2007 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 470 Early Warning System (EWS) plots scattered throughout Washington and Oregon in 2007. In 2007, the overall average trap catch for the Region increased slightly from 2006. In many of the trapping areas the number of moths/trap either remained the same or decreased. However, trap catches increased significantly on the Wallowa –Whitman, and Malheur NF areas, and slightly on the Okanogan NF area and Colville Indian Reservation. 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. Trapping in 2008 will be very important for continuing to monitor the insect trends on these Forests, and some on-the-ground monitoring should be initiated. Defoliation may be evident in some localized areas in 2008.

The remaining participating Forests and cooperators should also continue EWS monitoring.

Background
Douglas-fir tussock moth, *Orgyia pseudotsugata* (McCunnough) (Lepidoptera: Noctuidae:Lymantriinae), 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 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. Traps are located in "sentinel sites", or areas where DFTM populations are likely to express themselves early in a building population. Sites usually have a history of DFTM in the areas, but are not necessarily in areas of specific management objective or concern. 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. The permentant plots help establish a history or trend of the DFTM populations. This report summarizes the sampling results for 2007.

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 25 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 should be 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 or low levels, however, the average trap catch increased slightly. 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 Blue Mountain Ranger District on the Malheur, the Pine Ranger District on the Wallowa-Whitman NF. Not all Districts on the Wallowa-Whitman NF were not trapped, therefore, the actual increase on that Forest may be underestimated. In Washington, the Methow Valley and Tonasket Ranger Districts on the Okanogan NF and adjacent lands also show an increase in populations.

Overall regional trend is up as approximately 65 percent of traps caught some moths.

The populations on the Wallowa-Whitman and the Malheur NF's should be monitored closely. If the trend continues, the populations in these areas could be moving from phase II to phase III in 2008 (Figures 8 & 10, respectively). Areas of special interest should be identified and additional ground monitoring should be done. EWS trap results in 2008 will be critical. If the trend continues, treatment should be considered, possibly as early as the fall of 2008, and especially by 2009. It is possible that some defoliation in localized areas will be evident in 2008. Parts of the Okanogan NF should be monitored, as well. To effect the most foliage protection, treatment must occur before the year when the most 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, 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 2005 - 2007, 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

Daterman, G.E.; R.L. Livingston; J.M. Wenz; and L.L. Sower. 1979. How to use pheromone traps to determine outbreak potential. US Dept. of Agric. Hdbk 546. 11p.

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.

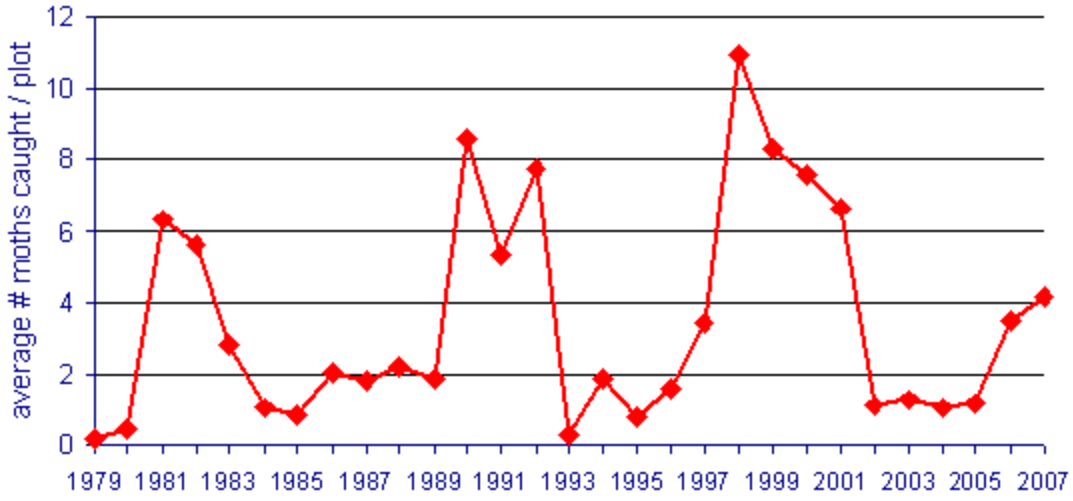

Figure 1: Average number of Douglas-fir tussock moths caught per plot in DFTM pheromone traps distributed throughout eastern Washington and Oregon. There was a slight increase in the overall Regional trend; however, the average increase was due to increases in four areas. The average number of moths trapped in most trapping areas either remained the same or decreased. (Refer to individual trapping area graphs)

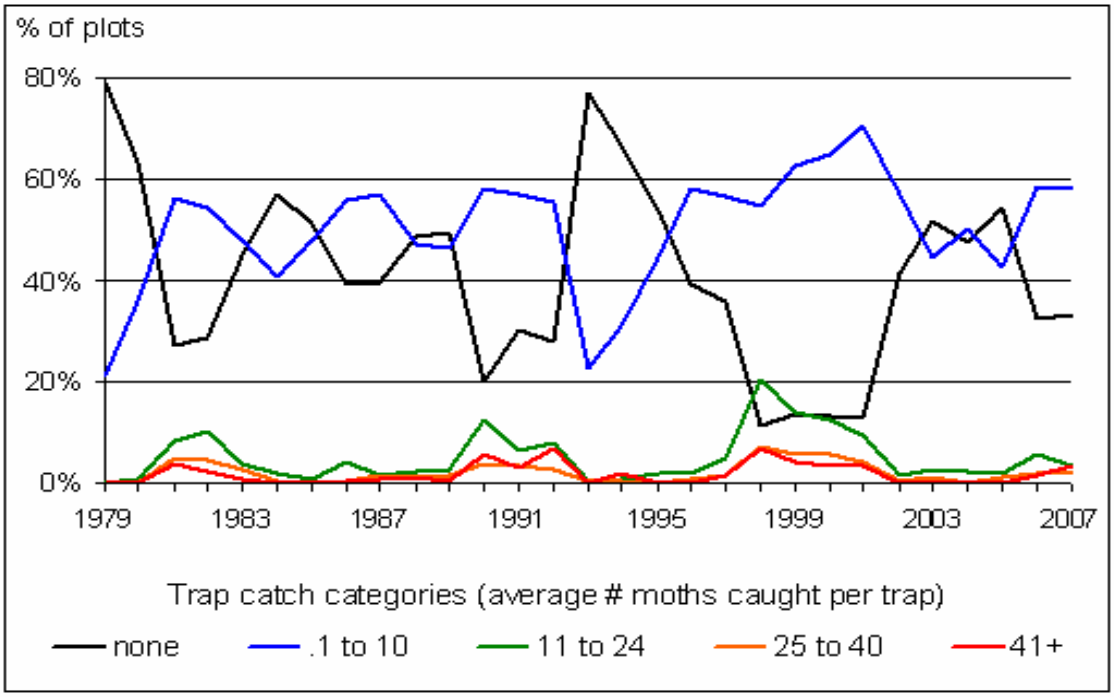

Figure 2: Trend of the average moth catches for the Region, by number of moths per trap.

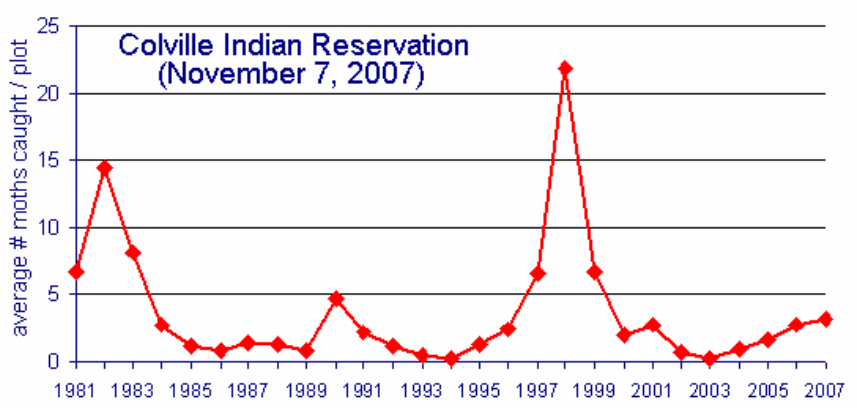

Figure 3: Average plot catch trends for the Colville Indian Reservation and adjacent lands, WA.

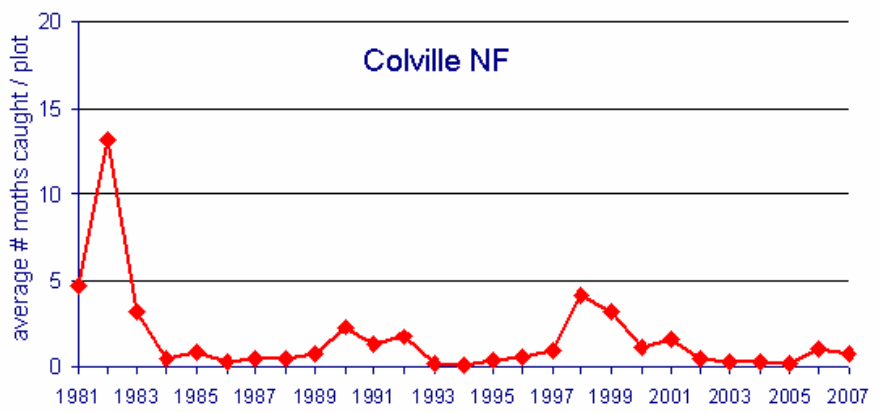

Figure 4: Average plot catch trends for the Colville NF, and adjacent lands, WA

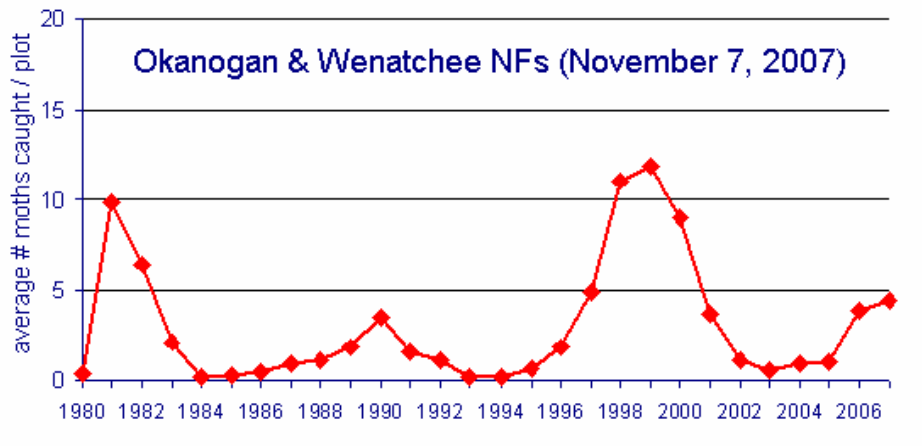

Figure 5: Average plot catch trends for the Okanogan and Wenatchee NF's and adjacent lands, WA

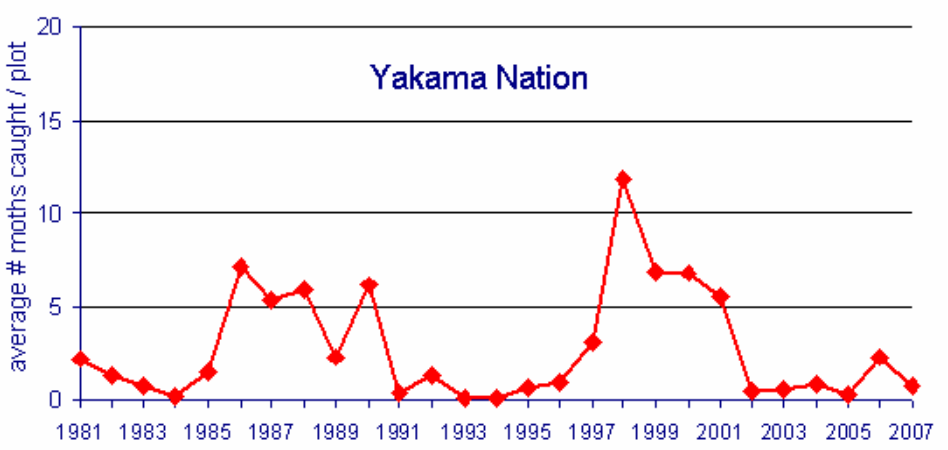

Figure 6: Average plot catch trends for the Yakama Nation and adjacent lands, WA

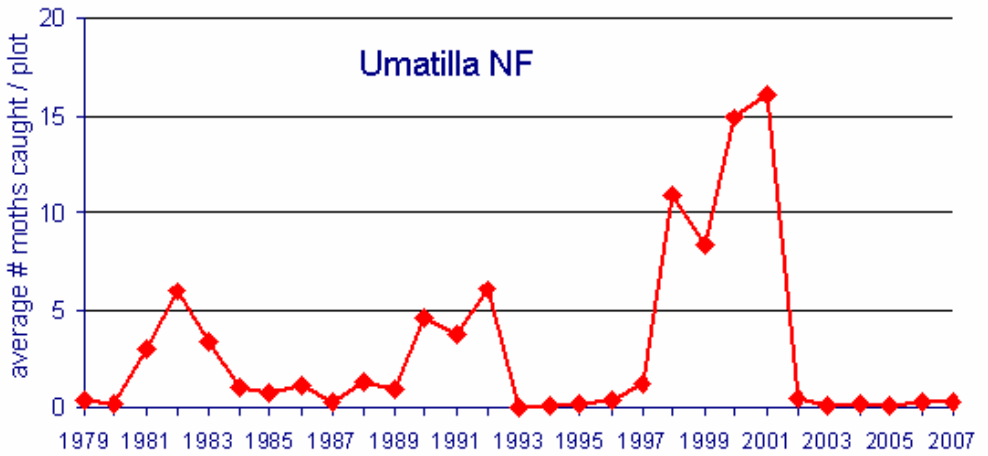

Figure 7: Average plot catch trends for the Umatilla NF and adjacent lands, OR

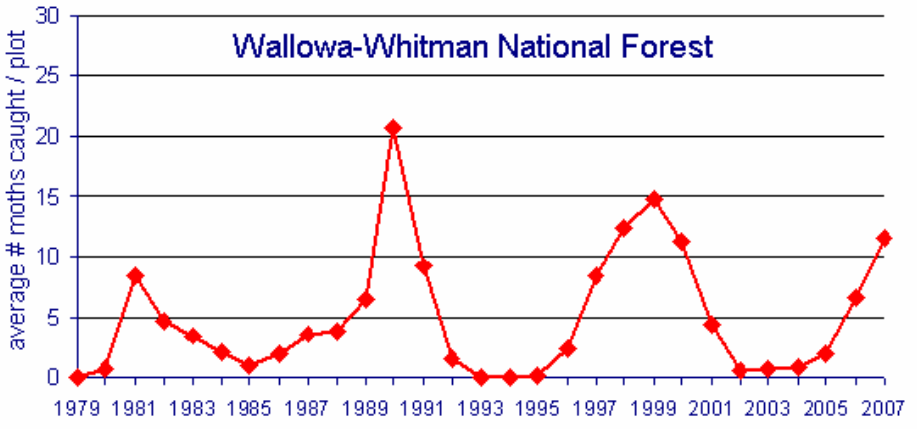

Figure 8: Average plot catch trends for the Wallowa-Whitman NF and adjacent lands, OR. Some plots on the W-W were not trapped, therefore, the average number of moths per tap may be higher than depicted here.

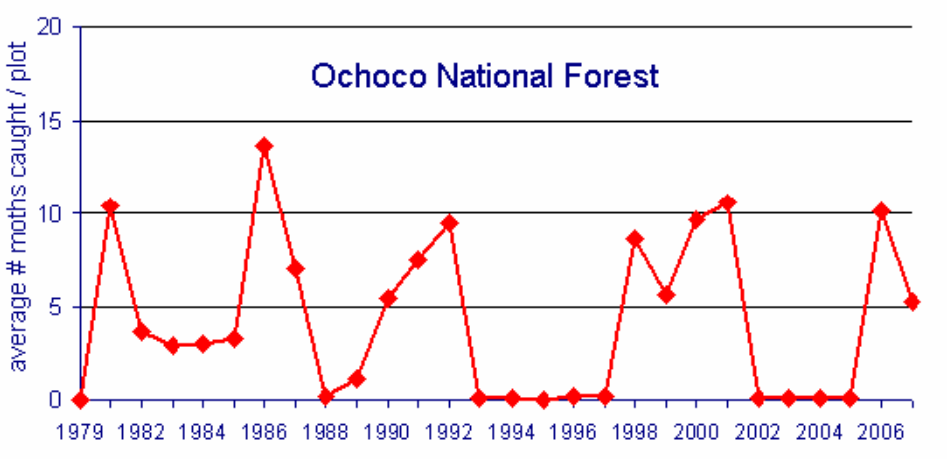

Figure 9: Average plot catch trends for the Ochoco NF and adjacent lands, OR.

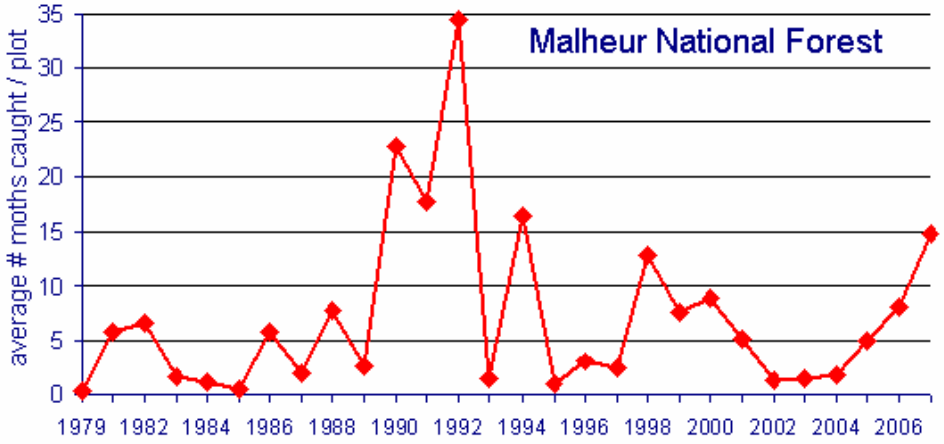

Figure 10: Average plot catch trends for the Malheur NF and adjacent lands, OR

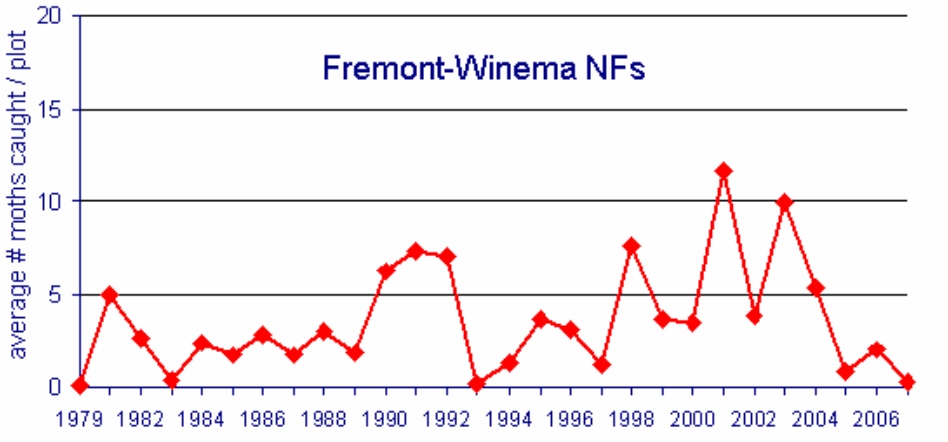

Figure 11: Average plot catch trends for the Fremont-Winema NF and adjacent lands, OR

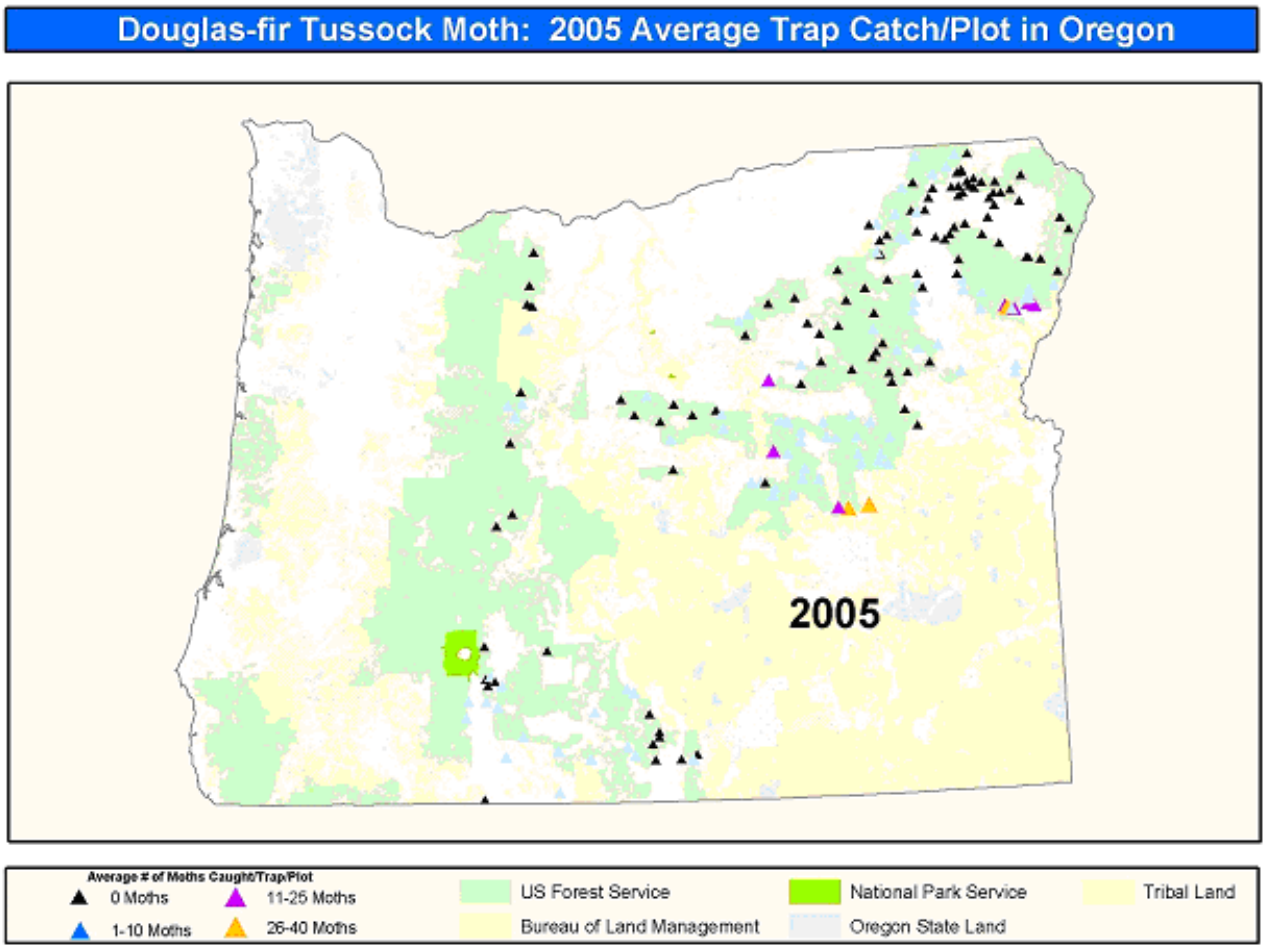

Figure 12: DFTM EWS trap locations and moth catches in Oregon for 2005. Note the decrease in the number of traps with higher moth catches in south central Oregon and the increase in the number of traps with higher trap catches in northeastern Oregon.

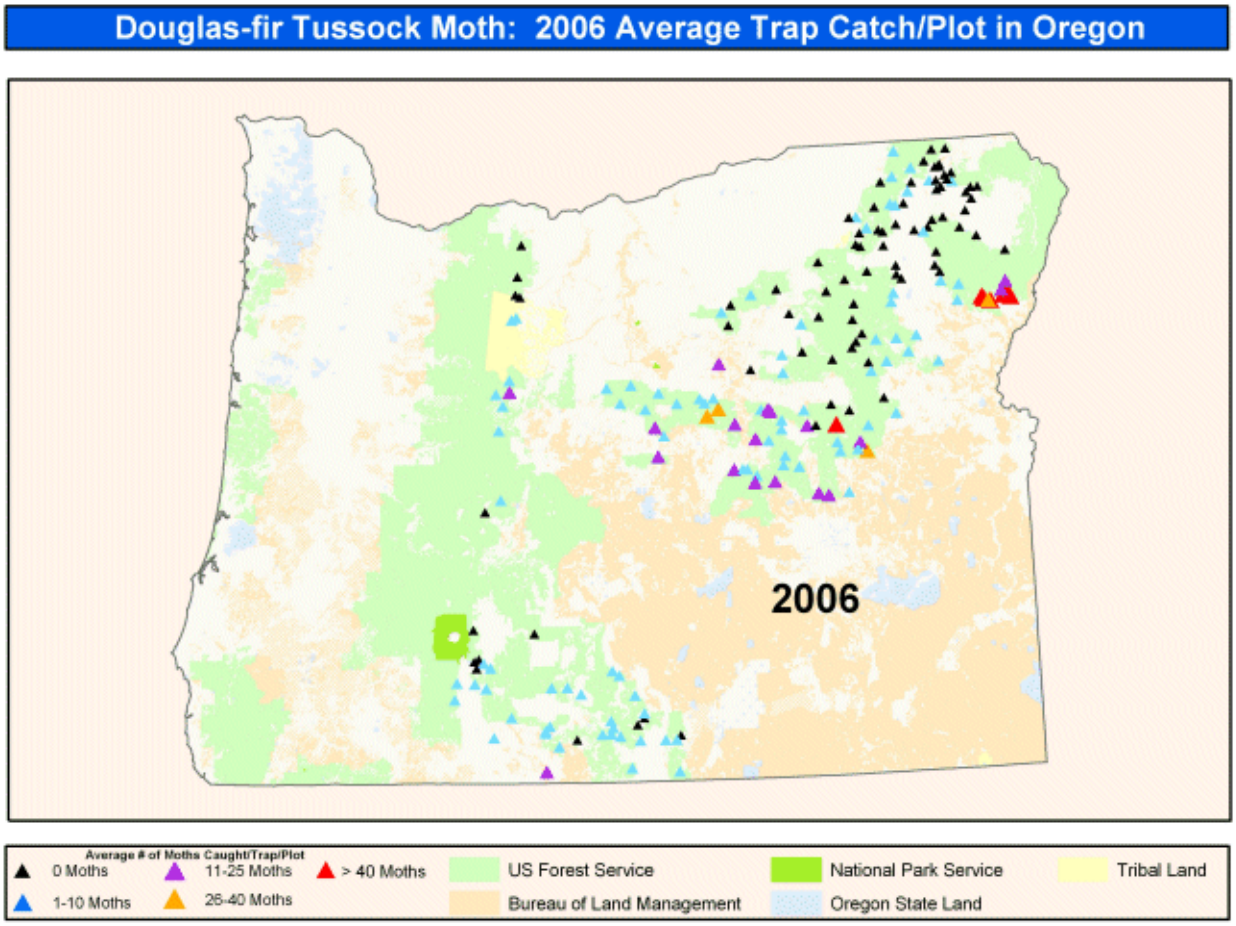

Figure 13: DFTM EWS trap locations and moth catches in Oregon for 2006. Note the increase in the number of traps with higher moth catches in Northeastern Oregon, especially on the Malheur and Wallowa-Whitman NF's and adjacent lands.

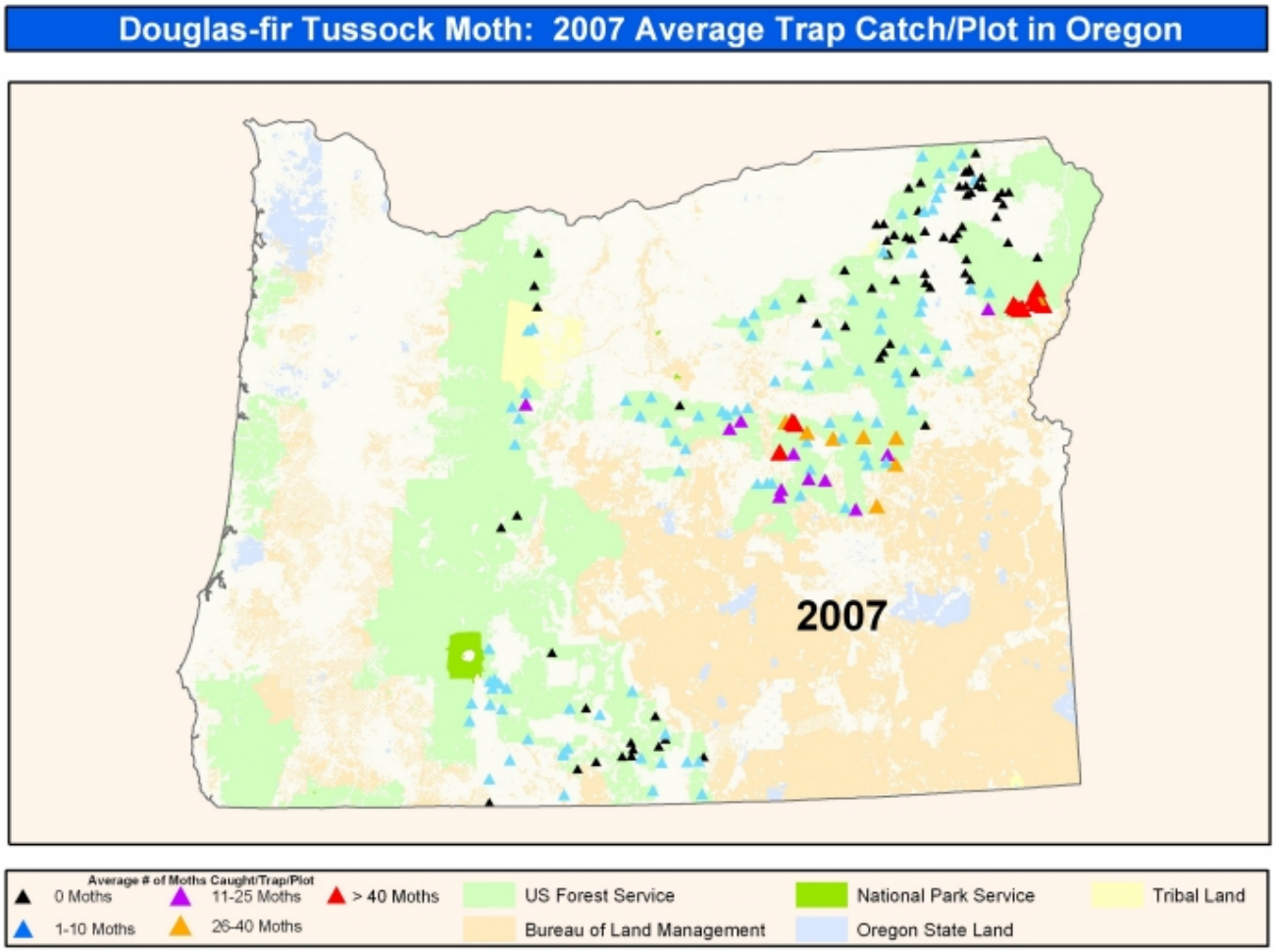

Figure 14: DFTM EWS trap locations and moth catches in Oregon for 2007. Note the increase in the number of traps with higher moth catches in northeastern Oregon, especially on the Malheur and Wallowa-Whitman NF's and adjacent lands.

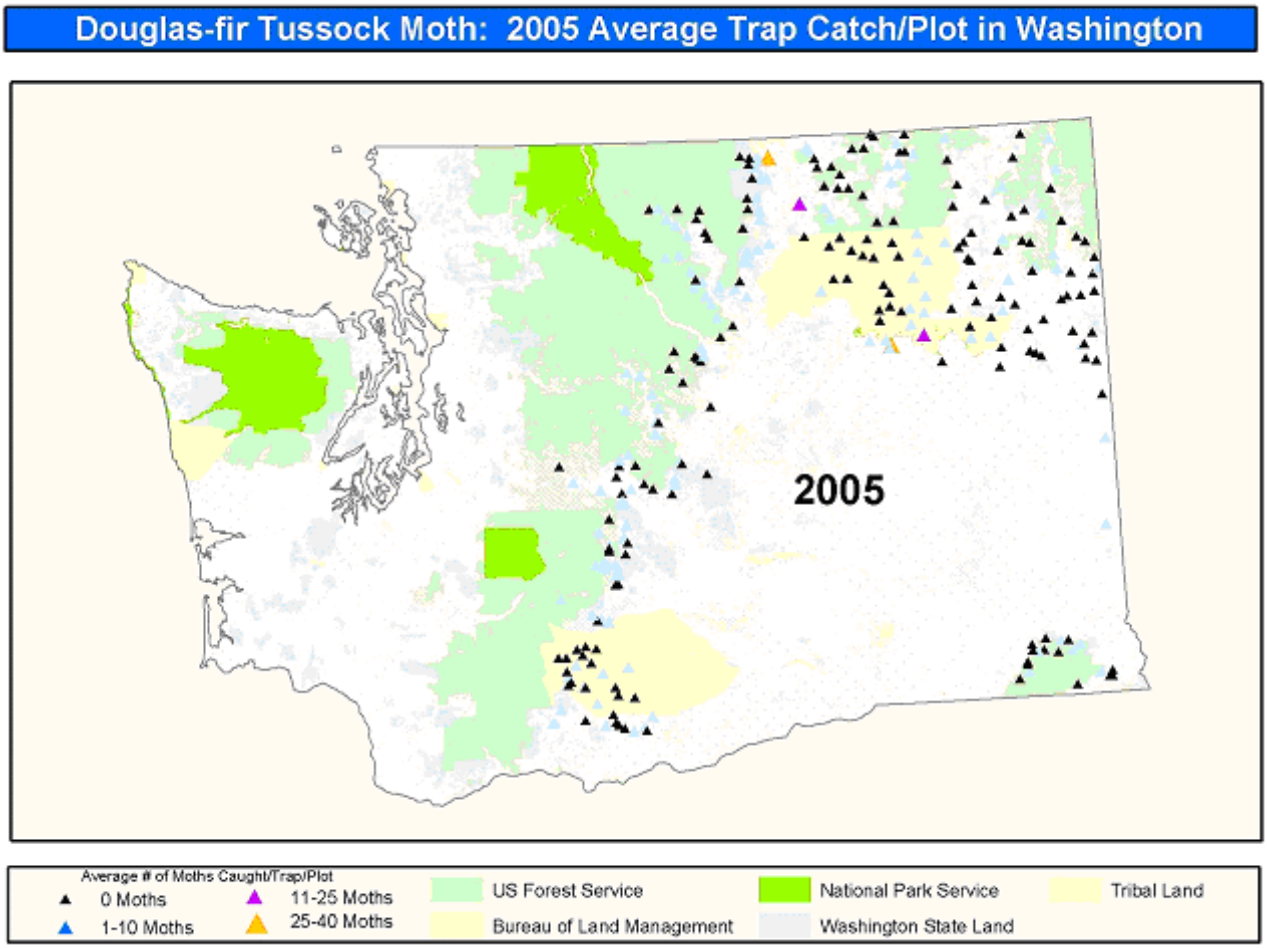

Figure 15: DFTM EWS trap locations and moth catches for Washington, 2005.

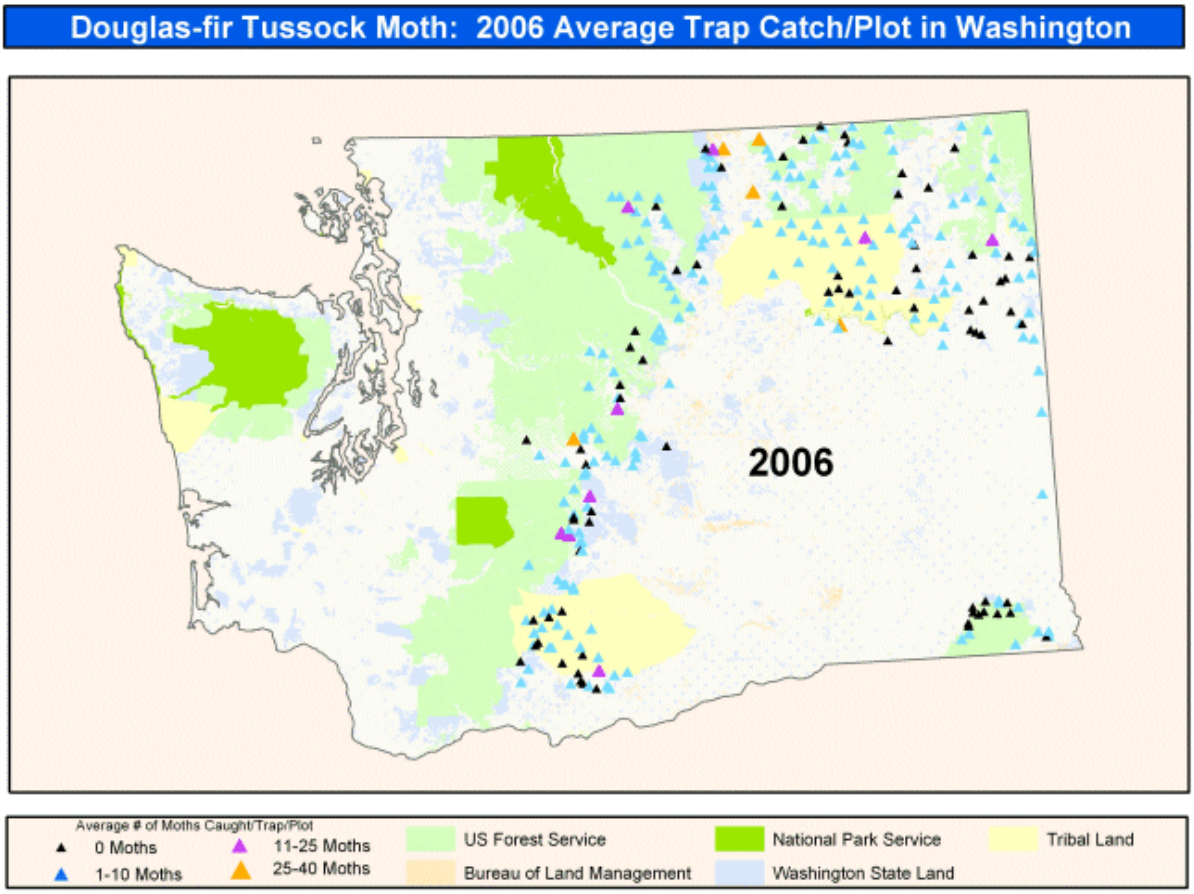

Figure 16: DFTM EWS trap locations and moth catches for Washington, 2006. Note the trend of fewer traps with no moths and more traps with some moth catches.

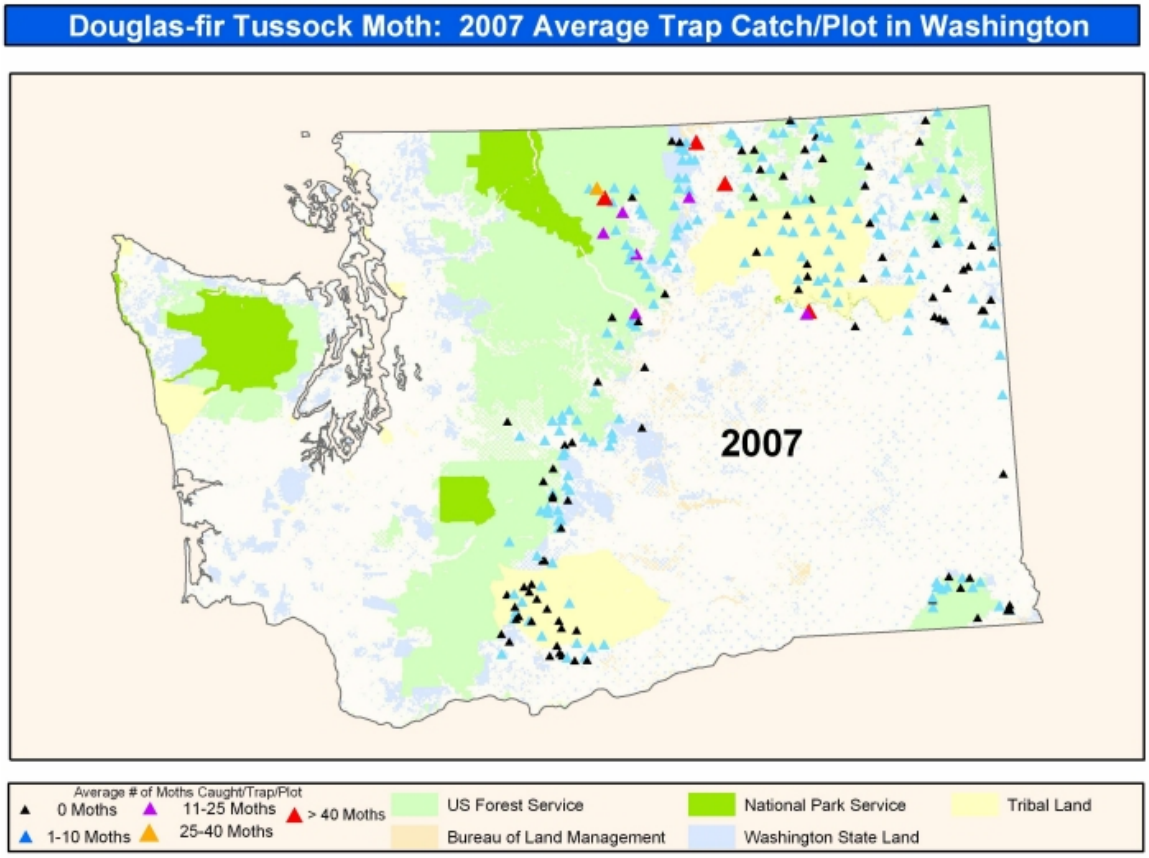

Figure 17: DFTM EWS trap locations and moth catches for Washington, 2007. Note the trend more traps with higher moth catches in north central Washington.

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

Nearest Forest	Nearest District	Plot#	Plot Name	Agency	Town.		Range		Sec	2000	2001	2002	2003	2004	2005	2006	2007
Colville IR	Sanpoil	6	Cody_Lake	bia	33	N	33	E	23	0.4	2.0	1.2	1.5	1.0	0.0	1.2	9.6
Colville IR	South	111	Keller_Ferry	dnr	28	N	33	E	31	15.8	21.4	1.6	0.6	6.4	26.0	27.8	45.8
Colville IR	South	112	North_Wilbur	dnr	27	N	32	E	1	7.0	13.0	0.6	0.2	2.0	5.2	6.0	12.4
Deschutes NF	Sisters	6	Bear_Springs	usfs	12	S	10	E	29	1.4	22.0	1.0	0.0	1.4	1.0	15.0	16.6
Malheur NF	Blue_Mtn	1	Johnson_Heights	blm	11	S	25	E	3	36.8	55.6		0.0	0.0		11.8	
Malheur NF	Blue_Mtn	1	Aldrich	usfs	14	S	28	E	22	5.6	1.0	0.0	0.3	0.2	0.4	7.2	29.2
Malheur NF	Blue_Mtn	2	Murderers_Creek	usfs	15	S	30	E	18	0.8	0.4	0.0	0.0	0.0	2.0	1.0	39.4
Malheur NF	Blue_Mtn	3	Starr_Ridge	usfs	15	S	31	E	36	5.5	1.2	0.8	0.0	1.4	1.2	18.2	31.4
Malheur NF	Blue_Mtn	6	Snowshoe_Summit	usfs	16	S	29	E	31	9.0	0.8	0.2	0.4	0.0	1.8	6.8	24.4
Malheur NF	Blue_Mtn	7	Buck_Cr	usfs	16	S	28	E	30	25.6	1.2	0.4	3.0	2.0	15.0	10.6	40.6
Malheur NF	Blue_Mtn	9	Hattie_Creek	usfs	14	S	29	E	19	31.6	2.3	0.2	0.0	0.0	1.8	16.6	48.6
Malheur NF	Blue_Mtn	10	Lost_Creek	usfs	14	S	29	E	29	53.5	2.0	0.2	0.4	1.6	2.6	16.6	49.6
Malheur NF	Emigrant_Cr	201	2850_Road	usfs	21	S	32	E	4	8.2	9.2	9.8	11.8	13.6	34.8	13.2	23.2
Malheur NF	Emigrant_Cr	205	Gold_Hill	usfs	18	S	31	E	32	0.4	0.4	0.0	0.0	0.2	1.8	3.6	11.2
Malheur NF	Emigrant_Cr	206	Cold_Spring	usfs	18	S	30	E	30	0.8	0.0	0.0	0.2	0.0	2.0	6.8	13.4
Malheur NF	Emigrant_Cr	208	Schoolmarm_Spr	usfs	19	S	28	E	18	0.6	0.4	1.0	10.0	0.8	6.0	3.0	12.4
Malheur NF	Emigrant_Cr	211	Thompson_Spring	usfs	20	S	33	E	36	3.8	7.4	10.0	8.4	14.8	33.2	6.8	33.4
Malheur NF	Emigrant_Cr	408	Coyote	usfs	19	S	27	E	36	27.6	1.2	3.0	0.2	3.2	8.4	12.0	11.8
Malheur NF	Prairie_City	1	Antelope	usfs	17	S	35	E	33	9.6	2.0	0.8	1.2	0.2	2.8	28.8	30.2
Malheur NF	Prairie_City	2	Mcallister_Spr	usfs	17	S	34	E	12	1.0	1.8	0.4	0.2	0.0	0.8	16.0	11.6
Malheur NF	Prairie_City	3	Mccoy	usfs	15	S	34	E	31	2.8	0.8	0.0	0.6	0.2	2.8	43.3	27.8
Malheur NF	Prairie_City	5	Northfork	usfs	16	S	35	E	3	8.6	5.2	1.0	1.6	0.0	1.4	7.0	33.2
Ochoco NF	Paulina	4	Frazier_Creek	blm	15	S	26	E	22	34.4	12.4		0.2	0.4		10.8	
Ochoco NF	Paulina	1	Bearskull	usfs	14	S	25	E	9	8.6	1.6	0.0	0.2	0.2		32.4	17.4

Ochoco NF	Paulina	2	Cottonwood_Cg	usfs	13	S	24	E	32	5.2	22.0	0.0	0.0	0.0	0.2	6.8	10.0
Ochoco NF	Paulina	4	Yuma	usfs	14	S	24	E	34	20.4	9.2	0.0	0.6	0.0	0.4	33.4	16.0
Okanogan&Wen. NFs	Chelan	16	Yacht_Club	dnr	28	N	21	E	21	54.8	12.4	2.6	1.2	0.4	1.8	7.4	14.6
Okanogan&Wen. NFs	Methow_Valley	41	Libby_Creek	dnr	32	N	21	E	23	55.8	5.6	0.6	0.2	0.4	2.8	9.4	23.4
Okanogan&Wen. NFs	Methow_Valley	65	Sandy_Butte	dnr	36	N	19	E	26	46.6	9.2	0.0	0.0	0.6	2.4	11.4	41.6
Okanogan&Wen. NFs	Methow_Valley	67	Lost_River	dnr	36	N	19	E	5	64.0	38.0	0.6	0.2	1.0	3.2	5.8	33.8
Okanogan&Wen. NFs	Methow_Valley	86	Weeman	dnr	35	N	20	E	25	41.4	39.2	0.8	0.0	2.4	3.6	5.6	24.8
Okanogan&Wen. NFs	Tonasket	6	Conconully_Lake	dnr	36	N	25	E	33	4.8	1.4	1.0	1.0	2.0	1.0	3.0	11.2
Okanogan&Wen. NFs	Tonasket	8	Palmer_Lake	dnr	39	N	26	E	7	34.4	9.4	13.0	4.6	18.6	28.4	33.2	47.4
Okanogan&Wen. NFs	Tonasket	9	Loomis_Lower	dnr	38	N	26	E	15	25.0	4.4	3.0	1.8	1.6	2.2	1.6	9.6
Okanogan&Wen. NFs	Tonasket	173	Dusty_Mtn_Meadow	dnr	36	N	28	E	6	52.6	40.0	26.6	7.8	3.0	17.8	34.2	67.4
Okanogan&Wen. NFs	Methow_Valley	43	Twisp_River	usfs	33	N	19	E	3	39.2	25.2	2.0	0.4	1.8	2.0	8.4	12.8
Okanogan&Wen. NFs	Wenatchee River	78	Icicle_Mac_Cr	usfs	24	N	16	E	2	8.0	10.4	0.2	0.0	0.2	2.0	9.6	
Wallowa-Whitman NF	La_Grande	7	Balm_Cr.	usfs	7	S	42	E	11	34.6	0.8	0.2	0.4	0.2	1.8	6.8	21.0
Wallowa-Whitman NF	Pine	71	Paddy_Seed_Orch	usfs	7	S	44	E	11	59.2	9.4	2.0	9.6	5.6	33.8	60.2	69.6
Wallowa-Whitman NF	Pine	72	Big_Bend	usfs	7	S	46	E	4	54.4	22.0	2.2	1.2	0.6	8.8	18.8	43.4
Wallowa-Whitman NF	Pine	73	Upper_Clear_Cr	usfs	6	S	46	E	30	21.6	2.0	1.2	0.6	0.2	2.2	14.8	52.0
Wallowa-Whitman NF	Pine	74	Summit_Pt_Rd	usfs	7	S	45	E	17	56.2	23.6	3.2	1.6	3.2	12.8	51.0	59.6
Wallowa-Whitman NF	Pine	75	Rd_050_Dry_Cr.	usfs	7	S	46	E	11	54.0	56.0	7.0	3.8	6.6	19.0	48.6	79.4
Wallowa-Whitman NF	Pine	76	Clr_Cr._Beecher	usfs	7	S	46	E	5	71.6	23.4	4.2	6.0	3.8	13.0	40.8	88.8
Wallowa-Whitman NF	Pine	77	Spring_Cr	usfs	7	S	45	E	18	54.0	22.7	4.0	3.0	0.8	4.0	27.0	97.8
Wallowa-Whitman NF	Pine	78	Gold_Eagle_Pack	usfs	7	S	44	E	3	12.2	6.0	1.8	2.0	2.0	11.6	41.2	55.2
Wallowa-Whitman NF	Pine	79	Fish_Lake	usfs	6	S	46	E	28	50.6	3.4	2.6	4.0	5.8	10.0	54.6	40.0