

Monitoring Douglas-fir Tussock Moth Outbreak Populations across Southern Idaho in 2017

BFO-PR-2017-01

INTRODUCTION

Outbreaks of Douglas-fir tussock moth (DFTM) occur once a decade in the same general geographical areas across southern Idaho. Across the West the most important natural enemy driving outbreak declines is a nucleopolyhedrosis virus (NPV) capable of decimating an outbreak, but it usually appears only after trees have been seriously defoliated and DFTM is stressed by food shortages. Grand-fir and Douglas-fir are the primary hosts. Trees defoliated over 90 percent during an outbreak may die, especially those growing on the upper 1/3 of slopes. Those defoliated less heavily will have reduced growth and may be subsequently attacked by bark beetles. DFTM can affect human health as well as tree health. Tussockosis, associated with large outbreaks of DFTM, is a very serious allergic reaction to the urticating hairs of the caterpillar and historically has caused problems where there is high human traffic in outbreak areas.

A Douglas-fir tussock moth (DFTM) (*Orgyia pseudotsugata* McDunnough) outbreak began in 2015 in southern Idaho and population progression has varied depending on location. In 2015 and 2016, high trap catches of adult DFTM on the Salmon-Challis, Sawtooth and Boise National Forests indicated an outbreak was developing across historically defoliated areas (Lowrey 2016). Hot spots of DFTM activity were located in 2016 in forest stands surrounding Sage Hen Reservoir and a suppression treatment aimed at reducing public exposure of tussockosis was planned for 2017, but was not completed (Lowrey 2016).

Since Aerial Detection Surveys (ADS) cannot detect early stages of the DFTM outbreaks, ground surveys of various life stages were used in 2017 to delimit the actual outbreak area surrounding locations with high trap catches. Larval, adult and egg mass surveys were intended for planning suppression treatments and historical documentation and were based upon guidance from Bureau of Land Management, Forest Service and State land managers.

SURVEY METHODS, RESULTS AND DISCUSSION

Larval sampling

Larval sampling in 2017 was used to fill in knowledge gaps about DFTM activity in the 1990s outbreak area near high value areas. Larval sampling of first and second instars occurred from June 28 through July 17, 2017 to delimit the outbreak area near recreation areas potentially slated for suppression treatment in 2018 (Figure 2). We followed sequential sampling lower crown beating techniques developed by Mason (1978). Sage Hen Reservoir area, Soldier Mountain Ski

Area and the Big Wood River Valley, specifically Bald Mountain Ski Area were prioritized for survey based upon input from land managers and 2016 survey work (Lowrey 2016). Infestations were classified as either low level or suboutbreak (capable of outbreak levels within one year). Crews surveyed 88 locations, 38 predicted defoliation in 2018 and 59 predicted no defoliation (Figure 2). Hot spots were the Big Wood River Valley and Sage Hen Reservoir/High Valley/Tamarack Flats on the Emmett Ranger District, for the second year in a row.

Early Warning System Trapping

Early warning system (EWS) baited pheromone traps were deployed the middle two weeks of July and retrieved the last week of September and the first week of October. Trap catches of the current year give indications of future populations that should be verified immediately with egg mass surveys to estimate populations for the next summer. Trapping results indicated that populations were up throughout the outbreak area with 25 sites trapped and 20 sites with moth captures. Five sites were at the 15 moths per trap threshold level, which indicates building populations. Three sites indicated high levels (over 25 moths) and one site indicated very high populations (over 50 captures). The highest capture was 304 male moths for 5 traps at one site, Tamarack Flat. Trapping areas are shown in Figure 2 as low, moderate, or high captures. Table 2 shows trends of trap catches increasing starting in 2014, the first year increases were noted, i.e. over 15 moths per trap were noted. Sharps Canyon traps catches first went up on in 2014 and ADS recorded defoliation in 2017 some distance from the trap location. Egg mass surveys 1 mile in Cardinal directions around the trap catch yielded nothing in 2016 and few egg masses in 2016.

Egg mass surveys

To take advantage of the early warning part of the trapping program, sites with high trap catches are typically followed up in the fall with egg mass delimitation surveys to determine source population locations and to inform managers as early as possible of potential outbreaks areas. Egg mass survey collections can also indicate the level of parasitism and pathogenic virus in the population.

Egg mass surveys were conducted at all trap locations and also at 1 mile up and down the road from the trap location if trap catch exceeded 25 moths on average (Table 2). Sampling methods are adapted from Shepard et al. (1985) as described in Sampling Methods for Forest and Shade Tree Insects of North America Volume 1 (Fettig et al. 2001). This method uses fall egg mass densities per three lower branches per tree and tree density classes to predict defoliation levels the following summer. Resulting defoliation predictions are worst case scenarios and may not reflect stand means:

- **0-0.7** egg masses per tree: No or light defoliation as characterized by less than half of the trees suffering complete defoliation of current foliage in the upper crown and only minor dieback is observed.
- **0.7 to 1.9** egg masses per tree: Most current foliage and up to half of the older foliage being damaged. Usually significant growth loss occurs, but only minor dieback and mortality is observed.
- **> 2.0** egg masses per tree: Severe defoliation as characterized by most current foliage and more than half of the older foliage consumed. At least 20% of trees will be completely defoliated, and significant growth loss, dieback, and mortality will occur.

Egg mass surveys predict visible defoliation in 2018 at 2 sites near Sage Hen Reservoir and Craters of the Moon National Monument (NM) (Table 2) (Table 2, Figures 5 and 7). Every larval sampling area was also surveyed for egg masses on Bald Mountain ski Area in October to inform potential suppression treatments, whereas Sage Hen larval sampling areas were not surveyed for egg masses because no further information needed for planning suppression treatments (Table 2, Figure 5, 7). Moderate defoliation levels are expected around Sage Hen and likely High Valley based on larval sampling (Table 2). No to low defoliation is expected at Bald Mountain Ski Area, since no new only old egg masses were found and trap catches were low, most likely the result of populations being impacted by parasitoids.

In the future I recommend delimit egg mass surveys if trap catches exceed 15 moths/trap to improve descriptions of outbreak extent. Weatherby et al. (1997) found that the year following the second year of high catches had visible defoliation even though the trap catch goes down overall the third year, i.e., the outbreak is building and moths are finding each other rather than the traps. I think 2017 was the year trap catches went down because populations were high. I expect trap catches to continue to decrease as the outbreak collapses. I expect to find more defoliation visible from the air in 2018 near the traps with the highest moth counts: Bear Saddle on the Payette; Cottonwood, Tamarack Flats and Antelope Trail on the Boise and south of Sharps Canyon on the Sawtooths; and, Lick Creek on the Salmon-Challis (Table 2, Figures 4-9) and at the Craters of the Moon and Owyhee sites (Table 2, Figures 8-9).

Other ground and aerial observations

There were many reports of caterpillars and defoliation throughout the summer in areas other than our sampled sites (Table 2, Figure 4-9). These sites were visited for ground confirmation of DFTM. There were reports of large numbers of moths in the tops of Douglas-fir at a timber sale in the Owyhees in September, 2017, and heavy defoliation and very high egg mass density was confirmed in October, though the trap numbers in 2016 and 2017 nearby were low (Figure 3, 9).

There were also high numbers of caterpillars and egg masses at a timber sale near Brundage Ski Area and two other timber sale areas on the Payette NF. DFTM caterpillars were also observed near two recreation sites on the Salmon-Challis NF.

Very limited defoliation was recorded from ADS in 2017 likely because timing of flights did not match the biological window for defoliation and over ten years of western spruce budworm masked light defoliation (Figure 1). Aerial Survey Detection recorded small polygons of defoliation in Craters of the Moon NM, BLM land south of Sharps Canyon, and in the Owyhees. We also observed defoliation from the road in the upper slopes of Cold Springs and Shingle Creek, Payette NF, though this defoliation was not recorded by ADS (Table 3, Figure 3). Based on walk through estimations by FHP or land managers, 2018 defoliation in Shingle Creek and other Payette NF locations and Owyhee sites, there will be moderate defoliation as well that should be visible during ADS in 2018 (Figure 4, 9, Table 2). Reports of caterpillars at Williams Creek Summit, Wallace Lake and Twin Creek Campground on the Salmon-Challis NF should be noted as possible areas for visible defoliation in 2018 (Figure 8 , Table 2).

Nuclear Polyhedrosis Virus (NPV) levels

Egg masses were collected from areas near Sage Hen Reservoir and from the Big Wood River Valley (Sharps Canyon, Cold Springs and Bald Mountain Ski Area) during the middle of June 2017. Larvae were reared from these egg masses by Karl Polivka, USFS PNW Research, Joe Mihaljevic and Greg Dwyer, University of Chicago for virus studies to estimate initial population infection rates in those two areas. They are developing a model that uses information on larval population density (estimated from cocoon or egg mass surveys) and initial infection rate determined from infection assays done on egg masses sampled from the area to predict the severity of an NPV epizootic. From the epizootic prediction model, FHP specialists can recommend whether or not to apply a cultured NPV spray to suppress DFTM populations. Egg masses from 2017 adults were collected in October 2017 and used to determine 2018 virus load by converting egg mass surveys into larval densities and running the model. Based on these model runs, they do not recommend treatment in 2018. The model predicted that a natural epizootic will cause a population crash within 20-50 days upon hatch with initial infection as low as 1 in 10,000 larvae (Figure 3).

Rusty Tussock Moth

A co-occurring outbreak of rusty tussock moth (*O. antiqua* L.) was documented in areas of the Boise and Payette NFs (Table 1). The rusty tussock moth feeds on a wide variety of shrub and tree hosts including Douglas-fir, huckleberries, willow, alder, snowberry and service berry. Its egg masses are hairless as opposed to the very hairy DFTM egg masses. High number of rusty

tussock moth were counted in many of our EWS traps and several caterpillars were collected from the Payette and Boise NF areas and sent to entomologists for identification. Carl Jorgensen (FHP Entomologist), Laura Lowrey, and Paul Klasner (Payette NF Silviculturist), visited Bear Basin Recreation Area to evaluate populations of reported tussock moths that had caused tussockosis in huckleberry pickers and discuss suppression needs (Table 2, Figure x). Tom Eckberg and Erika Eidsen, Idaho Department of Lands and Laura Lowrey also visited the same area to look for 2017 egg masses. We saw defoliation of grand fir and shrub component along FS 788 and 810, south of Brundage ski area near Bear Basin. Egg mass counts were high on the lower branches and there was evidence of parasitoids. DFTM EWS trap catches from Bear Basin and Brundage Ski Area were mostly rusty tussock moths, 25 and 23, respectively, not Douglas-fir tussock moth (Table 1). We suspect DFTM is in the area as well, though defoliation is largely due to the rusty tussock moth outbreak.

RECOMMENDATIONS

1. **Direct DFTM suppression treatments are not recommended for 2018.** While heavy defoliation is predicted for some areas (Sage Hen, Craters of the Moon NM, Owyhees), I recommend not spraying based on several factors: DFTM has a cyclic population with 2-4 year long outbreaks, 2018 will be year 3 or 4 depending on location; NPV was present in all larval and egg mass sample areas sent from FHP to Karl Polivka and indicate overall population progression toward a decline in 2018; egg mass sampling which also was not yielding high levels of viable eggs in some areas; and DFTM caterpillars may run out of food in other areas. Only minor defoliation is expected in 2019 for Sage Hen, Payette Areas, Craters of the Moon NM.
2. Continue trapping and egg mass surveys and epizootic population dynamics evaluations in 2018 in collaboration with Polivka, Mihaljevic and Dwyer. If funded in 2018, they will continue to monitor this outbreak to test their predictions in 2018 and 2019. FHP will continue to trap sites in 2018 that were trapped in 2017 and conduct egg mass surveys when trap catches equal 25 male moths or more. Advise our FHP staff if any additional areas should be added to the trapping list for 2018 and beyond.
3. Develop a proactive public education plan this winter and spring to take precautions against tussockosis, a severe allergic reaction that can be common in campgrounds and huckleberry picking areas. Modes of outreach could include, campground signage, timely news releases, social media posts. FHP can assist in developing these product with managers.
4. Request ADS flights at the end of August or later to fully capture DFTM defoliation.
5. No larval sampling will be conducted in 2018.

6. Evaluate the need for MCH in heavily impacted areas where fir engraver and Douglas-fir beetle populations are active near high-value areas.
7. Install plots in 2018 and 2019 to monitor mortality from DFTM and associated bark beetles in areas mapped from ADS. Staff at the Craters of the Moon National Monument already installed monitoring plots in one stand of Douglas-fir.

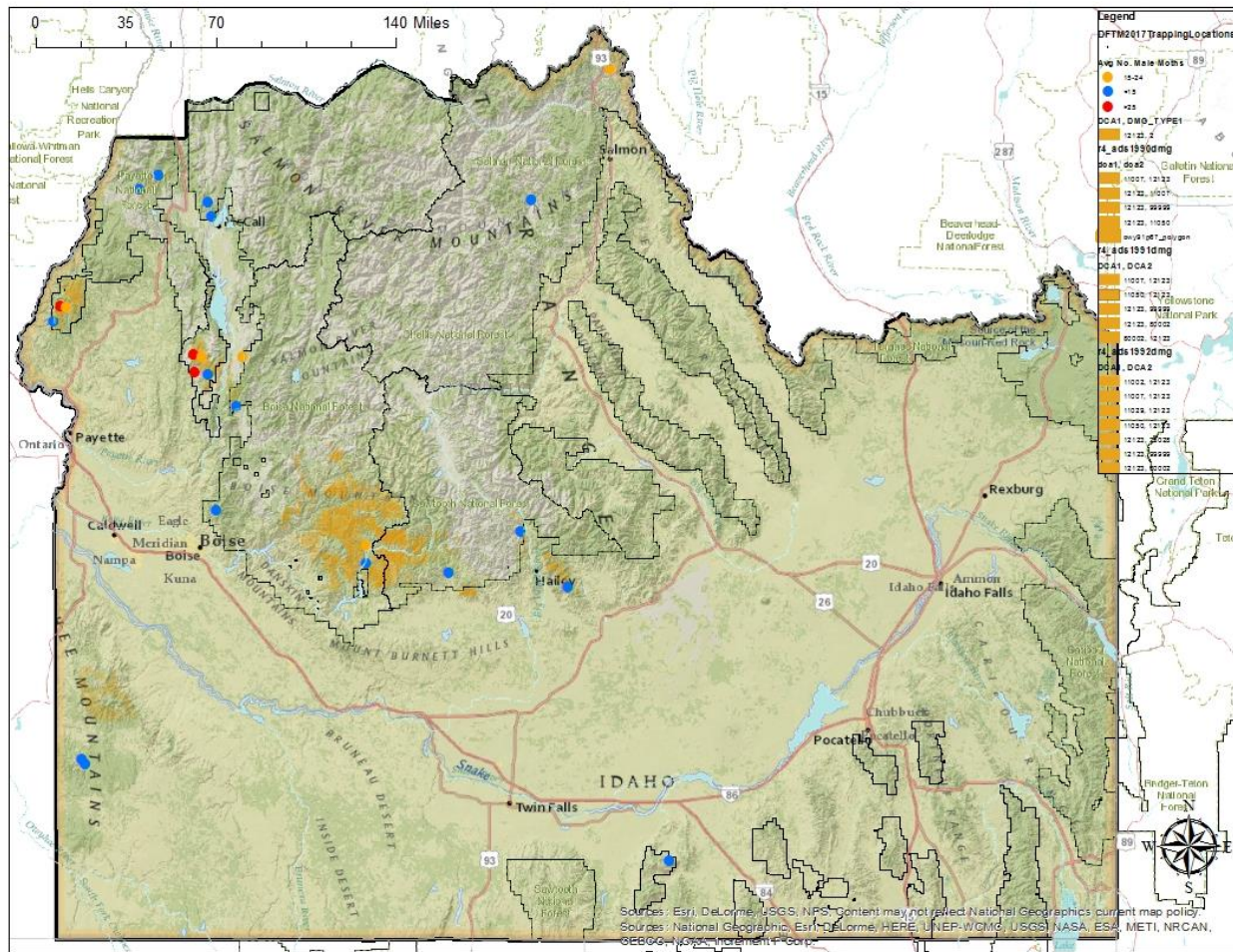


Figure 1. Map of 1990s DFTM defoliation (indicated by orange shaded areas) and current trap locations (red circles = high catch >25 moths, yellow circle = moderate catch 15-25, blue circle = low catch, <15 moths). Expect defoliation near high and moderate catch areas.

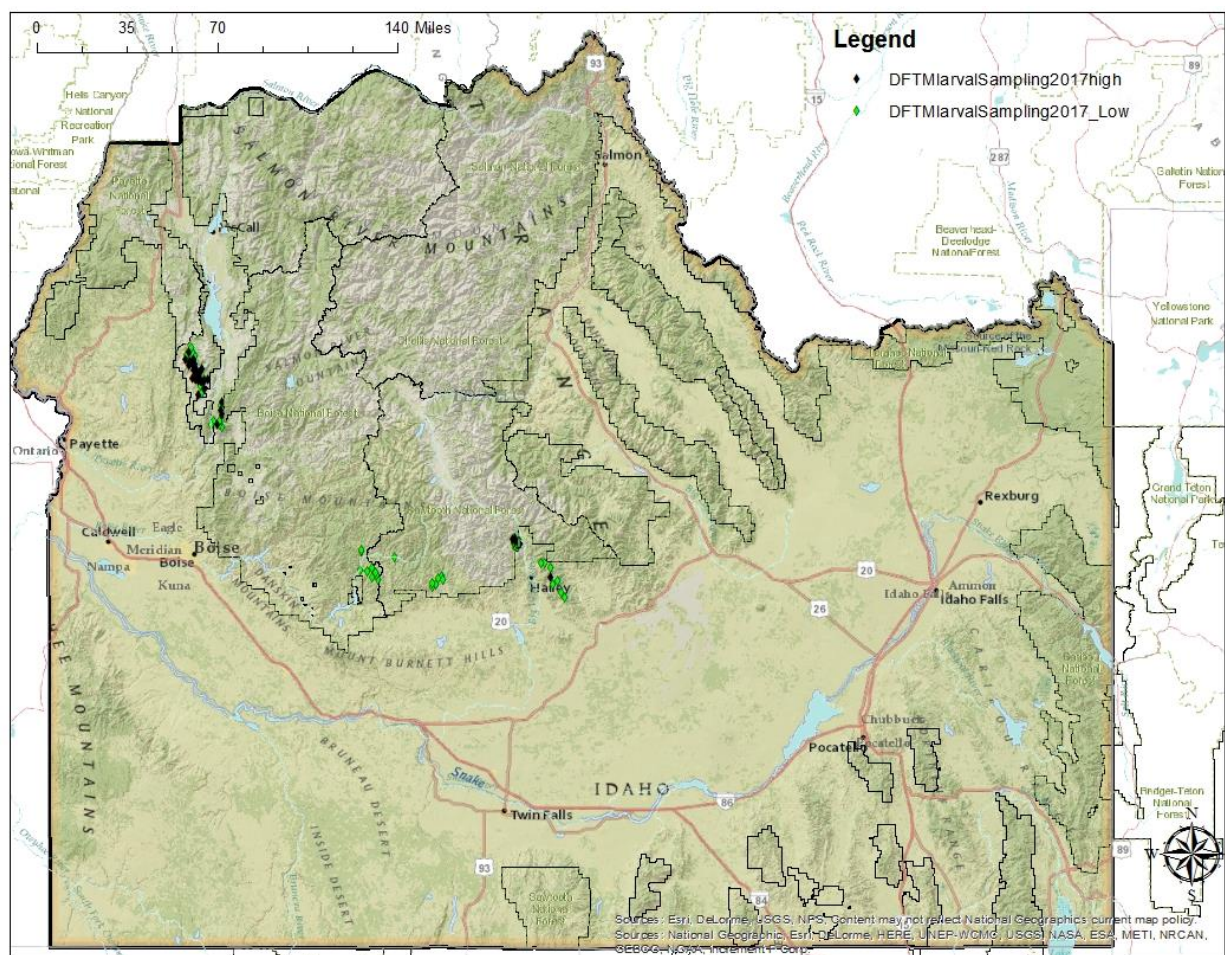


Figure 2. Map of DFTM early larval instar lower branch sampling locations in southern Idaho. This survey is used to delimit potential 2018 outbreak areas. [black diamonds = 2018 expected defoliation, green diamonds=no expected 2018 defoliation]. This survey method yields less accurate information than egg mass sampling done later in the year (June/July versus mid-October).

Table 1. DFTM Early Warning System trap locations and average male Douglas-fir tussock catch numbers from 2014 to 2017 to illustrate that 2014 was the first year traps indicated population increases. Also shown are the number of male rusty tussock moths (TM) in 2017 across southern Idaho, indicating a concurrent outbreak of this sibling species. Current trapping locations represent a subset of the 124 historical trapping locations trapped across southern Idaho from 1980-2002. 15 or more moths can indicate increasing population resulting in defoliation somewhere within 2 miles.

Ownership	Location	Latitude	Longitude	2014	2015	2016	2017	Rusty TM
BLM	South Fork Boulder Creek	42.726479	-116.849909	0	0	0.2	5.4	0
BLM	Mill Creek	42.747483	-116.867198	0	0.4	0.4	1.4	0
BLM	New York Summit	43.03812439	-116.7031084	0.4	2	2	N/A	0
Boise	Scriber Creek	44.189554	-116.005961	0	5.2	26.8	7.4	0
Boise NF	Tamarack Flat	44.3964935	-116.2374051	0.2	11.2	31.2	60.8	0
Boise NF	Antelope Trail	44.38799214	-116.1958718	0.6	0	65.2	22.4	0
Boise NF	Little Sage Hen	44.31633519	-116.1622529	0.2	26.2	25.8	6.8	0
Boise NF	Cottonwood	44.32753025	-116.2298459	1	8.2	27.4	42.8	0
Boise NF	Bogus Basin X-country	43.769586	-116.111292	1	2.8	10.4	3.4	11
Boise NF	Skunk Creek	44.38585043	-115.9579313	0.4	4	11	15.8	11
Boise	Paradise Hot Springs	43.551131	-115.266736	0.2	0.75	5.8	5.8	0
Boise	Cow Creek	43.62336186	-115.2713135	2.25	15.2	29.2	17	0
Boise	Cow Creek A	43.62873	-115.269	N/A	N/A	12.8	N/A	0
Boise	Cow Creek B	43.62574	-115.2849	N/A	N/A	43.4	N/A	0
Sawtooth	Sharps Canyon	43.454789	-114.135252	27.4	49.2	58	3.8	0
Sawtooth	Sharps Canyon A	43.44464	-114.1282	N/A	N/A	71.75	N/A	0
Sawtooth	Sharps Canyon B	43.46589	-114.1467	N/A	N/A	36.8	N/A	0
Sawtooth	Bald Mountain Ski Area	43.681164	-114.401231	N/A	N/A	N/A	0	0
Sawtooth	Wolftone	43.532153	-114.466403	5	15.4	39	N/A	0
Sawtooth	Wolftone A	43.52623	-114.4798	N/A	N/A	5.4	N/A	0

Sawtooth	Wolftone B	43.52081	-113.5492	N/A	N/A	19.2	N/A	N/A
Sawtooth	Howell Canyon	42.329719	-114.4597	N/A	0.7	0.2	0	0
Sawtooth	Couch Summit	43.515044	-114.801633	9	30.4	48	13.2	0
Salmon-Challis	Porphyry creek	45.016791	-114.337231	N/A	N/A	4.75	1.2	0
Salmon-Challis	Lick creek	45.533016	-113.896538	N/A	N/A	8	15.4	0
Salmon-Challis	Lick creek	45.53362	-113.8959	N/A	N/A	51.2	N/A	N/A
Payette	Adams creek	44.531389	-117.030128	N/A	N/A	0.2	0	0
Payette	Bear Saddle	44.59192371	-116.9874176	N/A	N/A	N/A	31.2	0
Payette	Mann Creek	44.5866527	-116.9546746	N/A	N/A	N/A	10	1
Payette	Cottonwood Springs	44.65478572	-116.9617537	N/A	N/A	N/A	N/A	N/A
Payette	Barrinaga Co	45.05991213	-116.5420648	N/A	N/A	N/A	0	26
Payette	Brundage Mt.	45.005786	-116.156694	0.2	0	0.4	0.8	23
Payette	Bear Basin	44.94952	-116.137	N/A	N/A	1.8	25	0
Payette	Brundage	45.00579	-116.157	0	0.4	0.8	0	0
Payette	Ant Basin	45.11443	-116.437	N/A	N/A	N/A	11.6	29

	Larvae/m ²	Median	Low	High
Craters of the Moon 3	43	0.93	0.89	0.96
Sage Hen Campground	62	0.95	0.93	0.96
Sage Hen Down	140	0.97	0.97	0.98
Sage Hen Up	170	0.98	0.97	0.98
Tamarack Flats	230	0.98	0.98	0.99
Craters of the Moon 2	620	0.99	0.99	0.99
Craters of Moon 1	2000	1.00	0.99	1.00

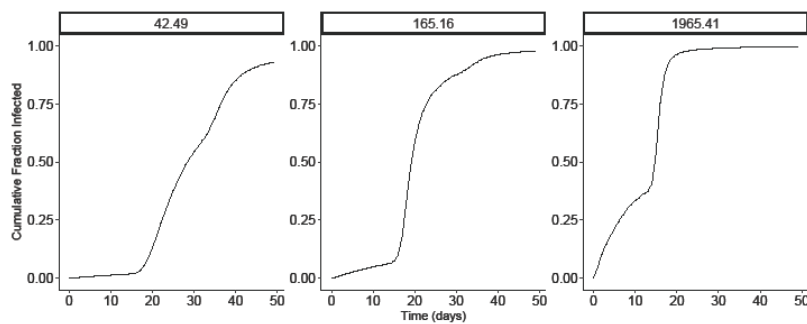


Figure 3. NPV Virus Model prediction (Polivka, Mihaljevic, and Dwyer 2017): Robust epizootic with initial infection rate of 0.0001, an indication that spraying is unnecessary. The 3 graphs indicate cumulative days needed to reach 100 infection level based on initial larval density and infection level.

Table 2. Other estimates of DFTM populations through ground observations by land managers, university personnel, and FHP egg mass surveys. [**defoliation mostly due to rusty tussock moth; **rusty tussock moth caterpillars and/or egg masses observed at low levels; Sites in bold = egg mass survey completed*]

Ownership	SITE	Latitude	Longitude	Cumulative Egg Masses/Total Trees Surveyed	2018 Life stages	ADS observed defoliation	Ground observed defoliation	Expected 2018 Defoliation Level
Salmon-Challis NF	Lick creek @traps	45.53633	-113.88995	0/20	none	no	no	none to low
Salmon-Challis NF	Lick creek @1 mile up rd	45.53384	-113.88486	1/20	egg mass	no	light	none to low
Salmon-Challis NF	Lick creek @creek (down rd)	45.53183	-113.89485	0/20	none	no	no	none to low
Salmon-Challis NF	Williams Creek summit	45.09551	-114.0845	2/20	larvae, egg masses	no	light	none to low
Salmon-Challis NF	Twin creek Campground	45.60806	-113.9675	2/20	egg mass, larvae	no	light	none to low
Salmon-Challis NF	Wallace Lake	45.2468	-114.0046	N/A	caterpillars	no	light	none to low
Boise NF	Low scriber-1.5miles up rd	44.19998	-116.00654	0/20	none	no	no	none to low
Boise NF	Low scriber at traps	44.18744	-116.00085	0/20	none	no	no	none to low
Boise NF	Low scriber 1 mile up rd	44.1937	-116.00883	0/20	none	no	no	none to low
Boise NF	Paradise hot springs	43.55113102	-115.2667356	0/60	male pupae	no	no	none to low
Boise NF	Little sage hen**	44.31631	-116.16237	15/60	egg mass, larvae	no	light	none to low
Boise NF	Little sage hen down**	44.30997	-116.17524	40/17	egg mass, larvae	no	light	heavy
Boise NF	Little sage hen Up**	44.31905	-116.1537	2/20	egg mass, larvae	no	light	none to low
Boise NF	Cottonwood**	44.32738	-116.23001	7/26	egg mass, larvae	no	light	none to low
Boise NF	Cottonwood Up**	44.32696	-116.21588	1/20	egg mass, larvae	no	light	none to low
Boise NF	Cottonwood Down**	44.32514	-116.24382	1/20	egg mass, larvae	no	light	none to low
Boise NF	Tamarack flat	44.39652	-116.23744	3/20	egg mass, larvae	no	light	none to low
Boise NF	Tamarack Flat Polivka	44.38755	-116.21191	40/20	egg mass, larvae	no	light	heavy
Boise NF	Tamarack flat Up	44.40788	-116.23284	5/20	egg mass, larvae	no	light	none to low
Boise NF	Tamarack flat down	44.38671	-116.24297	0/20	none	no	no	none to low
Boise NF	Skunk creek	44.38618	-115.95776	0/20	egg mass, larvae	no	no	none to low
Boise NF	Antelope trail	44.38816	-116.19589	4/20	egg mass, larvae	no	light	none to low
Boise NF	Antelope trail Up	44.37541	-116.19745	4/20	egg mass, larvae	no	light	none to low

Boise NF	Antelope trail down	44.38327	-116.20503	9/20	egg mass, larvae	no	light	none to low
Boise NF	High Valley*	44.20157	-116.1409	N/A	larvae	no	light	moderate
Sawtooth NF	Couch summit	43.51504389	-114.8016331	5/20	egg mass, pupae	no	light	none to low
Sawtooth NF	Wolftone	43.532153	-114.466403	0/20	none	no	no	none to low
Sawtooth NF	Bald Mtn Ski Area	43.68091634	-114.4003659	0/20	pupae	no	light	none to low
Crater's NM	Crater1	43.45734	-113.57745	51/3	egg mass, larvae	yes	heavy	heavy
Crater's NM	Crater2	43.45719	-113.58108	43/6	egg mass, larvae	no	light	heavy
Crater's NM	Crater3	43.47269	-113.56721	14/38	egg mass, larvae	no	light	none to low
BLM	Sharps Canyon	43.454789	-114.135252	0/20	none	yes	moderate	none to low
BLM	Cold Springs	43.657873	-114.379929	N/A	N/A	no	heavy	light
BLM	Owyhees	42.928383	-116.562716	N/A	egg masses	yes	heavy	moderate
Payette NF	Cow creek	43.62336186	-115.2713135	2/20	egg mass	no	light	none to low
Payette NF	Ant basin	45.08725	-116.44517	2/20	egg mass	no	light	none to low
Payette NF	Ant basin down 074	45.07283	-116.43594	1/20	egg mass	no	light	none to low
Payette NF	Ant basin Up 179	45.09447	-116.44823	3/20	egg mass	no	light	none to low
Payette NF	Mann creek	44.58839	-116.95416	1/20	egg mass	no	light	none to low
Payette NF	Mann creek up road	44.59888	-116.95701	0/20	none	no	no	none to low
Payette NF	Mann creek 1 mile down road	44.57146	-116.94798	3/20	egg mass	no	light	none to low
Payette NF	Bear saddle*	44.59143	-116.98791	1/20	egg mass	no	light	none to low
Payette NF	Bear saddle Down*	44.58466	-116.97508	2/20	egg mass	no	light	none to low
Payette NF	Bear saddle Up*	44.60227	-116.99552	0/60	none	no	no	none to low
Payette NF	Shingle Creek	44.78027	-116.3482	N/A	caterpillars, egg masses	no	moderate	moderate

Payette NF	Grouse Creek	44.959096	-116.544990	N/A	caterpillars, egg masses	no	moderate	moderate
Payette NF	Beaver Creek	44.92913	-116.3713	N/A	caterpillars, egg masses	no	moderate	moderate
Payette NF	Rubicon	45.00656	-116.3476	N/A	caterpillars, egg masses	no	moderate	moderate
Payette NF	Council-Cuprum Rd	44.74827	-116.5707	N/A	caterpillars, egg masses	no	moderate	moderate

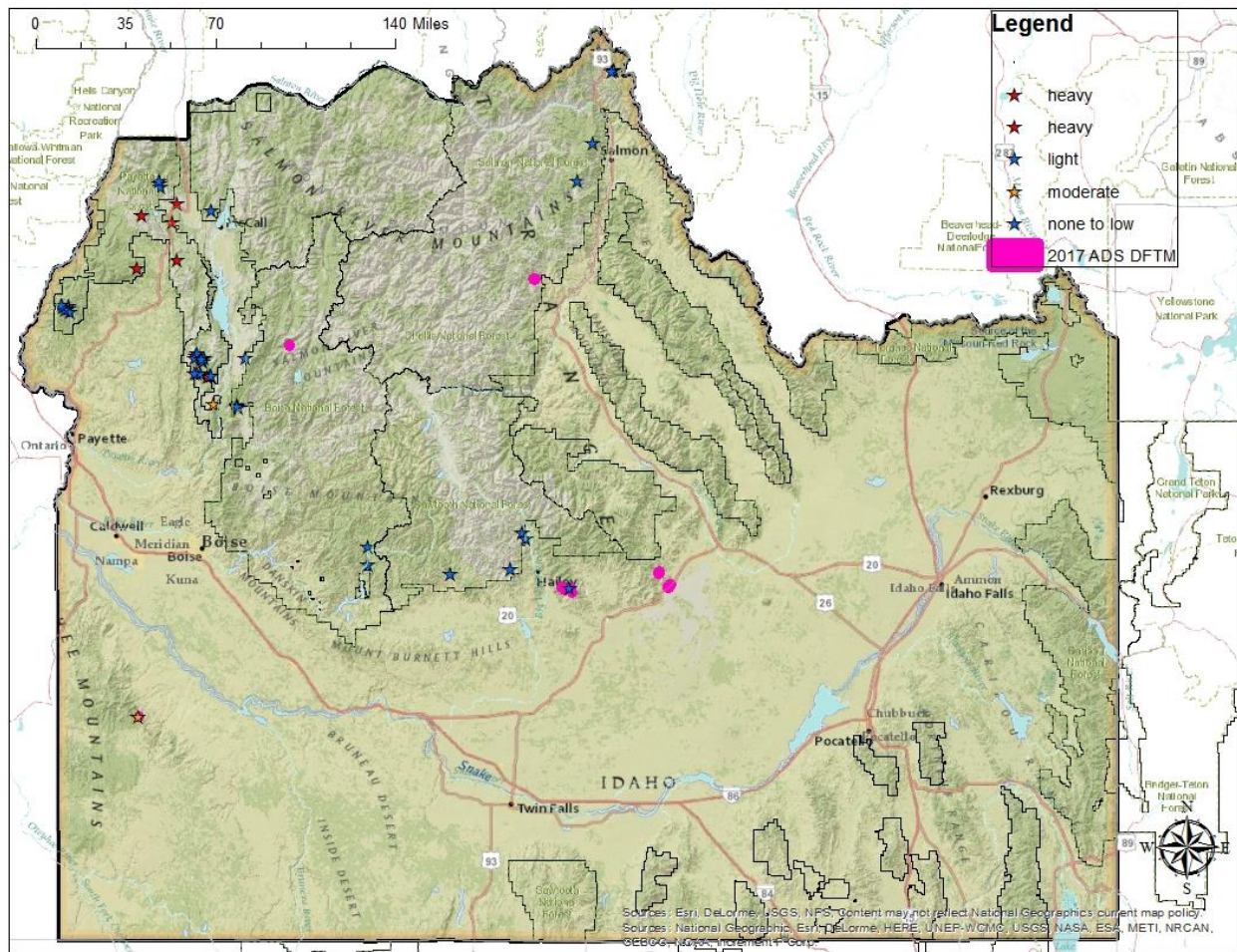


Figure 4. DFTM defoliation expected in southern Idaho in 2018 based on 2017 ADS and ground observations (FHP egg mass surveys, land managers reports). Defoliation will likely be visible in 2018 near all pink ADS areas and areas indicated by red and orange stars.

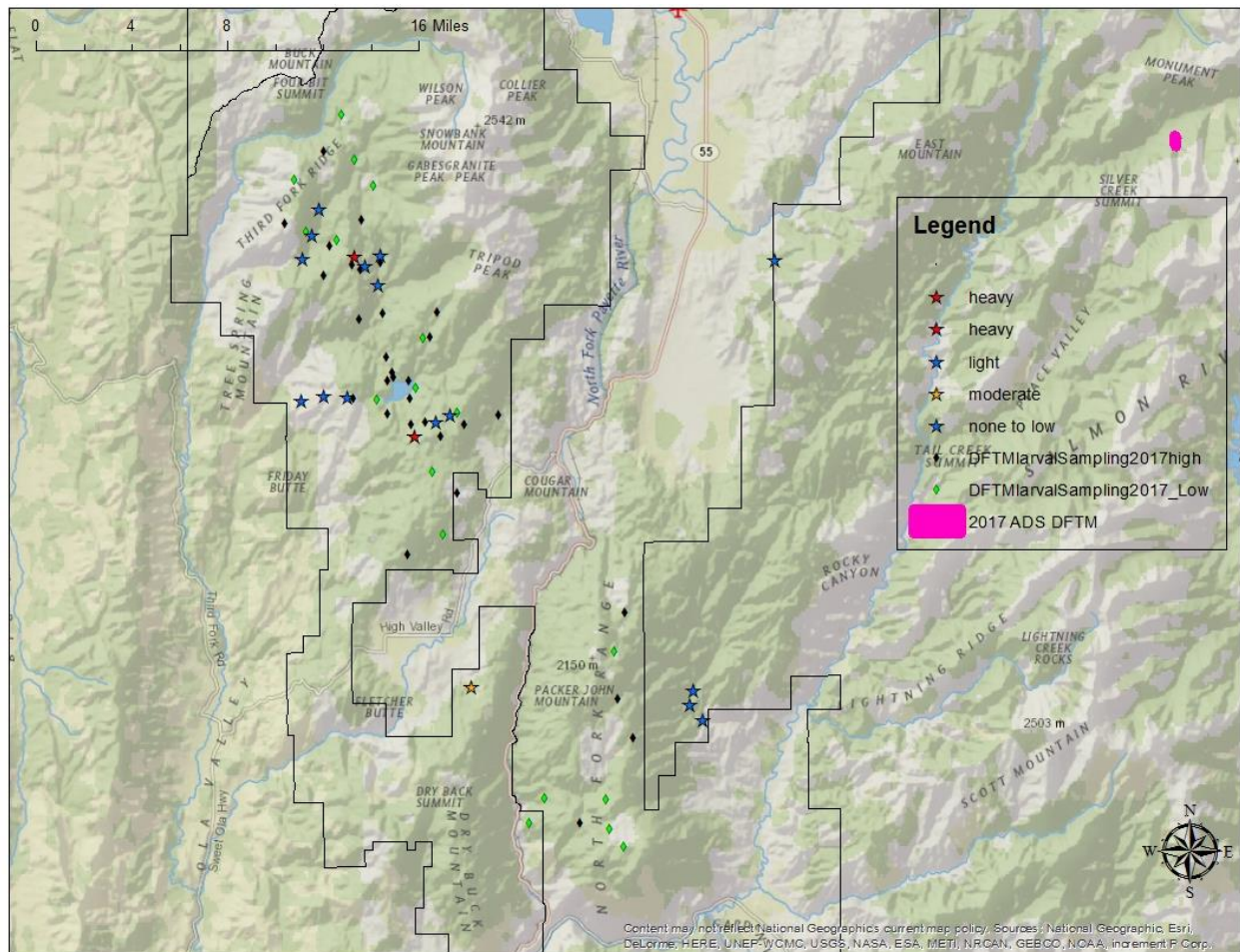


Figure 5. Close-up map of Boise National Forest, Emmett Ranger District areas with expected 2018 DFTM defoliation. Estimates are based on 2017 egg mass survey, larval sampling (black diamonds=2018 defoliation; unfilled diamonds= no 2018 defoliation), other ground observations, and 2017 ADS observations. Visible defoliation will likely occur near the pink polygons, full black diamonds and red and yellow stars.

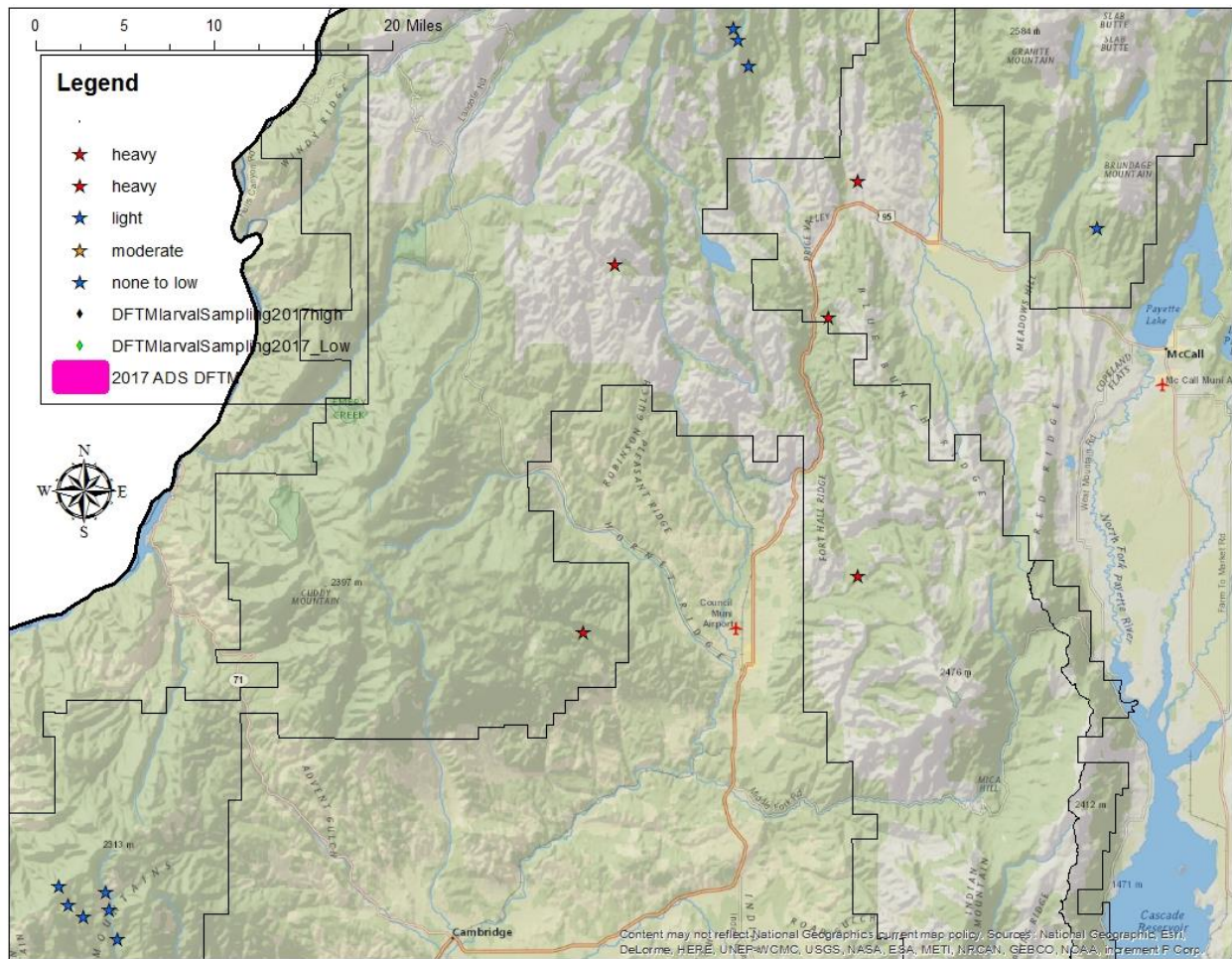


Figure 6. Close-up map of Payette National Forest, showing areas with expected DFTM defoliation in 2018 based on 2017 egg mass survey predictions, other ground observations, and ADS observations (red stars = high defoliation, blue stars = no to low defoliation).

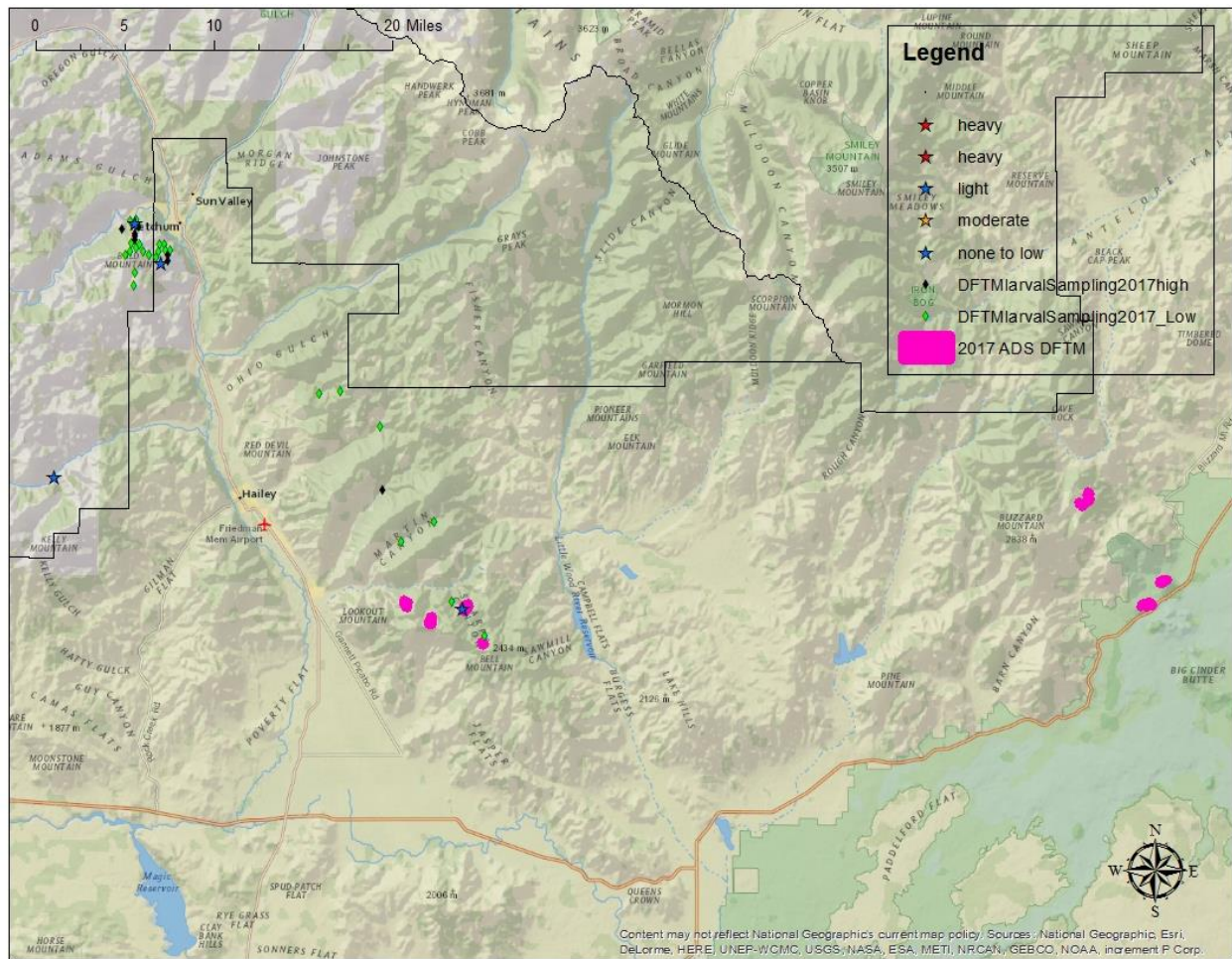
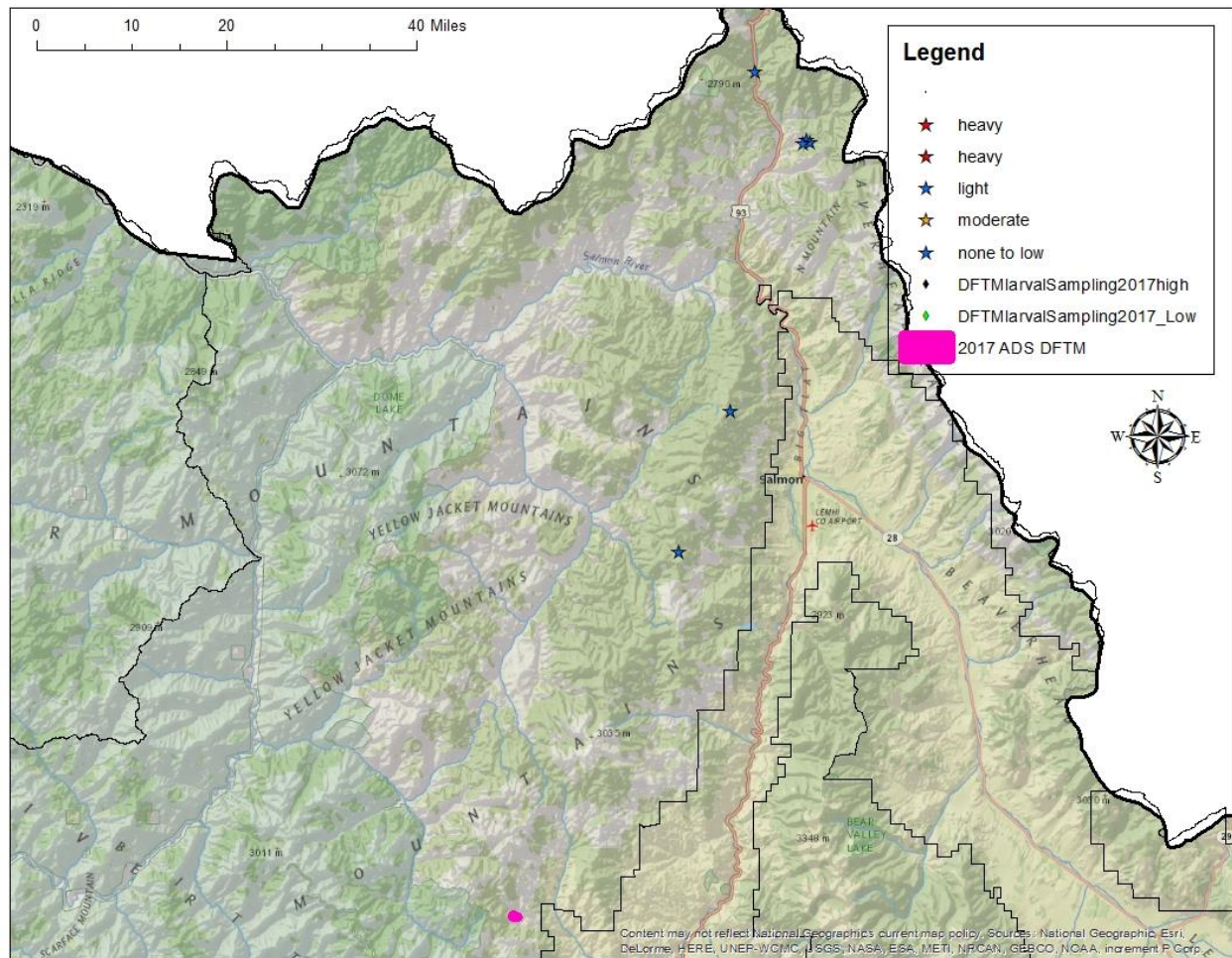


Figure 7. Close-up map of Ketchum Ranger District, Sawtooth National Forest and IDL and BLM land ownerships, and Craters of the Moon National Park. Expected DFTM defoliation levels in 2018 are shown by blue stars (no to low 2018 defoliation) and pink polygons recorded during 2017 ADS (likely areas for 2018 visible defoliation). Full Black diamonds indicate areas that predicted defoliation in 2018 based on June 2017 larval sampling, however, no egg masses or other life stages were found during the fall 2017 egg mass surveys and no defoliation is expected.



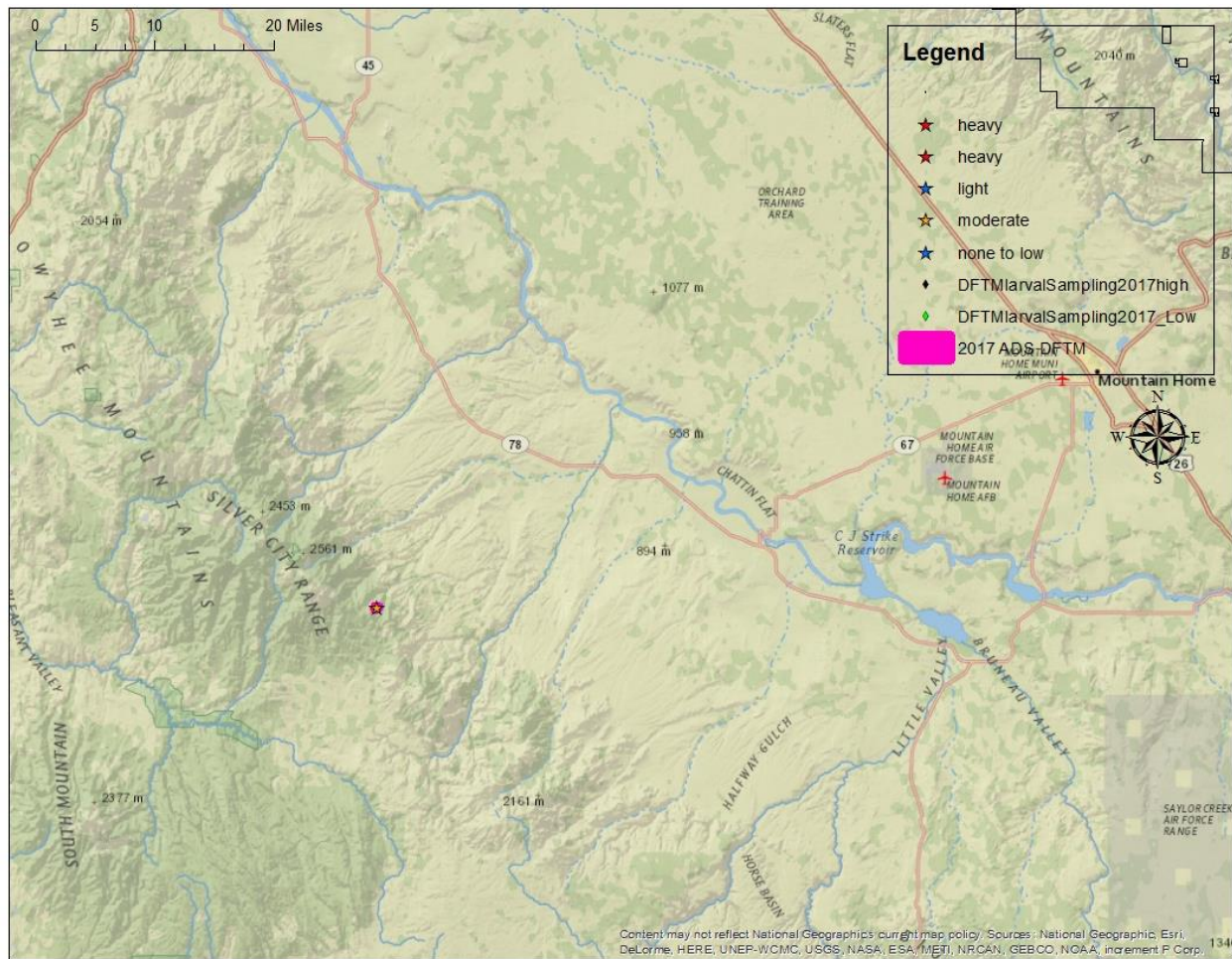


Figure 9. Close-up map of the BLM Owyhees, showing areas with expected DFTM defoliation in 2018 based on 2017 egg mass survey predictions and other ground observations (blue stars = no to light defoliation visible in 2018, orange and red stars indicate moderate and high defoliation levels), and 2017 ADS observations (pink = visible defoliation likely in 2018).

Please call me or Joel McMillin, FHP Boise Field Office Group Leader, 208-373-4227 at any time with questions or concerns regarding this report.

Sincerely,

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