2006 DOUGLAS-FIR TUSSOCK MOTH EARLY WARNING SYSTEM TRAPPING SUMMARY FOR OREGON AND WASHINGTON

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Summary
Douglas-fir tussock moth (DFTM) pheromone traps were located on approximately 508 Early Warning System (EWS) plots scattered throughout Washington and Oregon in 2006. In 2006, in almost all reporting areas, trap catches show an average increase from the previous year, and the overall average trap catch for the Region has increased. In most areas catches remained below threshold levels; however, there was noticeable increased trap catch on the Ochoco, Wallowa-Whitman, and Malheur NF's. These average trap counts are comparable to early trends prior to the outbreaks in 1989-1991, and the more recent outbreak of 1999-2001, and coincide with the cyclic outbreak of DFTM. If DFTM follows its cycle, we should see a significant increase in trap catches in 2007, especially on the Malheur and Wallowa-Whitman NF's. Trapping in 2007 will be very important for continuing to monitor the insect trends on these Forests, and some on-the-ground monitoring should be initiated. The remaining participating Forests and cooperators should also continue EWS monitoring.

Background
Douglas-fir tussock moth, *Orgyia pseudotsugata* (McCunnough) (Lepidoptera: Lymantriidae), outbreaks in the western United States and Canada tend to be cyclic, occurring about every 9 years (Shepard et al., 1988). In the Pacific Northwest, a Douglas-fir tussock moth population increase consists of four phases or years. During the first phase, the population begins to increase, but remains at suboutbreak levels. In phase II the population begins to increase to above the outbreak level threshold and some defoliation is apparent. In phase III, populations are extremely high and result in complete tree defoliation. Populations remain very high during phase VI; however, population pressure and insect pathogens cause the population to collapse during this phase. Additional defoliation will be incurred during this phase, subsequent to the collapse of the population.

Generally land managers do not recognize the significance of the severity of a DFTM outbreak until phase III when the first year of complete defoliation occurs. Once significant defoliation occurs, it is too late to implement any management options.

From 1971-1974, a widespread outbreak of Douglas-fir tussock moth occurred in eastern and central Washington, northeastern Oregon, and in adjacent Idaho. Since that time,

populations have fluctuated three times which resulted in defoliation. The first two fluctuations resulted in outbreaks in more localized areas near Burns, OR in the early 1980's and near Halfway, in northeastern Oregon in the early 1990's. In 1991, about 116,000 acres of that outbreak were treated with the biological insecticide, *Bacillus thuringiensis* var. *kurstaki*. A more extensive outbreak occurred from 1999 to 2002. Approximately 220,000 acres of defoliation were detected in northeastern Oregon in 2000, and 39,000 acres were treated with TM-BioControl-1, the natural virus of the DFTM. In 2001, an additional 16,690 acres were treated on the Okanogan National Forest in Washington. By the fall of 2002, populations had returned to near endemic levels.

The DFTM Early Warning System

DFTM population level trends are monitored annually throughout Oregon and Washington using pheromone traps. This on-going DFTM EWS is a cooperative effort by the USDA Forest Service, the Oregon Department of Forestry, the Washington Department of Natural Resources, the USDI Bureau of Indian Affairs, and the USDI Bureau of Land Management. Other western Regions and States also participate in this West wide survey. The objective of the EWS is to detect incipient DFTM outbreaks. When trap catches increase to predetermined levels, additional sampling activities are initiated to further quantify population levels (Sheehan, et al., 1993). The DFTM EWS is intended to provide an advance warning of population changes that would indicate a potential outbreak one to two years prior to the outbreak occurring. This would allow land managers an opportunity to evaluate, analyze, and implement management options before high levels of defoliation occur. Daterman, et. al. (2004) summarizes the results and the effectiveness of the System on over 20 years of DFTM population monitoring sampling in the West.

The pheromone traps are deployed according to standardized procedures (Daterman, et al., 1979) in specified trap sites in July and retrieved following moth flight in the fall. The pheromone lures contain a very low pheromone dose and are calibrated specifically to detect low populations. There are five traps per plot. The average number of moths per trap is calculated for each plot. Male DFTM are sampled annually on these permanent locations throughout eastern Oregon and Washington. This report summarizes the sampling results for 2006.

Population Monitoring Process

Plot trap catch averages, trends in trap catches on plots from year to year, and trap catch density patterns over larger geographic areas are the factors considered when determining future sampling intensity and methodology. When plot averages exceed predetermined threshold levels and the trend of trap catches is increasing in areas where defoliation would concern land managers, ground sampling is initiated.

Cocoon, egg mass, and/or larval surveys, using methods described by Fettig et al. (2001), are conducted in the fall of the same year, or spring and summer of the following year, in the vicinity of plots with trap catch averages exceeding 40 moths per trap within areas of concern. Cocoon and larval survey data provide estimates of population densities and

give more accurate indications of outbreak potential and population trends than the EWS pheromone trap data, which is intended to indicate population trends over larger geographic areas.

The DFTM Early Warning System is **not designed or intended** to predict exactly where the defoliation will occur; areas to be sampled on the ground should be selected on the basis of the impact of potential DFTM defoliation on management objectives. DFTM EWS traps are not calibrated for use during an actual DFTM outbreak. As populations increase, a decline in trap catches will typically be noted. Once the traps have signaled a population increase, larval and cocoon/egg mass surveys are used to determine what the populations are doing in a particular area.

Results and General Trend

Figure 1 shows the average number of moths caught in DFTM pheromone traps distributed throughout the host range in eastern Oregon and Washington. Throughout the Region, most trap catches remained at endemic levels, however, the average trap catch has increased. Figure 2 shows the trend of traps with trap catches by categories of moths per trap. Figures 3 - 11 show the trap catch trends of the reporting areas. These reporting areas include the trapping sites on the adjacent state and private lands, as well.
Most noticeable trap catch increases were on the Ochoco, Malheur, and Wallowa-Whitman NF's and adjacent lands.

The highest average population increase was on the Ochoco NF. However, past trapping trends (Figure 9) indicate that this is within the typical range of population fluctuations for that area. EWS trapping for 2007 should be done to verify that trend continues.

The populations on the Wallowa-Whitman and the Malheur NF's should be monitored closely. If the cyclic trend continues, the populations in these areas could be moving from Phase I to Phase II in 2007 (Figures 8 & 10, respectively). Areas of special interest should be identified and additional ground monitoring should be done. EWS trap results in 2007 will be critical. If the trend continues, treatment should be considered, possibly as early as 2008, and especially by 2009. It is expected that little defoliation will be evident in 2008 or 2009, however, to effect the most foliage protection, treatment must occur before the year when significant defoliation will be evident. Treatment could either be an application of a biological insecticide (*Bacillus thuringiensis* or TM-Biocontrol-1, the DFTM virus) in the spring of or a fall application of the DFTM pheromone for mating disruption.

Figures 12 -14 and 15-17, are maps showing the distribution and location of the DFTM traps and numbers of moths trapped in Oregon and Washington from 2004 - 2006, respectively.

Table 1 lists the plots throughout Washington and Oregon where traps with an average of 10 or more moths/trap were caught.

DFTM Early Warning System data and summaries for Oregon and Washington can be found on the R6 website: http://www.fs.fed.us/r6/nr/fid/data.shtml#dftm. Additional information on the DFTM Early Warning System, previous years' reports and maps of trap locations, and an animated map series showing the changes in trap catches from 1995-2006 can also be found on this site.

References Cited

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Daterman, Gary E.; J.M. Wenz; and Katharine A. Sheehan. 2004. Early warning system for Douglas-fir tussock moth outbreaks in the Western United States. Western J. of Applied For. 19(4): 232-241.

Fettig, Christopher J.: Jeffrey Fidgen; Quintin C. McClellan; Scott M. Salom. 2001. Sampling methods for forest and shade tree insects of North America. US Dept. of Agric., Forest Service, Forest Health Technology Enterprise Team, FHTET 2001-01. 273p.

Sheehan, K.A.; E.A. Willhite; A.Eglitis; P.T. Flanagan; T.F. Gregg; and B.B. Hostetler. 1993. Regional guidelines for sampling Douglas-fir tussock moth and western spruce budworm. US Dept. of Agric., Forest Service, Pacific Northwest Region, For. Pest Mgmt. R6-93-03. 18p.

Shepherd, R.F.; D.D. Bennett; J.W. Dale: S. Tunnock; R.E. Dolph; and R.W. Their. 1988. Evidence of synchronized cycles of outbreak patterns of Douglas-fir tussock moth, *Orgyia pseudotsugata,* (McCunnough) (Lepidoptera:Lymantriidae). Ipaths From a Viewpoint: The Wellington Festschrift on Insect Ecology. Mem. Ent. Soc. Can. 146:107-121.

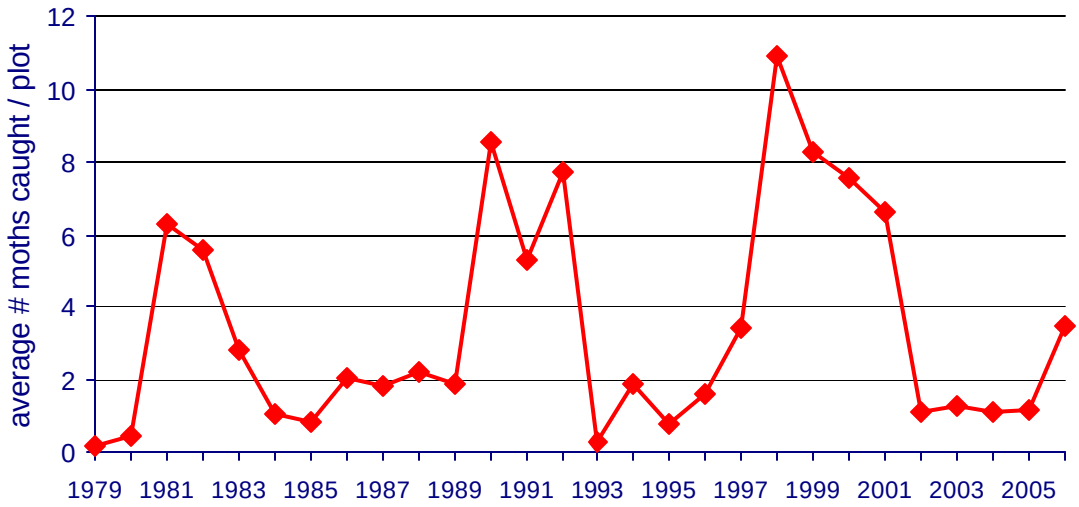

Figure 1: Average number of Douglas-fir tussock moths caught per plot in DFTM pheromone traps distributed throughout eastern Washington and Oregon. The overall Regional trend is increasing.

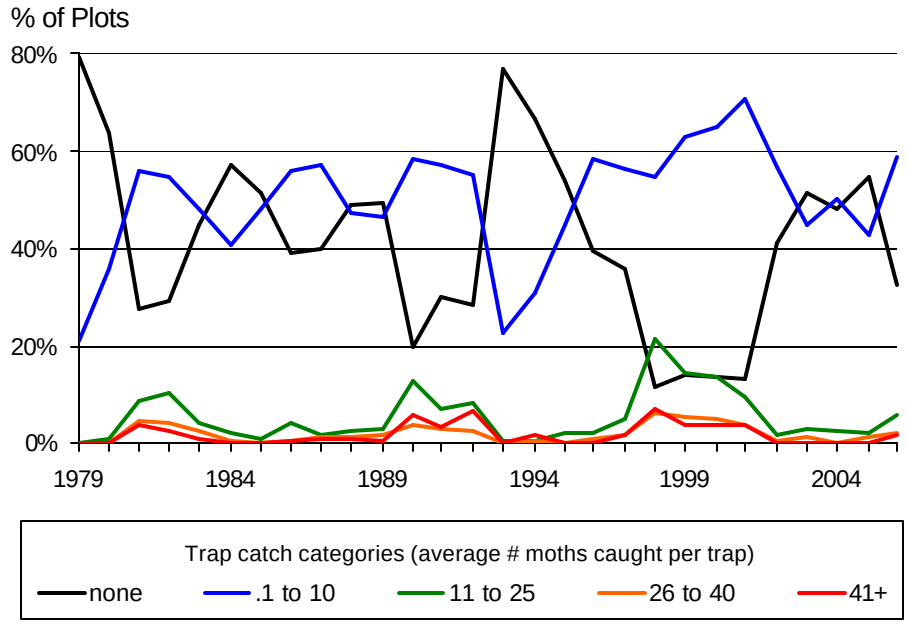

Figure 2: Trend of the average moth catches for the Region, by number of moths per trap. The number of traps with no moths decreases and the number traps catching some moths (primarily .1 – 10) increased.

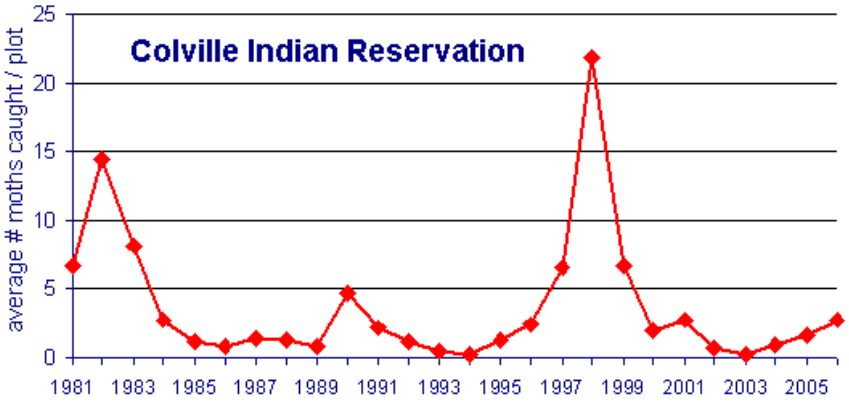

Figure 3. Average plot catch trends for the Colville Indian Reservation and adjacent lands, WA.

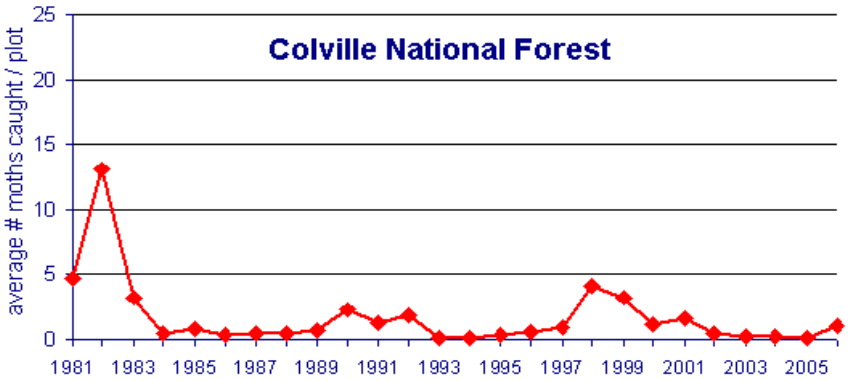

Figure 4: Average plot catch trends for the Colville NF, and adjacent lands, WA

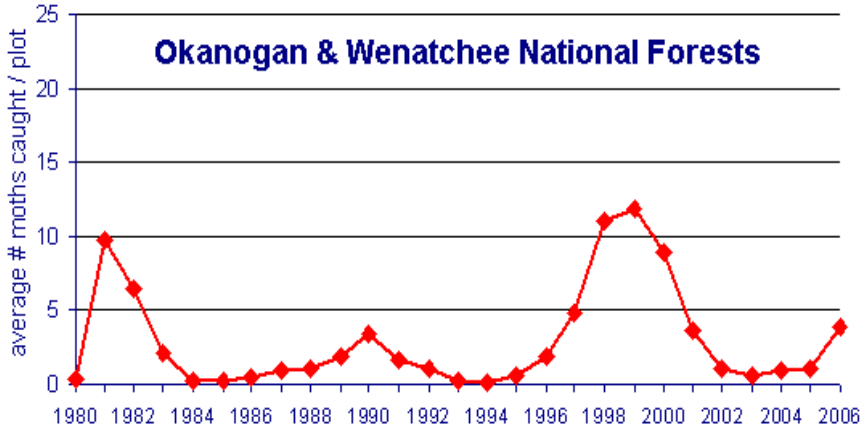

Figure 5:Average plot catch trends for the Okanogan and Wenatchee NF's and adjacent lands, WA

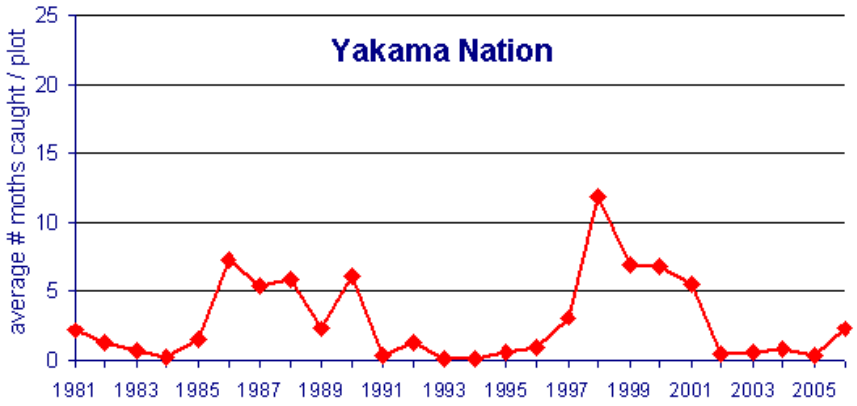

Figure 6: Average plot catch trends for the Yakama Nation and adjacent lands, WA

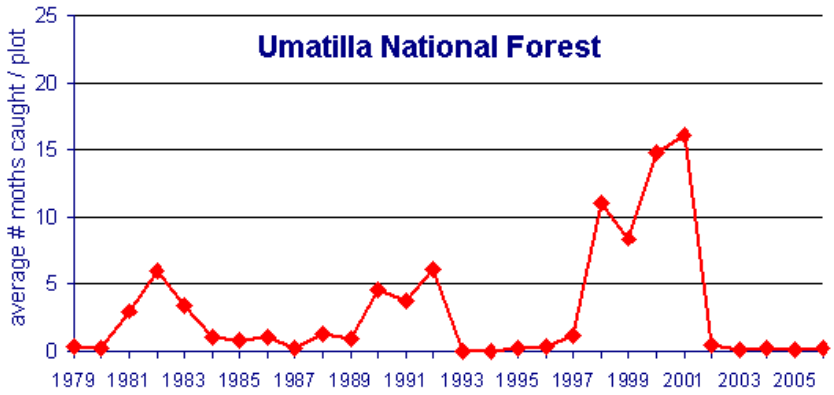

Figure 7: Average plot catch trends for the Umatilla NF and adjacent lands, OR

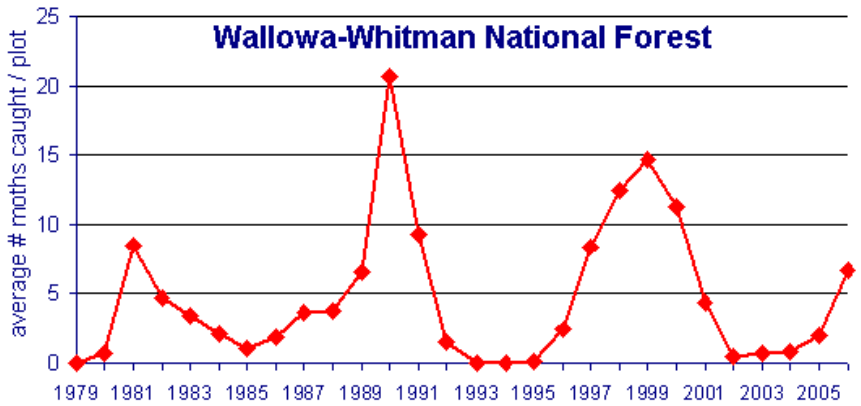

Figure 8: Average plot catch trends for the Walla-Whitman NF and adjacent lands, OR

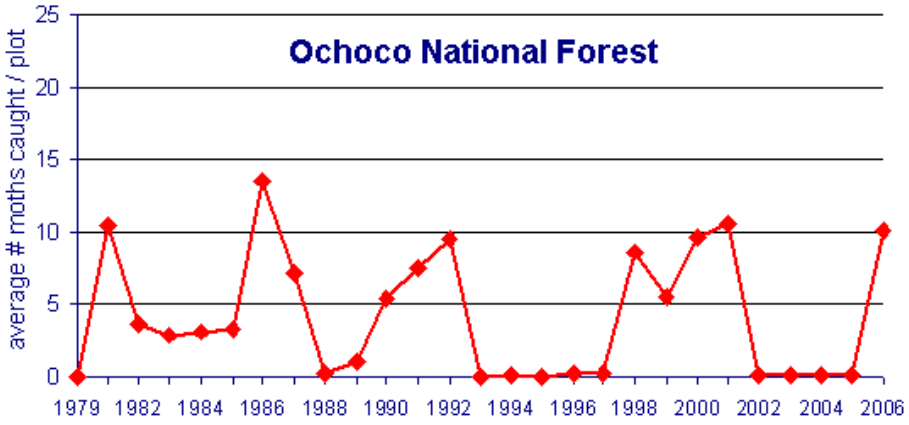

Figure 9. Average plot catch trends for the Ochoco NF and adjacent lands, OR.

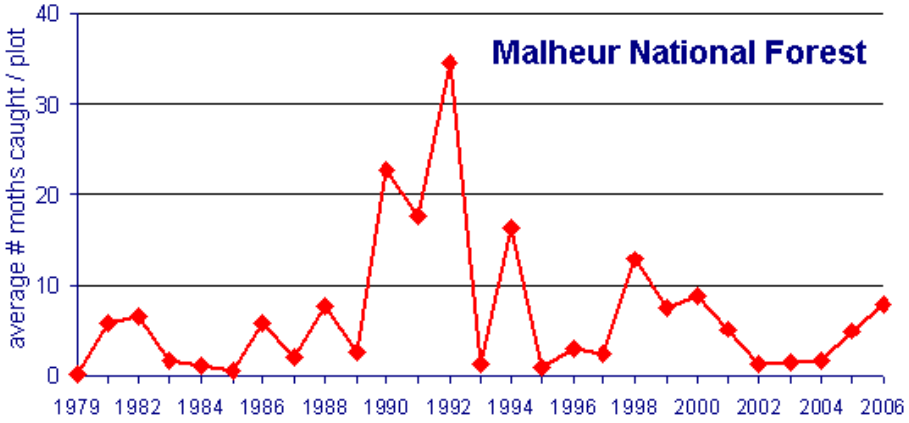

Figure 10: Average plot catch trends for the Malheur NF and adjacent lands, OR

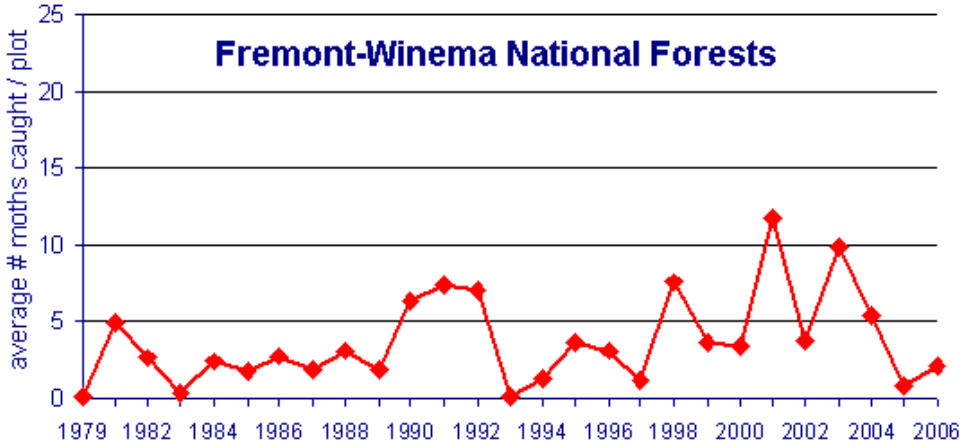

Figure 11: Average plot catch trends for the Fremont-Winema NF and adjacent lands, OR

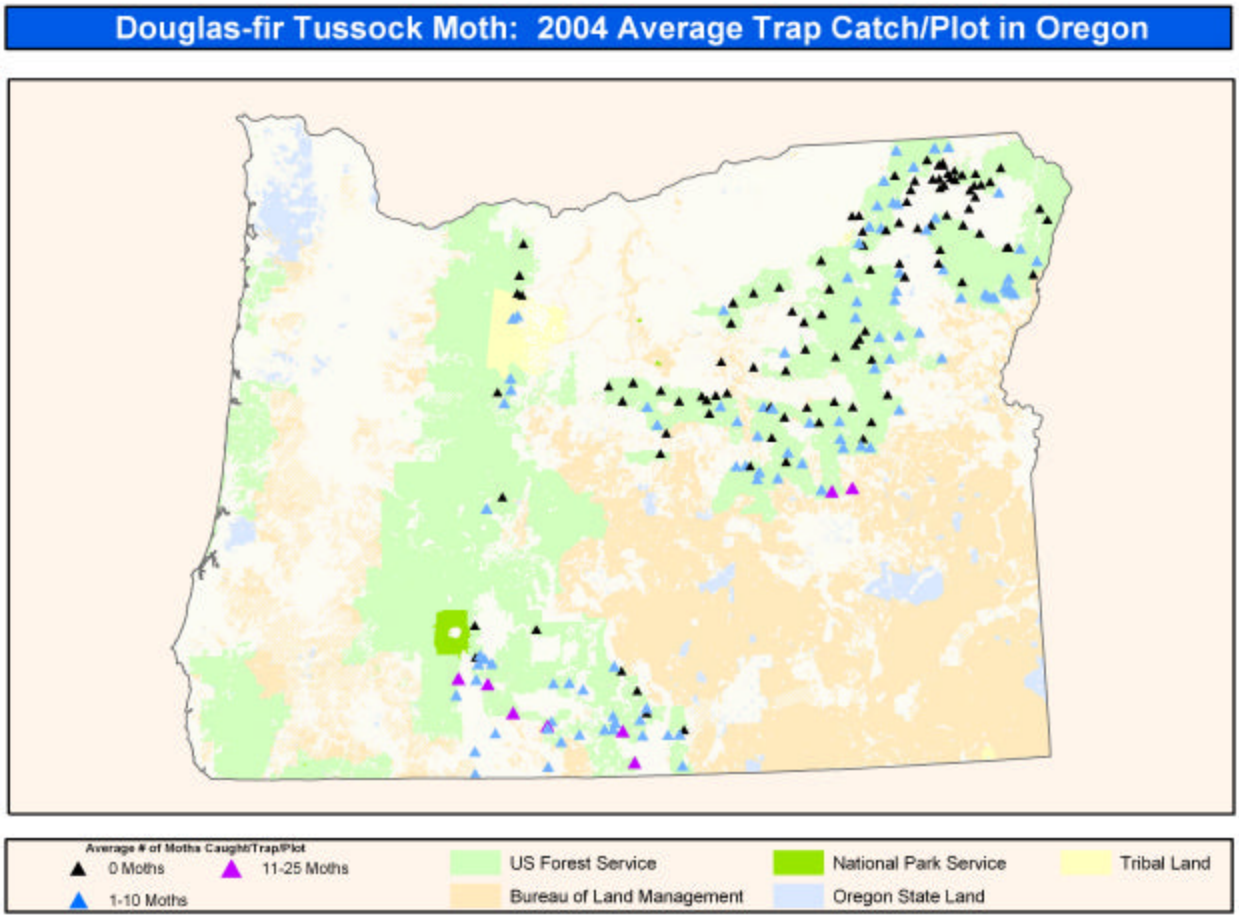

Figure 12: DFTM EWS trap locations and moth catches for Oregon, 2004.

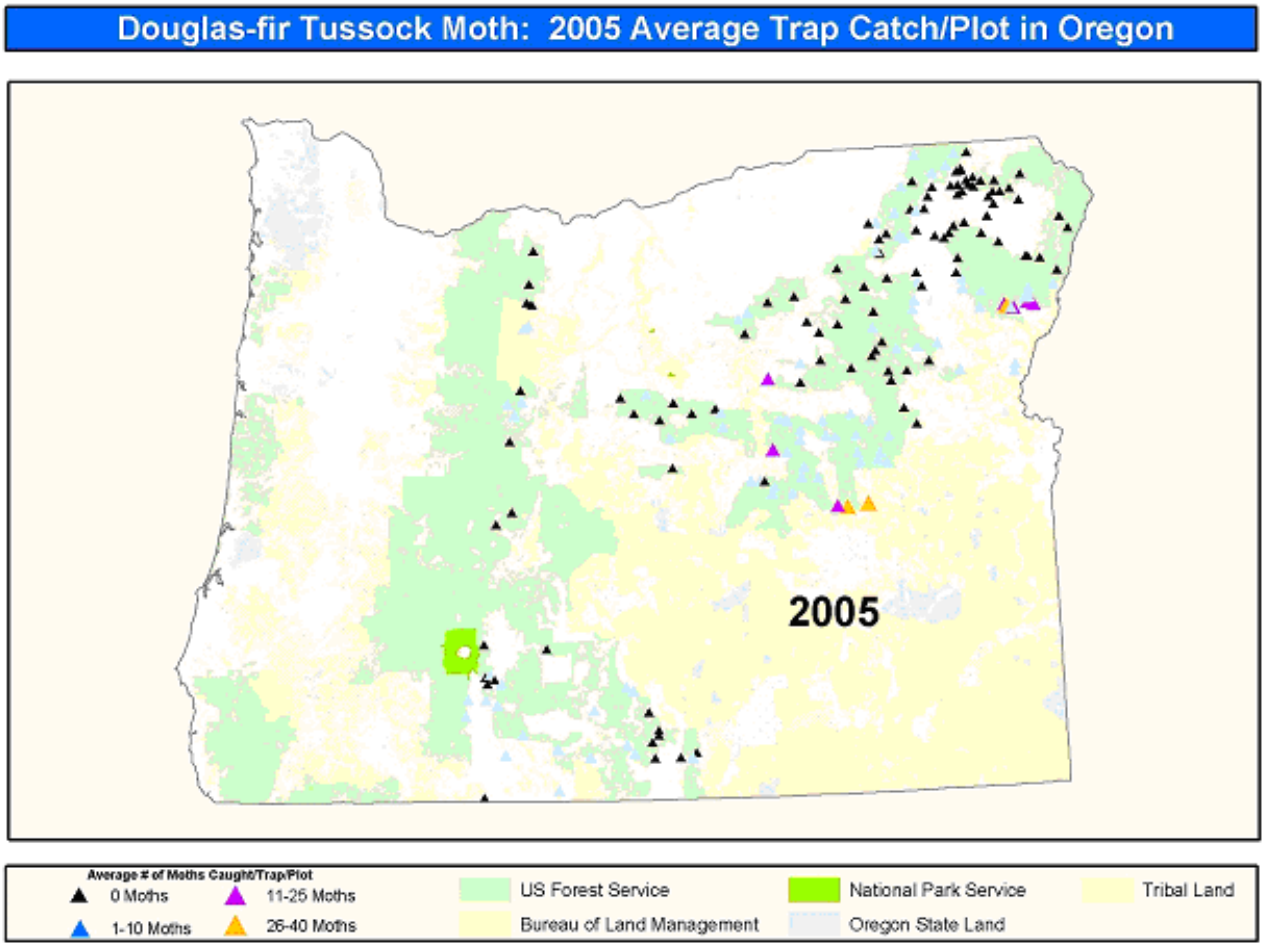

Figure 13: DFTM EWS trap locations and moth catches in Oregon for 2005. Note the decrease in the number of traps with higher moth catches in South Central Oregon and the increase in the number of traps with higher trap catches in Northeastern Oregon.

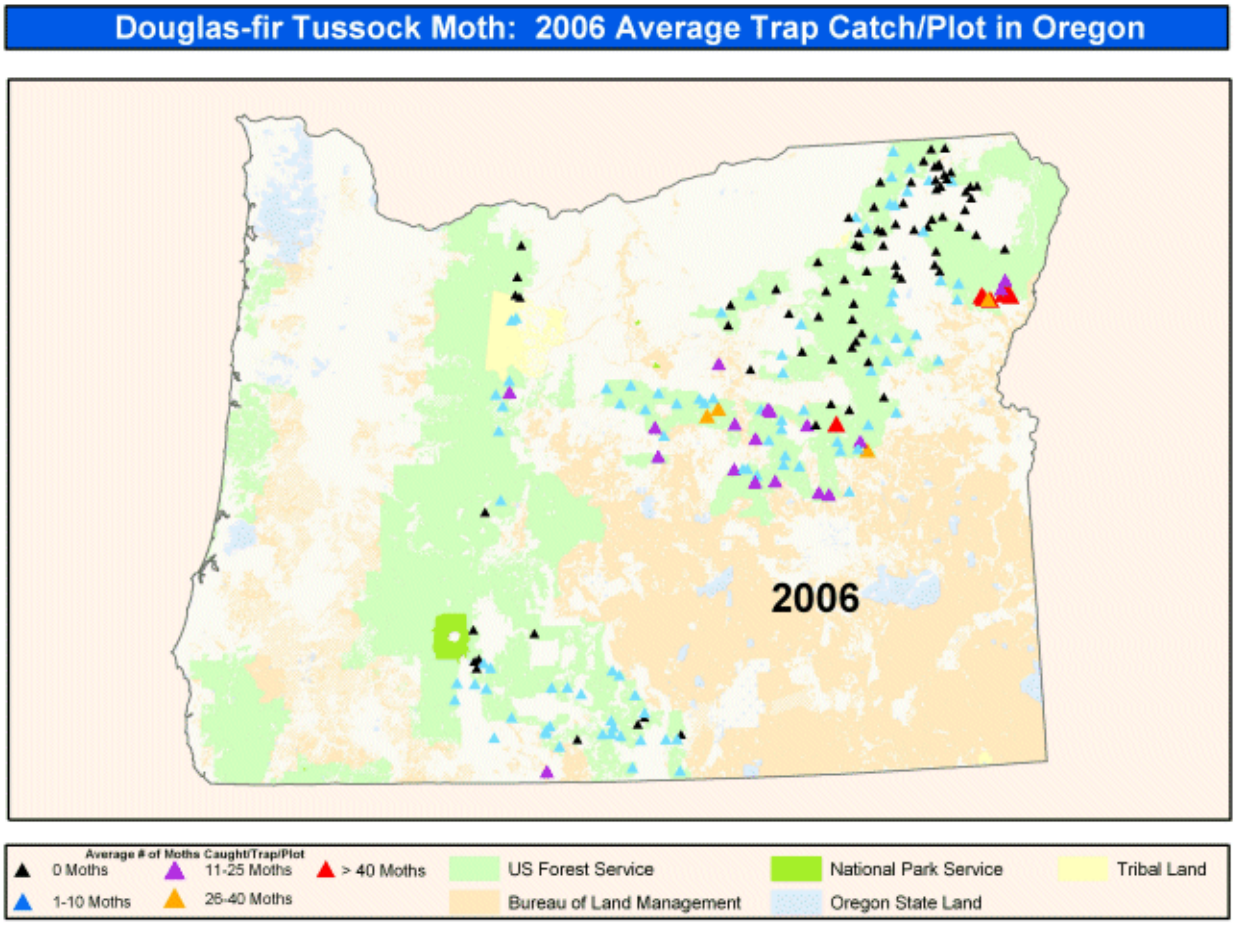

Figure 14: DFTM EWS trap locations and moth catches in Oregon for 2006. Note the increase in the number of traps with higher moth catches in Northeastern Oregon, especially on the Malheur and Wallowa-Whitman NF's and adjacent lands.

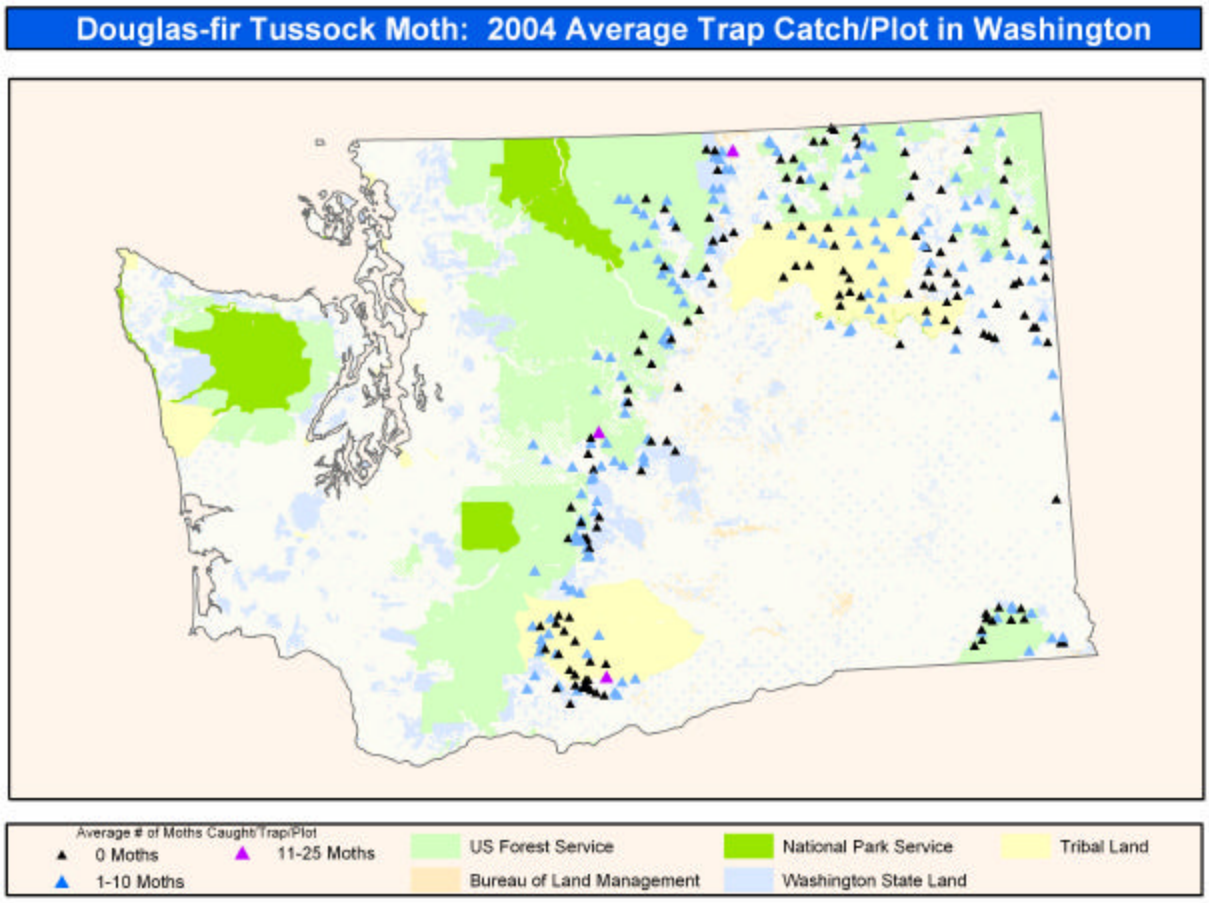

Figure 15: DFTM EWS trap locations and moth catches for Washington, 2004.

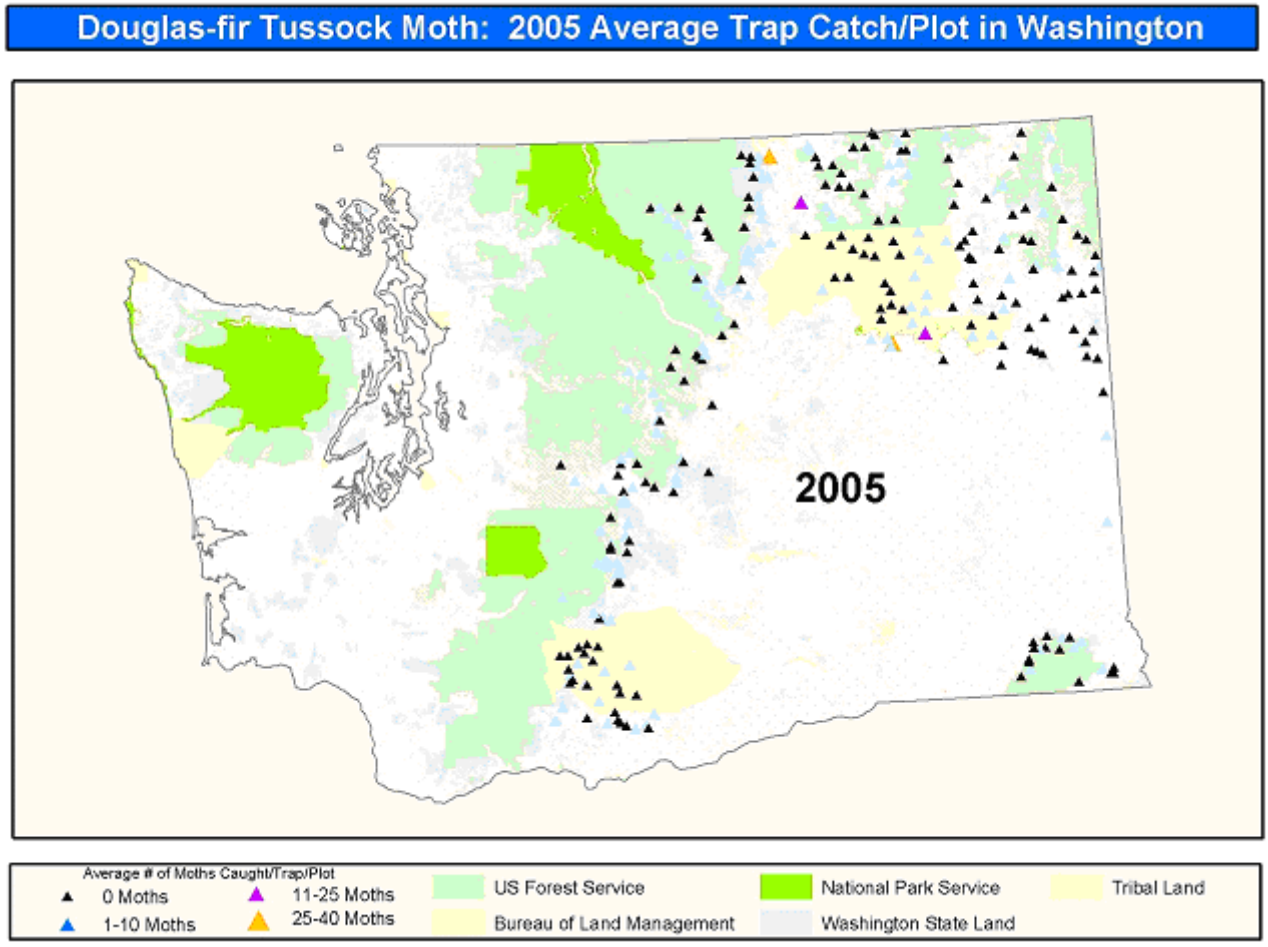

Figure 16: DFTM EWS trap locations and moth catches for Washington, 2005.

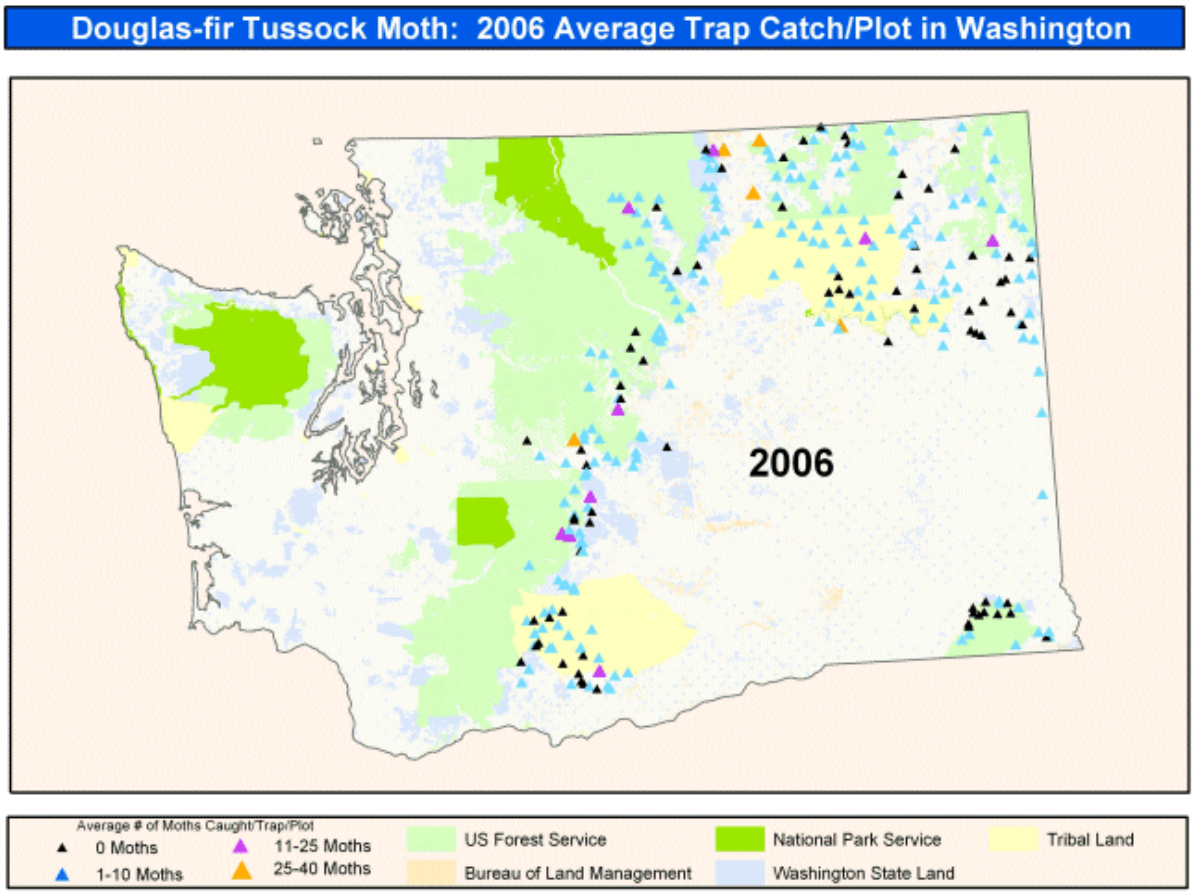

Figure 17: DFTM EWS trap locations and moth catches for Washington, 2006. Note the trend of fewer traps with no moths and traps with some moth catches.

Table 1: DFTM plots with average trap catches of 10 or more moths per trap, primarily on the Wallowa-Whitman and Malheur NF's.

NearestForest	Nearest District	PlotNo	PlotName	Agency	1999	2000	2001	2002	2003	2004	2005	2006
Colville IR	Inchelium	7	Lynx_Creek	bia	0.8	0.8	0.8	5.4	0.2	1.6	1.2	12.6
Colville IR	South	111	Keller_Ferry	dnr	50.4	15.8	21.4	1.6	0.6	6.4	26.0	27.8
Colville NF	Newport	2	Winchester_Cr	usfs	4.4	1.8	0.2	0.2	0.6	0.0	0.6	12.8
Deschutes NF	Sisters	5	Black_Butte	usfs	0.4	2.0	2.6	0.6	0.2	0.6	0.4	9.6
Deschutes NF	Sisters	6	Bear_Springs	usfs	0.4	1.4	22.0	1.0	0.0	1.4	1.0	15.0
Fremont-Winema NFs	Bly	KL-44	Private	odf	1.6	5.0	26.0	6.6	34.4	9.4	4.4	11.4
Malheur NF	Blue_Mtn	1	Johnson_Heights	blm	13.4	36.8	55.6		0.0	0.0		11.8
Malheur NF	Blue_Mtn	3	Starr_Ridge	usfs	1.8	5.5	1.2	0.8	0.0	1.4	1.2	18.2
Malheur NF	Blue_Mtn	7	Buck_Cr	usfs	10.8	25.6	1.2	0.4	3.0	2.0	15.0	10.6
Malheur NF	Blue_Mtn	9	Hattie_Creek	usfs	30.8	31.6	2.3	0.2	0.0	0.0	1.8	16.6
Malheur NF	Blue_Mtn	10	Last_Creek	usfs	37.4	53.5	2.0	0.2	0.4	1.6	2.6	16.6
Malheur NF	Emigrant_Cr	201	2850_Road	usfs	15.8	8.2	9.2	9.8	11.8	13.6	34.8	13.2
Malheur NF	Emigrant_Cr	202	King_Mountain	usfs	2.6	5.0	0.8	1.8	1.6	0.6	11.0	14.4
Malheur NF	Emigrant_Cr	207	Yellowjacket	usfs	7.0	9.4	4.0	4.2	2.4	3.0	0.2	12.8
Malheur NF	Emigrant_Cr	403	Boundary	usfs	13.2	9.2	3.2	0.4	0.2	4.4	3.2	11.4
Malheur NF	Emigrant_Cr	408	Coyote	usfs	20.6	27.6	1.2	3.0	0.2	3.2	8.4	12.0
Malheur NF	Prairie_City	1	Antelope	usfs	37.2	9.6	2.0	0.8	1.2	0.2	2.8	28.8
Malheur NF	Prairie_City	2	Mcallister_Spr	usfs	1.0	1.0	1.8	0.4	0.2	0.0	0.8	16.0
Malheur NF	Prairie_City	3	Mccoy	usfs	11.4	2.8	0.8	0.0	0.6	0.2	2.8	43.3
Ochoco NF	Lookout_Mtn	3	Maury_Mtn	usfs	3.8	2.0	4.8	0.0	0.4	0.0	0.0	18.0
Ochoco NF	Lookout_Mtn	8	Lutsey	usfs	5.8	1.0	1.6	0.0	0.0	0.2	0.2	18.6

NearestForest	Nearest District	PlotNo	PlotName	Agency	1999	2000	2001	2002	2003	2004	2005	2006
Ochoco NF	Paulina	4	Frazier_Creek	blm	14.0	34.4	12.4		0.2	0.4		10.8
Ochoco NF	Paulina	1	Bearskull	usfs	6.5	8.6	1.6	0.0	0.2	0.2		32.4
Ochoco NF	Paulina	4	Yuma	usfs	6.6	20.4	9.2	0.0	0.6	0.0	0.4	33.4
Okanogan&Wen. NFs	Cle_Elum	151	South_Fk_Monastash	dnr	16.0	9.0	5.0	0.8	0.2	0.8	1.6	11.4
Okanogan&Wen. NFs	Cle_Elum	196	Teanaway_Butte	dnr								26.6
Okanogan&Wen. NFs	Cle_Elum	2	Red_Top	usfs	22.0	5.4	0.8	0.6	1.4	7.2	0.0	9.6
Okanogan&Wen. NFs	Cle_Elum	3	Stafford	usfs	17.4	7.2	0.6	0.4	1.0	10.8	0.8	10.0
Okanogan&Wen. NFs	Methow_Valley	65	Sandy_Butte	dnr	50.8	46.6	9.2	0.0	0.0	0.6	2.4	11.4
Okanogan&Wen. NFs	Naches	158	Cowpuncher_Ridge	dnr	13.0	10.0	12.6	2.0	0.4	3.8	5.2	18.8
Okanogan&Wen. NFs	Naches	86	Rattler	usfs	4.6	3.0	5.0	2.0	0.8	0.0	3.6	12.6
Okanogan&Wen. NFs	Naches	88	Hell_Creek	usfs	5.4	1.4	0.8	4.6	1.0	3.0	1.8	9.6
Okanogan&Wen. NFs	Tonasket	8	Palmer_Lake	dnr	58.6	34.4	9.4	13.0	4.6	18.6	28.4	33.2
Okanogan&Wen. NFs	Tonasket	59	Chopaka	dnr		9.6	8.6	7.2	2.2	0.6	0.8	12.2
Okanogan&Wen. NFs	Tonasket	68	Molson	dnr		0.4	2.0	4.2	0.4	3.0	1.0	40.0
Okanogan&Wen. NFs	Tonasket	173	Dusty_Mtn_Meadow	dnr	55.0	52.6	40.0	26.6	7.8	3.0	17.8	34.2
Okanogan&Wen. NFs	Wenatchee_River	88	Camas_Land	dnr		31.0	0.8	0.2	0.0	1.2	0.2	13.0
Okanogan&Wen. NFs	Wenatchee_River	78	Icicle_Mac_Cr	usfs	9.2	8.0	10.4	0.2	0.0	0.2	2.0	9.6
Wallowa-Whitman NF	Pine	71	Paddy_Seed_Orch	usfs	63.6	59.2	9.4	2.0	9.6	5.6	33.8	60.2
Wallowa-Whitman NF	Pine	72	Big_Bend	usfs	93.0	54.4	22.0	2.2	1.2	0.6	8.8	18.8
Wallowa-Whitman NF	Pine	73	Upper_Clear_Cr	usfs	71.0	21.6	2.0	1.2	0.6	0.2	2.2	14.8
Wallowa-Whitman NF	Pine	74	Summit_Pt_Rd	usfs	87.8	56.2	23.6	3.2	1.6	3.2	12.8	51.0
Wallowa-Whitman NF	Pine	75	Rd_050_Dry_Cr.	usfs	88.8	54.0	56.0	7.0	3.8	6.6	19.0	48.6
Wallowa-Whitman NF	Pine	76	Clr_Cr._Beecher	usfs	94.4	71.6	23.4	4.2	6.0	3.8	13.0	40.8
Wallowa-Whitman NF	Pine	77	Spring_Cr	usfs	75.4	54.0	22.7	4.0	3.0	0.8	4.0	27.0
Wallowa-Whitman NF	Pine	78	Gold_Eagle_Pack	usfs	26.6	12.2	6.0	1.8	2.0	2.0	11.6	41.2
Wallowa-Whitman NF	Pine	79	Fish_Lake	usfs	59.8	50.6	3.4	2.6	4.0	5.8	10.0	54.6
Yakama Nation	Yakama Nation	18	Simcoe Butte	bia	0.0	0.0	0.0	0.0	7.6	15.4		23.8