Spruce Budworm in Maine 2019

Michael Parisio, Forest Entomologist
Maine Forest Service, DACF
168 State House Station, Augusta, ME 04333
(207) 287-7094 michael.parisio@maine.gov
April 1, 2020

Introduction

As spruce budworm numbers remain on the rise throughout Maine, the Maine Forest Service and its cooperators continue to track populations carefully in anticipation of an approaching outbreak.

A successful spruce budworm (SBW) monitoring program requires a multi-pronged approach and relies on the use of methods such as pheromone trapping, light trapping, overwintering larval sampling, and aerial and ground survey. At the core of the Maine Forest Service (MFS) monitoring program lies the extensive pheromone trap network throughout the spruce-fir forests of northern Maine. A permanent pheromone trap network was first established in 1992 and was made up of about 80 sites operated by MFS, J.D. Irving Ltd, Penobscot Nation Department of Natural Resources, and the USDA Forest Service. Since 2014, with the support of a large cooperator team of more than twenty land owners and managers, the pheromone trap network has grown to include more than 400 sites.

SBW is a native insect whose outbreaks cover vast regions and spread through massive dispersal flights as moths migrate from heavily impacted areas to new ones. In northeastern North America, SBW outbreaks tend to return on a 30-60 year interval and the last major SBW outbreak to directly affect Maine occurred during the 1970s-80s. Historical data tell us that Maine is due for another SBW outbreak and monitoring efforts illustrate that over the last several years, SBW population levels appear to have left the endemic or “stable” phase experienced between outbreak events. For several years now in Maine, both pheromone trap and light trap catches have been above numbers expected during the endemic phase and millions of acres of defoliation in neighboring Canadian provinces continues to encroach on the Maine border. Large in-flights of migrating moths from outbreak areas in Canada into northern Maine were well-documented in 2019. The impacts of these migration events on Maine’s forests remain to be seen.

2019 Spruce Budworm Pheromone Trap Survey Cooperator Team:

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

Pheromone Trapping

Pheromone trapping efforts are more concentrated in those parts of northern Maine where the spruce-fir resource is greatest. Cooperators are asked to locate pheromone trap sites in spruce-fir dominated stands greater than 25 acres at a density of one site per township, or about every six miles along forest roads. Stands can vary between pole-sized or mature stands, uncut or lightly cut stands, and pre-commercially thinned or shelterwood stands, but as a minimum requirement at least half the trees should be pole-sized or larger. Once established, cooperators tend to reuse sites annually, but sites are periodically decommissioned or established due to active management, change in access, or other reasons.

Pheromone trapping methods follow a standardized protocol used by both Canadians and Americans since 1986. Further details can be found at http://phero.net/iobc/montpellier/sanders.html

The trap network employs re-usable Multipher traps baited with SBW pheromone lures made by ISCA Technologies and distributed by Solida and equipped with Vaportape II insecticide strips (1" x 4", 10% DDVP) made by Hercon Environmental. These high-capacity traps are capable of monitoring SBW moth numbers over a wide range of population densities and adult moth catches can range from 0–20 at low population densities to over l,000 at high densities.

Each site consists of a cluster of three traps arranged in a triangle with approximately 130 feet between traps. Instructions are to place traps away from the road and at an average elevation for the area. Traps are deployed during the first three weeks of June and retrieved in mid-August or later. Joe Bither, our senior entomology technician in Stockholm, manages the logistics of getting supplies to and samples from cooperators in northern Maine. Trap catches are then processed at the entomology lab in Augusta.

A total of 385 usable samples were collected in 2019 and the expanded pheromone trap network shows that spruce budworm is widespread, and that average trap catch has increased substantially from 2018 (Figure 1). Statewide overall and in Aroostook County, average trap catches increased more than threefold (Figure 2). Also statewide, the percentage of traps that averaged 100 moths or more increased from just two percent in 2018 to 20 percent in 2019. Other notable county-wide increases in average trap catches were seen in Penobscot, Piscataquis, and Somerset Counties. Average trap catches remained comparable to 2018 numbers in Franklin, Oxford, Somerset and Washington Counties.

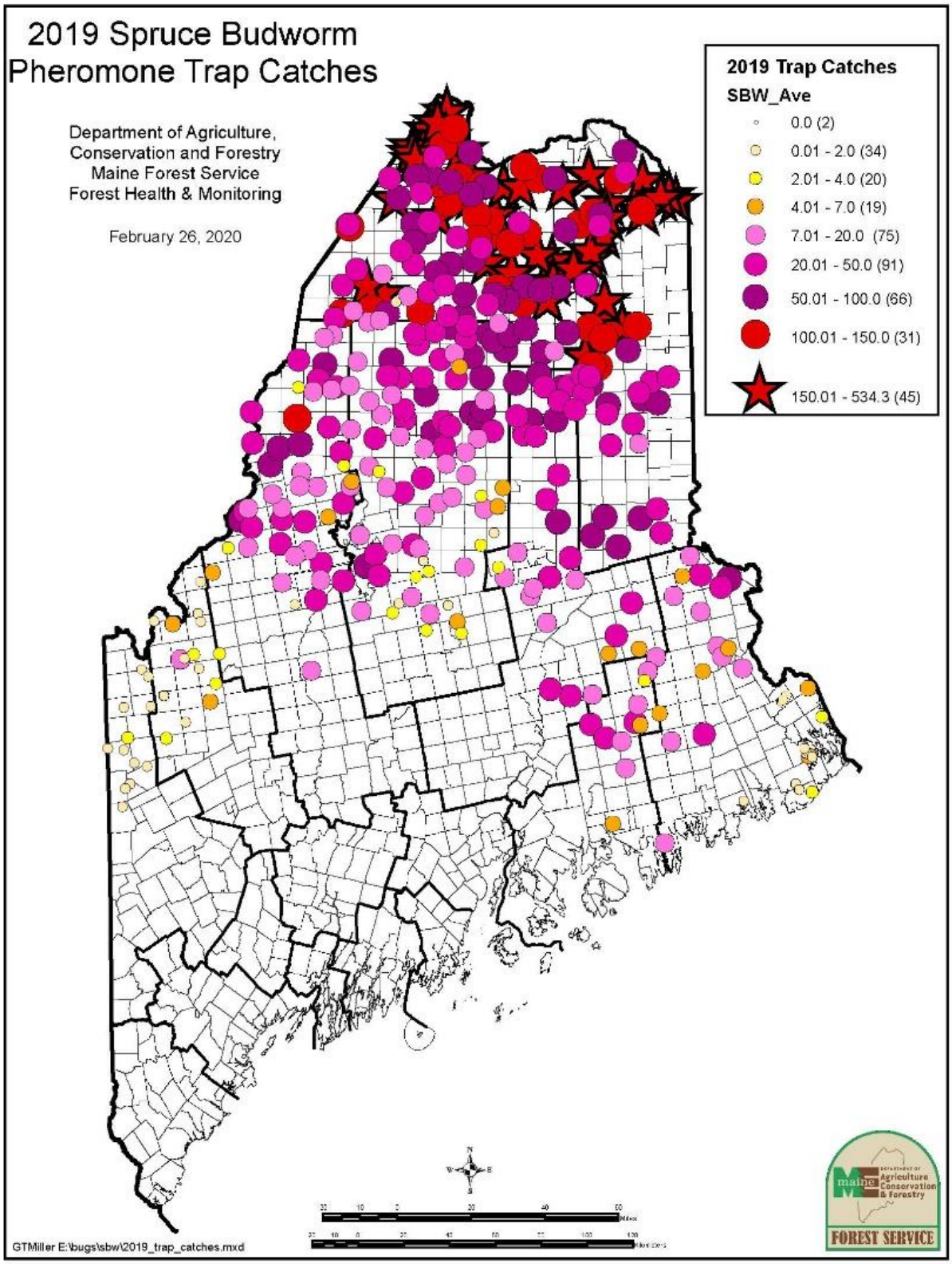

Figure 1. Map of statewide spruce budworm pheromone trap catches, 2019.

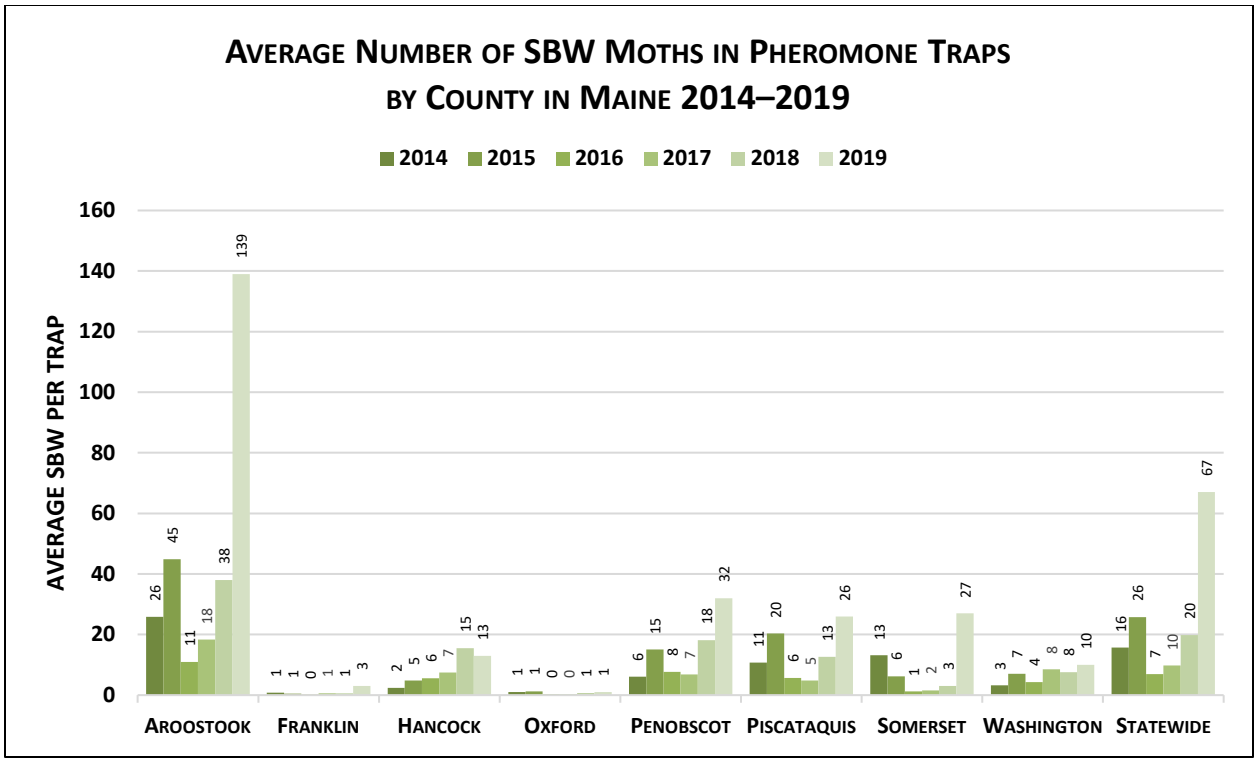

Figure 1. Average number of SBW moths in pheromone traps by county in Maine 2014–2019.

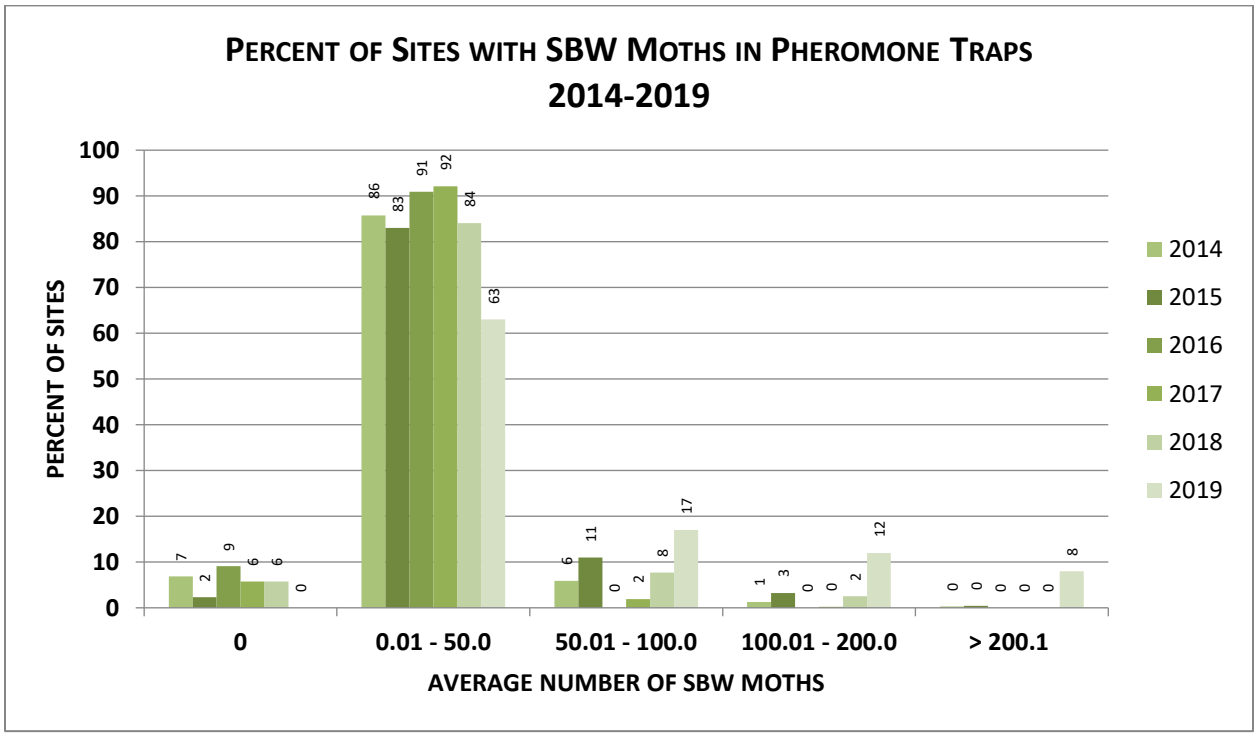

Figure 2. Percent of SBW-positive sites by average trap capture, 2014–2019.

As noted earlier, the Maine Forest Service has been monitoring a core set of long-term pheromone trap sites since 1992. From 1992 to 2012, the average number of moths caught in these traps remained well below 10. That average jumped to 18 in 2013, followed by further increase in 2014 and 2015 to more than 20 moths per trap. Average catches fell to seven moths per trap in both 2016 and 2017, but once again returned to double digits in 2018 as it rose to 15 moths per trap. Most recently in 2019, we observed a dramatic increase as the average soared to about 55 moths per trap (Figure 3).

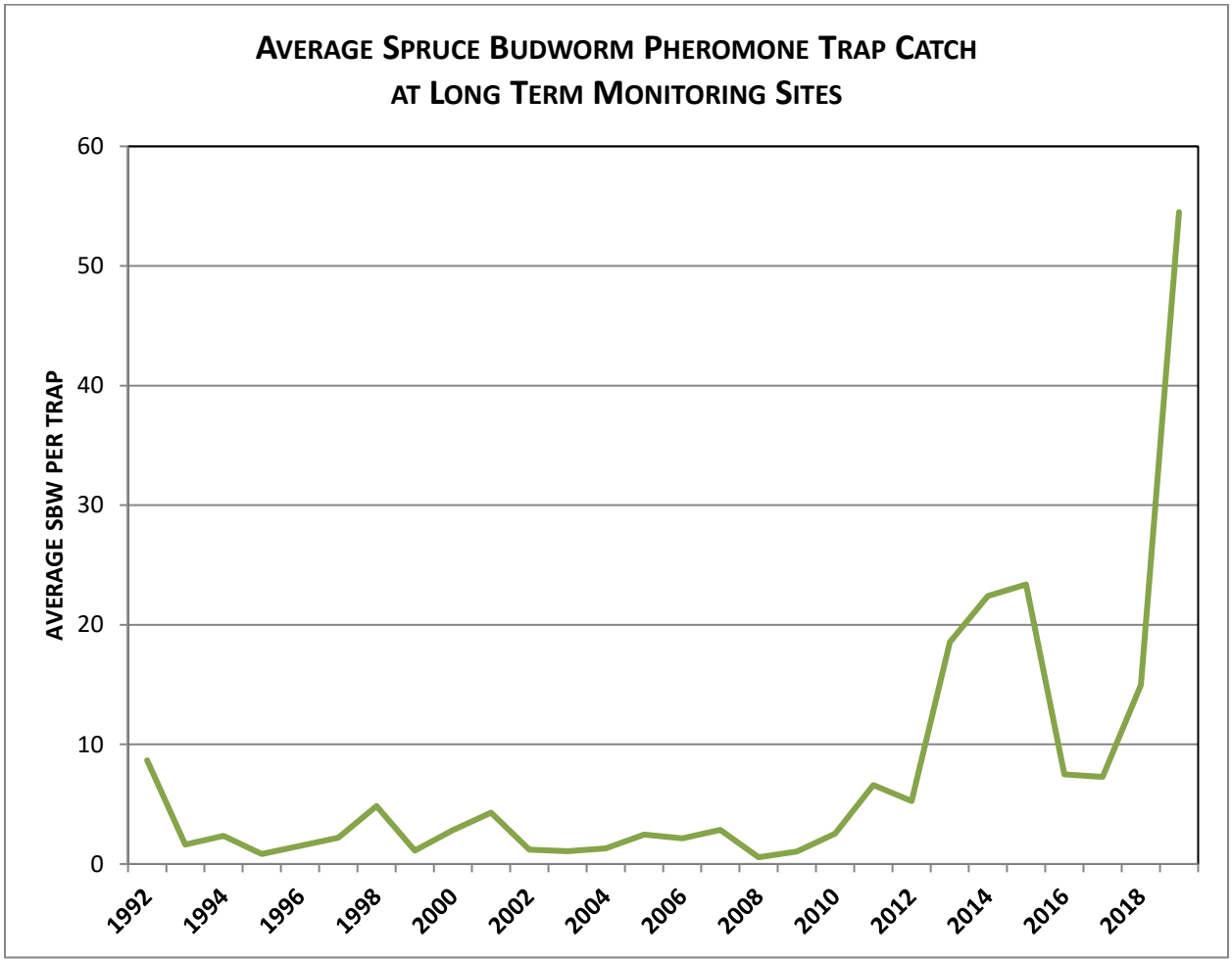

Figure 3. Average spruce budworm pheromone trap catch at long term sites operated since 1992 by the Maine Forest Service, J.D. Irving Ltd., Penobscot Nation DNR, and USDA Forest Service.

Additionally, other volunteers in Maine are committed to collecting moths on a weekly or more frequent basis in pheromone traps. Data from these particular sample locations are included in the Healthy Forest Partnership's Budworm Tracker Program. This project is managed by the Healthy Forest Partnership. Results can be requested at www.budwormtracker.ca.

Light Trapping

Light traps have been used in Maine for more than seven decades to monitor SBW and other forest defoliators and remain a useful monitoring tool to this day. In 2018, 21 traps were run by Maine residents in their backyards and twelve sites in the light trap network caught a total of 202 spruce budworm moths. In 2019, 17 light traps were operated statewide and we witnessed a dramatic increase in light trap catches, with 502 adult SBW moths caught at twelve sites, although not the same sites as in 2018 (Table 1, Figure 4). Most moths were recovered from just four sites in Aroostook County (135 in Garfield, 127 in Crystal, 82 in St. Pamphile (T15 R15 WELS) and 27 in New Sweden). We believe many of these moths were migrants from a massive in-flight of moths in late July from the ongoing Quebec outbreak (Figure 5).

Table 1. Spruce budworm caught in light traps in 2015 through 2019.

TOWN	COUNTY	2015	2016	2017	2018	2019
Allagash	Aroostook	**3**	**25**	N/A	**23**	**44**
Ashland	Aroostook	0	**3**	0	**29**	N/A
Big Twenty Twp	Aroostook	N/A	N/A	N/A	**54**	N/A
Bowerbank	Piscataquis	**1**	0	0	**2**	**1**
Calais	Washington	**2**	0	**6**	**2**	**1**
Cape Elizabeth	Cumberland	0	0	0	**1**	**0**
Clayton Lake Twp	Aroostook	N/A	N/A	N/A	**10**	**65**
Crystal	Aroostook	**5**	**53**	**7**	**42**	**127**
Exeter	Penobscot	**0**	**0**	0	**2**	**0**
Garfield	Aroostook	N/A	N/A	N/A	N/A	**135**
Jackman	Somerset	N/A	**0**	0	**0**	**0**
Millinocket	Penobscot	**1**	**1**	0	0	8
Monson	Piscataquis	N/A	N/A	N/A	0	3
Mount Desert	Hancock	N/A	**4**	N/A	0	N/A
New Sweden	Aroostook	**2**	**3**	0	**12**	**27**
Rangeley	Franklin	**1**	0	0	0	1
Salem	Franklin	N/A	N/A	0	0	4
South Berwick	York	**0**	0	0	0	1
Topsfield	Washington	0	**44**	**18**	**22**	**1**
T3 R11 Wells	Aroostook	**2**	**13**	0	0	N/A
T15 R15 WELS	Aroostook	**17**	0	**10**	**3**	**89**
TOTAL NUMBER OF MOTHS		**34**	**146**	**41**	**202**	**517**

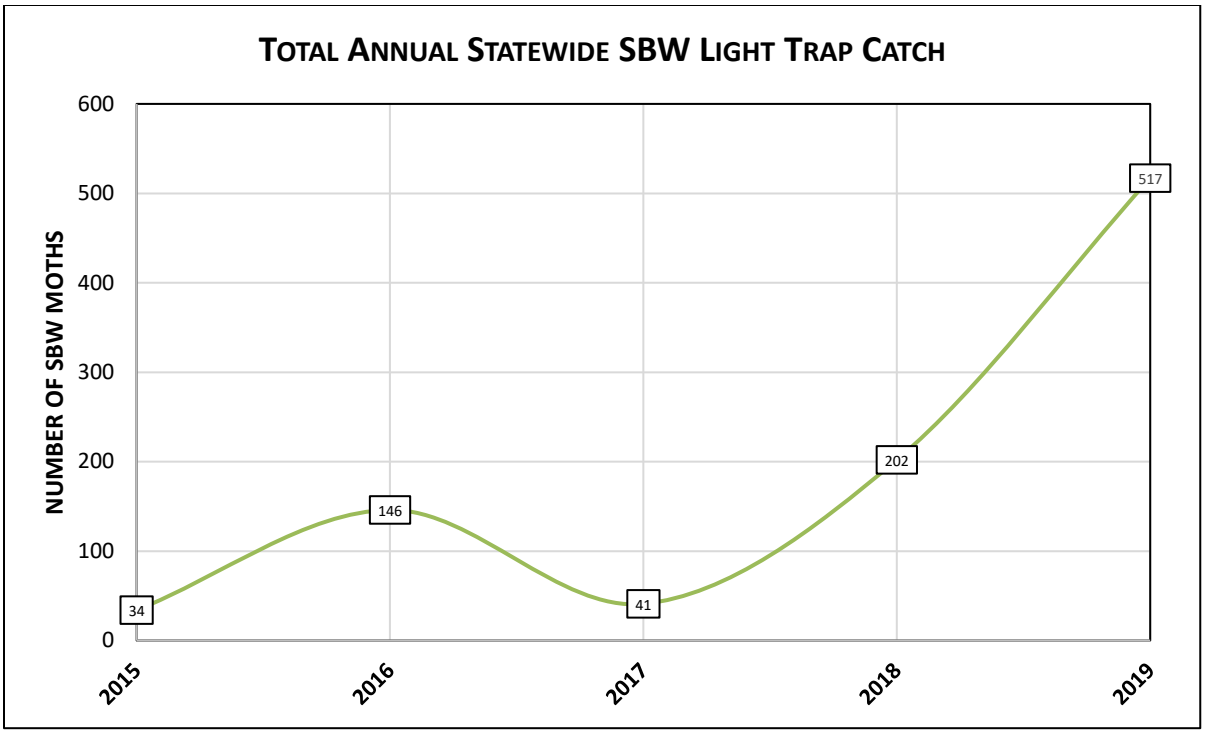

Figure 4. Total annual statewide light trap catches of SBW moths 2015–2019.

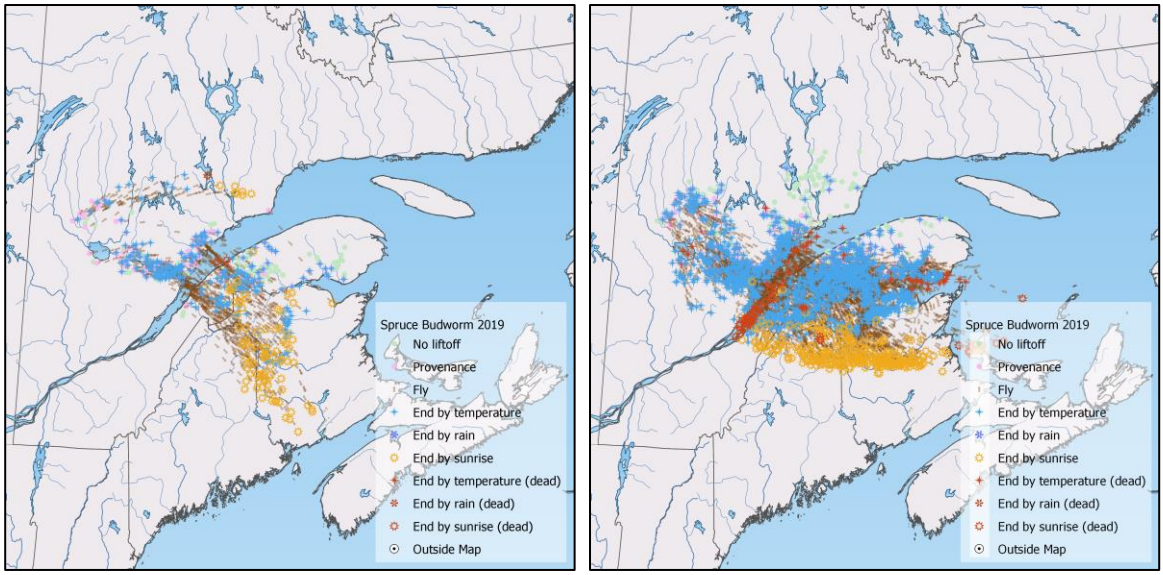

Figure 5. Flight models demonstrating large in-flights of adult SBW moths from outbreak areas in Canada on July 15th (above left) and July 20th (above right). Images generating BioSIM, courtesy of R. Saint-Armant, Canadian Forest Service

Overwintering Larval Sampling

The University of Maine Cooperative Forestry Research Unit (CFRU) continues to lead the overwintering larval sampling portion of the monitoring program, targeting second instar (L2) larvae, 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 2020.

Since 2014, branch samples from SBW host species, primarily balsam fir, have been collected during the fall or winter in areas where pheromone trap catches were high, where modeling has predicted at-risk stands, or where previous samples had been collected. At each sample site, one 30-inch-long branch is cut from the mid-crown of each of three trees. Branch samples are sent to Canada for processing at the Canadian Forest Service lab in Fredericton, NB. The list of sites where overwintering larvae have been recovered, going back to 2014, can be viewed in Table 2. Just under six percent of sites were positive in 2018, with a combined total of 25 larvae recovered from 17 of 290 sites. Just over 10 percent of sites were positive in 2019, with a combined total of 70 larvae recovered from 30 of 271 sites (Figure 6). The maximum average larvae per branch increased from 1.3 in 2018 to four in 2019. For reference, seven larvae per branch is usually the threshold where treatment is considered. A second round of sampling is currently underway at sites where overwintering larvae were recovered in 2019 to evaluate sample accuracy. Those results are forthcoming and will be available from CFRU.

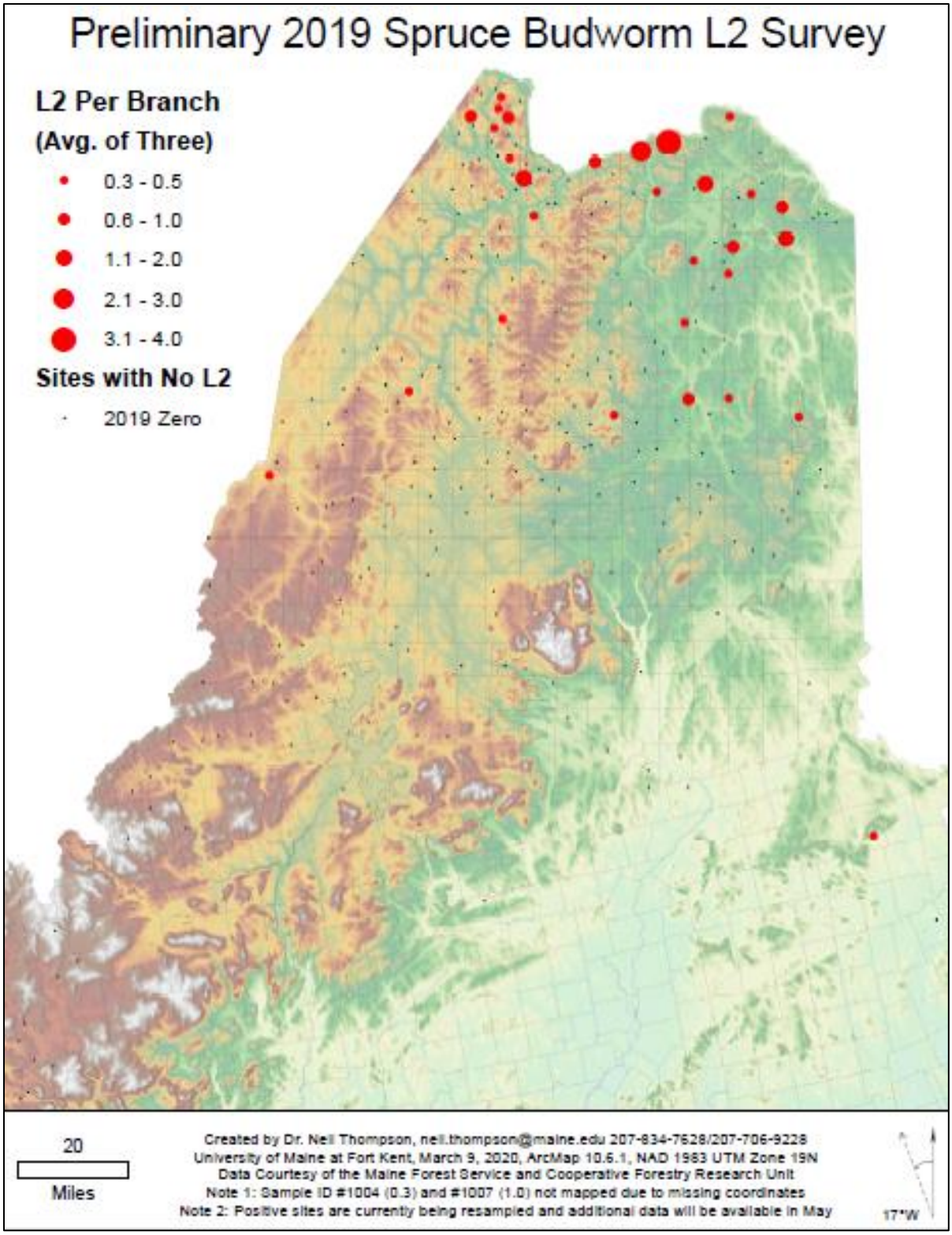

Figure 6. Preliminary map of 2019 SBW overwintering L2 larval densities provided by CFRU.

Table 2. Overwintering larvae recovered during L2 surveys in Maine 2014-2019

YEAR	TOWN	COUNTY	SITE ID	L2 PER 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
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

Table 2 (continued)

YEAR	TOWN	COUNTY	SITE ID	L2 PER BRANCH
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
2018-2019 (N sites = 290, 5.9 percent positive)	Connor Twp	Aroostook	MFS-CON-ALT	.6
	Cross Lake Twp	Aroostook	MFS-175	1
	Cross Lake Twp	Aroostook	MFS-175-ALT	1.3
	Dennistown Plt	Somerset	MFS-DEN-2	.3
	Fort Kent	Aroostook	MFS-FTK	1
	Fort Kent	Aroostook	MFS-FTK-2	.3
	Frenchville	Aroostook	MFS-FRV	.3
	Hamlin	Aroostook	IRV-HML-48	.3
	Hobbstown Twp	Somerset	PC-HOBT	.3
	Soldiertown Twp	Somerset	PC-SLDT	.3
	T10 R14 WELS	Piscataquis	LV-1014	.3
	T11 R14 WELS	Aroostook	MFS-1114	.3
	T17 R4 WELS	Aroostook	IRV-174-56	.3
	T18 R10 WELS	Aroostook	IRV-1810	.3
	T19 R12 WELS	Aroostook	MFS-B20	.3
	T9 R8 WELS	Aroostook	LV-98	.3
	Topsfield	Washington	MFS-ltTOP	.3

Table 2 (continued)

YEAR	TOWN	COUNTY	SITE ID	L2 PER BRANCH
2019-2020 (N sites = 271, 10.3 percent positive)	Allagash	Aroostook	IRV-ALL-80	.3
	Big Twenty Twp	Aroostook	TT-BTT-4	.3
	Connor Twp	Aroostook	MFS-CON-ALT	2
	Cross Lake Twp	Aroostook	MFS-175	.6
	Cross Lake Twp	Aroostook	MFS-175-ALT	1.6
	Fort Kent	Aroostook	MFS-FTK	4
	Fort Kent	Aroostook	MFS-FTK-2	3
	Garfield Plt	Aroostook	MFS-GAR	.6
	Madawaska	Aroostook	MFS-MAD	.3
	New Canada	Aroostook	IRV-NCA	.3
	Perham	Aroostook	IRV-PER	1.3
	Portage Lake	Aroostook	IRV-POL	.3
	Saint John Plt	Aroostook	MFS-SAJ	1
	Stockholm	Aroostook	IRV-STO	.6
	T10 R8 WELS	Aroostook	LV-108	.3
	T11 R4 WELS	Aroostook	SI-114	.3
	T13 R11 WELS	Aroostook	IRV-1311	.3
	T15 R5 WELS	Aroostook	IRV-155-33	.3
	T17 R4 WELS	Aroostook	IRV-174-56	.3
	T18 R10 WELS	Aroostook	PL-1810	1.6
	T18 R11 WELS	Aroostook	IRV-1811	.3
	T19 R11 WELS	Aroostook	IRV-1911	1
	T19 R11 WELS	Aroostook	LV-1911-2	.3
	T19 R12 WELS	Aroostook	MFS-B20	.6
	T8 R18 WELS	Somerset	LV-818	.3
	Topsfield	Washington	MFS-ItTOP	.3
	Westfield	Aroostook	IRV-WST	.3
	Westmanland	Aroostook	IRV-WES-36	.6

Defoliation Surveys and Assessments

Both ground and aerial surveys were conducted in 2019, looking specifically for spruce budworm in northern Maine where damage would be expected to first appear. Usable branch samples were collected from 271 sites and assessed for defoliation by CFRU student employees using the Fettes Method, which systematically quantifies defoliation on current-year growth. It was used during the last budworm outbreak in Maine and is currently being used in the Canadian provinces. CFRU staff received training on implementing the method during a 2018 demonstration at the University of Maine and again in 2019 with an online webinar. The Fettes Method captures defoliation from all causes and can be used to estimate both current-year defoliation and cumulative defoliation. 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. Full results will be available from the CFRU.

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 still too low everywhere in Maine to expect that level of feeding yet. Fettes defoliation assessment indicated there was in fact a shift towards higher levels of defoliation severity, with fewer sites being categorized as trace and more sites now falling into the low and moderate categories (Figure 7). There remain concerns regarding the overall sample quality for many sites in 2019 however. Sites receiving high defoliation scores will be evaluated on-site in 2020 to determine whether observed defoliation is in fact attributable to SBW.

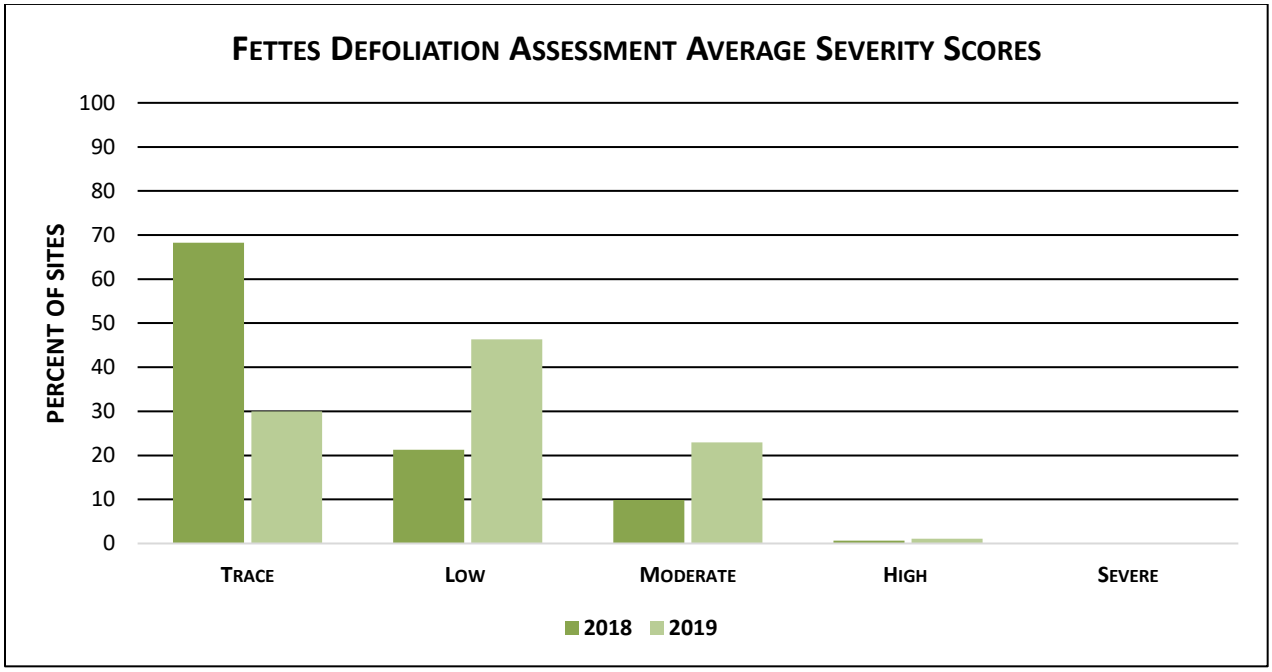

Figure 7. Percentage of sites by defoliation severity as categorized using the Fettes defoliation assessment protocol.

Discussion

The devastating outcome of the last SBW outbreak during the 1970s-80s in Maine reflects in part the ideal forest condition for the pest leading up to the outbreak. Millions of acres of mature and over-mature spruce-fir forest were impacted and a blow of hundreds of millions of dollars was dealt to Maine's forest-based economy. Although we know SBW populations continue to climb, predicting the precise trigger point and trajectory of a modern outbreak remains difficult given the changes in forest composition between then and now. The fir component of northern Maine is now younger on average and has been substantially reduced, however some 5.8 million acres of spruce-fir forest and 27.3 million cords of merchantable fir at still at risk. As long as the potential for serious damage on this scale exists, a rigorous population monitoring program involving managers at all stages will remain one of the most important components of a timely response when the next SBW outbreak finally takes off.

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

Acknowledgements

On behalf of the Maine Forest Service, we wish to thank our cooperators for their continued participation and dedication to this large and long-term project. The overall success of this program would not be possible without them.

As the new program lead, I also wish to extend a personal thanks to everyone who helped me become familiarized with the ins-and-out of this program, especially considering I came onto the scene in the midst of field season. Former program lead and now State Entomologist, Allison Kanoti, made sure I had the necessary background in the program to hit the ground running. Joe Bither, our Senior Entomology Technician in Stockholm, plays an essential role in all stages of this program and was crucial in pre-season communications and making sure cooperators were equipped to begin the trapping season. Amy Emery, our Conservation Aide at the Entomology lab in Augusta, counted all SBW recovered in light trap samples and a great deal of pheromone trap samples as well.

At the University of Maine, Brian Roth was also key in providing background on the program and helping me to connect with cooperators. Since Brian's departure, Neil Thompson has assumed that role and also has done an outstanding job with the organization of the Fettes defoliation assessments and overwintering L2 larval sampling. Thanks to all of the University of Maine students as well who performed the defoliation assessments and helped to input and manage the large amount of data. Last but not least, thank you to our friends at the Canadian Forest Service, who are the ones to actually process our branch samples for overwintering larvae, and all of our other Canadian colleagues who are always willing to share their ongoing SBW experiences with us.