Spruce Budworm in Maine 2017

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The Maine Forest Service (MFS) and its cooperators are closely watching spruce budworm in Maine to monitor and prepare for another epidemic of this native defoliator. Over the last several years, many indicators have pointed to the imminence of the next epidemic: pheromone and light trap catches have been up above zero for a number of years, defoliation in Quebec has increased year after year, defoliation has been mapped in New Brunswick. This is an insect whose epidemics cover vast regions and flights of moths from heavily infested areas can migrate to new areas. That there will be another outbreak in Maine, soon, is undeniable. When, where, how severe, and what the specific impacts and reactions may be remain to be seen.

The Maine Forest Service, cooperators within and outside the state, and Canadian provinces are working together to monitor and predict the growth of the spruce budworm population and its potential impact on the region's forests. Monitoring takes place using pheromone traps, light traps, overwintering larval samples and ground and aerial surveys.

The most sensitive method of monitoring budworm is pheromone traps. Permanent pheromone trap locations were established in the early 1990's across the northern half of the State and have been run yearly for the past twenty years. In recent years, that network has run about 80 sites set up by the Maine Forest Service, J.D. Irving Ltd, Penobscot Nation Department of Natural Resources and the USDA Forest Service. Since 2014, the pheromone trap monitoring program has been significantly expanded, with more than twenty land owners and managers participating in setting and retrieving traps at more than 400 sites. In 2017 we welcomed Passamaquoddy Tribal Forestry Department and The Nature Conservancy as new cooperators.

Spruce budworm pheromone survey cooperators 2017

American Forest Management	Maine Forest Service
Appalachian Mountain Club	Passamaquoddy Tribal Forestry Department
Baskahegan Company	Penobscot Experimental Forest
Baxter State Park	Penobscot Nation Department of Natural Resources
Forest Society of Maine	Prentiss & Carlisle
Hilton Timberlands, LLC	Rangeley Lakes Heritage Trust
J.M. Huber Corporation	Seven Islands Land Company
J. D. Irving Ltd.	The Nature Conservancy
Katahdin Forest Management, LLC	USDA Forest Service
LandVest	Wagner Forest Management, Ltd.
Maine Bureau of Public Lands	Weyerhaeuser

Cooperators were asked to place traps approximately one per township or every six miles in stands that were 25 acres or larger and at least 50% pole-sized or larger spruce/fir. These could be mature or pole sized stands, uncut or lightly cut spruce-fir dominated and could be pre-commercially thinned or shelterwood stands. Cooperators chose the sites based on where they had monitored in the past, with new sites established due to previous or planned management, change in access or other reasons.

The trapping method follows standardized protocol used by both Canadians and Americans since 1986. http://phero.net/iobc/montpellier/sanders.html.

Each site had a three-trap cluster with traps arranged in a triangle with approximately 130 feet between traps. Instructions were to place traps away from the road and at an average elevation for the area. Cooperators were asked to deploy traps during the first three weeks of June and retrieve them after mid-August. The catch was sent to the Maine Forest Service entomologist in Old Town for processing.

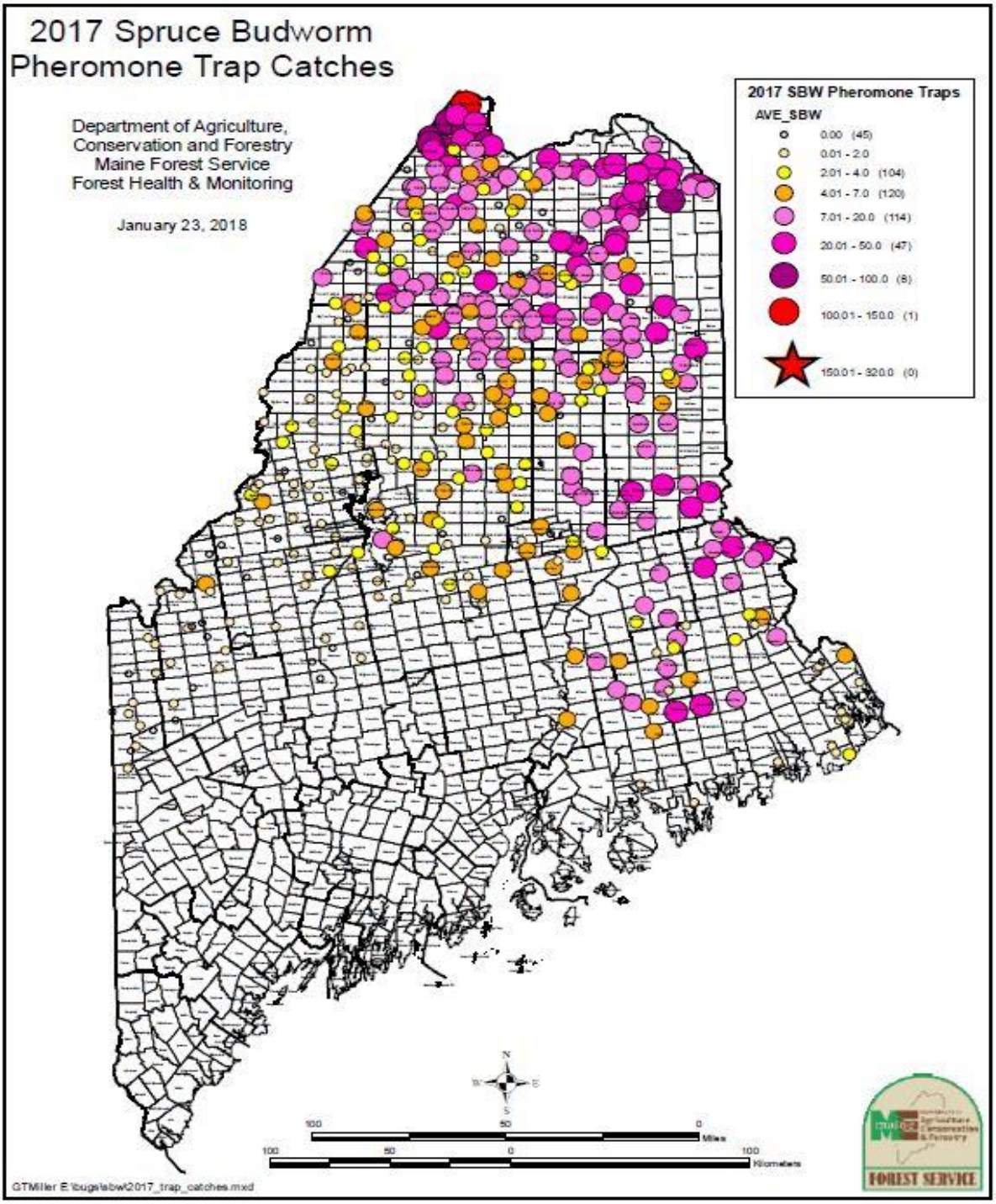


Figure C1. 2017 distribution of spruce budworm pheromone traps and trap catches across Maine.

The traps used were high capacity re-usable Multipher traps capable of monitoring spruce budworm moth populations over a wide range of densities. Using the lure provided, catches will range from 0–20 at low population densities to over l000 at high densities. The SBW lure was made by Synergy Semiochemicals Corp. http://www.semiochemical.com. This lure was first used in Maine in 2014, in previous years, a Contech brand lure was used. The insecticide used in the traps is a 1" x 4" strip (10% DDVP) brand Vaportape II.

The expanded spruce budworm pheromone survey shows spruce budworm is widespread but still at low numbers across the trapping range (Figure C1 and Figure C2). Trapping effort was heaviest in the northern third of the state, light across the middle of the state, with no trapping in the south where budworm is not expected to have a direct impact (Figure C1). Across most counties trapped, the average number of moths caught was fairly stable compared to 2015 (Figure C2). As in previous years, the majority of traps (92 percent) captured trace to 50 moths/trap (Figure C3).

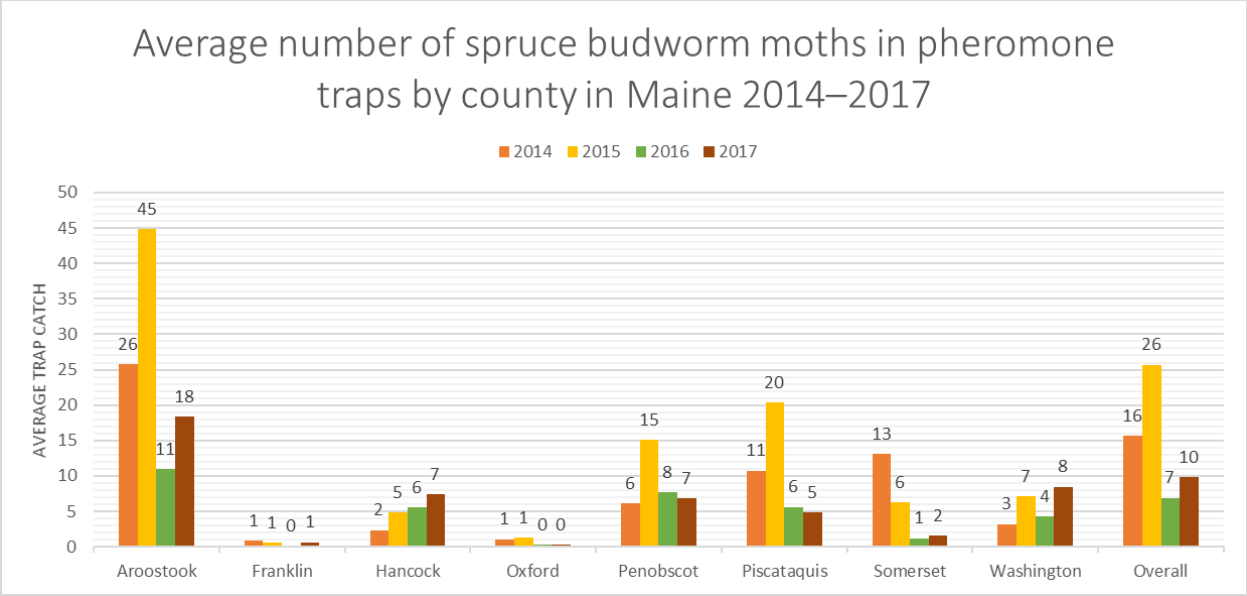


Figure C2. Average number of spruce budworm moths in pheromone traps by county in Maine 2014–2017.

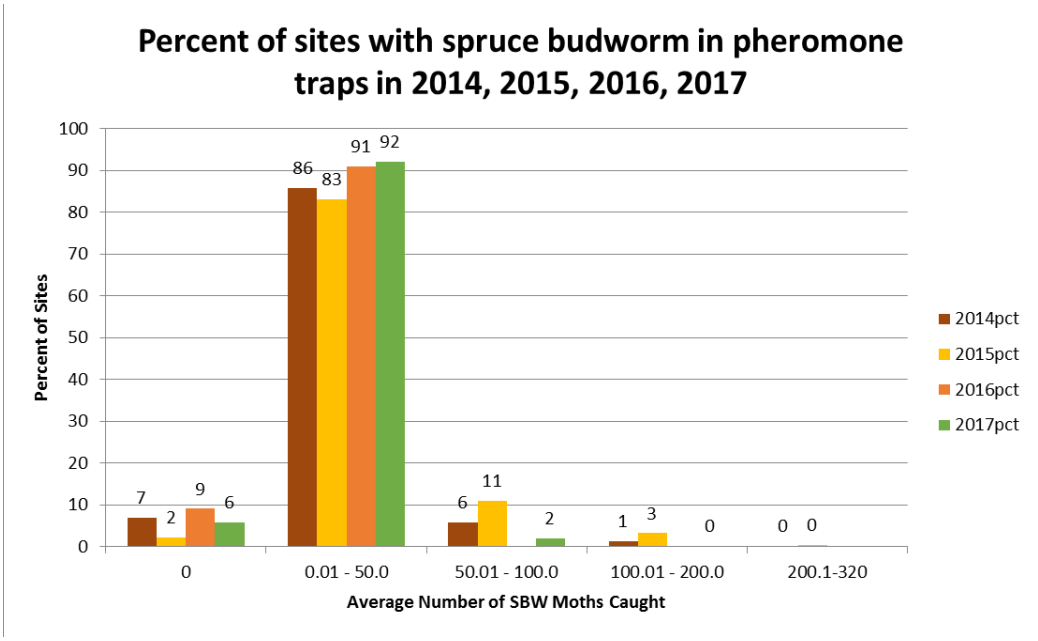


Figure C3. Percent of sites with spruce budworm in pheromone traps by catch 2014–2017.

As noted earlier, the Maine Forest Service has monitored collections at a set of longer term pheromone trap sites for the past 25 years. During that time, the average number of moths/trap stayed well below 10 until 2013 when the number jumped to 18 (Figure C4). In 2014 and 2015 it was above 20 moths/trap. In 2016, average catches declined to seven moths/trap, where they stayed in 2017.

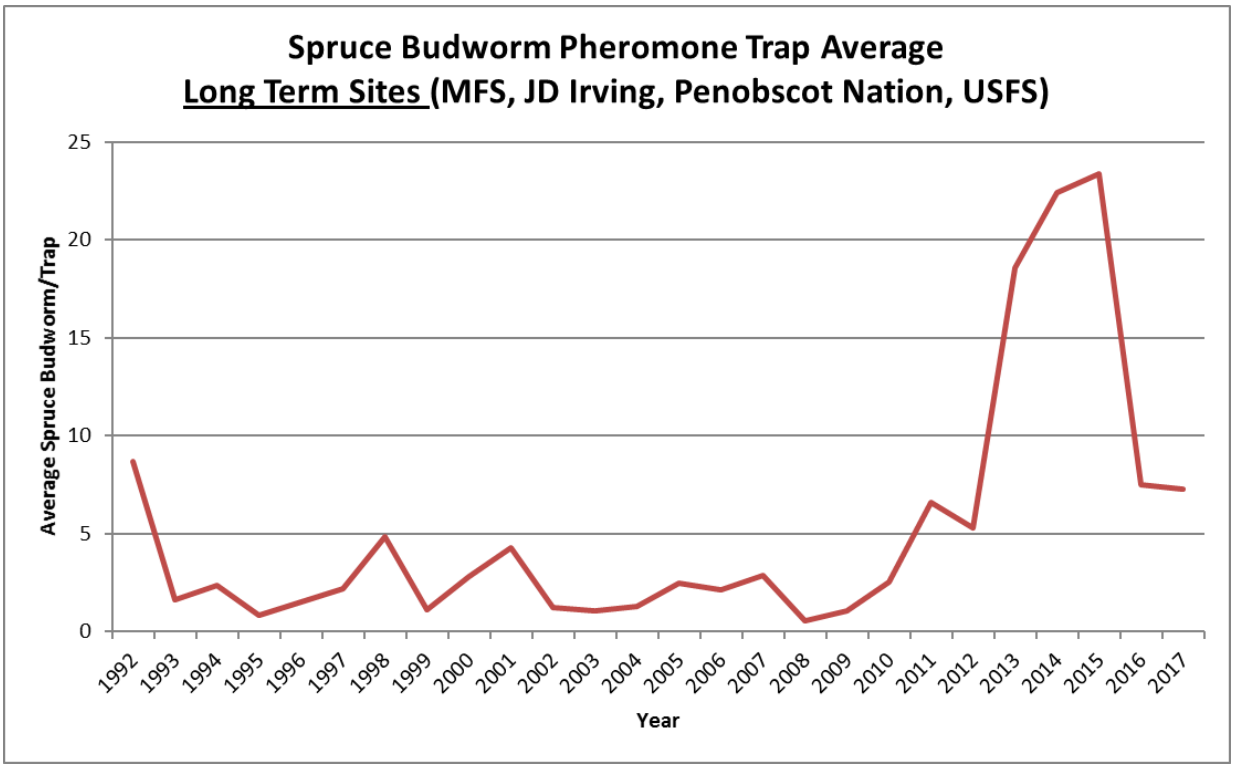


Figure C4. Spruce budworm pheromone trap average catch long term sites only (Maine Forest Service, J.D. Irving Ltd., Penobscot Nation DNR, USDA Forest Service).

Light traps have been used in Maine for more than seven decades to monitor spruce budworm populations and other forest defoliators and continue to be used today. In 2017, 18 traps were run by Maine residents in their backyards. They are paid a small stipend for checking the traps daily. Budworm moth counts from light traps were similar to 2014 and 2015 levels, down from 2016 (**Figure C5**). Four sites in the network caught a total of 41 moths (**Table C1**). In 2017 there was no trap operated in the Allagash area, a significant gap in our network—over the years 2013-2016 that site had trapped an average of 17 moths/year. In the 10 years before 2013 there were less than 10 spruce budworm moths caught in all the light traps combined. Therefore, the past years are a significant increase. At such low numbers, apparently wide fluctuations are not surprising.

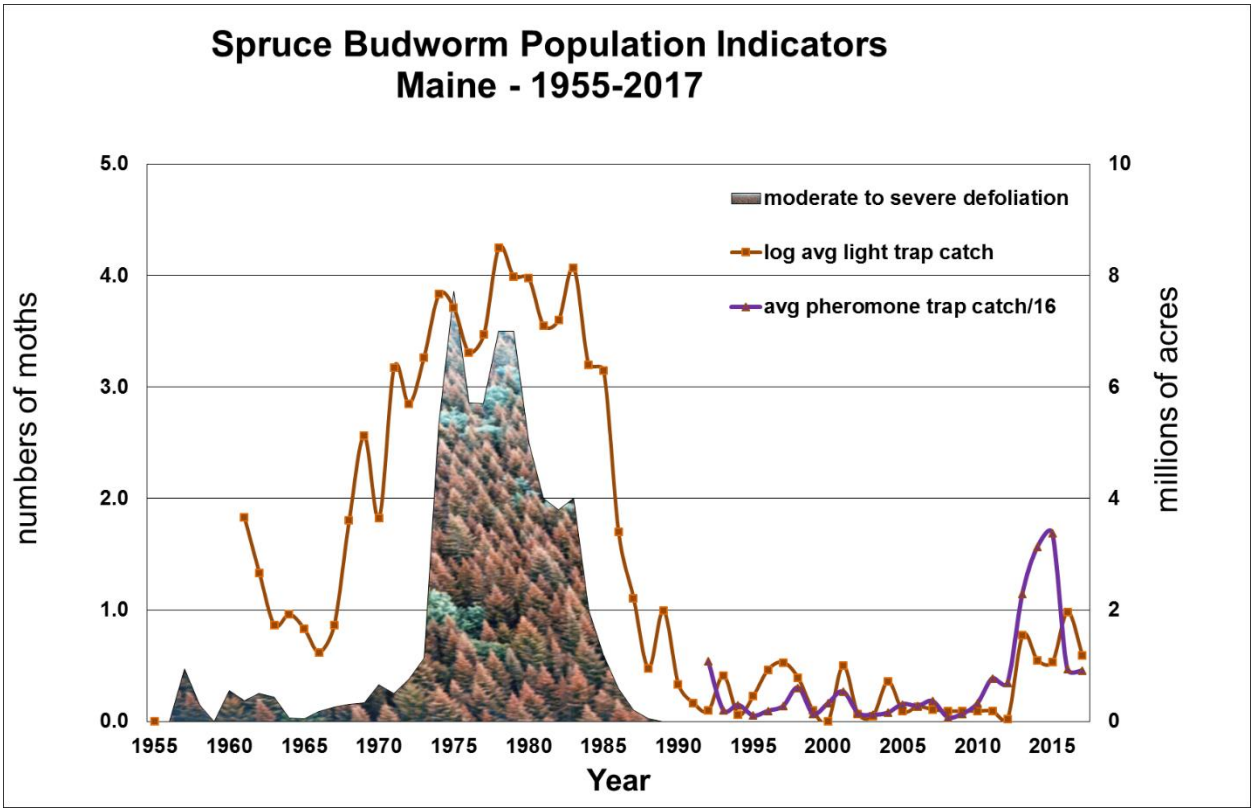


Figure C5. Composite graph of spruce budworm population indicators: defoliation, light trap and pheromone trap data 1955–2017.

Table C1. Spruce budworm caught in light traps in 2015 through 2017.

Town	County	SBW 2015	SBW 2016	SBW 2017
Allagash	Aroostook	**3**	**25**	n/a
Ashland	Aroostook	0	**3**	0
Bowerbank	Piscataquis	**1**	0	0
Calais	Washington	**2**	0	**6**
Crystal	Aroostook	**5**	**53**	**7**
Millinocket	Penobscot	**1**	**1**	0
Mount Desert	Hancock	n/a	**4**	0
New Sweden	Aroostook	**2**	**3**	0
Rangeley	Franklin	**1**	0	0
Topsfield	Washington	0	**44**	**18**
T3 R11 Wells	Aroostook	**17**	**13**	0
T15 R15 WELS	Aroostook	**2**	0	**10**
Total number of moths		**34**	**146**	**41**

More than 30 volunteers committed to collecting moths on a weekly or better basis at Maine sites. These sample locations were included in the Healthy Forest Partnership's Budworm Tracker Program. This project is managed by the Healthy Forest Partnership. Results will be reported at www.budwormtracker.ca.

The University of Maine Cooperative Forestry Research Unit (CFRU) continues to head up an "L2" sample program in conjunction with the Canadian Forest Service as part of the Healthy Forest Partnership. The L2 project goals are to assemble a broadly distributed long-term time series of budworm population monitoring data to: (1) enhance opportunities for management planning by identifying incipient local populations as early as possible and (2) add to a database that can be linked with vegetation data and information about natural enemies in the future to fill important knowledge gaps about how landscape conditions influence local outbreak dynamics. CFRU members have approved funding for support of this survey through 2019.

Since 2014, spruce budworm host branch samples have been collected during the fall and winters in areas where pheromone trap catches had been high, modeling predicted at-risk stands, or previous samples had been collected. One 30-inch-long branch is cut from the mid-crown of each of three trees at each sample site. Samples are sent to Canada for processing at the Canadian Forest Service lab in Fredericton. The data can be viewed on the healthy forest partnership research map at: http://www.healthyforestpartnership.ca/en/research/what-where-and-when/. 2017 samples from Maine yielded a total of 32 larvae across 13 sites. No larvae were recovered at 242 of the 255 sites sampled (**Table C2**).

Table C2. Overwintering larvae recovered during L2 surveys in Maine 2014-2017

Year	Town	County	Site ID	L2/ 30 inch Branch
2014-2015 (N sites = 100, 6.0 percent positive)	Saint Francis	Aroostook	IRV-STF-59	1.0
	T12 R12 WELS	Aroostook	OT-1212	0.3
	T14 R13 WELS	Aroostook	OT-1413	0.3
	T14 R7 WELS	Aroostook	IRV-147	1.0
	T14 R8 WELS	Aroostook	IRV-148-15	0.3
	Westmanland	Aroostook	IRV-WES-30	0.7
2015-2016 (N sites = 241, 5.8 percent positive)	Allagash	Aroostook	IRV-ALL-32	0.3
	Dyer Brook	Aroostook	IRV-DRB	0.7
	Perham	Aroostook	IRV-PER	0.3
	Portage Lake	Aroostook	IRV-POL	0.3
	T12 R9 WELS	Aroostook	IRV-129-12	5
	T13 R11 WELS	Aroostook	IRV-1311	0.3
	T13 R7 WELS	Aroostook	IRV-137	0.3
	T15 R11 WELS	Aroostook	IRV-1511	0.3
	T15 R15 WELS	Aroostook	MFS-1515	0.3
	T16 R4 WELS	Aroostook	IRV-164	0.7
	T17 R5 WELS	Aroostook	IRV-175	0.3
	T18 R10 WELS	Aroostook	OT-1810	0.3
	T5 R20 WELS	Somerset	MFS-520	1.3
	T6 R8 WELS	Penobscot	MFS-68	0.3

Year	Town	County	Site ID	L2/ 30 inch Branch
2016-2017 (N sites = 219, 4.1 percent positive)	Lower Cupsuptic Twp	Oxford	SI-LCT	0.3
	New Canada	Aroostook	MFS-VOS	1
	New Canada	Aroostook	MFS-VOS2	0.3
	Portage Lake	Aroostook	IRV-POL	0.3
	Princeton	Washington	MFS-PRI	0.3
	T15 R12 WELS	Aroostook	IRV-1512	0.3
	T17 R5 WELS	Aroostook	IRV-175	0.3
	Topsfield	Washington	MFS-ltTOP	0.3
	Wallagrass	Aroostook	IRV-WAL	0.3
2017-2018 (N sites = 255, 5.1 percent positive)	Connor Twp	Aroostook	MFS-CON	0.3
	Cross Lake Twp	Aroostook	MFS-175	1.3
	Cross Lake Twp	Aroostook	MFS-175-ALT	0.3
	Fort Kent	Aroostook	MFS-FTK	0.7
	Fort Kent	Aroostook	MFS-FTK-2	2.3
	Hamlin	Aroostook	IRV-HML-48	0.3
	Madawaska	Aroostook	MFS-MAD	1
	Saint John Plt	Aroostook	MFS-SAJ	0.7
	T11 R8 WELS	Aroostook	SI-118	0.3
	T17 R4 WELS	Aroostook	IRV-174-56	0.3
	T9 R9 WELS	Aroostook	SI-99	0.3
	TC R2 WELS	Aroostook	IRV-TC2-05	2.3
	Wallagrass	Aroostook	IRV-WAL	0.3

Both ground and aerial surveys were conducted in 2017, looking specifically for spruce budworm in northern Maine where damage would first appear. This year we looked for defoliation on a subset of MFS-sampled L2 sites and additional sites in northern Maine. The Fettes Method was used to quantify defoliation on current-year growth. This method provides a systematic approach to measuring defoliation. It was employed during the last budworm outbreak in Maine, and is currently in use in Quebec. MFS staff received training on implementing the method in a July 2016 field training held in the Matapedia Valley in Quebec. The Fettes Method captures defoliation from all causes and can be used to estimate both current-year defoliation and cumulative defoliation. Trace defoliation was recorded at all 26 sample sites, with levels ranging from 0.2 to 3.9 percent foliage missing. Only four sample sites had defoliation that was in a pattern typical for the feeding behavior of spruce budworm. These were found in two sites near Estcourt Station in Big 20 Twp, one site in Cross Lake Twp and one site in Connor Twp (**Figure C6**). We plan to repeat this survey in July 2018. CFRU is contemplating collecting Fettes data for all L2 survey samples collected in 2018. A brief introduction to the Fettes Method is provided in this document: http://www.sampforestpest.ento.vt.edu/defoliating/spruce-budworm/pdf/montgomery-etal1982-sbw.pdf. A sample data sheet is shown in **Figure C7**.

No defoliation was detected during aerial survey. Feeding needs to be approaching a moderate level of damage before it is visible from the air. All population measures indicate that numbers are too low everywhere in Maine to expect that level of feeding yet.

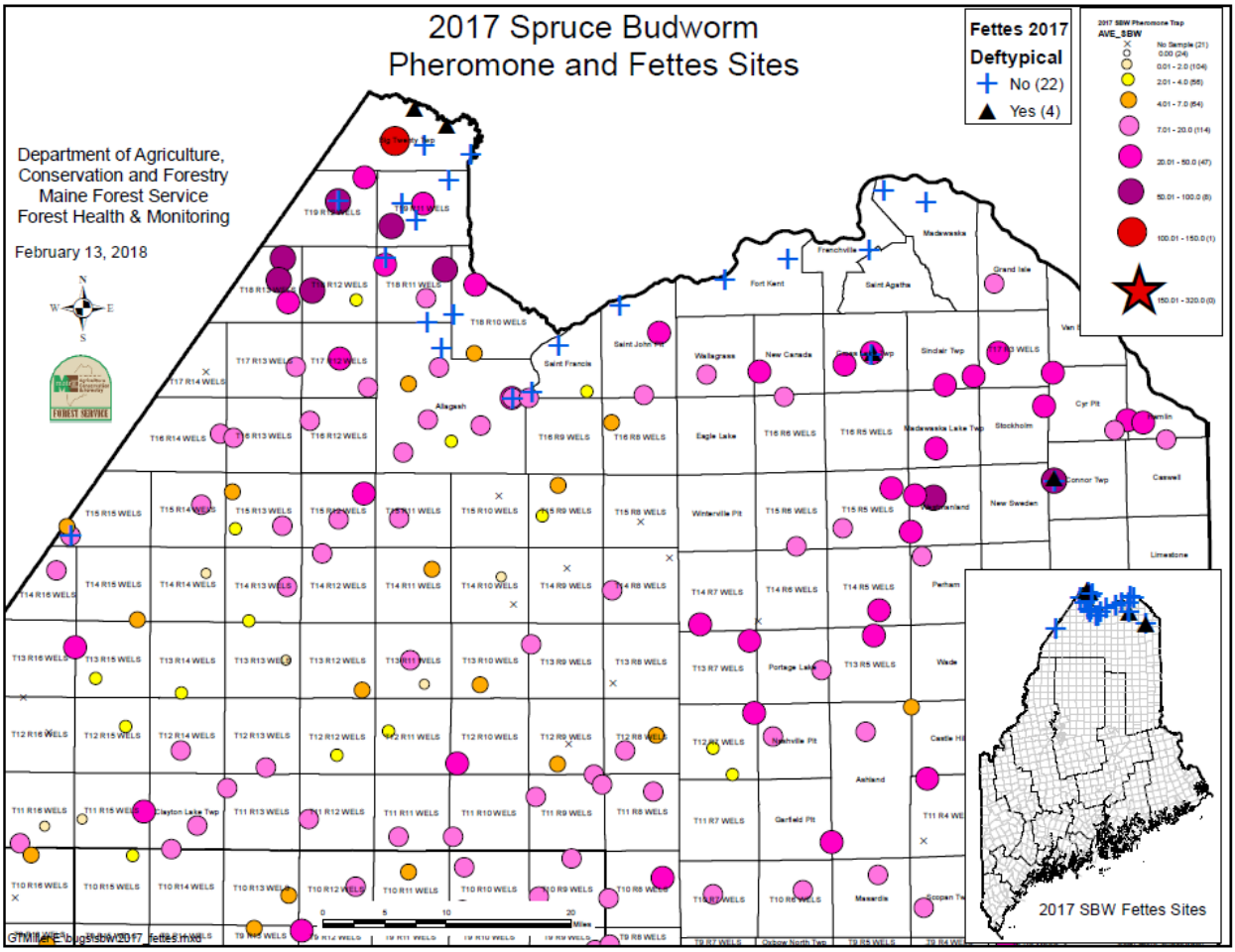
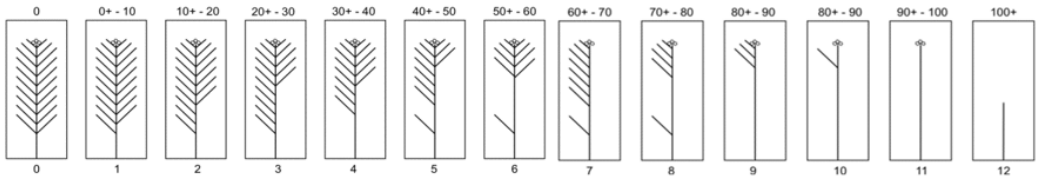


Figure C6. Locations of Fettes defoliation survey sites and pheromone trap sites. Triangles indicate sites where defoliation pattern was typical of that which would be expected from spruce budworm feeding.

SBW Defoliation--Fettes Method, CURRENT YEAR: Examine 20 tips per mid-canopy branch and rate using graphic, multipy N*Value, Sum products and divide by Total number of tips to get percent defoliation by branch or site. Try to do 3 branches from 3 trees at each site.



Lat: _____ **Long:** _____ **Date:** _____ **Operator:** _____

Township: **No. Branches:** **Species:**

Tally													**TOTALS:**
N tips													**N:**
(Value)	0	5	15	25	35	45	55	65	75	85	95	100	100	
Product														**Σ:**

OWNER INFO (Optional) **Branch Defoliation (Σ/N):** _____

Figure C7. Sample data sheet (Excel file available upon request). Data were generally collected on hand-held tablets using DoForms, however paper data sheets were made available.

Populations of spruce budworm in Maine remain low, but detectable through trapping. Maine is poised at the beginning of another spruce budworm outbreak. Outbreaks occur on a roughly 40-year cycle in response to maturing forest stands and reduced pressure from parasites; the last time budworm was a problem in Maine was in the 1970's and 80's. This native defoliator of balsam fir and spruce has been defoliating trees in Quebec north of the Saint Lawrence Seaway for more than 10 years and has now been mapped within 10 miles of our northwestern boundary. Defoliation, which has spread to the south shore and into New Brunswick, currently covers more than 17 million acres. Current population levels in the state will allow more time to prepare before trees begin to experience growth-loss from budworm feeding.

Updates to this report will be posted to www.sprucebudwormmaine.org as well as www.maineforestservice.gov.

Acknowledgements:
A big thank you goes out to all the folks who paid attention to details of the trap protocol and worked to get the traps out and samples back in for processing. A lot of effort goes into the trap network, from people in the woods to those in the office who manage data from multiple surveyors. We appreciate their efforts and the support of the Spruce Budworm Task Force members.

Thanks to the MFS field crews that helped with the surveys this year. Special thanks to Mike Devine who provided hands-on training in recognizing subtle signatures of spruce budworm feeding and is a valuable sounding board for the project. Charlene Donahue (retired, MFS) coordinated the light trap program, Amy Ouellette screened the catches. Patti Roberts was instrumental in procuring supplies for the survey.