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2001 Western Washington Pheromone-trap Delimiting Survey and Field Observations for European Poplar Shoot Borer, *Gypsonoma aceriana* (Duponchel) (Lepidoptera: Tortricidae), an Old World Poplar Pest New to North America)

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Background

In 1998 and 1999, three male adults of European poplar shoot borer (EPSB), *Gypsonoma aceriana* (Duponchel), were collected, as non-target captures in various exotic pest surveys, in western Washington State. The first EPSB was found in the Seattle port area, in a mercury vapor light trap. Another specimen emerged inside a cage placed over leaf litter beneath hybrid poplars at the Washington State University Research Station near Puyallup, in Pierce Co. (T. Murray, collector). A third was found at a tree nursery near Roy, also in Pierce Co., in a trap baited with European pine shoot moth, *Rhyacionia buoliana* [D. & S.], lure. (Figure 1.)

EPSB is a notable pest of many poplar species, *Populus spp.* (Salicaceae), as well as hybrids in plantations and nurseries in Europe, where infestation of up to 93.7% of growing tips has been recently reported (Georgiev and Velcheva 1999). Young larvae mine leaves and older larvae bore into terminal shoots, often causing gall-like swellings (Bradley et al. 1979).

In exterior appearance, adults of *G. aceriana* (Kuznetsov 1987) (Figure 2.) are very similar to those of the North American cottonwood twig borer, *G. haimbachiana* (Kearfott) (Miller 1987). Genital anatomy provides the most reliable means of distinguishing the two species. For a more thorough review of EPSB pest status, biology, diagnostic characters, and the associated technical literature, please see Miller and LaGasa, 2001.

2001 Project Objectives

1. **Determine survey methods and survey area priorities.**
 - Research / acquire suitable pheromone attractant, dispensers, and trap type to conduct adult delimiting survey.
 - Plan a prioritized trap coverage of contiguous areas of poplar hosts in western Washington.
2. **Conduct a preliminary delimiting survey of EPSB distribution in western Washington.**
 - Conduct survey to delimit EPSB in as large an area as resources allow, beginning at known positive sites.
3. **Observe and record biology and impacts of EPSB in Western Washington.**
 - Examine host trees at sites of higher EPSB pheromone-trap captures for evidence of infestation.
 - Capture digital graphics of EPSB life stages, biology, and feeding damage where possible.

Figure 1. 1998 – 1999 European Poplar Shoot Borer Collection Sites in Western Washington

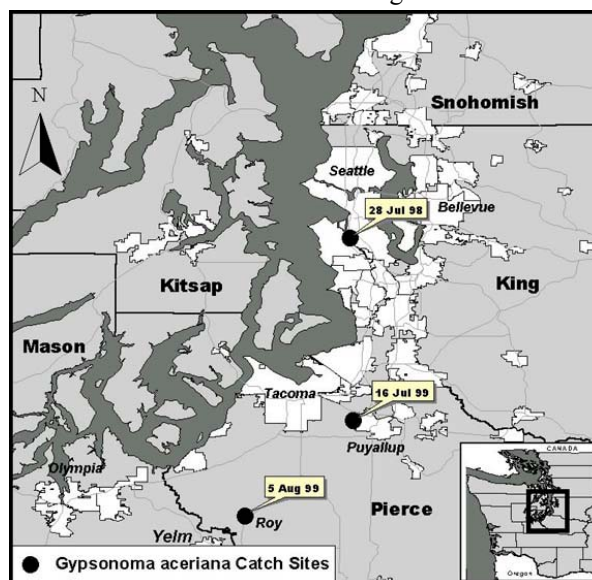


Figure 2. Adult *Gypsonoma aceriana* (Duponchel)



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Project Methods and Materials

Five hundred and forty two pheromone-lure baited traps were placed in counties along the Interstate-5 corridor in western Washington, from the Canadian border south to Clark County on the Columbia River / Oregon border. Trap placement, by county, is presented in Table 1. Traps were hung in roadside or residential yard *Populus spp.* trees, primarily cottonwood and various ornamental poplar varieties.

Because the principal survey objective was delimitation of EPSB in Western Washington, project funding allowed only three months of field activities, which limited most EPSB flight-season data collected. Trap placement began in May, to allow for completion of all initial trap sets by the beginning of expected adult moth flight in late-June or early-July, and most traps were removed by the end of July. To collect additional adult-flight information, trapping in Pierce County, where EPSB captures were highest in initial trap-captures, was continued until early-September.

Table 1. 2001 EPSB Trap-sites Monitored by County

County	Number of EPSB Trap-sites
Whatcom	79
Skagit	55
Snohomish	54
King	54
Pierce	79
Thurston	81
Lewis	40
Cowlitz	40
Clark	60
Total Sites	542

Pherocon 2® type traps (a.k.a. "diamond" traps) were used in this survey, based on trap performance in prior WSDA CAPS surveys, ease of use, and the avoidance of small-bird capture/mortality (which is a problem with other trap designs, particularly "wing-traps"). Traps were baited with pheromone-lures provided by the USDA APHIS Otis Methods Development Center. The EPSB pheromone-lures consisted of gray rubber septa (West Co., Lionville, PA.; cat.no. 1060-0275), each loaded with 0.1 ml (1 mg) of the following pheromone components (ISCA Technologies, Inc., Riverside, CA) in an approximate 3:1 mix:

- (E)-10-Dodecenyl acetate (0.725 mg/lure)
- (E)-10-Dodecen-1-ol (0.275 mg/lure)

Pheromone lures were changed every two weeks as much as possible during the observed period of adult flight. Traps with specimens were processed at the Olympia Entomology Lab, where EPSB specimens present were identified and counted. Selected sub-samples of EPSB were removed from the traps with Hemo-D citrus based solvent and had genitalia extracted and cleared (in KOH) to confirm identification.

To document EPSB biology, several visits to positive trap sites were conducted to collect and photograph life stages and host plant damage. EPSB larvae and other unknown immature insects found infesting poplar tips in May were also reared to the adult stage and/or identified at the WSDA Olympia Entomology Lab. Larvae were reared in individual containers, in the original poplar host material as much as possible.

Digital image files created for this project were captured with a Nikon® 990 camera, hand-held or mounted on a Leica® MS5 microscope, and macro-photographic images were created using daylight-corrected fiber-optic incandescent lighting and mylar diffuser-filters. Images were also cropped, adjusted, and labeled with Photoshop® 5.5.

Project Results and Discussion

A total of 4,245 adult male EPSB were captured in the delimiting survey traps, with EPSB recorded from every county surveyed. Catch data is summarized by county in Table 2.

These survey results clearly show that EPSB is well established across most of Western Washington. However, it should be noted that direct comparison of summary trap information from one county to another is difficult, given the variation in trapping duration (e.g. survey timeframes) due to survey emphasis, travel distances for field staff, and other variables.

Project Results and Discussion (Cont.)

Table 2. 2001 EPSB Survey Trap Results and Averaged Catch Data

County	EPSB Trap Sites	Pos. Sites	% Sites Pos.	Total EPSB	Ave. EPSB / Pos. Site
Whatcom	79	10	12.7%	43	4.3
Skagit	55	2	3.6%	3	1.5
Snohomish	54	3	5.6%	3	1.0
King	54	14	25.9%	42	3.0
Pierce	79	64	81.0%	3,249	50.8
Thurston	81	41	50.6%	252	6.1
Lewis	40	20	50.0%	274	13.7
Cowlitz	40	20	50.0%	274	13.7
Clark	60	15	25.0%	105	7.0
Totals	580	189	32.6%	4,245	12.6

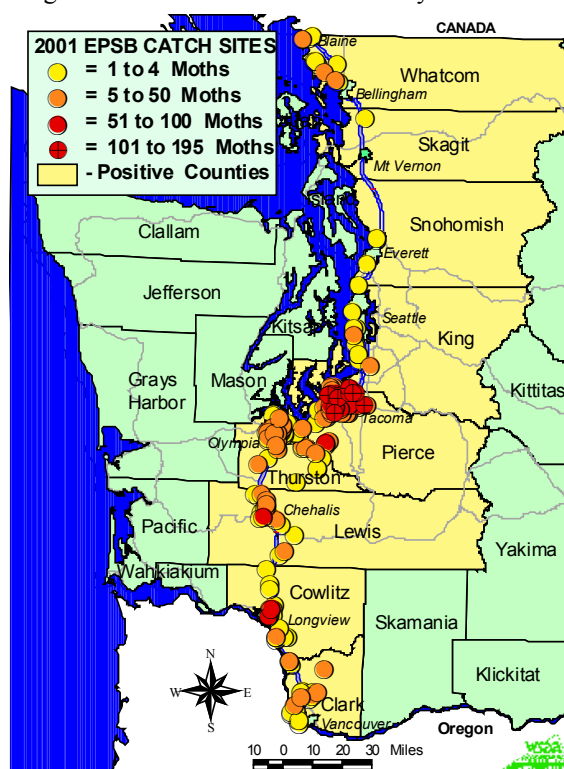
The widespread nature of current EPSB establishment in Western Washington is more clearly demonstrated when positive survey sites are plotted on a map, as in Figure 3. (Note: A larger format version of the 2001 EPSB Survey Sites Map, including negative trapping sites, is attached at the end of this document.)

Although statistical analysis of the survey data presented in Table 2 is limited by many variables, an indication of the relative prevalence of EPSB across the surveyed counties is suggested by the percentage of traps that caught moths in each county. In Pierce County, the greater Tacoma area appears to be the most generally infested area surveyed, with the majority of traps (81%) catching EPSB. Counties to the south of Pierce had higher positive-trap percentages than those to the north, and the average number of moths captured in positive traps is also higher to the south.

One survey parameter that is likely a noteworthy factor in these varying results, however, is the survey period timing. In all counties except Pierce, survey traps were removed around the end of July, which was fairly early in the adult emergence period observed in the extended Pierce County trapping. Adult EPSB emergence would be expected to began later in northern counties than those to the south (based on previous WSDA surveys for related defoliator moths), which would potentially result in lower EPSB catch numbers and fewer positive sites in the northern counties.

Adult EPSB flight activity for most of the season was recorded in Pierce County, where trapping continued until September 10 at some sites. For the purposes of examining variation in the adult EPSB adult catch over time, the number of moths caught for each positive trap check was divided by the number of interval days (between checks), to produce a value for the average number of moths captured per day at each site. These values were added for all sites in the county and grouped by average date of sequential trap checks (e.g.; average date for all first positive check, average date for second, and so forth). The grouping of dates for each sequential trap check (to calculate an average date) was necessary, since trap check intervals unavoidably varied from site to site due to travel and workload limitations, although the dates for each sequential check generally occurred within 2 or 3 days. The average dates for trap checks and the associated catch data are presented in Table 3 and the catch total and average rates of EPSB catch per day for each trap-check interval are plotted in Figure 4.

Figure 3. Positive 2001 EPSB Survey Sites

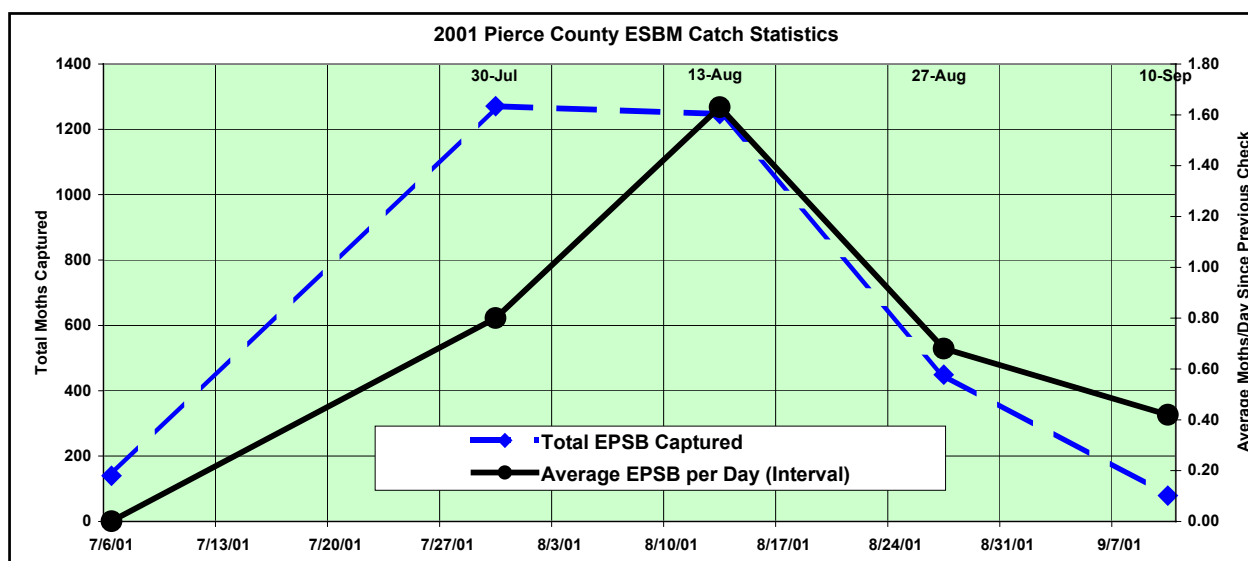


Project Results and Discussion (Cont.)

Table 3. 2001 Pierce County EPSB Pheromone-trap Catch Summary Statistics

Check Date (Average - see text)	Ave. Interval since last Check (Days)	Total EPSB Captured	Sum of Ave. EPSB per Day	Overall Average EPSM per Day
6-Jul-01	52.5	140	2.82	0.00
30-Jul-01	37.5	1,271	44.85	0.80
13-Aug-01	16.4	1,247	92.70	1.63
27-Aug-01	14.2	449	31.44	0.68
10-Sep-01	13.9	79	6.25	0.42

Figure 4. 2001 Pierce County EPSB Catch Totals and Average Moth Catch per Day



The Pierce County EPSB catch information shows an extended flight season for EPSB in 2001. Overall, the first adult EPSB pheromone-trap capture was recorded June 20, in Thurston County, and the last captures were the above Pierce County collections September 10, at which time there were still live adult EPSB in the traps. The end of EPSB flight activity (including that in Pierce County) was not recorded in this survey. Although only a few observation intervals (periodic trap checks) were possible in this survey, the Pierce County data suggests a single peak in adult flight activity in late-July or early-August in 2001.

Larval EPSB biology and feeding damage were observed and photographed at several field sites and during laboratory rearing and examination of field collected material. Larvae that hatch from eggs laid on host (poplar) leaves in the late summer and fall feed initially between leaf layers, creating distinctive “J”-shaped leaf mines, usually along the leaf mid-rib. Occasionally they will also bore into the leaf petiole (stalk). Early larval habits were not observed during the growing season, but both types of feeding damage were found on fallen leaves in the fall, and are shown here in Figures 4 and 5. After this leaf- or petiole-mining stage (and before leaf drop), EPSB larvae leave the leaf mines to find overwintering shelter in cracks and crevices on twigs and branches. Overwintering larvae create hibernacula (refuge chambers) from silk, covering them with frass (larval excrement) and bits of debris which makes them very cryptic and somewhat difficult to find. Figures 6 and 7 show a typical hibernacula, which is opened to show the resident overwintering larva in Figure 7. In spring, larvae resume activity, boring into and feeding in green shoots as they develop at branch ends. This spring shoot-boring deforms the new growth, produces rudimentary galls which may develop into woody knots in subsequent years, and may stunt or kill infested tips. Internally feeding larvae produce tubular silk and frass deposits at the entrances to feeding galleries, which may persist on infested twigs well into the fall and winter. A mature EPSB larva and examples of typical larval feeding sites and the subsequent galling of branch tips are shown in Figures 8 – 12.

Project Results and Discussion (Cont.)

Figure 4. Remains of EPSB Larval Leaf-mine.



Figure 5. Remains of EPSB Larval Feeding in Leaf-midrib.



Figure 6. EPSB Hibernacula



Figure 7. EPSB Hibernacula (Opened / Larva).



Figure 8. Mature EPSB Larva



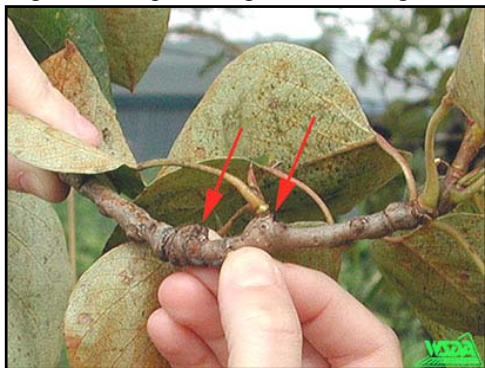
Figure 9. EPSB Frass / Tip-boring Site



Figure 10. Poplar Tip EPSB Damage



Figure 11. Poplar Twig EPSB Damage



Pertinent Literature

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Distribution / Content Note

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Attachment 1. 2001 Western Washington *Gypsonoma aceriana* Survey Sites and Results

