGLAE	**Ranunculus glaberrimus** var. **ellipticus**	elliptical buttercup	Ranunculaceae
RANUNC	**Ranunculus uncinatus**	hooked buttercup	Ranunculaceae
RIBVIS2	**Ribes viscosissimum**	sticky currant	Grossulariaceae
SALDRU	**Salix drummondiana**	Drummond's willow	Salicaceae
SALFAR	**Salix farriae**	Farr's willow	Salicaceae
SALPLA	**Salix planifolia**	diamondleaf willow	Salicaceae
SALSCO	**Salix scouleriana**	Scouler's willow	Salicaceae
SALTWE	**Salix tweedyi**	Tweedy's willow	Salicaceae
SAXAPE	**Saxifraga apetala**	dwarf saxifrage	Saxifragaceae
SAXODO	**Saxifraga odontoloma**	brook saxifrage	Saxifragaceae
SEDLAN	**Sedum lanceolatum**	lance-leaf stonecrop	Crassulaceae
SELDEN	**Selaginella densa**	dense spike-moss	Selaginellaceae
SENINT	**Senecio integerrimus**	lamb-tongue ragwort	Asteraceae
SENPAU	**Senecio pauciflorus**	rayless alpine butterweed	Asteraceae
SENPSE	**Senecio pseudaureus**	streambank ragwort	Asteraceae
SENSTR	**Senecio streptanthifolius**	Rocky Mountain ragwort	Asteraceae
SENSYL	**Senecio sylvaticus**	woodland ragwort	Asteraceae
SENTRI	**Senecio triangularis**	arrowleaf groundsel	Asteraceae
SHECAN	**Shepherdia canadensis**	russet buffalo-berry	Eleagnaceae
SIBPRO	**Sibbaldia procumbens**	creeping sibbaldia	Rosaceae
SOLMUL	**Solidago multiradiata**	northern goldenrod	Asteraceae
STECRI	**Stellaria crispa**	crisped starwort	Caryophyllaceae
STELONM	**Stellaria longipes** var. **monantha**	long-stalk starwort	Caryophyllaceae
STEOCC2	**Stenanthium occidentale**	bronze bells	Liliaceae
STIOCC	**Stipa occidentalis**	western needlegrass	Poaceae
STRAMP	**Streptopus amplexifolius**	clasping twistedstalk	Liliaceae
SUKRAN	**Suksdorfia ranunculifolia**	buttercupleaved saxifrage	Saxifragaceae
TAROFF	**Taraxacum officinale**	common dandelion	Asteraceae
THAOCC	**Thalictrum occidentale**	western meadowrue	Ranunculaceae
TRADUB	**Tragopogon dubius**	yellow salsify	Asteraceae
TRIACRA	**Trimorpha acris** var. **asteroides**	bitter boreal-daisy	Asteraceae
TRIACRD	**Trimorpha acris** var. **debilis**	northern daisy	Asteraceae
TRISPI2	**Trisetum spicatum**	spike trisetum	Poaceae
TROLAX	**Trollius laxus**	American globeflower	Ranunculaceae
VACCAE	**Vaccinium caespitosum**	dwarf huckleberry	Ericaceae

VACMYR2	**Vaccinium myrtillus**	whortle-berry	Ericaceae
VACSCO	**Vaccinium scoparium**	grouseberry, dwarf whortleberry	Ericaceae
VALDIO	**Valeriana dioica**	marsh valerian	Valerianaceae
VALSIT	**Valeriana sitchensis**	Sitka valerian	Valerianaceae
VERSERH2	**Veronica serpyllifolia** ssp. **humifusa**	thyme-leaf speedwell	Scrophulariaceae
VERVIR	**Veratrum viride**	American false hellebore	Liliaceae
VERWOR	**Veronica wormskjoldii**	American alpine speedwell	Scrophulariaceae
VIOADU	**Viola adunca**	long spurred violet	Violaceae
VIOMAC	**Viola macloskeyi**	smooth white violet	Violaceae
VIONUT	**Viola nuttallii**	Nuttall's violet	Violaceae
VIOORB	**Viola orbiculata**	round-leaved, or evergreen violet	Violaceae
VIOPAL2	**Viola palustris**	alpine-marsh violet	Violaceae
ZIGVEN	**Zigadenus venenosus**	meadow deathcamas	Liliaceae

TOTALS OF VASCULAR PLANT RECORDS

Total plant records entered (including duplicates) = 483
Total plant families represented = 41
Plants not identified to vascular species = 0
No. of duplicate, non blank records (redundant) = 265
No. of duplicate, non blank vascular taxa (unique) = 110
Number of unique taxa identified = 218
No. vars/spps duplicated as specifics (listed below) = 1
PENPRO
Recalculated no. of taxa, less variety duplicates = 217
Number of subspecific taxa identified = 52 (24%)
Number of species with more than one variety unidentified = 54 (25%)

LIFE FORM CLASSIFICATION

Number of identified species classed as trees = 8 = 3.9%
Number of identified species classed as shrubs = 21 = 10.1%
Number of identified species classed as forbs = 178 = 86.0%
TOTAL found in life form database: 207 100.0%

DETAIL OF LIFE FORMS (REDUNDANT COUNTS)

Number of grass species identified = 42 = 19.4%
Number of vine species identified = 0 = 0.0%
Number of cane species identified = 0 = 0.0%
Number of aquatic species identified = 0 = 0.0%
Number of parasitic species identified = 0 = 0.0%
Number of coniferous species identified = 6 = 2.8%
Number of forb species identified = 134 = 62.0%
Number of subshrub species identified = 10 = 4.6%
Number of woody species identified = 15 = 6.9%
Number of insectivorous species identified = 0 = 0.0%
Number of fern species identified = 4 = 1.9%
TOTAL REDUNDANT PERCENTAGES (OF UNIQUE TAXA = 216) 97.7%

DETAIL OF AGE CLASSIFICATION

Number of perennial species identified = 186 = 89.9%
Number of biennial species identified = 5 = 2.4%
Number of annual species identified = 16 = 7.7%
TOTAL: 207 100.0%

DETAIL OF LEAF CLASSIFICATION

Number of evergreen species identified = 7 = 3.4%
Number of deciduous species identified = 188 = 90.8%
Number of semigreen species identified = 12 = 5.8%
TOTAL: 207 100.0%

DETAIL OF NATIVE/INTRODUCED SPECIES

No. of Wash St Noxious weeds identified = 2 = .9%
No. of other introduced spp identified = 12 = 5.5%
List of introduced spp.(*=Noxious):
ARAGLA BROANO BROTEC *CIRARV
*CIRVUL DESSOP FILARV GERPUS
PLAMAJ POAANN POAPRA POLAVI
SENSYL TAROFF TRADUB
Number of (positively) native species identified = 188 = 86.2%
No. of species with ambiguous provenance = 16 = 7.3%
TOTAL: 218 100.0%

DETAIL OF RARITY CLASSIFICATION

Number of rare Washington plant species possible = 15 = 6.9%

A separate set of codes was used as a shorthand method for recording data along transects. These codes are presented in the table below:

-	NA	Not recorded	
ABLA	CONIF	Abies lasiocarpa	subalpine fir
ACCO	HERB	Aconitum columbianum	Columbian monkshood
ACMI	HERB	Achillea millefolium	common yarrow
AGEL	HERB	Agoseris elata	tall agoseris
AGGL	HERB	Agoseris glauca v. dasycephala	pale yellow false-dandelion
AGSC	GRAM	Agrostis scabra	rough bentgrass
AGTH	GRAM	Agrostis thurberiana	Thurber's bentgrass
ANMA	HERB	Anaphalis margaritacea	pearly everlasting
ANMI	HERB	Antennaria microphylla	rosy pussytoes
ANRA	HERB	Antennaria racemosa	racemose pussytoes
ANTEN	HERB	Antennaria sp.	pussytoes
AQFO	HERB	Aquilegia formosa	western columbine
ARABI	HERB	Arabis sp.	rockcress
ARCA	HERB	Arenaria capillaris	mountain sandwort

ARCO	HERB	Arnica cordifolia	heartleaf arnica
ARDI	HERB	Arnica diversifolia	diverse-leaved arnica
ARSP	HERB	Arabis sparsiflora	sicklepod rockcress
ASFO	HERB	Aster foliaceus	leafy aster
ASH	MINERAL	Ash	
ASH+HUMUS	MIX	Ash + humus	
BARE	MINERAL	Bare	
BEDR	MINERAL	Bedrock	
BLOWD	FORM	Blowdown mound	
BOULD	MINERAL	Boulder (Rock > 1m)	
BURNH	FORM	Burn hole	
CAAU	GRAM	Carex aurea	goldenfruit sedge
CABI	HERB	Caltha biflora v. biflora	elkslip
CACA	GRAM	Calamagrostis canadensis	blue reedgrass
CACA2	GRAM	Carex canescens	hoary sedge
CACO	GRAM	Carex concinnoides	northwestern sedge
CADI	GRAM	Carex disperma	softleaf sedge
CAEL	HERB	Castilleja elmeri	Wenatchee paintbrush
CALAM	GRAM	Calamagrostis sp.	reedgrass
CAMU	GRAM	Carex multicostata	many-ribbed sedge
CAREX	GRAM	Carex sp.	sedge
CARO	GRAM	Carex rossii	Ross's sedge
CARU	GRAM	Calamagrostis rubescens	pinegrass
CASC	GRAM	Carex scopulorum v. prionophylla	saw-leaved sedge
CHAR	ORGANIC	Charcoal	
CHAT	HERB	Chenopodium atrovirens	Fremont's goosefoot
CIAR	HERB	Cirsium arvense	Canada thistle
CIVU	HERB	Cirsium vulgare	bull thistle
COUN	HERB	Cornus unalaschkensis	western cordilleran bunchberry
CRYPT	CRYPT	Cryptogam	
DENU	HERB	Delphinium nuttallianum	Nuttall's upland larkspur
DODE	HERB	Dodecatheon dentatum	white shooting star
ELEL	GRAM	Elymus elymoides (Sitanion hystrix)	bottle-brush squirreltail
EPAN	HERB	Epilobium angustifolium	fireweed
EPCI	HERB	Epilobium ciliatum s. watsonii	Watson's willow-herb
EPHA	HERB	Epilobium halleanum	Hall's willow-herb
EPILO	HERB	Epilobium sp.	willow-herb
EPLE	HERB	Epilobium leptocarpum	small-flowered willow-herb

		(Epilobium glandulosum v. macounii)	
EPMI	HERB	Epilobium minutum	small-flowered willow-herb
EQAR	HERB	Equisetum arvense	field horsetail
ERAC	HERB	Erigeron acris s. politus (Erigeron acris v. asteroides)	bitter boreal-daisy
ERPE	HERB	Erigeron peregrinus	wandering daisy
ERSP	HERB	Erigeron speciosus	showy daisy
FIAR	HERB	Filago arvensis	field cotton-rose
FRVI	HERB	Fragaria virginiana	Virginia strawberry
FUNGI	FUNGI	Fungi	
GADI	HERB	Gayophytum diffusum s. parviflorum	spreading groundsmoke
GAYOP	HERB	Gayophytum sp.	ground smoke
GEAM	HERB	Gentianella amarella s. acuta	northern gentian
GETR	HERB	Geum triflorum	old-man's-whiskers
GNMI	HERB	Gnaphalium microcephalum	white cudweed
GNPA	HERB	Gnaphalium palustre	lowland cudweed
GRAV	MINERAL	Gravel (1cm - 5cm)	
HIAL	HERB	Hieracium albiflorum	white-flowered hawkweed
HIERA	HERB	Hieracium sp.	hawkweed
HUMUS	ORGANIC	Humus	
JUCO	CONIF	Juniperus communis	common juniper
JUDR	GRAM	Juncus drummondii	Drummond's rush
KOMA	GRAM	Koeleria macrantha (K. cristata)	prairie junegrass
LEAF	ORGANIC	Leaf litter	
LEGL	BROAD	Ledum glandulosum (Rhododendron glandulosum)	false Labrador tea
LIBO	BROAD	Linnaea borealis	twinflower
LITT	ORGANIC	Litter	
LITT+CHAR	ORGANIC	Litter + char	
LOBR	HERB	Lomatium brandegei	Brandege's lomatium
LOG	ORGANIC	Log (> 2m)	
LOIN	BROAD	Lonicera involucrata	clasping honeysuckle
LOUT	BROAD	Lonicera utahensis	Utah honeysuckle
LUAR	HERB	Lupinus arcticus	arctic lupine
LUPA	GRAM	Luzula parviflora	smallflowered woodrush

LUWY	HERB	Lupinus wyethii	Wyeth's lupine
MAPO	CRYPT	Marchantia polymorpha (a foliose liverwort)	Marchantia liverwort
MIPE	HERB	Mitella pentandra	five-stamen bishop's-cap
MOSS	CRYPT	Moss	
MUCK	ORGANIC	Muck	
NEEDL	ORGANIC	Needle litter	
ORSE	HERB	Orthilia secunda (Pyrola secunda)	sidebells pyrola
OSPU	HERB	Osmorhiza purpurea	purple sweet Cecily
PECO	HERB	Penstemon confertus	lesser yellow beardtongue
PHAL	GRAM	Phleum alpinum	alpine fescue
PHHA	HERB	Phacelia hastata	silver-leaf phacelia
PHPR	GRAM	Phleum pratense	timothy
PICO	CONIF	Pinus contorta v. latifolia	lodgepole pine
PIEN	CONIF	Picea engelmannii	Engelmann spruce
POA	GRAM	Poa sp.	bluegrass
PODI	HERB	Potentilla diversifolia v. diversifolia	mountain-meadow cinquefoil
PODIP	HERB	Potentilla diversifolia v. perdissecta	cut-leaf cinquefoil
PODR	HERB	Potentilla drummondii	Drummond's cinquefoil
POEL	HERB	Polemonium elegans	elegant Jacob's-ladder
POLYT	CRYPT	Polytrichum spp. (hair-cap mosses)	haircap moss
POPR	GRAM	Poa pratensis	Kentucky bluegrass
POPU	HERB	Polemonium pulcherrimum s. pulcherrimum	showy Jacob's-ladder
POTR	BROAD	Populus tremuloides	quaking aspen
POVI	HERB	Polygonum viviparum	alpine bistort
PSME	CONIF	Pseudotsuga menziesii	Douglas fir
PYUN	HERB	Pyrola uniflora	woodnymph
RAES	HERB	Ranunculus eschscholtzii	Eschscholtz's buttercup
RAUN	HERB	Ranunculus uncinatus	hooked buttercup
RHAL	BROAD	Rhododendron albiflorum	white-flowered rhododendron
RILA	BROAD	Ribes lacustre	swamp currant
RIVI	BROAD	Ribes viscosissimum	sticky currant
ROCK	MINERAL	Rock (5cm-1m)	
ROOT	ORGANIC	Root	
RUPE	HERB	Rubus pedatus	five-leaf bramble
SAFA	BROAD	Salix farriae	Farr's willow

SALIX	BROAD	Salix sp.	willow
SANDB	MINERAL	Sandbar	
SAOD	HERB	Saxifraga odontoloma	brook saxifrage
SAPL	BROAD	Salix planifolia	plane-leaf willow
SARA	BROAD	Sambucus racemosa	red elderberry
SASC	BROAD	Salix scouleriana	Scouler's willow
SEDE	CRYPT	Selaginella densa	dense spike-moss
SELA	HERB	Sedum lanceolatum	lanceleaf stonecrop
SEPS	HERB	Senecio pseudoaureus	streambank ragwort
SEST	HERB	Senecio streptanthifolius	Rocky Mountain butterwort
SESY	HERB	Senecio sylvestris	logger's ragwort
SETR	HERB	Senecio triangularis	arrowleaf groundsel
SHCA	BROAD	Shepherdia canadensis	russet buffalo-berry
SIPA	HERB	Silene parryi	Parry's catchfly
SLICH	SLICH	Soil lichen	
SNAG	ORGANIC	Snag	
SOMU	HERB	Solidago multiradiata	northern goldenrod
SPBE	BROAD	Spiraea betulifolia v. lucida	shiny-leaf spiraea
SPHAG	CRYPT	Sphagnum moss	
STAM	HERB	Streptopus amplexifolius s. chalazatus	clasping twistedstalk
STCR	HERB	Stellaria crispa	wavy-leaf starwort
STELL	HERB	Stellaria sp.	starwort
STERI	INANIM	Sterile ground (all non-living)	
STLO	HERB	Stellaria longipes	long-stalked starwort
STUMP	ORGANIC	Stump	
THOC	HERB	Thalictrum occidentale	western meadow rue
TRDU	HERB	Tragopogon dubius	yellow salsify
TRLA	HERB	Trollius laxus	American globeflower
TRSP	GRAM	Trisetum spicatum	spike trisetum
UNK	UNK	Unknown vascular plant	
VACA	HERB	Vaccinium caespitosum	dwarf huckleberry
VAME	BROAD	Vaccinium membranaceum	thinleaf huckleberry
VAMY	BROAD	Vaccinium myrtillus	bilberry
VASC	BROAD	Vaccinium scoparium	grouseberry, dwarf whortleberry
VASI	HERB	Valeriana sitchensis	Sitka valerian
VESE	HERB	Veronica serpyllifolia v. humifusa	thyme-leaved speedwell
VETH	HERB	Verbascum thapsus	flannel mullein
VEWO	HERB	Veronica wormskjoldii	American alpine speedwell

VIAD	HERB	Viola adunca	long-spurred violet
VIGL	HERB	Viola glabella	woodland violet
VIOLA	HERB	Viola sp.	violet
VIOR	HERB	Viola orbiculata	round-leaved violet
VIPA	HERB	Viola palustris	swamp violet
WATER	WATER	Water	
WOOD	ORGANIC	Wood (non-log)	
ZIVE	HERB	Zigadenus venenosus	death camas

Appendix C. Initial TES plant surveys for the Forest Service

From: George Wooten, Okanogan NF
To: Thunder Interdisciplinary Analysis Team
Re: Thunder Analysis Area surveys
Date: July 25, 1995

SURVEY DATES:
Dog Creek, lower end - 6/29/95
Thirtymile & Twentymile Creek saddle (Skull and Crossbones) - 7/6/95,7/7/95
Thirtymile Creek, Ridge NW of Thirtymile meadow - 7/8/95, 7/9/95

Purpose of survey was to determine the location of sensitive plants in the area of the Thunder burn (1994); to propose alternative conservation measures for their continued viability; to inventory wildlife and vegetation components within cutting unit boundaries and within the burn area; and to inspect riparian reserves and their integrity for species within reserves.

Note: This report accompanies a vegetative analysis report and three sensitive plant survey forms.

HABITATS INVENTORIED:

BIGDRY Partly burned, dry sagebrush meadow 1 mi. ENE of Thirty mile meadows.
BOT HB Hot burned, riparian bottomlands in Dog Creek.
BOTSTAND Partially burned tributary bottomlands with standing water.
CLASSBOG Mostly unburned bog 1.5 mi ENE of Thirtymile meadows on a southwest flowing triburary of Thirtymile Creek. Some scorched, and fallen burned trees present.
OTHER Miscellaneous plant records, this survey.
U30 Upper Thirtymile Creek, in saddle above upper Twentymile Creek.
U30-BOT Upper Thirtymile and Twentymile Creeks, saddle, in Botrychium lunaria site.
UNBURNED Westernmost unburned patch at lowermost end of Dog Creek in burn.
WET Dog Creek Meadows at main tributary junction.

FIRE, VEGETATIVE TRENDS

Several types of burn condition are present in Thunder fire. Four noted are (1) hot burned areas,

which left no visibly living vegetation in 1995, primarily in lodgepole stands; (2) understory burned areas, with canopies more than 50% intact, primarily in Douglas fir/pinegrass areas; (3) scorched areas, with 50% to 90% of the overstory killed; and (4) unburned areas.

On 6/29/95, vegetative conditions inside and outside burned areas were assessed at the lowermost, western edge of Dog Creek at approx. 5000 ft. elevation. Both leader growth and vegetation cover were measured. Plants growing in the same habitats inside and outside areas that were burned hot had the following differences in leader growth of the year.

Species	**Burned Growth"**	**Unburned Growth**	**Burned %Cover**	**Unburne %Cover**
Vaccinium scoparium	6"		0	40
Carex scopulorum prionophylla	8"	12"	20	20
Ledum glandulosum	5"		0	5
Lupinus latifolius	1"	4"	1	5
Valeriana sitchensis	4"		0	5
Alnus sinuatus	4"			
Equisetum arvensis	6"			
Luzula parvifolia	2"			
Polemonium pulcherrimum	3"			
Streptopus amplexifolius	24"	24"		
Lonicera involucrate	6"			
Arnica cordifolia	2"			
Stenanthium occidentale	6"			
Cornus stolonifera	3"			

From this it can be seen that fire generally reduces both aerial coverage as well as leader growth. The affect of fire on the growth of different species is highly variable, however. In lodgepole uplands, the commonest plant is often whortleberry, *Vaccinium scoparium*. This species was almost completely absent from hot burned areas in 1995. On the other hand, the common riparian plant *Carex scopulorum* var. *prionophylla* remains unchanged in coverage. Since its growth is 50% higher where unburned, this suggests that its lower roots were not harmed by the fire due to saturated soils. This is not the case with Sitka valerian, *Valeriana sitchensis*. In 1996, it was not visible in hot burned areas where it apparently occurred before the fire. The twisted stalk, *Streptopus amplexifolius*, was apparently unchanged by the fire, and this plant also shows the most rapid leader growth of the forbs in hot burned areas. Most shrubs are sprouting adequately in the hot burned area, except labrador tea, *Ledum glandulosum*, which may have been completely killed wherever it burned.

Other expected observations were rapid sprouting of deciduous shrubs, seeding out of pinegrass, *Calamagrostis rubescens*, and widespread seedling growth of fireweed, *Epilobium angustifolium*.

SENSITIVE AND RARE PLANTS AND COMMUNITIES

Carex norvegica, Scandinavian sedge. R-6 Sensitive. This plant was found by George Thornton in a dozen or so localities in upper Thirtymile Creek. It prefers edges of bog/fen habitats where it is

associated with *Carex disperma* and mosses and where *Carex scopulorum* var. *prionophylla* and other agressive competitors are less dominant. Little is known about its biology here, but it does not occur south of Idaho. Suspected reasons for its rarity are habitat loss. It is currently undergoing development of a Conservation Strategy. A second population was found by Mary Poss near Round Meadow.

Salix tweedyi, Tweedy's willow. R-6 Sensitive. George Thornton found one male plant of *Salix tweedyi* on the Thirtymile side of the saddle between Twentymile Creek. Repeated searches found no more of this. Tweedy's willow prefers aerated, rapidly moving water, with open canopies, at elevations above 6000 ft., although it will tolerate slower-moving water or denser or more open habitats, or lower elevations. The characteristics of its preferred habitats are limited and declining in Thirtymile drainage, and its continued presence here is tenuous. It is an indicator for chemical water quality and stream gradient and changes in these two environments would be detrimental to it.

Botrychium lunaria, moonwort. R-6 Sensitive. Five plants found in the saddle of Thirtymile and Twentymile Creeks. It was growing in the only grass dominated site in a small island in the middle of the fen/bog in the saddle. The ground here was dry enough to sit on. This is expected, since *Botrychium* species often occur at the edges of wetlands, where some seasonal drying can occur. This habitat occurs in Thirtymile Meadows, and more plants undoubtedly exist there. Plants often occur with *Fragaria* spp., *Potentilla* spp., and other *Botrychium* spp.

Botrychium pinnatum, pinnate moonwort. R-6 Sensitive. Five plants found with *Botrychium lunaria*, above. See discussion under *Botrychium lunaria*.

Botrychium minganense, Victorin's moonwort. R-6 Sensitive. One plant found in a large dry meadow, 1 mi. ENE of Thirtymile Meadows, apparently in association with mountain sagebrush, Artemisia tridentata var. vaseyana. I have found *Botrychium minganense* associated with mountain sagebrush on DNR land, in nearly identical habitats. This plant was growing 2" from the base of a live sagebrush. Relationship may be mycorrhizal, as sagebrush forms mycorrhizal associations with a number of species, for instance, *Orobanche*, and *Comandra*. The fire in the big meadow burned approx. one half of the sagebrush plants, however its affect on other species in this plant community is not apparent. Threats are loss of mountain sagebrush, and invasion by *Poa pratensis*, Kentucky bluegrass, which can change fire and mycorrhizal characteristics with the flora.

Carex scopulorum var. *prionophylla*. R-6 Sensitive. Throughout the area, wherever wet. Plant more common than previously thought. Plant is an indicator species for saturated soil and wetlands.

Potentilla diversifolia var. *perdissecta*. R-6 Sensitive. In wet habitats, this variety of *Potentilla diversifolia* can be predominant. Identification complicated by the presence of the similar *Potentilla drummondii*. Relatively distinct populations occur at the bend in the final headwaters of Twentymile Creek, and in the small bog 1.5 mi ENE of Thirtymile Meadows in a small unburned tributary. Populations not mapped due to intergradient forms with Potentilla diversifolia var. diversifolia.

Dodecatheon pulchellum var. *watsonii*. WNHP Monitor. Known from Thirtymile Meadows and Dog Creek Meadows. Intergradient with D. pulchellum v. pulchellum.

Saxifraga apetala. WNHP Monitor. Forms of this species apparently occur in this area, however more taxonomic work needs to be done to establish its status.

Geum triflorum var. *campanulatum*. Subalpine populations of *Geum triflorum* are partly cleistogamous (selfers) and this condition has been classified as an Olympic Mountain ecotype (plants of the same genome with different habits in differing environments--they are not technically varieties). Although our entity may be the same, no systematic study has been to demonstrate whether or not the plant is an ecotype or indeed, a variety, and whether our plants are the same as those on the Olympic. Status unknown.

ECOLOGY NOTES
See attachment with floral data.

The total number of taxa for this survey, approx. 106, is typical for surveys of several miles in extent, lasting a day or two. Comparison with more complete surveys indicate 52 of 278 species in common with the Granite Analysis Area, 51 of 310 species in common with the Horseshoe Basin area, and 57 of 244 species in common with the North Boulder Analysis Area. This number found on this survey is lower partly because many of genera have not been keyed to species. The largest group of sensitive species, which was undersampled in this survey, are the sedges, *Carex* spp. Although difficult to key out, this would allow assurances that affected species are not TES species. This coupled with the low overall plant count and the short time spent, over only a small percentage of the area, indicates that the plant survey is not valid under NEPA.

The number of perennial species is notable at 99%. This is typical of the Pacific Northwest and temperate coniferous forests.

The number of introduced species is notably low at 2 or 2%. Few areas in the state still remain this free of weeds.

The number of rare plant taxa is relatively high, and indicates caution should be taken in those special habitats.

Appendix D. List of wetland plants observed in the Okanogan Range

The following plants of the Okanogan Range are listed in the National list of plants occurring in wetlands for Region 9 of the US Army Corps of Engineers, available on the internet at http://www.nwi.fws.gov/ecology.htm. (Key R9 = R9 indicator status for the current list, SUPP = indicator status for the supplement to Region 9, GWREV = recommendations submitted to NWI by George Wooten for changes, based on their occurrenc in wetlands here; OBL = obligate wetland,

FAC = facultative, FACW = facultative, mostly wet, FACU = facultative, mostly upland, UPL = upland, NI = no information or purportedly not occurrring in area, (*) = species needing further information, (+) = categories leaning toward more to wet, (-) = categories leaning more toward dry.

Taxon	R9IND	SUPP	GWREV
Abies lasiocarpa	FACU	.	.
Achillea millefolium	FACU	.	.
Agoseris aurantiaca	.	FACU	.
Agoseris glauca var. *dasycephala*	FAC	FAC-	.
Agoseris lackschewitzii	NI	.	.
Agropyron caninum	FAC-	.	.
Agropyron spicatum	FACU-	UPL	.
Agrostis thurberiana	.	.	FACW
Alnus sinuata	FACW	.	.
Angelica arguta	FACW	.	.
Antennaria microphylla	.	.	FAC
Antennaria umbrinella	FACU	.	.
Aquilegia formosa	FAC	.	.
Arabis holboellii var. *holboellii*	FACU-	.	.
Arabis holboellii var. *retrofracta*	FACU-	.	.
Arctostaphylos uva-ursi	FACU-	.	.
Aster foliaceus	FACW-	.	.
Astragalus alpinus	FAC-	.	.
Betula glandulosa	OBL	.	.
Botrychium lunaria	FAC	.	.
Bromus ciliatus	FAC+	FAC*	.
Bromus inermis ssp. *pumpellianus* var. *tweedyi*	.	.	FAC*
Calamagrostis canadensis	FACW+	.	.
Caltha biflora var. *biflora*	.	.	OBL
Carex aurea	FACW+	.	.
Carex disperma	FACW	.	FACW+
Carex hoodii	NI	FAC	FACU
Carex norvegica	FACW	.	FACW+
Carex petasata	.	.	FAC
Carex phaeocephala	FACU	.	.
Carex raynoldsii	FACU	.	.
Carex scopulorum var. *prionophylla*	FACW	.	.
Castilleja elmeri	.	.	FACU-
Chenopodium fremontii var. *atrovirens*	FACU	.	.
Cirsium vulgare	FACU	.	.
Claytonia lanceolata	FAC-	.	.
Conyza canadensis var. *canadensis*	FACU	.	.
Cystopteris fragilis	FACU	.	.

Danthonia intermedia	FACU+	.	.
Dodecatheon dentatum	FAC-	.	FACW
Dodecatheon pulchellum	FACW	.	.
Epilobium alpinum	.	.	FAC
Epilobium alpinum var. *lactiflorum*	.	.	FAC
Epilobium angustifolium	FACU+	.	.
Epilobium glaberrimum	FACW	.	.
Epilobium halleanum	FACW	.	.
Equisetum arvense	FAC	.	.
Erigeron peregrinus	FACW	NI	.
Festuca idahoensis	.	FACU*	.
Festuca ovina var. *brachyphylla*	.	FACU*	.
Fragaria virginiana	UPL	FACU*	FACU
Galium trifidum	FACW+	.	.
Gentiana amarella var. *acuta*	.	.	FACU
Geum aleppicum	FACW-	.	.
Geum macrophyllum	FACW+	FACW-*	FACW+
Geum triflorum	FACU	.	.
Juncus drummondii	FACW-	.	.
Juncus parryi	FAC+	.	.
Ledum glandulosum	FACW+	.	FACW
Lewisia pygmaea	FACU	.	.
Linnaea borealis	FACU-	.	.
Listera cordata	FACW	FACU*	FAC
Lonicera involucrata	FAC	FAC+*	FAC+
Lonicera utahensis	FACU+	FAC	.
Lupinus latifolius	.	.	FACU+
Lupinus polyphyllus var. *burkei*	FAC+	.	.
Luzula parviflora	FAC-	.	.
Luzula spicata	FACU	.	.
Melica bulbosa var. *bulbosa*	FACU	.	.
Microsteris gracilis	FACU	.	.
Mitella pentandra	FACW+	FAC*	.
Osmorhiza purpurea	FAC+	.	.
Penstemon procerus	NI	.	.
Penstemon procerus var. *tolmiei*	NI	.	.
Phleum alpinum	FAC	FACW	.
Picea engelmannii	FAC	.	.
Pinus contorta	FAC-	FAC	.
Platanthera dilatata	FACW+	.	.
Poa annua	FAC-	FAC	.
Poa leptocoma	FACW+	.	.
Poa pratensis	FACU+	FAC	.

Polygonum aviculare	FACW-	.	.
Polygonum douglasii	FACU	.	.
Polygonum viviparum	FAC	.	.
Potentilla diversifolia	FACU	.	.
Potentilla diversifolia var. *perdissecta*	FACU	.	.
Potentilla drummondii	FAC	.	.
Potentilla fruticosa	FAC-	.	.
Pseudotsuga menziesii	.	FACU*	.
Pyrola asarifolia	FACU	.	FACW
Pyrola minor	FACU+	.	.
Pyrola secunda	FACU	.	.
Ranunculus eschscholtzii	FACW	FACW*	FAC
Ranunculus uncinatus	FAC	FAC-	FACW-
Ribes viscosissimum	NI	FAC	.
Salix drummondiana	FACW	.	OBL
Salix farriae	OBL	.	.
Saxifraga arguta	FACW+	.	.
Senecio integerrimus	FAC	FACU	.
Senecio pauperculus	FACW	.	.
Senecio streptanthifolius	FACU	.	.
Senecio triangularis	FACW+	.	.
Shepherdia canadensis	NI	.	.
Sitanion hystrix	FACU-	.	.
Solidago multiradiata	FACU	.	.
Stellaria longipes var. *altocaulis*	FACW-	.	.
Stenanthium occidentale	FACW	FAC*	.
Streptopus amplexifolius	FAC-	.	.
Suksdorfia ranunculifolia	FAC	.	.
Taraxacum officinale	FACU	.	.
Thalictrum occidentale	FACU	FACU*	.
Trisetum spicatum	FACU-	UPL	FACU-
Trollius laxus	OBL	.	.
Vaccinium caespitosum	.	.	FACU+
Vaccinium myrtillus	NI	.	FACU
Vaccinium scoparium	FACU-	.	.
Valeriana dioica	FACW	.	FACW+
Valeriana sitchensis	FAC	.	FACW
Veratrum viride	OBL	FACW	.
Veronica wormskjoldii	FAC+	FAC*	FAC+
Viola adunca	FAC	.	.
Viola macloskeyi	OBL	.	.
Viola palustris	OBL	.	.
Zigadenus venenosus	FAC	FACU*	UPL

Appendix E. Transect summary information

5. Transect Data file structure

After recording field data, records were transcribed into twelve relational database tables. Two of the tables recorded information for each sample point. These were the overstory data (TH11OVER) and the shrub-herb data (TH9TRAN). Field definitions for the tables and metadata is given in the Data Dictionary in appendix I.

Data transformations were performed so that each sample had a single observation (sample unit, "SU" or "SUL"), along with the ATTRI field for that layer and a field (LAY) for recording the layer number as 1-5. The sampling rules in the field RULES were parsed out into separate fields. New selection and variable fields were included in the transformed tables as necessary.

10. Notes on data processing

The ana7 and ana8 folders contains data analyzed in 2007. Database STRAN8.DB, was copied from STRAN7.DB with only a few changes in format (see appendix).

Data was prepared for analysis by the use of selection criteria as follows:

Selection criteria for STRAN8.DB subsets:

Lay: 1, 2, 3, 4, 5, 91 (overstory 1), 92 (overstory 2)

XVLAY: 1M (4 layers) or 1V (1 layer). 1M: record topmost vascular layer and use the vascular plant multiplier factor to record the diameter and distance to the nearest vascular plant which intersects the previous one foot of sampling tape.

XCRYP: +C (record cryptogams); /C (only record cryptogams if no vascular plants); /D (use plant multiplier to record missing cryptogams).

XNLIV: +L/B (always record litter or bare as bottom layer); /L/B (only record litter or bare if there are no plants), S-- (only record sterile if there are no plants).

TYP2 categorization of TYPE:

For TYP2 = 0, TYPE = WATER, FORM, INANIM, MINERAL, ORGANIC
For TYP2 = 1, TYPE = BROAD, CONIF, GRAM, HERB, UNK
For TYP2 = 2, TYPE = CRYPT, FUNGI, SLICH

FIR2 categorization of FIRE:

For FIR2 = 0, FIRE = 0
For FIR2 = 1, FIRE = 10, 15, 20, 25
For FIR2 = 2, FIRE = 30

DRY2 categorization of MOISTURE:

For DRY2 = 0, MOISTURE = WET
For DRY2 = 1, MOISTURE = MOIST+WET
For DRY2 = 2, MOISTURE = MOIST, MOIST-DRY
For DRY2 = 3, MOISTURE = DRY

LOG2: (Choices are 0 or 1)

Subsets of this database were created as described in the summary below.

TH1DESC: Qualitative description of transect location, area ecology, transect character, obvious disturbances and size and number of transect segments, subplots and habitats.

TH2SITE: Qualititative and quantititative site information: USGS Quad, Township, Range, Section, Quarter Section, minimum and maximum elevation (ft), minimum and maximum aspect (degrees), minimum and maximum slope (degrees), horizontal and vertical microtopography, landform classification, topographic position, habitat classification, adjacent vegetation classification, geologic and soil features.

TH3PHOTO: Photograph information including year, starting point and end point of photo, azimuth, date, focal length, photo number, print/slide/both/missing, field notes.

TH4DIST: Stand Disturbance information including date, extent, frequency, magnitude and evenness of the following disturbances: overstory fire, understory and shrub fire, surface fire, animal trampling and species of animal, animal grazing and species of animal, windthrow, avalanche, flooding, erosion, clearcut logging, selective and partial logging, high-grade logging, thinning, road use, mechanized excavation, manual trail construction, non-natural seeding and planting, other disturbance types, vegetative non-fire disease disturbances for overstory, understory and low canopy.

TH5NVASC: Baseline information on nonvascular and bare ground cover including: observer initials, bedrock visible 5' up, bedrock at ground surface, boulders, 3+', rocks 3"-3', gravel 0.25"-3", fines <0.25", needles and conifer duff, humus and deciduous leaf, wood < 2m long; includes punky logs, total of surface and suspended, small Logs <6" dia; longer than 2 m, medium Logs 8-18" dia; longer than 2 m, large Logs >18" dia; longer than 2 m, soil lichen coverage, soil moss coverage, soil liverwort coverage, soil moss + soil liverwort coverage, name of other litter type coverage, pooled water, day of measurement, arboreal lichen (0-4), rock lichen (percent of rock), canopy density 0-100%, number of tree canopies (1-3).

TH6TREE: Baseline information on tree species, snags, and canopies including: location of plot center, year of measurement (EST=estimate), tree species, canopy density (estimated) before the fire, canopy density of all green + bare snags + needle-covered snags (GREEN+SNAGDEN) or (GREEN+NEEDLE+POSTNEED), canopy density of live trees only; snags not included, canopy density or other measure of snags only (NEEDLE + POSTNEED, if known), canopy density while needles are still on trees (0 for hot-burned), canopy density of trees after needles fall off, canopy Density (avg of 4 densiometer readings), number of tree canopies, overstory (>10 m) cover %, understory (2-10 m) cover %, regenerative (0 - 2 m) cover %, krumholz cover %, height of overstory (90th percentile), diameter of overstory trees (50th percentile), diameter of overstory trees (90th percentile), age of overstory trees (90th percentile), BAF for trees and snags, number of each species of trees and snags counted "in" for basal area calculation, estimated overstory trees per acre, calculated basal area for trees and snags, estimated snags per acre, height of snags (90th percentile), diameter of snags (50th percentile),

diameter of snags (90th percentile).

This data was summarized in a separate spreadsheet, by years 1997, 1998, 2000. The average values (or best single value if no two values were were usable) were used for the final tallies within the summary worksheet for the values of canopy density (estimated) before the fire, canopy density of all green + bare snags + needle-covered snags (GREEN+SNAGDEN) or (GREEN+NEEDLE+POSTNEED), defined to represent the 2000 densities without needles, canopy density of live trees only; snags not included, BA sum of snags + green trees, Total stems per acre snags + green trees, Source data (year) for density, and if different, prefire density..

TH7VEG: Baseline information on vascular plant percent cover (exclusive of tree species), including: name of meter quadrat if this is one, years since fire, plant species code, % cover, stem frequencies, reproductive state, average height of plants (90th percentile).

TH8RULES: Transect descriptive information and sampling rules as defined above.

TH9TRAN: Transect records of the observed layers of living and non-living ground cover and their attributes (understory vascular plants only), as defined above.

TH10HAB: Brief description of all transect habitats (HAB field) along with a summary of burn intensity, soil moisture, or presence of logging, as defined above.

TH11OV: Transect records of the observed overstory plant cover (plants > 10m).

TH12BAF: Qualitative information on tree density including: Fixed plot radius, number of snags by species, number of trees by species.

SPPLOOK: Lookup table for plant codes used in TH7VEG and TH9TRAN.

Note that plots 1-26 were established in 1996; plots 30-36 were added in 1997, along with a transect at plot 3

Plot Dimensions

1 1-100, 101-200, 201-300 = 300 ft
2 1-50, 61-70, 101-146, 201-300, 301-323 , 229 points / 0.5 mi transect
3 1-100 = 100 pts
4 1-100 = 100 pts
5 1-100, 101-194, 201-300, 310-400, 401-500= 494 pts
6 1-100 = 100 pts
7 1-100 = 100 pts
8 1-100, 101-200 = 200 pts
9 1-100, 101-200, 201-300 = 300 pts
10 1-100, 101-150, 201-250 = 200 pts
11 1-100, 101-200 = 200 pts
20 1-50 = 50 pts + 2 m-quadrats, Quad-10.0 and Quad-40.0
21 1-100, 101-138 = 138 pts
22 1-94 = 94 pts + 2 m-quadrats, Quad-15.0 and Quad-85.0, changed in 1997 to Quad-15.2 and Quad-84.2
23 1-75 = 75 pts + 1 m-quadrat, Quad-15.0
24 1-97 = 97 pts
25 1-100 = 100 pts

26 1-100, 101-200 = 200 pts
30 1-100, 101-150 = 150 pts
31 1-100 = 100 pts + 2 m-quadrats
32 1-100 = 100 pts
33 1-89 = 89 pts
34 1-76 = 76 pts
35 1-99 = 99 pts
36 1-100, 101-190 = 190 pts

Data processing
A subset of samples was selected from transects through dry, hot-burned areas (FIR2 = "2"; DRY2 = "3") and placed in data table Dryhot8.db. A total of 3,946 sample points are contained in this set for 4 years of sampling. A total of 4,242 observations were recorded including more than one layer of vascular plant species. The number of plant species (TYP2=1) was determined as a percentage of all observations for all layers as shown in the table below.

A subset of samples located in wet, hot-burned wet areas (FIR2 = "2"; DRY2 = "0" or DRY2 = "1") was selected and placed in data table Wethot8.db. The number of vascular plant species (TYP2=1) was determined only from the subset of data samples with observations of multiple layers (XVLAY="4V"), since multiple plant layers were common in wet areas within the first year after the fire. A total of 734 sample points are represented in the data set for 4 years of sampling, with a total of 1,141 observations from samples with more than one layer of plants, as shown in the table below.

Appendix F. Habitat categories observed along transects

Broad habitat categories: burn intensity, soil dryness, logging occurrence.

The following table lists all 81 habitats designated in all transects, along with burn intensity [(O)verstory 0-5, (U)nderstory 0-5, (S)urface 0-5), soil moisture (dry, moist, or wet), and logging intensity (Yes, No, or Near (a unit)]. (red text indicates records added in 2003)

Transect	Fire	Soil	Logged	Description
01-1a	O3U3S3	dry	Yes	Dill Cr. PICO unit edge low-int. burn, tractored
01-1b	O3U3S3	dry	Near	Dill Cr. unlogged PICO adj. unit 6 low-int. burn
02-1	O3U3S3	dry	Yes	Dill Cr. PICO unit logged
02-2(1b)	O3U3S3	dry	Yes	Dill Cr. PIEN unit moist, logged draw
02-3(1c)	O3U3S3	moist	No	Dill Cr. PICO unit leave-tree reserve
02-4(1d)	O3U3S3	dry	Yes	Dill Cr. PICO unit logged south end
02-2	O3U3S3	moist	Yes	Dill Cr. moist, logged PIEN swale in unit 6.
02-3	O3U3S3	dry	No	Dill Cr. unlogged, upland PICO in unit 6 leave-tree

				reserve.
02-4	O3U3S3	dry	Yes	Dill Cr. logged, upland PICO in unit 6 south end.
03-1	O5U5S5	dry	No	Dill Cr. PICO (PSME) hot-burned rocky ridge
04-1	O4U4S1	dry	No	Dog-30mi ridge patchy vegetation slope
04-2	O2U3S4	dry	No	Dog-30mi ridge patchy vegetation slope
04-3	O2U3S1	dry	No	Dog-30mi ridge patchy vegetation slope
04-4	O3U3S4	dry	No	Dog-30mi ridge patchy vegetation slope
04-5	O3U2S0	dry	No	Dog-30mi ridge patchy vegetation slope
05-1	O4U2S2	moist	No	Dog-30mi ridge PIEN/LEGL bench
05-2a	O3U4S3	dry	No	Dog-30mi ridge ABLA/VASC bench
05-2b	O4U4S3	dry	No	Dog-30mi ridge ABLA/VASC bench
05-2c	O4U2S0	dry	No	Dog-30mi ridge ABLA/VASC bench
05-2d	04U4S3	dry	No	Dog-30mi ridge ABLA/VASC bench
05-3	O5U5S3	moist	No	Dog-30mi ridge PIEN moist draw
05-4	O5U5S4	dry	No	Dog-30mi ridge PICO across draw
05-3b(4a)	O5U5S4	moist	No	Dog-30mi ridge PIEN across draw
05-4b	05U5S4	dry	No	Dog-30mi ridge PICO across draw
06-1	O3U3S3	moist+wet	No	Dog Cr. partial burn riparian conifer
06-2	O4U4S4	moist	No	Dog Cr. partial burn ripar. conif burned drier patch
07-1	O5U5S4	dry	No	Dog Cr. hot-burned bank, open
07-2	O5U5S4	moist+wet	No	Dog Cr. hot-burned bottom riparian
07-3	O5U5S4	dry	No	Dog Cr. hot-burned south aspect
08-1	O5U5S5	dry	No	Dog Cr. ABLA/VASC/CARU[PICO/EPAN] slope
08-2	O5U5S5	moist+wet	No	Dog Cr. moist bench bottom
08-3	O5U5S5	dry	No	Dog Cr. south-facing, sandy bank outside unit
09-1	O4U4S4	dry	No	Dill Cr. adj. unit streambank upland outside unit
09-2	O4U4S4	wet	No	Dill Cr. trib adj. unit 6 riparian outside unit
09-3	O4U4S4	dry	No	Dill Cr. adj. unit 6 north bank upland outside unit
09-4a	O4U4S4	dry	Near	Dill Cr. trib adj. unit unlogged bench outside unit
09-4b	O4U4S4	dry	Near	Dill Cr. trib adj. unit unlogged bench inside unit
09-5	O4U4S4	dry	Yes	Dill Cr. trib adj. unit logged bench
10-1	O4U4S3	dry	Near	Dill Cr. finger wetland adj. unit 6 north (dry) bank
10-1b	O4U4S3	dry	Near	Dill Cr. finger wetland adj. unit 6 north (dry) bank
10-1c	O4U4S3	dry	Near	Dill Cr. finger wetland adj. unit 6 north (dry) bank
10-2	O3U3S3	wet	Near	Dill Cr. finger wetland adj. unit 6
10-2b	O3U3S3	wet	Near	Dill Cr. finger wetland adj. unit 6
10-2c	O3U3S3	wet	Near	Dill Cr. finger wetland adj. unit 6
10-3	O4U4S3	moist	Near	Dill Cr. finger wetland adj. unit 6 south PIEN bank
11-1a	O2U2S0	dry	No	Upper 30-mi. drainage mixed conifer spur-bench
11-1b	O0U3S3	dry	No	Upper 30-mi. drainage mixed conifer spur-bench
11-2	O0U1S0	dry	No	Upper 30-mi. drainage mixed conifer spur-bench
11-3	O3U3S4	dry	No	Upper 30-mi. drainage mixed conifer spur-bench

11-4	O4U5S5	dry	No	Upper 30-mi. drainage mixed conifer spur-bench
20-1	O3U3S3	dry	No	Dill Cr. bottom PICO medium int. burn
21-1	O4U5S5	dry	No	Dog Cr. slope PICO
21-2	O4U5S3	dry	No	Dog Cr. slope PICO
22-1	O4U4S4	dry	No	Dog Cr. swale on slope PICO
22-2	O4U4S4	dry	No	Dog Cr. bench on slope PICO
23-1	O4U5S4	moist-dry	No	Dog-30mi. ridge-saddle drier edge of PIEN
23-2	O4U5S3	moist	No	Dog-30mi. ridge-saddle lush PIEN swale
24-1	O4U5S4	dry	No	30mi Cr. upper ridge S-facing erosive lupine
25-1	O3U3S1	wet	No	30mi. fen CASCP, scorched ABLA-PIEN
25-2	O4U4S4	wet	No	30mi. fen margin burned CASCP growth effects
25-3	O4U4S4	wet	No	30mi. fen hot burned margin EQUIS-EPILO-ASFO
25-4	O4U4S4	moist	No	30mi. fen moist subirrigated EPAN/MAPO
25-5	O4U4S4	moist	No	30mi. fen dry, subirrigated EPAN
25-6	O4U4S4	moist	No	30mi. fen ARCO moist upland
25-7	O4U4S4	dry	No	30mi. fen VASC upland
26-1	O2U2S2	dry	Yes	Upper 30mi. pulverized clearcut landing
26-2	O2U2S2	dry	No	Upper 30mi. PICO medium burn adj to CCut
30-1	O0U0S0	dry	No	Dog Cr-rd jcn unburned drier adj. to creek
30-2	O0U0S0	moist+wet	No	Dog Cr-rd jcn unburned bottomland
31-1	O4U4S5	dry	No	Sheep Mtn hot-burned PICO near unburned PICO
32-1	O4U4S4	dry	No	Sheep Mtn light-burned PICO pole stand
33-1	O0U0S0	dry	No	30mi Mead. PICO [PSME] patchy burn
34-1	O2U3S4	dry	No	S of 30mi Mead. partial burn in PICO [PSME]
35-1	O5U5S5	moist-dry	No	Dill Cr. bench near ravine - moist, concave draw
35-2	O5U5S5	dry	No	Dill Cr. bench near ravine - dry convex esker
36-1	O0U0S0	dry	No	Adj to CCut - unburned, unlogged PICO pole
36-2	O0U0S0	dry	Near	CCut edge - uncut more open more blowdown
36-3	O0U0S0	dry	Near	CCut edge blowdown unlogged no soil disturbed
36-4	O1U1S1	dry	Yes	CCut edge rd-30mi. logged, soil disturbed
36-4b	O1U1S1	moist	Yes	CCut edge rd-30mi. logged, soil disturbed swale
36-5	O1U1S1	dry	Yes	CCut edge rd-30mi. logged, soil disturbed

Appendix H. Timeline and record of survey visits, 1994 onward

This section lists dates and attendees of workshops and long-term ecological research work in the Thunder Mountain Fire area.

1994 Summary:

The 8000 acre Thunder Mountain Fire started and burned for the rest of the year in the Okanogan Range north of Road 39. Heavy equipment was used to clear triple-width

firelines, opening many miles of formerly roadless areas to future development. The Second Artists in the Forest Gathering was held in late summer and offered hikes into the still-smoldering Thunder fire.

1994 Timeline:

09/10/94 - The Artist in the Forest Gathering sponsored a hike into the Thunder Mountain fire via Thirtymile Creek. Attendees included Mary Poss, George Wooten, Peter Morrison, and about four others.

09/23/94-09/25/94 - A workshop on forestry, hydrology and forest microcosms instructed by the Public Forestry Foundation, Dr. Al Isaacson, and Dr. Art Partridge was sponsored by Inland Empire Public Lands Council and East Side Task Force. The Thunder fire area was visited with Greg Harty from Public Forestry Foundation. Attendees included Peter Morrison, Mary Poss, George Wooten, Tod Johnson, and about 10 others.

1995 Summary:

Wetland inventory and noxious plant workshop (Dates: 07/07/95-07/08/95): Purpose: To educate interested persons about non-native weed species in the Methow Valley. To conduct a vegetative inventory of a large wetland in a high intensity burn portion of the Thunder Mt fire area. Location: Boulder Creek, tributary of the Chewuch River, and a large wetland near Thirtymile Meadows in the Thunder Fire area. Coordinator: George Wooten. Participants: George Wooten, Mary Poss, Gina Monteverde, Alton Gaskill, John Jakubowski, Brian Muldoon, Josh Wozniak, Will Betz, Scott ..., cooperating with Okanogan Chapter of the Washington Native Plant Society. Status: Two day workshop, funded from undesignated monies from Patagonia grant. Successfully Completed. Wetland plant information entered into database for flora list for Thunder Mountain area.

Amphibian Surveys (Dates: 07/95-09/96): Purpose: To determine the incidence of amphibian species within the Thunder Mt Fire area. To inventory wetlands in and around the area included in the Thunder Mt fire perimeter for amphibian breeding sites. Location: Thunder Mountain Fire area. Five visits to the area were made. Methods: Sites are visited and evaluated by visual encounter and by setting larval traps. Sites and specimens are photographed and described. Coordinator: Dana Visalli. Contributors: Dana Visalli, Mary Poss, Josh Wozniack. Status: Eighteen month project supported by a grant from the Mountaineers Foundation. Final report issued to Mountaineers Foundation in Nov 1996.

Wildlife Tracking Surveys (Dates: 12/28/95-01/01/96 (Tripod Peak); 02/29/96-03/10/96 (Thunder Mountain): Purpose: To assess habitat utilization by all wildlife and avian species in target areas. To determine how areas affected by a natural fire influence carnivore activity. To survey for Threatened, Endangered and Sensitive species. Mary Poss, Alton Gaskill. Location: Meadows area from Tripod Peak area north to the northern boundary of the Thunder Mountain Fire area. Methods: Data is collected by winter wildlife track surveys, conducted twice each winter. Transects through burn area are inventoried for all tracks. Track descriptions are recorded and photographed. Funding: Partial grant support from Mountaineers Foundation grant.

1995 Timeline:

02/95 - A coalition of volunteers conducted a 10 day winter wildlife tracking survey in the Thunder fire area. They documented that lynx and other wildlife were actively using high intensity burn areas. Mary Poss.

04/95 - Volunteers conducted a five day winter wildlife tracking survey in the Thunder fire area. They documented snowmobile use on the northern fire perimeter road. Mary Poss.

06/95 - A survey into Dog Creek was conducted to evaluate revegetation and soil stability in the high intensity burn areas. Mary Poss

06/29/95 - Timber Sale surveys were begun at the lower end of Dog Creek, where it goes over cliffs into the Chewuch, for the Forest Service's TES plant survey program. George Wooten.

07/06/95-07/07/95 A Forest Service survey into the Thirtymile-Twentymile Creek Saddle area was continued by George Wooten and George Thornton, with a volunteer from Outward Bound. Lost in a fog bank, George and the volunteer learned the lesson that no moss grows on the north side of a tree after a forest fire.

07/07/95- 07/09/95 - The Trust for Habitat Conservancy and members of the Okanogan Chapter of the Washington Native Plant Society joined in a workshop in the Thunder Fire area focusing on noxious weeds, wildfire, wetlands, ecology, and field studies. (Dates: 07/07/95-07/08/95): Purpose: To educate interested persons about non-native weed species in the Methow Valley. To conduct a vegetative inventory of a large wetland in a high intensity burn portion of the Thunder Mt fire area. Location: Boulder Creek, tributary of the Chewuch River, and a large wetland near Thirtymile Meadows in the Thunder Fire area. Coordinator: George Wooten. Participants: George Wooten, Mary Poss, Gina Monteverde, Alton Gaskill, John Jakubowski, Brian Muldoon, Josh Wozniak, Scott xxx..., Will Betz... Status: Two day workshop, funded from undesignated monies from Patagonia grant. Successfully Completed. Wetland plant information entered into database for flora list for Thunder Mountain area.

07/10/95 - Thirtymile Cr., Ridge NW of Thirtymile meadow, FS TES plant survey. George Wooten.

07/95- Conducted amphibian surveys in the Thunder fire and located 4 spotted frog breeding sites. Purpose: To determine the incidence of amphibian species within the Thunder Mt Fire area. To inventory wetlands in and around the area included in the Thunder Mt fire perimeter for amphibian breeding sites.

Location: Thunder Mountain Fire area. Dates: 07/95-09/96 - Five visits to the area were made.

Methods: Sites are visited and evaluated by visual encounter and by setting larval traps. Sites and specimens are photographed and described. Coordinator: Dana Visalli. Contributors: Dana Visalli, Mary Poss, Josh Wozniack. Status: Eighteen month project supported by a grant from the Mountaineers Foundation. Final report issued to Mountaineers Foundation in Nov 1996.

Documented damage to wetlands in the Sheep Creek drainage from the fire perimeter roads. Mary Poss.

12/28/95-01/01/96 - A wildlife tracking survey to Tripod Peak was completed. Mary Poss, Alton Gaskill.

1996 Summary:

Thunder Mountain Biological Evaluation - Beginning of revegetation study; vegetation transects and plots are established (Dates: 08/17/96-08/19/96, 09/06/96-09/09/96): Purpose: To study the post-fire revegetation of this unique boreal ecosystem. Location: Thunder Mountain Fire area. Methods: Control and experimental vegetation transects and aerial plots are permanently fixed in areas with defined burn intensity. Vegetation and habitat parameters recorded. Plots are to be reread every year, and the data analyzed for trends. The sites are used to establish a study route for other projects. Coordinator: Mary Poss. Contributors: George Wooten, Mary Poss, Mark Lawler. Paid work: George Wooten (field work): 8/17, 8/18, 8/19, 9/8, @$150 per day = $450. An additional $150 was procured during December bring the total 1996 funding to $600 Status: Funded as a pilot project through a Mountaineers Foundation grant. Plans include expanding the Thunder Mt RNA proposal throuh proposals to be submitted to the Bullitt Foundation and to EDF minigrants.

Thunder Mountain Birding and Ecology Workshop & Hike (Dates: 09/21/96-09/22/96, 09/27/96-09/29/96): Purpose: To promote the educational value of the unique ecological area of the Thunder Mt Fire, through an outreach program of hikes and educational opportunities. Locations: Thirtymile and Dog Creek junctions with road 39, in the Thunder Mountain fire area. Hikes radiated from these areas. Coordinator: Mary Poss. Participants: (9/21/96-9/23/96) Dave Rudholme, Meagan Rudholme, Tilden Rudholme, Brett Floyd, Rieto Riesen (Vancouver, BC), Mark Colombino (Seattle), Yuriko Takahashi (Vancouver, BC), Becky McEachern, Kathleen McEachern (Albion, BC), Geoff Cattrall (Vancouver, BC), Jerry Broadus (Puyallup, WA), Clarice Clark (Puyallup, WA), Chrissy Yeung, Dan, Pat and Graham Legen (Stamwood, WA), George Wooten, Mary Poss; (09/27/96-09/29/96) Mary Poss, George Wooten, Maryann Baird, Susan Crampton, Ed Swan, Leahe Swayze, Peter Morrison, Mark Lawler. Status: No grant support.

1996 Timeline:

02/29/96-03/10/96 - Thunder Mountain winter wildlife tracking survey was completed in Thunder fire area. Snowmobile use of the southwestern fire perimeter road was documented. Mary Poss, Alton Gaskill.

07/13-14/96 - Amphibian survey and TES plant survey conducted in the Thunder burn area; surveys from Smarty Cr to for the upper Sheep Creek by MP, GW along fireline. Discrepancies between the unit design and what had been marked on the ground. Many mosquitoes, came out to meet Lanette and almost hugged a grizzly.

8/17/96, 8/18/96, 8/19/96, 9/8/96 - Field work - 4 days @$150 per day = $600. This was funded as a pilot project through a Mountaineers Foundation grant. $450 of this was paid in the fall, and an additional $150 was procured during December to bring the total 1996 funding to $600 Status. 1996 field work included 4 days donated time from

Mary Poss and 1 day donated time from Mark Lawler.

09/07/96-09/09/96 - Thunder Mountain Revegetation study was continued and additional vegetation transects were established. Mary Poss, George Wooten.

09/21/96-09/22/96 - Thunder Mountain Birding and Ecology Workshop & Hike: Purpose: To promote the educational value of the unique ecological area of the Thunder Mt Fire, through an outreach program of hikes and educational opportunities. Locations: Thirtymile and Dog Creek junctions with road 39, in the Thunder Mountain fire area. Hikes radiated from these areas. Dates: 09/21/96-09/22/96, 09/27/96-09/29/96. Coordinator: Mary Poss. Free to the public. rticipants: (9/21/96-9/23/96) Dave Rudholme, Meagan Rudholme, Tilden Rudholme, Brett Floyd, Rieto Riesen (Vancouver, BC), Mark Colombino (Seattle), Yuriko Takahashi (Vancouver, BC), Becky McEachern, Kathleen McEachern (Albion, BC), Geoff Cattrall (Vancouver, BC), Jerry Broadus (Puyallup, WA), Clarice Clark (Puyallup, WA), Chrissy Yeung, Dan, Pat and Graham Legen (Stamwood, WA), George Wooten, Mary Poss; (09/27/96-09/29/96) Mary Poss, George Wooten, Maryann Baird, Susan Crampton, Ed Swan, Leahe Swayze, Peter Morrison, Mark Lawler. Status: No grant support.

09/26/96 - Ecology plots were established in Timber Creek spruce wetlands by George Wooten and Mary Poss.

09/27/96-09/29/96 - A Thunder Mountain Birding and Ecology Workshop Hike was held. Mary Poss was coordinator, attending were Susan Crampton, George Wooten, Maryann Baird, Ed Swan, Leahe Swayze, Peter Morrison, and Mark Lawler. Maryann discussed here studies on soil nutrient cycling following fire that she conducted at the University of Washington.

1997 Summary - Second year sampling

Wildlife tracking: snowmobile trip into Thirtymile area (01/15): Mary Poss, Todd Johnson.

Thirtymile Meadows reconnaissance to plan the season (06/17): George Wooten, Mary Poss.

Forest Microcosms and Forest Ecology Workshop (Dates: June 26-28): Chewuch drainage and Eightmile Creek. Instructor(s): Art Partridge, Forest Pathologist. Location: Okanogan Meadows Area, upper Chewuch drainage, Thunder Fire Area in North Central Washington.

Thunder Boreal Ecosystem Workshop with Art Partridge (July 19): Art, Susan and George see grizzly and cub on the way up.

Boreal Ecology Workshop (Dates: Thu, Fri, July 24, 25). Instructors: Charley Dewberry, George Wooten. Location: Okanogan Meadows Area, upper Chewuch drainage, Thunder Fire Area in North Central Washington. This was a two-day workshop about the integration of forest and wetland ecology specific to the boreal ecosystem. Participants were introduced to concepts of plant geography and geomorphology. Emphasis was placed on understanding adaptations of plants and animals to this unique ecosystem.

Ecology Research Workshop (Dates: Fri, Sat, Sun, July 25-27). Instructors: Charley

Dewberry, George Wooten. Location: Okanogan Meadows Area, upper Chewuch drainage, Thunder Fire Area in North Central Washington.

[Funding for K-12 teacher workshops sponsored by Trust for Habitat Conservation in 1997 came through an EPA Outreach Grant with the goals of providing K-12 teachers with both the field experience and material support that they need in order to incorporate principles of wetland ecology into an innovative science, art or environmental studies curricula.]

Chewuch River Research Natural Area (RNA) survey (07/31 through August): This was an ecological survey funded by the Forest Service in the Sheep and Trench Creek drainages overlapping into the Thunder fire, with the purpose of writing an establishment report justifying the Chewuch River RNA.

1997 Timeline:

01/15/97 - Snowmobile to Thirtymile, M. Poss, Todd.
06/17/97 - GW, MP visit Thirtymile Meadows to plan the season.
06/19/97 - 06/21/97 - Database development - 3 days at $150 per day = $450, to George Wooten
06/26/97 - Art Partridge Workshop, Chewuch, Eightmile, Thunder.
07/19/97 - Thunder Boreal Ecosystem Workshop with Art Partridge. Art, Susan and George see grizzly and cub on the way up.
08/31/97, 09/09/97-09/11/97, 09/19/97 - Field Sampling (08/31, (09/09, 10, 11, 19) - 5 days at $150 per day = $750, to George Wooten
09/09-11/97 - Thunder ecology plot surveys.
09/19-20/97 - Thunder ecology plot surveys. Field Sampling 2 days time donated, Mary Poss
09/97 - A September, 1997 note appended on an invoice to Treasurer Mark Lawler indicates that this brings total expenditures paid to George Wooten for the vegetation surveys to $1800, the amount originally alloted by the Board, but that "analysis and reporting still need to be completed separately".
09/20/97 - Annual Thunder Trundle
10/97 - Data entry - 2 days time donated by George Wooten
12/17/97 - Initial report writing - 2 days time donated by George Wooten

1998 Summary:

Workshop: *Fire in the Boreal Ecosystem* (Sunday, Monday and Tuesday, July 19-20), was presented by Charlie Dewberry, Dave Rudholm, Mary Poss, and George Wooten at Thirtymile Meadows Area, in the upper Chewuch drainage, in the Thunder Fire Area in North Central Washington.

This was a 2-½ day workshop that concentrated on studying the interrelationships of fire in the boreal ecosystem. Participants explored areas with varying intensities of fire from the 1994 Thunder fire, including some of our established vegetation recovery plots, and examined the changing successional relationships between animals, fish, birds, fungi and plants.

Attending the workshop were a number of interesting participants, including three teens and an instructor from the Okanogan Work-Study Center, and a member of the US Fish and Wildlife Service Outreach Program. Participants got to see newly revegetated areas, they had hands on experience in comparing the vegetation of wetlands with uplands, they got to erect and monitor birding mist-net stations, and they sampled the aquatic ecosystem to learn how macroinvertebrates function in the ecosystem, all while taking pleasant hikes through to the various areas around Thirtymile Meadows. In the evenings, we had pleasant conversations around the campfire, discussing scientific methods and other pertinent items.

[From the 1999 Draft Annual Report] Boreal Ecology (Thirtymile Meadows, July 18-19, 1998). This workshop integrated forest and wetland ecology specific to the boreal ecosystem. It provided the background for the second workshop and most of the 8 participants took both courses. All these workshops were paid for through an EPA outreach grant.

At the Sept 27, 1998 THC Board Meeting, Mary Poss proposed putting $566.52 + $1188.21 = $1754.73 from 2 Mountaineers Foundation grants, which was surplus money resulting from Mary donating time that was budgeted for salary in the grant into a combined "research fund". Discussion continued over what research was and what the money would be for. A vote was held that the money would be earmarked for Thunder related research with spending subject to board approval. The motion was approved.

1998 Timeline:

07/17-19/98 - Boreal Ecology Workshop at Thirtymile Meadows with Charlie Dewberry, Mary Poss, Dave Rudholme family, Art Partridge, GW, et. al.

07/21/98 - Fire Ecology Workshop - Thirtymile Meadows; Charlie Dewberry, Dave Rudholm, Mary Poss, George Wooten.

07/98 Data entry from 1997 - 2 days time donated, George Wooten

08/05/98 - Loomis Forest Wetland Surveys: George Wooten, Sarah Masco, Martha Stauss, Peter Morrison.

08/98 - Preparation (includes form generation) 2 days in August time donated, George Wooten

08/4/98,08/30-31/98, 9/2/98 Field sampling: 4 days donated time, George Wooten

09/02/98 - Visit to Thunder fire, GW, MP, cows in massive willow die-off.

09/25-27/98 - Annual Thunder Trundle.

1999 Summary:

In 1999, no vegetation sampling was performed.

Wildlife surveys (March 13-20) [from the 2000 Annual Report]: We conducted our fifth annual winter tracking survey of the Thunder Mountain Fire. The “resident” lynx was located in the same area that we have found tracks for the last four years. In addition, we found lynx tracks in 2 new areas. There were no unusual sightings on this trip although all of our regulars were present and accounted for. We thank the Washington State Department of Wildlife for assistance with transportation to the area.

From the May 15, 1999 Board Meeting: George gave a report on long term ecological

research in the Thunder Mountain fire. Baseline data, including 3 seasons of data, was completed for all sites. Sites are linear transects with 50-500 points. Ninety-six hundred sites come from 31 plots. All of these have recorded burn intensities, elevation, aspect, slope, shading, and live tree cover. Twenty-five sites have been sampled for the past two years. Eleven sites were added in 1997 and resampled last year. Data entry and report writing is in progress. The 97 report was suggested as adequate for a summary of the proposal (for boreal ecological research). The annual report should describe trends seen. George will put a budget together. George said that the data management: recording, encoding, and entering, would require a full time person for two weeks per year. Mary suggested that proposals for grants must be done one year in advance, as obtaining actual money from a grant takes one year lag time. Mark suggested we need to publish our work in a refereed journal such as the Journal of Conservation Biology. This would give our work more weight. Aileen suggested we monitor the sites again after 5-10 years. George said that if we decide this study merits a long term grant, we should ask Mary Pat to estimate how difficult the analysis would be. Volunteers should be recruited to do the field work. George needs an hourly rate of $10-20 to enter data. To finish the report George needs 3 days pay ($10 per hour) for typing and 3 days pay for proofreading. Mary said we have fulfilled our requirements for our funders. Larry volunteered to coordinate reports.

1998 Timeline:

06/4-6/1999 - Washington Native Plant Society Annual Plant Study Weekend. Hike to Chewuch RNA. Thunder Fire / Thunder / Chewuch RNA: The Chewuch Research Natural Area presents geomorphic features along the Chewuch River. Thunder Fire is reached via a two-mile hike on a fireline east of the river, in subalpine meadows of aspen and sagebrush. If inaccessible, an alternative hike is planned up the level Chewuch River Trail to Chewuch Falls, 3 miles in. Leader, George Wooten

2000 Summary - Year 5 after the fire - fourth year of sampling

Hummock Wetland Workshop (06/23-25) Held at South Fork Twentymile Meadows Trailhead, with excursions to Thirtymile Meadows, Smarty Creek and Round Meadows. GW, Pam (PBI), Jo Ann Burkett, Sarah, Alex, Martha Hall.

2000 Timeline:

09/2000 - Data preparation (early September) - 2 days time donation, George Wooten
09/09-11/2000 - Field work - 3 days time donation, George Wooten
11/05/2000 - Edit report - 1 day time donation, George Wooten

2001 Timeline:

01/06-07,13/2001 - Finish data entry from 2000 - 3 days donated, George Wooten
01/14/2001 - Proofread data - 1 days donated, George Wooten
01/15/2001 - Send standardized data to Mary Pat Larsen - 1 day donated, George Wooten
01/16/2001 - Data analysis - general trends - 1 day donated, George Wooten

2003 Timeline:
3/2006 Complete data preparation for Mary Pat Larsen in folder ana7

2007 Timeline:
1/2007 Resume data analysis in folder ana8

Appendix I. Data dictionary for Thunder Ecology plots

File updated: 6/23/97, 12/12/97, 8/3/98, 9/4/00, 2/8/2003
D:\DAT\ECO\THUNDER\DOCS\APP-I-DATADCT.DOC

The ecological study of Thunder Mountain fire by Trust for Habitat Conservation is based on collection of data from field sites designed to portray typical features of hot crown fires. Methods involve sampling vegetation in fixed plots over time, with an emphasis on gaining information on a wide array of biological and wildlife effects following a hot overstory canopy fire, as well as with logging practices.

The sampling sites consist of named and field-marked plots, which are partitioned into 100-ft (30.48 m) linear transects and/or 1-meter areal quadrats. Transect TH-2 was the only transect that used a different method for locating sample points along the transect. Since that transect was 0.5 miles long, the transect samples were separated by 4 paces of observer GW, with each point located at the location of the toe of the final step. Each transect was permanently fixed with a stake at both ends. Meter-quadrats were marked with four stakes located a fixed distance along the transect. Within transects, sample points are numbered 1 to 100, and are located exactly at each 1-ft mark along a transect tape. Different plant or communities, major structural differences or different disturbance intensities are mapped along the transects, for use in pooling the sample points into grouped data.

Data is recorded in the field on forms, then later entered into relational databases, or spreadsheet tables, described below. Field names are given here within square brackets. The key fields used for unique identification of samples and linking databases, are plot name [LOCNUM], sampling date [Date], sampling year [Yr], plant community [Hab], and transect sampling point [SUBNUM] or name of quadrat [QPlot]. In addition, the photograph database has a number of specific fields for locating and focusing the camera. Transect names do not have a field in these databases, but are referred to by their starting point which is always a three digit multiple of 100, starting with the first, "000".

Data for the plots is stored in both Microsoft Access as well as Borland Paradox tables and metadata is given in appendix I, the data dictionary. The key fields needed to differentiate all are the following:

- Database field names [within square brackets]:
- plot name [LOCNUM]
- sampling date [Date]
- sampling year [Yr]
- plant community [Hab]
- transect sampling point [SUBNUM] or name of quadrat [QPlot].

GENERAL DESCRIPTION OF DATABASE CONTENTS (combined databases are noted)

TH1Desc (MSWord) - General site descriptions and orientation.

a. Plot descriptions

b. General descriptions for the year

TH2Site (Paradox) - General site quantitative information on features such as location, topography, elevation, etc.

TH3Photo (MSWord) - Information used to replicate photographs of plots and transects.

TH4Dist (Paradox) - Baseline disturbance information, primarily of fire intensity, grouped by habitat type (Hab field).

TH5Nvasc (Paradox) - Baseline information on nonvascular and bare ground cover.

TH6Tree (Paradox) - Baseline information on tree species, snags, and canopies.

TH7Veg (Paradox) - Baseline information on vascular plant percent cover (exclusive of tree species).

a. Plant list for site

b. Quadrat plot data

TH8TranRules (Paradox) - Transect descriptive information and sampling metholodogy.

TH9Tran (Paradox) - Transect records of the layers of living and non-living ground cover and their attributes recorded on transects at fixed sample points (usually 1 ft apart) for understory vascular plant information.

TH10Habs (Paradox) - Brief description of all transect habitats (or communities) from the Hab field, along with a summary of burn intensity, soil moisture, or presence of logging

TH11Over (Paradox) - Transect records with overstory plant information (plants > 10m).

TH12BAF.DOC - Descriptive information for basal area dbh or trees IN the BAF prism (17), or fixed radius plot as given.

SPPLOOK - This is a lookup table for plant codes used in TH7Veg and TH9Tran (but not the plant report).

DETAILS OF DATABASE STRUCTURE AND FIELD CODES

Tables of database structural information (note: Typ column key: A = character field of Len lenght; M = Memo field; D = Date field; S = short number (integer). Key fields with an asterisk (*) represent unique key fields in the database.

TH1Desc – General Description

Database relationship for Description database:[LOCNUM]is 1:1 for each field plot.
TH1DESC table structure:

LOCNUM	Plot number; TH1-000,...; Date of plot establishment; original observers' initials
Location	Description of location

DescRem	Description of plot and site ecology
Trandesc	Description of transects
DistNotes	Description of disturbances
Dimensions	Size and number of plots, subplots and habitats

TH2Site – Site information

Database relationship for Site database:[LOCNUM] is 1:1 for each field plot.

TH2SITE table structure:

Field name	Typ	Len	Key	Values
LOCNUM	A	20	*	Plot number; TH1-000,...
Quad	A	12		USGS Quad
Twp	A	2		Township
Rng	A	2		Range
Sec	A	2		Section
Qtr/Qtr	A	6		Quarter of Quarter Section, eg NEofNE, Sof2, SE, SHALF
Minelev	S			Minimum elevation, ft.
Maxelev	S			Maximum elevation, ft.
F=AllFlat?	A	1		Note flat slope plots with an "F" here
MinAspDeg	S			Minimum aspect degrees
MaxAspDeg	S			Maximum aspect degrees
MinSlopeDeg	S			Minimum slope degrees
MaxSlopeDeg	S			Maximum slope degrees
HTOPO	A	10		Choice of Plane Concave Convex Undulating Jagged
VTOPO	A	10		Choice of Plane Concave Convex Undulating Jagged
Landform	A	27		Standard landform classification
Posit	A	16		Standard topographic position
Habitat	A	37		Standard habitats
AdjVeg	A	30		Adjacent vegetation

Geology	A	34		Description of geologic and soil features

TH3Photo – Photograph database (in MS Word - the MS Access table structure in TH.MDB is no longer used). Photographs were taken yearly at each site at permanent, marked points within the plot area, and information about the photographs noted.

Database relationship for Photo database:[LOCNUM] is Many:1.
TH3PHOTO Table structure:

Field name	Typ	Len	Key	Values
LOCNUM	A	20	*	Plot number; TH1-000,...
Yr	A	4	*	Year after fire to photo date 1994 = year 0
From	A	20	*	Start point in plot or on transect of photo
To	A	20	*	End point in plot or on transect of photo
Az	A	20	*	Azimuth of photo
Date	D			Date of photo
mm	A	20		focal length of photo
NumPho	A	20		Number of photo
Print	A	20		Choice of print/slide/both/missing
Note	A	100		Field notes

TH4Dist – Disturbance data
A zero in the percentage column for a disturbance means none of that disturbance occurred on the site. Database relationship for Disturbance database:[Hab] is 1:1. Burn intensities were measured for each sample point or quadrat within each habitat. These burn intensities were the magnitude, from a low of 0, or none, to a maximum of 5, or complete stand lethality and charring of small limbs less than 1" dia. Intensity was measured at three forest strata, overstory, understory (including shrubs) and surface.

TH4DIST table structure:

Field name	Typ	Len	Key	Values
LOCNUM	A	20	*	Plot number, TH00001,...
Hab	A	20	*	Delineated pooled samples' habitat

Date	D		*	Date of earliest measurement of disturbance
TFire%	A	3		Total Fire disturbance percentage of plot
TFireYr	A	3		Disturbance frequency, or number of years since last occurrence, or year of occurrence. Freq of 0 refers to events that don't occur; 1 refers to event less than or equal to 1 year, or to.
TFireMag	A	3		Magnitude of disturbance (0-5, least to most)
TFireEven	A	3		Evenness of disturbance (E)ven or (U)neven
OvFire%	A	3		Overstory fire
OvFireYr	A	3		
OvFireMag	A	3		
OvFireEven	A	3		
UndFire%	A	3		Understory and shrub fire
UndFireYr	A	3		
UndFireMag	A	3		
UndFireEven	A	3		
SrfFire%	A	3		Surface fire
SrfFireYr	A	3		
SrfFireMag	A	3		
SrfFireEven	A	3		
Tramp%	A	3		Animal trampling
TrampYr	A	3		
TrampMag	A	3		
TrampEven	A	3		
TrampSp	A	10		Species of animal trampling
Graz%	A	3		Animal grazing
GrazYr	A	3		

GrazMag	A	3		
GrazEven	A	3		
GrazSp	A	10		Species of grazing
Windth%	A	3		Windthrow
WindthYr	A	3		
WindthMag	A	3		
WindthEven	A	3		
Aval%	A	3		Avalanche
AvalYr	S	3		
AvalMag	A	3		
AvalEven	A	3		
Flood%	A	3		Flooding
FloodYr	A	3		
FloodMag	A	3		
FloodEven	A	3		
Eros%	A	3		Erosion
ErosYr	A	3		
ErosMag	A	3		
ErosEven	A	3		
CCut%	A	3		Clearcut and seed tree logging <10% remaining
CCutYr	A	3		
CCutMag	A	3		
CCutEven	A	3		
Sel%	A	3		Selective and partial logging and seed cuts with >10% remaining.
SelYr	A	3		

SelMag	A	3		
SelEven	A	3		
OvRem%	A	3		High-grade logging
OvRemYr	A	3		
OvRemMag	A	3		
OvRemEven	A	3		
Thin%	A	3		Thinning logging
ThinYr	A	3		
ThinMag	A	3		
ThinEven	A	3		
Road%	A	3		Road use (construction may fall under excavation)
RoadYr	A	3		
RoadMag	A	3		
RoadEven	A	3		
ExcFill%	A	3		Mechanized excavation and filling
ExcFillYr	A	3		
ExcFillMag	A	3		
ExcFillEven	A	3		
Trail%	A	3		Manual trail construction and excavation
TrailYr	A	3		
TrailMag	A	3		
TrailEven	A	3		
Planting%	A	3		Non-natural seeding and planting
PlantingYr	A	3		
PlantingMag	A	3		
PlantingEven	A	3		

OthDisType	A	3		Other disturbance type
Oth%	A	3		Other disturbance
OthYr	A	3		
OthMag	A	3		
OthDisEven	A	3		
DisType	A	3		Disturbance type for quantification of overstory (>10 m tall), understory (1-10 m tall) and low canopy (<1 m tall) vegetation
Dis>10m	A	3		overstory (>10 m tall) vegetation % disturbed
Dis1-10m	A	3		understory (1-10 m tall) vegetation % disturbed
Dis<1m	A	3		low canopy (<1 m tall) vegetation % disturbed

TH5NVasc – Plant observations

Database relationship for Nonvascular database:[Hab] is 1:1, however the allowance for a date field, allows future remeasurement. Habitat delineation (community classification) was made along transects and within quadrats. Habitats, as used here, are synonymous with plant communities, which were delineated by visually comparing the soil surface, overstory composition and fire intensity, and matching these to changes in vegetative cover. The visual habitat boundary is based on the concept of the 50% turnover rate, which is to designate a new habitat when an average of half of all of the different species vegetative cover has changed by a factor of two.

TH5NVASC table structure:

Field name	Typ	Len	Key	Values
LOCNUM	A	20	*	Plot number, TH1-000,...
Date	D		*	Earliest date of data record unless data changed, in which case create a new record and only record changed fields.
Hab	A	2	*	Delineated pooled samples' habitat
Obs	A	15		Observers
BedVis	A	2		Bedrock visible 5' up
BedSrf	A	2		Bedrock at ground surface
BldVis	A	2		Boulders, 3+'

BldSrf	A	2		
RkVis	A	2		Rocks 3"-3'
RkSrf	A	2		
GrvVis	A	2		Gravel 0.25"-3"
GrvSrf	A	2		
FinVis	A	2		Fines <0.25"
FinSrf	A	2		
NeeVis	A	2		Needles and conifer duff
NeeSrf	A	2		
HumVis	A	2		Humus and deciduous leaf
HumSrf	A	2		
WooVis	A	2		Wood < 2m long; includes punky logs
WooSrf	A	2		
WooTot	A	2		Total of surface and suspended
SLogVis	A	2		Small Logs <6" dia; longer than 2 m
SLogSrf	A	2		
SLogTot	A	2		
MLogVis	A	2		Medium Logs 8-18" dia; longer than 2 m
MLogSrf	A	2		
MLogTot	A	2		
LLogVis	A	2		Large Logs >18" dia; longer than 2 m
LLogSrf	A	2		
LLogTot	A	2		
SLichVis	A	2		Soil lichen coverage
SLichSrf	A	2		

SMosVis	A	2		Soil moss coverage
SMosSrf	A	2		
SLivVis	A	2		Soil liverwort coverage
SLivSrf	A	2		
SMos+LivVis	A	2		Soil moss + soil liverwort coverage
SMos_LivSrf	A	2		
OthCovName	A	10		Name of other litter type coverage
OthCovVis	A	2		
OthCovSrf	A	2		
WatVis	A	2		Pooled water, day of measurement
WatSrf	A	2		
Arblich	A	2		Arboreal lichen (0-4)
Rklich	A	2		Rock lichen (percent of rock)
CanDensio	A	3		Canopy density 0-100%
NumTreCan(1-3)	A	2		Number of tree canopies (1-3)

TH6Tree.db – Overstory tree observations.

During sampling, overstory tree cover was measured in 4 ways:

1. Sample-point density. The overstory was sampled along the transect by looking up and estimating the cover above the sample points - as you will recall, this is highly inaccurate on a point-by-point basis, but it is fairly accurate for a group of adjacent points, since the observer could adjust the datasheets so that the total canopy added up correctly (for instance, the plot we were in was somethingly like 30% dead and 40% green, but at each point it was just a fuzzy blur. So in tallying the sheet, the observer just made sure that the total of dead trees, live trees and openings summed up correctly, without worrying about whether each individual point was accurate. But this measurement is only meant to be applied to the transect part of the stand. It is not representative of the data for a whole stand. This measurement of overstory treats is more useful for determining (1) if any trees survived the fire, in which case by definition it was not a hot-overstory fire, and in allowing inclusion of the control data.

2. Densiometer Density is the shading produced by a canopy 10 meters above the ground, measured within 30 degrees of perpendicular to the measuring point. It was measured with a spherical densiometer. It is only accurate in evenly distributed forests with greater than about 40% cover. Our densiometer readings were taken along the transect, thus they may not be representative of the average density of the forest "stand". This was compensated for in two ways - the general location of plots were chosen in areas where the vegetation was generally even, and the transect location where the reading was taken was established at a spot where the vegetation was most even. For instance, in a plot where only one tree was present, it was taken some distance from the tree.

3. Canopy density is a visual estimate of the Densiometer Density given above. It can be estimated from aerial photos or on the ground, by looking up, and having familiarity with a densiometer. It is about as accurate as measured density, but serves as a check in cases where the measured density was sampled in an atypical part of the stand. Unlike the measured density, the canopy density represents the average density of the forest "stand", i.e., the area where tree cover is constant within a given amount. The canopy density figure was used to estimate the density of the stand before the fire, based on the standing snag cover and imagining them to be covered with needles. The HAB category was designated partly on the basis of having an even canopy, so the canopy density is defined within a given HAB.

4. Basal area of the stem diameters, and tree-per acre estimates.

Database relationships for Tree database:[Hab] is less than 1:1, because only selected habitats were measured. In addition the allowance for a date field allows future remeasurement, which would result in data relationships to [Hab] of Many:Many.

TH6TREE table structure:

Field name	Typ	Len	Key	Values
Locnum	A	20		Plot number, TH1-000,...
SUB	A	3		Location of plot center
Hab	A	4		Delineated pooled samples' habitat
Yr				Year of measurement (EST=estimate)
TreeSp	A	7		Tree species code
PREFIREDEN	A	3		Canopy density (estimated) before the fire.
DENSUM (POSTALL)	A	3		Canopy density of all green + bare snags + needle-covered snags (GREEN+SNAGDEN) or (GREEN+NEEDLE+POSTNEED). Even though most densities are calculated from 1998 data, for this project, the density is defined to represent the 2000 densities without needles.

GREENDEN (OVERCAN, LIVETREE)	A	3		Canopy density of live trees only; snags not included.
SNAGDEN	A	3		Canopy density or other measure of snags only (NEEDLE + POSTNEED, if known)
NEEDEN (NEEDLE, NEEDLRED)	A	3		Canopy density while needles are still on trees (0 for hot-burned).
POSTNEEDEN (POSNEEDL)	A	3		Canopy density of trees after needles fall off.
				(ALLTREE) (field not used) - Densiometer measurements of all live trees, with no snags
				(TREESNAG) (field not used) - Used to define all trees and snags taken together as a unit.
Dens	A	3		Canopy Density avg 4 densiometer readings
Cans	A	3		Number of tree canopies
Over	A	3		Overstory (>10 m) cover %
Under	A	3		Understory (2-10 m) cover %
Regen	A	3		Regenerative (0 - 2 m) cover %
Krum	A	3		Krumholz cover %
OvHt90	A	3		Height of overstory (90th percentile)
OvD50	A	3		Diameter of overstory trees (50th percentile)
OvD90	A	3		Diameter of overstory trees (90th percentile)
OvAge90	A	3		Age of overstory trees (90th percentile)
BAFTree	A	3		Basal area factor for trees
BATr	S			Calculated Basal area for trees. G is the sum of the basal area of all (living) trees in a stand. G can be estimated using a variable probability sampling approach called angle count sampling, point sampling, variable radius plot sampling (VRP sampling), plotless cruising, angle counting, probability proportional to size (PPS) sampling or horizontal point sampling. This sampling approach allows unbiased estimates of G to be made very quickly without the need to measure the dbh of each tree. The speed and efficiency of angle count sampling, in conjunction with the correlation of G with so many stand parameters of interest has meant that G is almost always measured in any stand inventory or assessment, and measured using angle count samping. G is estimated as the number of IN trees times the BAF of 14.
Tin	S			Number of each species of trees counted "in" for Basal area calculation. Basal Area can be measured optically with a

				gauge. A gauge of known width is held at a set distance from the eye. The observer stands on a set point, and observes each tree that can be seen from that point, pivoting a full circle. The observer views the width of the tree at breast height. If a tree appears wider than the gauge, it is recorded a `1', if the tree is exactly the same width as the gauge it is given a `1/2' and if the tree appears narrower than the gauge, it is not recorded at all. The total count of "IN" trees is multiplied by the BAF to give the Basal Area in ft^2/ac. Stand basal area = (number of hits) × (basal area factor).
OvTPA	S			Estimated overstory trees per acre
BAFSnag	A	3		Basal area factor for trees
SnIn	S			Number of each species of snag counted "in" for Basal area calculation
BASn	S			Calculated snag basal area
SnTPA	S			Estimated snags per acre
HtM90	A	3		Height of snags (90th percentile)
SnD50	A	3		Diameter of snags (50th percentile)
SnD90	A	3		Diameter of snags (90th percentile)

TH6tree-calc.xls – tree metrics

This spreadsheet holds data transcribed from TH6TREE. These were divided up by years 1997, 1998, 2000. The average values (or best single value if no two values were were usable) were used for a summary worksheet, with those fields in bold below.

Field name	Values
Locnum	Plot number, TH1-000,...
SUB	Location of plot center
Hab	Delineated pooled samples' habitat
Yr	Year of measurement (EST=estimate)
TreeSp	Abbrev for tree species
PREFIREDEN	**Canopy density (estimated) before the fire.**
DENSUM (POSTALL)	**Canopy density of all green + bare snags + needle-covered snags (GREEN+SNAGDEN) or (GREEN+NEEDLE+POSTNEED). Even though most**

	densities are calculated from 1998 data, for this project, the density is defined to represent the 2000 densities without needles.
GREENDEN (OVERCAN, LIVETREE)	**Canopy density of live trees only; snags not included.**
SNAGDEN	Canopy density or other measure of snags only (NEEDLE + POSTNEED, if known)
NEEDLE (NEEDLE, NEEDLRED)	Canopy density while needles are still on trees (0 for hot-burned).
POSTNEEDEN (POSNEEDL)	Canopy density of trees after needles fall off.
NEEDROP	Canopy density of needles only while they are still on the trees (0 for hot-burned). NEEDROP is the number of red, dead needles dropped between 1998 and 2000. NEEDROP is calculated as SNAG98 - SNAG2000.
	(ALLTREE) (field not used) - Densiometer measurements of all live trees, with no snags
	(TREESNAG) (field not used) - Used to define all trees and snags taken together as a unit.
Over	Overstory (>10 m) cover %
BATr	Calculated Basal area for trees. G is estimated as the number of IN trees times the BAF of 14.
TrIn	Number of each species of tree counted "in" for Basal area calculation.
OvTPA	Estimated overstory trees per acre
BASn	Calculated snag basal area with BAF = 13.
SnIn	Number of each species of snag counted "in" for Basal area calculation
SnTPA	Estimated snags per acre
BA_Total	**BA sum of snags + green trees**
Tree+SnagPA	**Total stems per acre snags + green trees**
EstSource	**Source data (year) for density, and if different, prefire density. If estimated from the appearance of photos and the descriptions, then 'est' is recorded. This field is taken from Est Source in TH6ree-calc.xls, and added to for additional estimates not measured:** **98,00** **98** **98, PRE=est**

TH7Veg – Transect data

Data is recorded by date beginning with the initial plot establishment. Two types of data records share this database: (1) Generalized habitat plant coverage estimates for a given community, [Qplot] = blank; habitat keyed in [Hab], and (2) quantified data from meter quadrats; [Qplot] = blank; both coverage AND number of plants is always recorded.

Database relationships for the Quadrat Vegetation database:Meter Quadrats, [QPlot] is 1:1; relationships to [Hab] is less than 1:1, because only selected habitats in a limited number of plots were measured, however a date type of field ([Yr], year since the fire) allows future remeasurement.

Meter quadrat samples: Some transects were located in areas that had microclimates and small individual plant occurrences which could not be adequately sampled with linear transects. For these areas, a meter square grid was staked out along the transect, and records of species, number of individuals, percent areal coverage, and optionally, reproductive state, were taken.

TH7VEG table structure:

Field name	Typ	Len	Key	Values
LOCNUM	A	20	*	Plot number
Hab	A	3	*	Delineated pooled samples' habitat; G = found in general area
Qplot	A	10	*	Name of meter quadrat if this is one; blank if not
Yr	A	2		Years since fire (1994 - 0)
CODE	A	10		Plant species code. Codes with question marks at the end are not positively identified.
Cover	A	3		% Cover; 0 = 0 to 1%; P=Present; T = Trace
Stems/Clumps	A	1		Enter for measurements other than percent cover: "S" if data is for stem numbers; "C" if data is for numbers of clumps; M if data is in mats not separable as individuals. # = number of plants/stems.
Repr				Reproductive state V=Vegetative, F=Flowering, #=no. of plants.
Ht				Avg Height of 90th percentile population in ft and inches

TH8Rules – Sampling rule set

Sampling rules
Each sample point is associated with a sampling methodology that is a compromise of detail and efficiency. Depending on the type of plot, a variety of sampling rules were used and recorded for each transect. Sampling rules specify which ground cover types are allowed as the topmost and last layers.

General rules. Each point sampled along a transect may be assigned a ground cover type ("hit") beneath it which may be a living plant or non-living category as defined here. Ground cover types are recorded directly under the sample points. Provisions are made for recording more than one layer, as described under stopping rules. Overstory layers are recorded if the sample point would intersect part of a tree over 30' (10 m) tall, even if the tallest point of the tree is not directly over the point. For diffuse items, i.e., overstory canopy needles, the overstory canopy density is recorded, e.g., 80%. For non-circular plants in which the profile is diffuse, or more than twice as long in one direction, the horizontal extent of the plant is mentally reduced to its minimum circular profile, and then recorded as a hit if the sample point intersects the mental image of the circle (see under plant multiplier).

Sterile matter such as logs or rocks that lie above living layers are recorded in the layer they occur in.

When observations were undefined or unknown in the field, as for example, at the endpoints of the plot, then the '-' or 'NR' symbol was recorded in the SU field. This rule failed to work when attempted in wetland plot TH-010, as the wet bottom layers contained a mix of both non-living water and numerous living undetermined mosses.

Cover class aggregation rules. Cryptogams include mosses, liverworts, and lichens, but not fungi. One moss and one liverwort were segregated from their categories of MOSS and LIVER, respectively. These were the liverwort, *Marchantia polymorpha*, and the moss genus *Polytrichum*. Some of the aquatic liverworts that superficially resemble mosses may have been misclassified as mosses. The category of ground cover, *Polytrichum* (POLYT) was created when it was discovered that this single species of moss was of major importance. Since there was no way to go back and change the previous year's data, analyses of *Polytrichum* and moss cover required prior selection of data subsets using the rule.

Cryptogams include mosses, liverworts, and lichens, but not fungi. One moss and one liverwort were segregated from their categories of MOSS and LIVER, respectively. These were the liverwort, *Marchantia polymorpha*, and the moss genus *Polytrichum*. Some of the aquatic liverworts that superficially resemble mosses may have been misclassified as mosses.

All roots were counted as category of litter, whether living or not.

The sampling rules described below are coded in the A12 field RULES, with each rule

occupying the following digits in the code, and also given in the parsed fields in the table STDTRAN as given:

Rule / Definition	Parsed code field name in STDTRAN	Digits used to code in the field RULES	Possible codes
Cover type unit boundary	XSPAN	1-2	+[-[
Layer counting rule & vascular plant multiplier	XVLAY	3 (number of layers) 4 (vascular plant multiplier)	1M 1V 4V
Cryptogam counting rule	XCRYP	5-6	+C /C /D
Lowermost layer rule	XNLIV	7-10	+L/B /L/B /S--
Sample exclusion rule	XCLU	11-12	XX XN

Cover type unit boundary (XSPAN brackets)

+[individuals spanning more than one sample point are ALWAYS noted in attrib by beginning an. ending brackets

-[individuals spanning more than one sample point are not noted in the ATTRIB field.

When the cover type spanned more than one sample point, e.g., for rocks and logs or large shrubs, the ATTRI field included left and right square brackets '[', ']' to mark the beginning and end of the individual cover type item.

Layer counting rule combined with vascular plant multiplier (XVLAY)

1M count only the topmost layer, and use the vascular plant multiplier factor to record the diameter and distance to the nearest vascular plant which intersects the previous one foot of sampling tape.

1V record only 1 vascular plant layer.

4V record up to 4 vascular plant layers.

This rule determined the maximum number of vascular plant layers to count and whether to use a vascular plant multiplier. Recording of layers was continued as long as successive strata were vascular plants; it ended after a non-vascular plant was encountered.

Size multiplier factor. Sample points made in some transects for the years 1996 and 1997 used a multiplier factor to increase the magnitude of the observed response. The multiplier factor was used in transects where many small plants occurred with a low or variable distribution which the transects could not capture. Transects which incorporated multiplier factors were those which had less than 5% total sampled vegetation by 1997.

The multiplier factor enlarged the sampling point to include the entire, preceding 1-ft line

segment along the transect tape. Any plants that crossed the 1-ft line, were recorded in a separate field, along with the diameter of the plant and the distance of the center of the plant to the true transect point. Plants that intersected the true sample point were recorded in a normal fashion, however their size was recorded to allow a consistent application of an algorithm across the entire transect in determining abundance.

If an exact hit recorded a vascular plant, then the line intersect was not used, however the distance was recorded as 0.0 ft, and the diameter of the clump recorded. Use the multiplier when sterile ground or a cryptogam is under the exact 1-ft sampling point. Record the (1) species name, (2) distance to the center of the nearest plant crossing the previous 1' transect segment, and (3) mean diameter of the clump. The data for distance and diameter, in that order, were recorded in the attribute field for the layer, in decimal ft, separated by a comma. Use the mean diameter of the clump for the intersection diameter because otherwise grasses with long, angling or fallen stems stood a greater likelihood of intersection with the sample line. The distance to the center of the plant should not then be greater than 1 ft. When using the multiplier no plant layers were recorded. In TH-026, a vascular and cryptogram combined multiplier refers to cases where the multiplier is used on *all* living matter, including cryptogams. This was only used in plot TH-026. This form of the count multiplier adds all vascular and nonvascular within the previous foot, but reads the closest, topmost stratum only.

Cryptogam counting rule (XNCRYP).
This rule was used when cryptogams (mosses and liverworts) occurred in a layer. Cryptogams were usually counted as the lowest and last layer, since it was generally impossible to see what substrate was underneath them. The rule is as follows:

/C stop recording layers after recording a vascular plant and do not record underlying cryptogams, or if no vascular plant is present, then and only then count a single cryptogam layer if it is present.

+C require recording all cryptogams which intersect sample points, regardless of superimposed vascular layers.

/D stop at the superimposed vascular plant and do not record underlying cryptogams, or if no overlying vascular plant occurs, then and only then record a single cryptogam layer using a multiplier factor for cryptogams that record the diameter and distance to the nearest vascular plant which intersects the previous one foot of sampling tape.

The following codes and operators were used to describe the criteria for counting subsequent layers beyond vascular plants.

<u>Codes which are grouped sets and their meaning as used in TH8RULES.DB include the following:</u>

B - inorganic non-living matter; bare includes silt + gravel < 3", rocks (ROCK), boulders

(BOULD), and bedrock (BEDR), but not litter (LITT) or sterile (STERI, which is a separate category of bare).

C - cryptogams, a set that includes mosses, liverworts and lichens (MOSS, POLYT, MAPO, SLICH), but not fungi (FUNGI).

D - record cryptogams using a 1' multiplication factor as in vascular plants.

L - litter; organic, non-living matter; includes coniferous needle & duff (NEEDL), deciduous leaf (LEAF), humus (HUMUS), wood & logs <2m long (WOOD), logs (LOG) and roots (ROOT).

S - sterile; non-living matter; all categories classed as litter (LITT) plus bare (BARE); 'STERI' for sterile was used in some 1997 plots to insure that no blank fields were recorded. In the case of using plant multiplier factors, blank fields could not be allowed, but even without multiplier factors, the requirement to fill all SUs presents an asset during subsequent data analysis. Thus calculation of the percentages of living and non-living items is straightforward. The only exception to not allowing blank fields is when SUDs were undefined or unknown in the field, as for example, at the endpoints of the plot, where the category was undefined, in which case the '-' or 'NR' symbol was used in the SU. This rule failed to work when attempted in wetland plot TH-010, as the wet bottom layers contained a mix of both non-living water and numerous living undetermined mosses.

Lowermost layer rule (XNLIV), combined with a rule for the definition of the "sterile" cover type.

/L/B stop recording if a plant or cryptogam is recorded, or if no plant or cryptogam is recorded, then record either litter or bare ground in that order.

+L/B require that litter is recorded under each sample point regardless of superimposed layers, and stop recording; otherwise if no litter occurs, and no overlying plants or cryptogams occur, then and only then record a bare ground layer.

/S-- stop recording if a plant or cryptogam is recorded, or if no plant or cryptogam is encountered, enter S for sterile. This rule was used in some 1997 plots to insure that no blank fields were recorded. In the case of using plant multiplier factors, blank fields could not be allowed. This made the calculation of the percentages of living and non-living items more straightforward.

When vascular plants were covered by non-living layers such as logs, the non-living layer was recorded as a layer, and counting proceeded to the next vascular plant or cryptogam layer. This was an exception to the typical case where the non-living layers are the lowest and last layer recorded.

For densely vegetated wetlands where more than three layers of vegetation were present the recording of multiple layers was stopped at the last vascular plant, which is reasonable since moss cover approached 100% in wetlands.

Standing water was always counted if it was the lowest layer, even when beneath a

cryptogam layer that was not counted as a last layer (but note that peaty mosses such as *Drepanocladus* spp. may hide standing water from visibility, in which case the water is NOT counted). Standing water was always counted last, even if cryptogams or logs were under the surface, although if vascular plants were growing underwater, they would have been counted last. Sample points which had sterile layers above water, e.g., logs going across streams, recorded both the log and the water.

Burn holes and blowdown mounds (which were undefined as to their cover type composition) were counted as last layers regardless of other stopping rules.

Transects used grouping rules to aggregate the ground cover types. For instance, Bare normally refers to silt + gravel < 3". In 1997, plots TH001, 021, 022, 023, 024 used an aggregate code, STERILE, to represent all of: bedrock (BEDR), boulder (BOULD), rock (ROCK), bare gravel or mineral fines (BARE), coniferous needle, duff and cones (NEEDL), deciduous leaf (LEAF), humus (HUMUS), wood & log <6' long (WOOD), logs (LOG), and roots (ROOT).

Sample exclusion rule (XCLU). Because TH-2 used a variable transect size with variable sample point distances, the HAB categories had different numbers of points, some of which did not match the same HAB boundaries. It was necessary to exclude some of the points from analysis for two situations: (1) points which did not correspond to the same habitat from a different year, and which would not be used in any analyses; and (2) points which needed to be excluded in order to equitably balance the numbers of samples in each HAB category for different years, but which could be added back in for analyses such as percent cover which were not sensitive to the total number of samples. The three possible ways of treating these points was coded as follows:
XX Exclude sample points from all analyses.
XN Exclude sample points only from analyses that require the number of samples in each HAB category be equitable.
OK Include sample points in all analyses.

TH8RULES table structure:

Field name	Typ	Len	Key	Values
LOCNUM	A	20	*	Plot number
SUBNUM	A	20	*	Transect No. Grouping and stopping rules are normally understood to refer to **ALL** transects if this field is not specifically marked, but in a few cases, some sections of some transects were treated with different rules than other sections.
Yr	S		*	Year since fire (1994 = 0)
Stopping	A	12		See above rules for code descriptions.

TH9Tran
Longitudinal transects were laid out along 30.5 m belts (100 ft), sometimes contiguously; each 100 samples is referred to as a subtransect. Sampling and numbering of vegetation and site strata occurred along the transect every 0.305 m (1 ft) interval, starting at the first interval and continuing to the hundredth. Continuation of another belt or subtransect is numbered consecutively beginning at each new hundred-multiple.

Transect sampling points: Each point records the actual strata visible from a perpendicular to the ground, beginning with the topmost item and continuing through successive types of strata until reaching the ground or rule for stopping. Items such as rocks, snags, logs, and vegetation could be attributed with a second, optional, field for structural information such as average width, diameter or height (respectively, in that order). Coding of these optional attributes was consistent within a 30.5 m transect in that if recording of the optional attribute field was begun for a particular type of strata, recording was continued for the remainder of the transect. This insured that sampling of these structural attributes was not biased within plots. Items such as logs and rocks in which single items were so large as to incur two sample records were noted as single items in the attribute field.

Each species of plant, or other ground cover type, as defined by grouping and stopping rules, is allowed on only one record per layer per sample point. Plants entry codes are given in table 13. During subsequent data entry, unreadable or otherwise questionable items received a question mark as in the attribute column.

Two plants normally classed as cryptogams, were given generic or specific status. These were the hair-cap mosses, *Polytrichum* sp., and the liverwort, *Marchantia polymorpha*. This specificity was used from the outset for the liverwort, but was only begun for the *Polytrichum* group during the latter part of the 1996 season.

TH9TRAN entry codes and meanings.

Entry codes	Display Code	Meaning	Attribute
-	-	No data; null; not measurable; not recorded; not a category of observation for this data; illegible; examples include vertical sides of snags, sample points located on the top of a transect stake; unreachable spots over water, upper layers that are undefined but which have defined lower layers. Records with null observations should be deleted from the sample set before performing most calculations, i.e., they are treated as no-data rather than zeroes. These records were retained in the database only to make data interpretation easier. The symbol '-' was used instead of a blank or deleting the record because it is easier to edit and proofread, and left no question that the sample would have been valid under different circumstances, such as in a different	

		record year.	
A	ASH	Ash; white ash; beginning in 1996 with plot TH23, TH24, TH25, and continuing into 1997, ash is either white, still referred to as Ash, or dark, subsequently referred to as Char.	
B	BARE	Bare = mineral fines (+ gravel<3"	
BD	BLOWD	Blowdown mound	
BR, BEDR, BEDR0	BEDR	Bedrock	
BH	BURNH	Burn Hole	
BO, BOULD	BOULD	Boulder	
CH	CHAR	Char, Charcoal; see note under Ash	
CRYPT	CRYPT	All soil cryptogams	
FU, FUNG, F	FUNGI	Fungus	
FI	FINES	Fine mineral + organic litter (added in 2000; <1cm)	
GR	GRAV	Gravel (1cm - 5cm)	
H, HUM	HUMUS	Humic material, decomposed litter	
L	LOG	Log (min 2 m long)	dia" (not after 1997)
LIT, LT	LITT	Litter (TH-011, 1997)	
LITVIS	LITVIS	Litter visible (Quad TH-020, 1998)	
LITSUR	LITSUR	Litter surface (Quad TH-020, 1998)	
LITTOT	LITTOT	Litter total (Quad TH-020, 1998)	
LF	LEAF	Leaf, grass litter (Added in 2000)	
LIVER	LIV	Liverwort (not used - changed to MAPO)	
M	MOSS	Moss, sans Polytrichum sp. and Marchantia polymorpha	
MUCK	MUCK	Muck (added 2000)	
N	NEEDL	Needles and Cones	
NA	NA	Not applicable (code not used)	
POLY, POLYT	POLYT	Polytrichum moss sp.	

RK, RC	ROCK	Rock (>5cm, <1m)	longest dim"
RT, ROOT	ROOT	Root	diameter "
SB, SANDBAR	SANDB	Sand bar	
SEEDL	SEEDL	Seedling	
SLI, LI	SLICH	Soil lichen	
SN, S	SNAG	Snag	dia"
ST, STE	STER	Sterile (includes: Bedrock, Boulder, Rock, Gravel, Fines, Water, Coniferous Needle & Duff, Deciduous Leaf & Humus, Wood & Log <6' Long, Log, Root)	
STU	STUMP	Stump	
SPHAG	SPHAG	Sphagnum moss	
UNK	UNK	Unknown plant	
W	WOOD	Wood	
WAT, WA	WATER	Water	

TH9TRAN Table structure:
Database relationship:[SUBNUM] sample points is 1:1 for for each year of sampling. Up to 5 layers of ground cover classes can be recorded along with certain attributes for each layer. A Paradox for Dos script EDITTRAN.SC is used to simplify manual entry of this data, followed by the script XCLEANUP.SC to standardize ground cover codes.

(Note that a field, [SEL], was added whenever error trapping the habitat data (HAB) between different years was required. The field is deleted after the analysis.)

The field STOPPING was added by querying against TH8RULES.DB.

TH9TRAN table structure.

Field name	Typ	Len	Key	Values
PLOTKEY	A	10	*	Plot number-Sample point. Key fielding is optionally turned off.
YR	A	6		Year of data record.
LOCNUM	A	10		Plot number
SUBNUM	A	3		Sample point

HAB	A	2		Habitat
A-LAYER	A	12		Layer item Field Codes - see entry codes
A-ATTRI	A	10		Item attribute. Attributes for snags, logs, are for diameter in inches. Attributes for forbs are in inches height. Tree attributes are for height in feet, or for overstory trees, % cover. Attributes for rock and boulders are for the longest dimension in inches unless specified otherwise. Attributes for single items spanning more than one sample point, e.g., trees, boulders, rocks, and logs, were noted in the attribute field by bracing by angle brackets before and after the beginning and end of their occurrence, e.g., [and]. For sporadic occurrences of the same log, the intervening sample points are marked ".". If more than one piece of attribute information belongs in the field, the brackets are placed last. Attributes for Vascular plant multipliers are described there.
B-LAYER	A	12		As above through this table.
B-ATTRI	A	10		
C-LAYER	A	12		
C-ATTRI	A	10		
D-LAYER	A	12		
D-ATTRI	A	10		No attributes for the D-layer 1996-2000.
E-LAYER	A	12		
E-ATTRI	A	10		No attributes for the E-layer 1996-2000.
STOPPING	A	12		Stopping rules from query against TH8TRAN.DB (see TH8RULES for codes).

TH10Hab3 - Habitats

TH10HAB3 Table structure:

Fieldname	Typ	Key	Values
LOCNUM	A10	*	Plot number
HAB	A5	*	The code for the habitat/community used on the transect, used as a link for the various tables. The limit of the described area is generally defined by the extent of consistent vegetation within a circle equal to the habitat as delineated on the transect. If the transect is too small to be representative of the habitat, an area of greater extent may be used in the description.

HAB2	A4		1ST two digits of transect no + 2 digits for Hab, with leading 0 if Hab only has 1 digit, e.g., for TH-001 HAB = 1A, HAB2 = 011A, for TH-002, HAB = 3, HAB2 = 0203.
HAB3	A2		This is a two-digit sequence numbering from 01 to 81 (leading zeroes explicit) scheme to differentiate the HAB categories, for a total of 81 habitat categories
HAB4	A2		This is a two-digit sequence that pools spatially separated HAB3 categories from the same LOCNUM into the same category for a total of 55 habitat categories.
HABSEL	A7		**Composite habitat index**. The fire intensity, soil moisture and logging presence were combined into a single field, HABSEL during transformation into the standardized (STDTRAN) table. The field is coded as follows: Digits 1-3 F00 - Fire intensity 0 (unburned control) F10 - Fire intensity 10 F15 - Fire intensity 15 F20 - Fire intensity 20 F25 - Fire intensity 25 F30 - Fire intensity 30 (hot-burned) Digits 4-5 M0 - Soil moisture = DRY M1 - Soil moisture = MOIST-DRY M2 - Soil moisture = MOIST M3 - Soil moisture = MOIST+WET M4 - Soil moisture = WET Digits 6-7 L0 - Logging = NO L1 - Logging = YES
PTS			Sample points in this HAB category
DESC	A100		Brief description of habitat / community
LIVETREE	A10		Live overstory tree presence within the transect habitat. Live trees (as opposed to the numerous snags in the fire) that occur along transects were defined as vegetation above the sample point above eye level, with the top of the individual tree taller than 33' (10m). Trees with the sample point below the observer's eye level with only the top taller than 10 meters, would not be counted this way, however these do not (as of year 2000) occur on the transects. The indicator for tree presence is coded as follows, making the choice in the order presented. Choices are: Yes, No, Nearby, OverAlmost, Under, UnderAlmost, coded as follows: 1. Yes - Live trees intersect the transect habitat, and are counted in table TH9TRAN. 2. OverAlmost - Live trees occur nearby and within the transect habitat, but do not intersect it by random chance. 3. Nearby - Live trees occur near the transect site (not necessarily in the same habitat) in an adjacent stand. 4. Under - Live understory (but not overstory) trees that survived the fire intersect the transect 5. UnderAlmost - Live understory (but not overstory) trees that survived the fire, occur in the transect habitat. 6. No - Live trees do not occur in the transect habitat, nor nearby.
OVERBURN			Pre-1994 total canopy. (fields are optional; estimate to nearest multiple of 5 unless <5) > nnG green tree canopy (U means unburned; not necessarily unchanged) + nnR canopy with needles still on 1994-1998 (XR measn amount of red needles unknown) /LOG= amount after logging / nnS canopy after needle drop
OVFIRE	S		* Fire intensity overstory 0-5
UNDFIRE	S		* Fire intensity understory 0-5

SRFIRE	S		* Fire intensity surface 0-5
FIRE	S		(NONE) 0 - OV,UND,SRF=0 (LOW) 10 - OV<=3 AND UND<=3 AND SRF<=2 (MEDIUM-LOW) 15 - OV>=4 AND UND<=2 AND SRF<=2 (MEDIUM) 20 - OV<=4 AND UND=(3 OR 4) AND SRF=(3 OR 4) (HI-MEDIUM) 25 - OV>=4 AND UND>=4 AND SRF<=3 (HI) 30 - OV>=4 AND UND>=4 AND SRF>=4
FIR2	S		Selection variable for composite fire intensity; presently set at 1 = high-intensity (FIRE=30); 0 = unburned; blank = intermediate.
MOISTURE	A10		An indicator of whether the plot was dry, moist or wet. More than one of these are allowed, for instance in a transect that goes from dry to moist to wet. Wet is defined by the US Army Corps definition for a wetland, in this area, an obviously perennially wet area. Moist is defined here to be not quite as wet as a wetland, but supporting lusher vegetation and more wetland species. Moist draws and swales occur in several transects, sometimes in proximity to wetlands or riparian areas: Coded as: DRY, MOIST, WET, MOIST+WET, MOIST-DRY. Moisture indicates whether the surface soil of the transect was dry, moist or wet, from one of the following categories: DRY, MOIST, WET, MOIST+WET, MOIST-DRY. Wetness (WET) areas are dominated by obligate wetland species, in areas that are perennially wet, determined by visible surface moisture; DRY areas are completely dominated by upland species, and have well-drained soils. Moist areas are those with diverse mixtures of wetland and upland species on soils that retain moisture through the season. MOIST+WET is a special category for hummocky ground with high water tables which contains small wetland fingers and islands (< approximately 0.5 meter across), interspersed with moist areas which are not wetlands. The category MOIST-DRY was created for two areas, one in plot 23 and one in plot 35, which superficially resembled the MOIST category, but in which the water table often fell by fall allowing the soil to become dry. Moisture was partly controlled by dense shading. The criteria for designating plants as facultatively or obligatively wet was derived from the national list of wetland plants, and is given in appendix D. Moist draws and swales occur in several transects, sometimes in proximity to wetlands or riparian areas.
DRY2	S		Selection variable for surface soil moisture; presently set at 1 = DRY (MOISTURE=DRY) ; 0 = NOT(DRY); there are no blank values allowed in this selection.
LOGGING	A10		Logging occurrence: Yes, No or Near. An indicator for whether nearby logging has potentially affected the transect.
LOG2	S		Selection variable for logging presence on a transect habitat; presently set at 1 = LOG (LOGGING=YES); 0 = NOT(LOG); no blank values in this field.
PREDEN			Canopy density (estimated) before the fire. Field transcribed from TH6treecalc.xls.
DEN			Canopy density of all green + bare snags + needle-covered snags (GREEN+SNAGDEN) or (GREEN+NEEDLE+POSTNEED). Field transcribed from TH6treecalc.xls.
GREENDEN			Canopy density of live trees only; snags not included. Field transcribed from TH6treecalc.xls.
ESTDEN			Source data (year) for density, and if different, prefire density. If estimated from the appearance of photos and the descriptions, then 'est' is recorded. If estimated, then the figures are the midpoints of the ranges 0-20 (midpt=10); 20-40 (midpt=30); 40-70 (midpt=55); 70-90 (midpt=80) and 90-100 (midpt 95).(This field is taken from Est Source in TH6ree-calc.xls, and added to for additional estimates not measured): 98,0 98 98,PRE=est
BA			BA sum of snags + green. Field transcribed from TH6treecalc.xls.

TSPA			Total stems per acre snags + green. Field transcribed from TH6treecalc.xls.

* **Fire intensity codes**. An indicator of the overall fire intensity, in each of the three layers overstory: (1) in the crowns of trees >10m tall); (2) in the understory (in shrubby vegetation 1-10 meters tall; note the definition of understory for disturbance is different than that for tree understory (2-10 meters tall, and different again from tres counted in transects (overhead vegetation on trees over 10 meters tall); and on the surface (vegetation < 1 meter tall). The intensity comes from the fire disturbance information in table TH4DIST, using the same intensity levels of 0 to 5.

Summary of TH10HAB3.DB (red colored text indicates records added in 2003)

Transect	Fire	Soil	Logged	Description
01-1a	O3U3S3	dry	Yes	Dill Cr. PICO unit edge low-int. burn, tractored
01-1b	O3U3S3	dry	Near	Dill Cr. unlogged PICO adj. unit 6 low-int. burn
02-1	O3U3S3	dry	Yes	Dill Cr. PICO unit logged
02-2(1b)	O3U3S3	dry	Yes	Dill Cr. PIEN unit moist, logged draw
02-3(1c)	O3U3S3	moist	No	Dill Cr. PICO unit leave-tree reserve
02-4(1d)	O3U3S3	dry	Yes	Dill Cr. PICO unit logged south end
02-2	O3U3S3	moist	Yes	Dill Cr. moist, logged PIEN swale in unit 6.
02-3	O3U3S3	dry	No	Dill Cr. unlogged, upland PICO in unit 6 leave-tree reserve.
02-4	O3U3S3	dry	Yes	Dill Cr. logged, upland PICO in unit 6 south end.
03-1	O5U5S5	dry	No	Dill Cr. PICO (PSME) hot-burned rocky ridge
04-1	O4U4S1	dry	No	Dog-30mi ridge patchy vegetation slope
04-2	O2U3S4	dry	No	Dog-30mi ridge patchy vegetation slope
04-3	O2U3S1	dry	No	Dog-30mi ridge patchy vegetation slope
04-4	O3U3S4	dry	No	Dog-30mi ridge patchy vegetation slope
04-5	O3U2S0	dry	No	Dog-30mi ridge patchy vegetation slope
05-1	O4U2S2	moist	No	Dog-30mi ridge PIEN/LEGL bench
05-2a	O3U4S3	dry	No	Dog-30mi ridge ABLA/VASC bench
05-2b	O4U4S3	dry	No	Dog-30mi ridge ABLA/VASC bench
05-2c	O4U2S0	dry	No	Dog-30mi ridge ABLA/VASC bench
05-2d	04U4S3	dry	No	Dog-30mi ridge ABLA/VASC bench
05-3	O5U5S3	moist	No	Dog-30mi ridge PIEN moist draw
05-4	O5U5S4	dry	No	Dog-30mi ridge PICO across draw
05-3b(4a)	O5U5S4	moist	No	Dog-30mi ridge PIEN across draw
05-4b	05U5S4	dry	No	Dog-30mi ridge PICO across draw
06-1	O3U3S3	moist+wet	No	Dog Cr. partial burn riparian conifer
06-2	O4U4S4	moist	No	Dog Cr. partial burn ripar. conif burned drier patch
07-1	O5U5S4	dry	No	Dog Cr. hot-burned bank, open
07-2	O5U5S4	moist+wet	No	Dog Cr. hot-burned bottom riparian
07-3	O5U5S4	dry	No	Dog Cr. hot-burned south aspect
08-1	O5U5S5	dry	No	Dog Cr. ABLA/VASC/CARU[PICO/EPAN] slope
08-2	O5U5S5	moist+wet	No	Dog Cr. moist bench bottom
08-3	O5U5S5	dry	No	Dog Cr. south-facing, sandy bank outside unit
09-1	O4U4S4	dry	No	Dill Cr. adj. unit streambank upland outside unit
09-2	O4U4S4	wet	No	Dill Cr. trib adj. unit 6 riparian outside unit
09-3	O4U4S4	dry	No	Dill Cr. adj. unit 6 north bank upland outside unit
09-4a	O4U4S4	dry	Near	Dill Cr. trib adj. unit unlogged bench outside unit
09-4b	O4U4S4	dry	Near	Dill Cr. trib adj. unit unlogged bench inside unit
09-5	O4U4S4	dry	Yes	Dill Cr. trib adj. unit logged bench
10-1	O4U4S3	dry	Near	Dill Cr. finger wetland adj. unit 6 north (dry) bank
10-1b	O4U4S3	dry	Near	Dill Cr. finger wetland adj. unit 6 north (dry) bank
10-1c	O4U4S3	dry	Near	Dill Cr. finger wetland adj. unit 6 north (dry) bank
10-2	O3U3S3	wet	Near	Dill Cr. finger wetland adj. unit 6
10-2b	O3U3S3	wet	Near	Dill Cr. finger wetland adj. unit 6
10-2c	O3U3S3	wet	Near	Dill Cr. finger wetland adj. unit 6
10-3	O4U4S3	moist	Near	Dill Cr. finger wetland adj. unit 6 south PIEN bank
11-1a	O2U2S0	dry	No	Upper 30-mi. drainage mixed conifer spur-bench
11-1b	O0U3S3	dry	No	Upper 30-mi. drainage mixed conifer spur-bench

11-2	O0U1S0	dry	No	Upper 30-mi. drainage mixed conifer spur-bench
11-3	O3U3S4	dry	No	Upper 30-mi. drainage mixed conifer spur-bench
11-4	O4U5S5	dry	No	Upper 30-mi. drainage mixed conifer spur-bench
20-1	O3U3S3	dry	No	Dill Cr. bottom PICO medium int. burn
21-1	O4U5S5	dry	No	Dog Cr. slope PICO
21-2	O4U5S3	dry	No	Dog Cr. slope PICO
22-1	O4U4S4	dry	No	Dog Cr. swale on slope PICO
22-2	O4U4S4	dry	No	Dog Cr. bench on slope PICO
23-1	O4U5S4	moist-dry	No	Dog-30mi. ridge-saddle drier edge of PIEN
23-2	O4U5S3	moist	No	Dog-30mi. ridge-saddle lush PIEN swale
24-1	O4U5S4	dry	No	30mi Cr. upper ridge S-facing erosive lupine
25-1	O3U3S1	wet	No	30mi. fen CASCP, scorched ABLA-PIEN
25-2	O4U4S4	wet	No	30mi. fen margin burned CASCP growth effects
25-3	O4U4S4	wet	No	30mi. fen hot burned margin EQUIS-EPILO-ASFO
25-4	O4U4S4	moist	No	30mi. fen moist subirrigated EPAN/MAPO
25-5	O4U4S4	moist	No	30mi. fen dry, subirrigated EPAN
25-6	O4U4S4	moist	No	30mi. fen ARCO moist upland
25-7	O4U4S4	dry	No	30mi. fen VASC upland
26-1	O2U2S2	dry	Yes	Upper 30mi. pulverized clearcut landing
26-2	O2U2S2	dry	No	Upper 30mi. PICO medium burn adj to CCut
30-1	O0U0S0	dry	No	Dog Cr-rd jcn unburned drier adj. to creek
30-2	O0U0S0	moist+wet	No	Dog Cr-rd jcn unburned bottomland
31-1	O4U4S5	dry	No	Sheep Mtn hot-burned PICO near unburned PICO
32-1	O4U4S4	dry	No	Sheep Mtn light-burned PICO pole stand
33-1	O0U0S0	dry	No	30mi Mead. PICO [PSME] patchy burn
34-1	O2U3S4	dry	No	S of 30mi Mead. partial burn in PICO [PSME]
35-1	O5U5S5	moist-dry	No	Dill Cr. bench near ravine - moist, concave draw
35-2	O5U5S5	dry	No	Dill Cr. bench near ravine - dry convex esker
36-1	O0U0S0	dry	No	Adj to CCut - unburned, unlogged PICO pole
36-2	O0U0S0	dry	Near	CCut edge - uncut more open more blowdown
36-3	O0U0S0	dry	Near	CCut edge blowdown unlogged no soil disturbed
36-4	O1U1S1	dry	Yes	CCut edge rd-30mi. logged, soil disturbed
36-4b	O1U1S1	moist	Yes	CCut edge rd-30mi. logged, soil disturbed swale
36-5	O1U1S1	dry	Yes	CCut edge rd-30mi. logged, soil disturbed

TH11Over – Overstory trees
Transect information for overstory trees (>10 m in height). Fields are the same as in TH9Tran.

Trees occurring along the transect were defined as vegetation above the sample point above eye level, with the top of the individual tree taller than 33' (10m). Trees with the sample point below the observer's eye level with only the top taller than 10 meters, would not be counted this way, however these do not (as of year 2000) occur on the transects. These were recorded in a group with YR = "TREE". If the tree canopy was diffuse, as in a continuous canopy with speckled sunlight coming through, the entire area under the tree was counted as being under the tree, but the attribute was used to record the estimated percent cover.

TH12BAF.DOC - Descriptive information for basal area dbh or trees IN for fixed radius plot as given.

TH12BAF table structure:

LOCNUM	Transect number
PT	Location of fixed radius center
radius	Radius of fixed radius plot
PICOSNAG	Number of PICO snags
PICOTREE	Number of PICO trees
PIENSNAG	Number of PIEN snags
PIENTREE	Number of PIEN trees
PSMESNAG	Number of PSME snags
PSMETREE	Number of PSME trees
ABLASNAG	Number of ABLA snags
ABLATREE	Number of ABLA trees

SPPLOOK. This table contains lookup information for the items coded in TH7VEG.DB and TH9TRAN.DB.

SPPLOOK Table Structure:

FIELDNAME	**MEANING**	**TYPE**
CODE	Codes for observed sample hits	A10*
TYPE	Categories for observed sample hits: BROAD broadleaf shrubs > 1 dm tall with woody or pithy stems; includes all Vaccinium except V. caespitosum, Sambucus racemosa, and Spiraea betulifolia (LEGL, LIBO, LOIN, POTR, RILA, RIVI, SAFA, SALIX, SAPL, SASC, SHCA, SPBE, VAMY, VASC) CONIF coniferous plants (ABLA, JUCO, PICO, PIEN, PSME) CRYPT cryptogams; includes Selaginella densa, but not fungi (MAPO. MOSS, POLYT, SEDE) FORM landform; not strictly an item; includes blowdown mounds and burn holes = burned out roots (BLOWD, BURNH). FUNGI fungi; does not include lichens (FUNGI) GRAM graminoids; includes grasses, sedges and rushes. HERB herbaceous perennials < 1 dm tall and hemicryptophytes; includes Pyrola uniflora, Orthilia secunda, Rubus pedatus Cornus unalaschkensis and Vaccinium caespitosum, but not other species of Vaccinium or Spiraea betulifolia. INANIM inanimate; sterile; all mineral and non-living organic combined except water (STERI). When used, INANIM is an alternative for the combination of MINERAL + ORGANIC, meaning it includes logs. It was used as a means of expediency, and only in situations where only a single, topmost layer was recorded. These plots are the only ones that use it: TH-001 (1997), TH-021 ('97 & '98), TH-022('97 & '98), TH-023 ('97 & '98), TH-024 ('97 & '98). MINERAL mineral; bare, gravel, rock, boulder, bedrock, ash, but not water (ASH, BARE, BEDR, BOULD, GRAV, ROCK, SANDB). MIX mix of any of these categories. NA not applicable; not recorded. ORGANIC non-living organic' includes litter, logs, humus, charcoal, but not ash (CHAR, HUMUS, LEAF, LITT, LOG, MUCK, NEEDL, ROOT, SNAG, STUMP, WOOD) SLICH soil lichen, but not fungi (SLICH). UNK unknown WATER water (WATER).	A7
TYPE2	Broad categories: 0 - NOT AN ITEM; IGNORE; NOT APPLICABLE; NOT COUNTED 1 - VASCULAR PLANT 2 - CRYPTOGAM OR FUNGI 3 - ORGANIC; HUMIC 4 - INORGANIC; MINERAL; WATER 5 - NON-LIVING MIXED ORGANIC AND INORGANIC	S
FULLNAME	Description or scientific name of item	A60

COMMON	Common name of item	A36

STDTRAN table structure

PLOTKEY	A unique key code for sample points, combined by adding the fields YR, LOCNUM, and SUBNUM with dashes, e.g., 00-001-214.	A10
UNIQID	Unique identifier made by concatening last 2 digits of LOCNUM, 3 digits of SUBNUM, 4 digits for YR & 1 digit for the layer number (1 is the topmost layer).	A12
LOCNUM	Transect number	A6
SUBNUM	Sample point number	A3
YR	Year of sampling	A4
HAB	Habitat. Habitat classification for pooling sample points within. Habitat categories within a given plot (LOCNUM) all use the same sampling scheme and have identical values for the variables for MOISTURE, BURN INTENSITY, and LOGGING. Usually overstory canopy and slope and aspect are similar.	A5
HAB3	This is a two-digit sequence numbering from 01 to 81 (leading zeroes explicit) scheme to differentiate the HAB categories, for a total of 81 habitat categories	A2
HAB4	This is a two-digit sequence that pools spatially separated HAB3 categories from the same LOCNUM into the same category for a total of 55 habitat categories.	A2
HABSEL	Composite habitat index. The fire intensity, soil moisture and logging presence were combined into a single field, HABSEL during transformation into the standardized (STDTRAN) table. The field is 7 characters long, coded as follows: Digits 1-3: F00 - Fire intensity 0 (unburned control) F10 - Fire intensity 10 F15 - Fire intensity 15 F20 - Fire intensity 20 F25 - Fire intensity 25 F30 - Fire intensity 30 (hot-burned) Digits 4-5: M0 - Soil moisture = DRY M1 - Soil moisture = MOIST-DRY M2 - Soil moisture = MOIST M3 - Soil moisture = MOIST+WET M4 - Soil moisture = WET Digits 6-7: L0 - Logging = NO L1 - Logging = YES	A7
SUL	Sample-unit-layer;. This is the observed ground cover at the sample point. It is a record of the item sampled above each transect point, taken from 140 species and non-living categories (see the data dictionary for definitions; see TYPE for categories)	A8
LAY	Layer number 1-5, corresponding to A-E, with 1 topmost.	S
ATTRI	Attribute(s). A field for storing attributes for each items recorded under the SUL, in text format (see data dictionary for definitions). When preceded by a left bracket ([), it indicates the beginning of a unit category item that spans more than one sample point, and when preceded by a right bracket (]) it indicates the final sample point covered by that item (see field XSPAN for rules).	A8
XVLAY	Sampling stopping rules for vascular plant layers. This rule determined the maximum number of vascular plant layers to count and whether to use a vascular plant multiplier. Recording of layers was continued as long as successive strata were vascular plants; it ended after a non-vascular plant was encountered: 4V - record up to 4 vascular plant layers. 1V - record only the topmost vascular layer. 1M - record only topmost vascular layer, but use the vascular plant multiplier factor to record the diameter and distance to the nearest vascular plant which intersects the previous one foot of sampling tape.	A2
XCRYP	Cryptogam counting rule (XNCRYP). This rule was used for cryptogams: mosses (MOSS &	A2

	POLYT), liverworts (MAPO) and soil lichens (SLICH), but not fungi (FUNGI).) Cryptogams were usually counted as the lowest and last layer, since it was generally impossible to see what substrate was underneath them. The rule is as follows: /C stop recording layers after recording a vascular plant and do not record underlying cryptogams, or if no vascular plant is present, then and only then count a single cryptogam layer if it is present. +C require recording all cryptogams which intersect sample points, regardless of superimposed vascular layers. /D stop at the superimposed vascular plant and do not record underlying cryptogams, or if no overlying vascular plant occurs, then and only then record a single cryptogam layer using a multiplier factor for cryptogams that record the diameter and distance to the nearest vascular plant which intersects the previous one foot of sampling tape.	
XNLIV	Sampling stopping rules for recording non-living items: /L/B - stop recording if a plant or cryptogam is recorded, or if no plant or cryptogam is recorded, then record a litter or bare ground category in that order. +L/B - require that litter is recorded under each sample point regardless of superimposed layers, and stop recording; otherwise if no litter occurs, and no overlying plants or cryptogams occur, then and only then record a bare ground layer. /S-- - stop recording if a plant or cryptogam is recorded, or if no plant or cryptogam is encountered, enter S for sterile.	A4
XSPAN	Sampling grouping rules for spanning brackets used in the field ATTRI: +[- brackets are used within the habitat set. -[- brackets are not used within the habitat set.	A2
XCLU	Sample exclusion rule (XCLU). Because TH-2 used a variable transect size with variable sample point distances, the HAB categories had different numbers of points, some of which did not match the same HAB boundaries. It was necessary to exclude some of the points from analysis for two situations: (1) points which did not correspond to the same habitat from a different year, and which would not be used in any analyses; and (2) points which needed to be excluded in order to equitably balance the numbers of samples in each HAB category for different years, but which could be added back in for analyses such as percent cover which were not sensitive to the total number of samples. The three possible ways of treating these points was coded as follows: XX Exclude sample points from all analyses. XN Exclude sample points only from analyses that require the number of samples in each HAB category be equitable. OK Include sample points in all analyses.	
TYPE	Type of item BROAD broadleaf shrubs > 1 dm tall with woody or pithy stems; includes all Vaccinium except V. caespitosum, Sambucus racemosa, and Spiraea betulifolia. CONIF coniferous plants. CRYPT cryptogams; includes Selaginella densa, but not fungi. FORM landform; not strictly an item; includes blowdown mounds and burn holes (burned out roots). FUNGI fungi; does not include lichens. GRAM graminoids; includes grasses, sedges and rushes. HERB herbaceous perennials < 1 dm tall and hemicryptophytes; includes Pyrola uniflora, Orthilia secunda, Rubus pedatus Cornus unalaschkensis and Vaccinium caespitosum, but not other species of Vaccinium or Spiraea betulifolia. INANIM inanimate; sterile; all mineral and non-living organic combined except water. MINERAL mineral; bare, gravel, rock, boulder, bedrock, ash, but not water. MIX mix of any of these categories. NA not applicable; not recorded. ORGANIC non-living organic' includes litter, logs, humus, charcoal, but not ash SLICH soil lichen, but not fungi. UNK unknown WATER water	A7
TYP2	Selection variable for SUL category; presently set at 0 = non-living, blank = not an item, e.g., a process.	S

	1=vascular plant (BROAD or GRAM or HERB or CONIF); 2 - cryptogam or fungus (TYPE=CRYPT, SLICH, FUNGI)	
FIRE	Composite surface fire intensity, 0 to 30, relative to the surface layer. Value 0 (unburned): OV, UND, SRF=0 Value 10 (Low): OV<=3 AND UND<=3 AND SRF<=2 Value 15 (Medium-Low): OV>=4 AND UND<=2 AND SRF<=2 Value 20 (Medium): OV<=4 AND UND=(3 OR 4) AND SRF=(3 OR 4) Value 25 (High-Medium): OV>=4 AND UND>=4 AND SRF<=3 Value 30 (High): OV>=4 AND UND>=4 AND SRF>=4	S
FIR2	Selection variable for composite surface fire intensity: 0 = Unburned; 1 = Intermediate (FIRE = 10-25 inclusive); 2 = High-intensity.	S
MOISTURE	One of 5 categories of soil surface moisture: DRY; MOIST; MOIST+WET; MOIST-DRY; WET	A10
DRY2	Selection variable for surface soil moisture; presently set at 0 =WET; 1 = MOIST+WET; 2 = MOIST OR MOIST-DRY; 3 = DRY.	S
LOG2	Selection variable for logging presence on a transect habitat; presently set at 1 = LOG; 0 = NOT(LOG); there no blank values in this field. These values came from an earlier version of this field (LOGGING) which could have 3 values: NEAR, NO or YES.	S

STRAN7B.DB and ST7X.DB – cumulative plant observations

The file STRAN7B has all of the samples and all layers recorded for all years of the study. In April, Mary-Pat and George agreed on a set of criteria for including data in the analysis.

These criteria were as follows (the records available for analysis were selected from table STRAN7B and put into a Excel spreadsheet called ST7X.xls):

Task	Step #	Done by:	What	Note
1		MP	For the following plots, only display results for vascular plants categories of BROAD, HERB, GRAM & CONIF. Don't display any values for other categories like MOSS or even WOOD, because these were all lumped together as STERILE. The plots are: TH1 ('97), TH21 ('97, '98), TH22 ('97, '98), TH23 ('97, '98), & TH24 ('97, '98).	
2	---	GW	The category SLICH (soil lichen) was eliminated from all hot-burned plots and has not returned in them. For hot-burned plots through year 2000, SLICH should only be displayed as a flat line on zero abundance for all those years, or alternately if it is not being compared with an unburned control, just eliminate it as a category.	Automatically completed as a consequence of when Step 6a was done
3	4	MP	Eliminate the display of CRYPT (cryptogam, e.g., MOSS, MAPO, POLYT) cover for all points sampled with the rule in field XCRYP of "/C" or "/D".	There are 762 records out of 2331 in the database that have a "/C" or "/D" in field XCRYP. Rather than eliminate these records, it is preferable to merely eliminate the display of MOSS, MAPO or POLYT for all points in this analysis, and afterward do a separate analysis just to capture the additional data for the cryptogams.
4	---	GW	Eliminate all points in transects TH2 &	Automatically completed as a consequence

			TH26 as logged transects	of when Step 6a was done
5	3	GW	Eliminate all samples with the rule in field XVLAY of "1V" OR "1M".	These included 1421 samples in transects TH3, TH5, TH9, TH11, TH21, TH22, TH24, TH25, AND TH31, which were all eliminated from the ST7X table, leaving 2331 records.
6a	1	GW	Only include records for sample points in hot-burned, dry, unlogged areas	I only included records in which the field HABSEL was equal to "F30M0L0". The result contained 3754 records.
6b	2	GW	Eliminate all samples with only one sampling year.	Three tables were developed to query for the number of years each sample was measured. These were YEARS2, YEARS2B & YEARS2C. The latter table indicated sample points with only a single year of sampling by a value of "1" in the field TOT. There were 347 of these samples in the STRAN7B table. By this procedure, an additional 2 records were eliminated from the result after step 6a, giving 3752 records.
7		MP	check cross-tabs to be sure all sample points have the same HAB for all years.	
Add	---		Don't include records for overstory samples (with a "91" or "92" in the LAY field. By definition, there can be no live trees in a hot-burned sample.	Automatically completed as a consequence of when Step 6a was done
Add	5	GW	Eliminate additional "orphaned" records which no longer have more than one year of sampling as a result of the above selection criteria.	An additional 206 records were eliminated from ST7X, yielding 2125 records to be handed over to Mary-Pat

Recommendations for future studies

Select by habitat first (step 6a). Skip 6b until last. Probably skip step 5 as long as the assumption that the overlapped layers that weren't sampled is in areas with less than 5% vascular cover overall.

ANA8 (2007): STRAN8.DB

Data preparation for table STRAN8 should order field TYP2 FIR2, DRY2 in front of TYPE; make TYP2 = 0 for TYPE-FORM. Add field N for counting and fill it with value 1; TYP2 = 3 for CRYPT, SLICH and FUNGI; Change values of TYP2, FIR2, and DRY2 as shown below.

Rules for recording sample point information

Sampling rules were established that would allow more details to be collected on some transects, up to a limit which the budgeted workload would allow. The rules were designed so that sample points with more data would have compatible fields for combining the data with the less detailed observations. The rules were recorded on the datasheets, and entered into table TH8RULES in a concatenated text field 'RULES', for use in processing the data through to the analysis stage. Some data transformations involved parsing the data and/or the sampling rules into new fields. The sampling rules are described below, along with the

name of the parsed database field that they are specified in, if applicable.

General sampling rules. Each sample point (or SU) along a transect is used to record a ground cover type beneath it which may be a living plant or non-living category as defined in the data dictionary. Provisions are made for recording more than one layer, as described under the sampling rules (in this case, each record is sometimes referred to as a SUL or Sample-Unit-by-Layer).

A few cases occurred where a sample point lay adjacent to either a diffusely branched plant (as with *Gayophytum*, or ground-smoke) or a linear, vine-like plant more than twice as long in one direction (as with *Linnaea borealis*, the twinflower) . These were rare cases because with the exception of conifers, vines and diffusely branched plants are uncommon in this ecosystem. When a sample point did occur adjacent to such a plant, the observation was made by mentally reducing the horizontal projection of the plant to its minimum circular profile, and then recording an observation if the sample point intersected the projected circle. For diffuse overstory conifers, the observation was recorded as an estimated canopy density for the range of samples covered, e.g., for a tree with an 80% canopy, "0.8" is recorded in each ATTRI field next to the set of sample points below the canopy. Overstory canopy layers were recorded if the sample point would intersect part of a tree over 30' (10 m) tall, even if the tallest point of the tree was not directly over the point.

Observations which were undefined or unknown in the field, e.g., at the endpoints of the plot, were marked in the SU field with the symbol '-' or 'NR'.

Cover class aggregation rules. Cryptogams include mosses, liverworts, and lichens, but not fungi. In a wetlands, some of the aquatic liverworts that superficially resemble mosses may have been misclassified as mosses. One moss and one liverwort were segregated from their categories of MOSS and LIVER, respectively. These were the liverwort, *Marchantia polymorpha*, and the moss genus *Polytrichum*. Some of the aquatic liverworts that superficially resemble mosses may have been misclassified as mosses. The category *Polytrichum* (POLYT) of ground cover was created in 1997 when it was found that this single species of moss was one of the dominant species. Since there was no way to go back and change the previous year's data, comparative analyses of *Polytrichum* and moss cover require interpretation.

All roots were counted as category of litter, whether living or not. Transects TH-1, TH-21, TH-22, TH-23 and TH-24 used an aggregate code, STERILE, to represent all of: bedrock (BEDR), boulder (BOULD), rock (ROCK), bare gravel or mineral fines (BARE), coniferous needle, duff and cones (NEEDL), deciduous leaf (LEAF), humus (HUMUS), wood & log <6' long (WOOD), logs (LOG), and roots (ROOT).

Sampling rules for cover type unit boundary (XSPAN field).
When the cover type spanned more than one sample point, e.g., for rocks and logs or large

shrubs, the ATTRI field included left and right square brackets '[', ']' to mark the beginning and end of the individual cover type item.

Brackets are used in TH9TRAN.DB as the right-most character in the ATTRIB field, with '[' standing for the beginning hit, '[' standing for the end, and '.' for the intervening hits on the item.

During the first years of the study, brackets were used rigorously whenever inanimate bare (typically ROCK, BEDR or BOULD) or litter (typically LOG) categories spanned more than a single point; however in 1998, shrubs began to be bracketed, and in 2000, some herbaceous plants were bracketed. Analyses of plant crown diameters using brackets should not be considered comprehensive, but only as an example of an upper range of diameters

Brackets were primarily designed for calculation of size distributions of logs and rocks, and their use may be ignored in most other calculations.

Layer counting rule combined with vascular plant multiplier (XVLAY field). Layer sampling rules specify which ground cover types are allowed as the topmost and bottom-most layers. Sampling was designed to allow recording up to five different layers of different species above transect sample points. The code for each cover type observed above the sampling point was recorded in a field SUL (for sampling unit) along with additional information about the observation in the field ATTRIB.

The layer sampling rule for vascular plant layers was coded in the variable XVLAY as follows:

4V - record up to 4 vascular plant layers.

1V - record only the topmost vascular layer.

1M - record only the topmost vascular layer, and use the vascular plant multiplier factor to record the diameter and distance to the nearest vascular plant which intersects the previous one foot of sampling tape.

This rule determined the maximum number of vascular plant layers to count and whether to use a vascular plant multiplier. Recording of layers was continued as long as successive strata were vascular plants; it ended after a non-vascular plant was encountered.

The rule allows an exception when a non-living layer lies above a vascular plant layer. In that case, the non-living layer is counted anyway, and counting proceeds to the next vascular plant or cryptogam layer. Sterile matter such as logs or rocks that lie above living layers are recorded in the layer they occur in.

Size multiplier factor. Sample points made in some transects for the years 1996 and 1997 used a multiplier factor to increase the magnitude of the observed response. The multiplier factor was used in transects where many small plants occurred with a low or variable distribution which the transects could not capture. Transects which incorporated multiplier factors were those which had less than 5% total sampled vegetation by 1997.

The multiplier factor enlarged the sampling point to include the entire, preceding 1-ft line segment along the transect tape. Any plants that crossed the 1-ft line, were recorded in a separate field, along with the diameter of the plant and the distance of the center of the plant to the true transect point. Plants that intersected the true sample point were recorded in a normal fashion, however their size was recorded to allow a consistent application of an algorithm across the entire transect in determining abundance.

Lowermost layer rule (XNLIV field), combined with a rule for the definition of the "sterile" cover type.
The layer sampling rule for counting non-living material is coded in the variable XNLIV as follows:
/L/B stop recording if a plant or cryptogam is recorded, or if no plant or cryptogam is recorded, then record either litter or bare ground in that order.

+L/B require that litter is recorded under each sample point regardless of superimposed layers, and stop recording; otherwise if no litter occurs, and no overlying plants or cryptogams occur, then and only then record a bare ground layer.

/S-- stop recording if a plant or cryptogam is recorded, or if no plant or cryptogam is encountered, enter S for sterile.

When vascular plants were covered by non-living layers such as logs, the non-living layer was recorded as a layer, and counting proceeded to the next vascular plant or cryptogam layer. This was an exception to the typical case where the non-living layers are the lowest and last layer recorded.

For densely vegetated wetlands where more than three layers of vegetation were present the recording of multiple layers was stopped at the last vascular plant, which is reasonable since moss cover approached 100% in wetlands.

Standing water was always counted if it was the lowest layer, even when it was beneath a cryptogam layer (in which case, the cryptogam was also counted). In cases where peat-forming mosses such as *Drepanocladus* spp. hid standing water from visibility, the water layer was NOT counted. Standing water was counted last even if cryptogams or logs were under the surface, although if vascular plants had been found growing underwater, a new rule would have been formulated to allow them to be counted. Sample points which had sterile layers above water, e.g., logs going across streams, contain a record for both the log and the water.

Cryptogam counting rule (XNCRYP field)
This rule was used when cryptogams (mosses and liverworts) occurred in a layer. Cryptogams were usually counted as the lowest and last layer, since it was generally

impossible to see what substrate was underneath them. In wetland transects such as TH-10, the wet bottom layers contained a mix of both non-living water and numerous living undetermined mosses (peat); thus observed cover estimates of cryptogams, sterile "litter" and water in some wetland areas are somewhat arbitrary.

The layer sampling rule for counting cryptogam occurrences is coded in the variable XCRYP as follows:

/C - stop recording layers after recording a vascular plant and do not record underlying cryptogams, or if no vascular plant is present, then and only then count a single cryptogam layer if it is present.

+C - require recording all cryptogams which intersect sample points, regardless of superimposed vascular layers.

/D - stop at the superimposed vascular plant and do not record underlying cryptogams, or if no overlying vascular plant occurs, then and only then record a single cryptogam layer using a multiplier factor for cryptogams that record the diameter and distance to the nearest vascular plant which intersects the previous one foot of sampling tape.

Sample exclusion rule (XCLU). Because TH-2 used a variable transect size with variable sample point distances, the HAB categories had different numbers of points, some of which did not match the same HAB boundaries. It was necessary to exclude some of the points from analysis for two situations: (1) points which did not correspond to the same habitat from a different year, and which would not be used in any analyses; and (2) points which needed to be excluded in order to equitably balance the numbers of samples in each HAB category for different years, but which could be added back in for analyses such as percent cover which were not sensitive to the total number of samples. The three possible ways of treating these points was coded as follows:

XX Exclude sample points from all analyses.

XN Exclude sample points only from analyses that require the number of samples in each HAB category be equitable.

OK Include sample points in all analyses.

Layer attributes (the ATTRIB field). Along with the sample point species or ground cover type recorded, a second field, ATTRIB, is allowed for recording additional details of the ground cover observation. For example, if the cover type was a log, the field ATTRIB was used to record the length of the log. The ATTRIB field was also used to indicate the beginning and end of a cover type that spanned more than one sample point, by marking the field with left and right square brackets ("[" and "]"), for the beginning and end, respectively, of the sampled item. Some times, the ATTRIB field contained brief notes about an observation, such as plant health or height.

The rule for coding attributes as single entities with brackets is recorded in the variable XSPAN as follows:

+[- brackets are used to indicate the beginning and end of individual cover types that

span more than one sample point.
-[- brackets are not used.

Overstory strata (living tree canopy) was recorded in a separate database. Overstory trees were recorded if the sample point would intersect part of a tree over 33 ft (10 m) tall, even if the tallest point of the tree was not directly over the point. Trees with the sample point below the observer's eye level with only the top taller than 10 meters would not be counted by this definition (no such trees with this characteristic occurred along the transects).

For diffuse items, i.e., overstory canopy needles, the overstory canopy density was also recorded, e.g., 80%. For non-circular plants in which the profile was diffuse, or more than twice as long in one direction, the horizontal extent of the plant was mentally reduced to its minimum circular profile, and then recorded as a hit if the sample point intersected the reduced hypothetical perimeter. Sterile matter such as logs or rocks lying above living layers were recorded in the layer they occur in.

Other variables. In addition to recording the ground cover at each sample point, surveyors recorded site characteristics for the following attributes: "habitat" (HAB, a classification variable), fire intensity, moisture, and logging, as defined below:

a. Habitats (HAB field) is a grouping variable for sample points that all have the same burn intensity, soil wetness, logging presence, overstory density and understory diversity. Habitat categories crossed by the transects are given in appendix F. Habitats were delineated in the field by observer GW, based on experience with ecological sampling (Almack et. al., 1983; Daubenmire, 1970). The habitat boundary between different vegetation categories is technically defined as the half-way turnover point for species or species abundance, although this was subjective in the field. The other categories were integrated into this determination in the field. This procedure is actually easier than it appears, because the samples were purposefully located in areas of even vegetation and burn intensity, and also because the soil moisture controls most of the other variables, including canopy density, and this is readily determined through familiarity with wetland characteristics in this ecosystem (see moisture, below). The validity of this procedure is supported by the relatively few habitats recorded for any transect (usually 1 or 2, up to 9 for transect TH-5). A total of 81 habitats were recorded in the field, however these can be combined into a smaller number of groups because spatially separated habitats with the other characters identical were given separate habitat designations. These spatially-separated, similar habitats were recombined to generate the experimental groups for analysis, and in performing ANOVA.

b. Fire intensity or burn intensity is defined as a combination of three scores, one for each of three forest canopies: ***overstory, understory*** and ***surface***. In calculating fire intensity, the ***overstory*** (variable OVFIRE) only applies to trees (which are defined as single-bole woody plants >10 m tall). The **understory** (variable UNDFIRE) comprises

short-statured trees and tall shrubs ranging from 1 - 10 m tall, which are a mix of seral lodgepole, Scouler's willow, aspen and Engelmann spruce. The ***surface*** (variable SRFFIRE) is represented by fine-fueled, herbaceous and short-statured shrubs <1 m tall. Fire intensity is recorded in each of the three canopies as intensity levels between 0 and 5. These represented intensities of 0 (no fire), 1 (very low, only slight scorching on some branches), 2 (medium-low, scorching more extensive, possibly with some mortality, but always with some survivors), 3 (intermediate, with most vegetation affected, and about 50% mortality), 4(medium-high, with >90% of the vegetation impacted and most of these killed or burned up, but with up to 10% survivors or uncharred stems remaining), and 5(high, with all stems dead, burned up or completely charred, with no needles or leaves remaining).

The scores for fire intensity in each stratum were combined as follows to yield an overall high-medium-low score for the selection variable FIRE as follows:

Fire intensity composite score (for variable "FIRE")	**Algorithm**
0 (none)	OVFIRE=0,UNDFIRE=0,SRFFIRE=0
10 (low)	OVFIRE<=3 AND UNDFIRE<=3 AND SRFFIRE<=2
15 (medium-low)	OVFIRE>=4 AND UNDFIRE<=2 AND SRFFIRE<=2
20 (intermediate)	OVFIRE<=4 AND UNDFIRE=(3 OR 4) AND SRFFIRE=(3 OR 4)
25 (medium-high)	OVFIRE>=4 AND UNDFIRE>=4 AND SRFFIRE<=3
30 (high, or hot-burned)	OVFIRE>=4 AND UNDFIRE>=4 AND SRFFIRE>=4

Another variable, "FIR2", designates hot-burned areas with composite scores of 30, by the codes 1 = high-intensity hot-burned; 0 = unburned; null = any other fire intensity.

c. **Moisture** indicates whether the surface soil of the transect was dry, moist or wet, from one of the following categories: DRY, MOIST, WET, MOIST+WET, MOIST-DRY. Wetness (WET) areas are dominated by obligate wetland species, in areas that are perennially wet, determined by visible surface moisture; DRY areas are completely dominated by upland species, and have well-drained soils. Moist areas are those with diverse mixtures of wetland and upland species on soils that retain moisture through the season. MOIST+WET is a special category for hummocky ground with high water tables which contains small wetland fingers and islands (< approximately 0.5 meter across), interspersed with moist areas which are not wetlands. The category MOIST-DRY was created for two areas, one in plot 23 and one in plot 35, which superficially resembled the MOIST category, but in which the water table often fell by fall allowing the soil to become dry. Moisture was partly controlled by dense shading. The criteria for designating plants as facultatively or obligatively wet was derived from the national list of wetland plants, and is given in appendix D. Moist draws and swales occur in several transects, sometimes in proximity to wetlands or riparian areas. The variable DRY2 is used as a selection variable for surface soil moisture, with 1 = DRY ; 0 = NOT(DRY); and null values not allowed.

d. Logging indicates for whether nearby logging has potentially affected the transect. Choices are YES, NO or NEAR (for logging nearby, which could produce indirect effects such as windthrow). The variable LOG is a selection variable for logging presence on a transect habitat set at logged = 1 = LOG; unlogged = 0 ; and no blank values in this field.

e. Composite selection variable HABSEL. The fire intensity, soil moisture and logging presence were combined into a single field, HABSEL during transformation into the standardized (STDTRAN) table format, for ease in selecting multiple cases. The field was 7 characters long, coded as follows:

Digits	Values
1-3	F00 - Fire intensity 0 F10 - Fire intensity 10 F15 - Fire intensity 15 F20 - Fire intensity 20 F25 - Fire intensity 25 F30 - Fire intensity 30
4-5	M0 - Soil moisture = DRY M1 - Soil moisture = MOIST-DRY M2 - Soil moisture = MOIST M3 - Soil moisture = MOIST+WET M4 - Soil moisture = WET
6-7	L0 - Logging = NO L1 - Logging = YES

Appendix J. List of Files

FILELIST.DOC - This file. A list of computer files and directories used with the Thunder Fire Analysis.

<DIR> \raw - Raw data in paradox databases and in MS Word documents.

TH1DESC.DOC
TH2SITE.DB
TH3PHOTO.DOC
TH4DIST.DB
TH5NVASC.DB
TH6TREE.DB
TH7VEG.DB
TH8RULES.DB
TH9TRAN.DB
TH10HAB3.DB
TH11OVER.DB
TH12BAF.DOC
SPPLOOK.DB (ancillary file - lookup table for plant codes used in TH7Veg and TH9Tran, but different from that used in the flora section of the report).

<DIR> \doc\todo - Lists of future and planned tasks remaining by year.
<DIR> \doc\ref - reference files.
<DIR> \doc - Documents describing analysis results and progress reports.

AA-report-openfile2003-1.doc. open file report documenting highlights of research and workshop presentations on the post-fire vegetation changes and related biology following the Thunder fire in north-central Washington state. Data is updated into this report on an ongoing basis.
analysis.doc. analytical procedures tracking file
App-A-H.doc
APP-I-DATADCT.doc. data dictionary containing details about the file contents; contains assumptions originally contained in the file consider.doc: documenting analytical processes, assumptions and important considerations caused by the transformation of the raw data into standardized tables.
database changes.doc. Track changes in files.
filelist.doc - this file; list of all important files or folders in the Thunder directory.
Thunder summary data by plot.doc

<DIR> \ana
<DIR> \ana3 - standardized summary analysis tables for performing analytical procedures.

STDTRAN1.DB. This is the original version of the STDTRAN files, which along with STDTRAN2, was superceded and replaced by STDTRAN3.DB
The output filename for standardized output generated by the script STDTRAN.SC.

Input data comes from TH9TRAN.DB and TH11OVER.SC.

Standardization involves manipulation of the following fields:

[PLOTKEY] This is a label field for easy reference when browsing the table. It contains 3 pieces of information separated by dashes: The last two digits of the sampling year, the transect number, with leading zeros to make 3 digits, and the sample point number. Example: 00-001-216. The field is redundant whenever a layer contains more than one observation.

[UNIQID] This is a unique identifier for each layer of each sample point, however it only contains records for layers with actual observations, i.e., there is no record for a second stratum of vegetation if only one vegetation stratum existed. The 11 digits are coded as follows: digits 1-2 - transect number with leading zeros; digits 3-5 - sample point number; digits 6-9 - year observed; digit 10 - 0 for understory (non-tree) vegetation, 9 for overstory tree vegetation; digit 11 - layer number (1=topmost, maximum = 5 for layers A-E).

Example for "01001199801":

01 is the last two digits of LOCNUM (the plot number)
001 is the SUBNUM (sample number)
1998 is YR (the year)
01 is LAY (layer number, 91 = tree layer 1, and 92 = tree layer 2)

[LOCNUM]
[SUBNUM]
[YR]
[HAB]
[SUL]
[ATTRI]

[XVLAY] The stopping rules are recorded as fields, according to the syntax in DATADCT.DOC

[XCRYP] The stopping rules are recorded as fields, according to the syntax in DATADCT.DOC

[XNLIV] The stopping rules are recorded as fields, according to the syntax in DATADCT.DOC

[XSPAN] The stopping rules are recorded as fields, according to the syntax in DATADCT.DOC

STDTRAN2.DB (includes logging, trees).

The raw field data is used to generate a table, STDTRAN2, which is standardized according to the same rules in the script STDTRAN.SC, with the addition of two fields:

[TYPE] a hierarchical categorization of the observations made by linking to SPPLOOK.DB, as defined in DATADCT.DOC.

[TYP2] a hierarchical categorization of the observations such that 1 = vascular plants and 0 = all other observations.

STDTRAN3.DB This expanded the number of fields to include variables for logging, but not trees. This was the first table used as the basis of analyses, in the folder

/ana3/. It includes additional fields for

[OVFIRE] Overstory (>10 m tall) fire intensity, 0-5 (see below for a description of the values).

[UNDFIRE] understory (1-10 m tall) fire intensity, 0-5

[SRFFIRE] surface (0-1 m tall) fire intensity, 0-5

Fire intensity is recorded in each of the three canopies as intensity levels between 0 and 5. These represented intensities of 0 (no fire), 1 (very low, only slight scorching on some branches), 2 (medium-low, scorching more extensive, possibly with some mortality, but always with some survivors), 3 (intermediate, with most vegetation affected, and about 50% mortality), 4(medium-high, with >90% of the vegetation impacted and most of these killed or burned up, but with up to 10% survivors or uncharred stems remaining), and 5(high, with all stems dead, burned up or completely charred, with no needles or leaves remaining).

[MOISTURE] DRY, MOIST, WET, MOIST+WET, MOIST-DRY.

[LOGGING] YES, NO or NEAR

STDTRAN4.DB. This is an abbreviated export version of STDTRAN3, created on 2/2/2001; now obsolete.

STDTRAN5.DB. (Created on 2/18/01; obsolete: This was created with the layer field changed to 2 digits to accomodate 2 tree layers, defined as 91 = layer A; 92 = layer B. It was exported from Paradox/Win as three files: STDTRAN5 (no logging or trees), STDTRANL (logging included), STDTRANT (trees included).

<DIR> \ana6

STDTRAN6.DB. This was first created on 2/18/01. Changes include:

[LAY] formatted as short integer

[FIRE] - Composite fire intensity 0-30 as follows:

Fire intensity composite score (for variable "FIRE")	**Algorithm**
0 (none)	OVFIRE=0,UNDFIRE=0,SRFFIRE=0
10 (low)	OVFIRE<=3 AND UNDFIRE<=3 AND SRFFIRE<=2
15 (medium-low)	OVFIRE>=4 AND UNDFIRE<=2 AND SRFFIRE<=2
20 (intermediate)	OVFIRE<=4 AND UNDFIRE=(3 OR 4) AND SRFFIRE=(3 OR 4)
25 (medium-high)	OVFIRE>=4 AND UNDFIRE>=4 AND SRFFIRE<=3
30 (high, or hot-burned)	OVFIRE>=4 AND UNDFIRE>=4 AND SRFFIRE>=4

[FIR2] Selection variable for composite fire intensity; presently set at 1 = high-intensity (FIRE=30); 0 = unburned; blank = intermediate.

[DRY2] Selection variable for surface soil moisture; presently set at 1 = DRY (MOISTURE=DRY); 0 = NOT(DRY); there are no blank values allowed in this selection.

[LOG2] Selection variable for logging presence on a transect habitat; presently set at 1 = LOG (LOGGING=YES); 0 = NOT(LOG); no blank values in this field.

STDTRANA.DB. This is a temporary table used to subtract out records with logging and trees to create STDTRANL.DB and STDTRANT.DB (see below).
STDTRANL.DB. This table contains records of logged transects.
STDTRANT.DB. This table contains records with trees
STDTRANV.DB. This table contains only vascular plants, not trees.

<DIR> \ana7. Data from March 2003, used by Mary Pat Larsen to finalize project.

<DIR> \ana8. Copy of Stdtran7 created in Jan, 2007, by George.

SYSTEM FILES:
HABTRAN.QBE