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Laboratory Services Division, Pest Program
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2000 Western Washington Exotic Wireworm Survey, a Preliminary Detection and Delimiting Survey for *Agriotes obscurus* and *A. lineatus* (Coleoptera: Elateridae)

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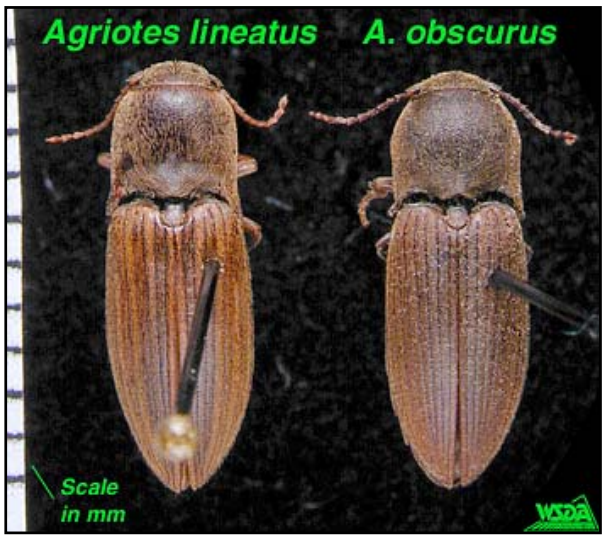
Background

Two European wireworms, *Agriotes obscurus* (L.) and *Agriotes lineatus* (L.), (family Elateridae) have been known to be present in British Columbia, Canada, since 1950 and may have been introduced as early as 1900 or before in dirt ballast from sailing ships. Currently, both species (Figure 1) occur throughout much of the Frasier River Valley and delta area in B.C., and in 1997 *A. obscurus* was found for the first time in the United States near Lynden, in Washington State (Vernon and Päts, 1997). In recent years these two species have become the most important pests of many crops throughout the lower Frasier Valley, causing between $500,000.00 and $800,000.00 in crop losses in 1994 (Vernon, 1998). Both species are considered major pests in Europe and western Asia (USDA APHIS, 1978).

Figure 1. Adult Click Beetles



Wireworms are the larval stage of click beetles (Figure 2). They live in soil where they feed on seeds, plant roots, and other organic material. The most serious crop damage from wireworms is generally related to spring larval feeding, when developing larvae are near the surface and actively seeking seeds for their high nutritional content. Wireworm larvae locate seeds by detecting the carbon dioxide produced during germination and they can be particularly destructive of spring crop seedings.

Figure 2. Wireworm larva

An effective pheromone attractant and trap for both species is being developed by Dr. Bob Vernon, Research Entomologist with Canada Dept of Food and Agriculture at the Agassiz Pacific Agri-Food Research Centre in British Columbia. A limited number of the new trap and lure combination was made available for survey in Washington State in 2000.

2000 Project Objectives

1. **Determine survey methods and appropriate survey site priorities.**
- Determine suitable field survey methods to conduct adult detection and delimiting survey in areas of highest risk for introduced populations.

2. **Detect and/or delimit *Agriotes lineatus* and *A. obscurus* distribution in western Washington.**
- Conduct surveys to detect or delimit *Agriotes spp.* in as many areas as resources allow.

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Project Methods and Materials

The pheromone trap and lures used in this survey are the product of an on-going research and methods development collaboration between Dr. Bob Vernon and PheroTech Inc. of British Columbia, Canada. Pheromone lure formulation remains proprietary information at this point, but the trap configuration is presented here via graphic images courtesy of PheroTech Inc. (Figure 3). The trap, constructed of durable polyvinyl chloride (PVC), is designed to capture and confine adult beetles that are attracted to the internal pheromone lure and fall in after ascending shallow ramps. No kill agent or preservative was used inside the traps, which relied on regular servicing to provide specimens in good condition. Traps were placed at ground level, with entry ramps flush with or slightly covered by adjacent soil to provide unimpeded beetle entry (Figure 4). Checking and sample collection involved removal of one of the ramp inserts and shaking the trap contents into a tray (Figure 5).

Figure 3. Click Beetle Trap

Figure 4. Click Beetle Trap in Strawberry Field

Figure 5. Servicing Click Beetle Trap

Traps were initially placed in the field from mid-April to early-May, and checked as frequently as possible until removal in July or early August. Trap checking intervals varied from weekly in priority areas of Whatcom county, to a month or more in southwestern Washington counties. At sites where multiple target beetles were collected in the first trap checks in Whatcom County, traps were subsequently relocated to more southern locations to attempt to gather additional delimiting information. Trapping sites in the northern counties of Whatcom and Skagit were initially selected in an approximate grid pattern, with between 2 or 4 miles between traps.

Physical criteria for trap sites included; proximity to areas of turf, pasture, or other grassy locations, which are considered favored wireworm habitat, and protected situations where traps would be less likely disturbed or damaged. Outside of the northern counties, traps were located near ports or nurseries where the target species may have been introduced through shipping balast or infested stock.

Project Methods and Materials (Cont.)

Trap site numbers and catch status by county are presented in Table 1.

Suspect beetles captured in the survey traps were compared with identified reference specimens provided by Agriculture and Agri-Food Canada for preliminary identification and a sub-sample of sorted beetles was sent to Dr. Paul Johnson, a USDA Systematic Entomology Laboratory identification collaborator at the University of South Dakota, for confirmation. The identities of suspect specimens of both target species were confirmed as A. obscurus and A. lineatus by Dr. Johnson on May 31, 2000.

Project Results and Discussion

Survey results by trap site for both target species are presented in figures 6 and 7.

Table 1. 2000 Agriotes spp. Survey Sites by County

Agriotes obscurus Trap Placement and Results			
County	# Trap Sites	# Positive Sites	% Positive
Whatcom	**27**	**19**	**70%**
Skagit	**20**	0	0%
Snohomish	**5**	0	0%
King	**15**	0	0%
Pierce	**5**	0	0%
Thurston	**5**	0	0%
Lewis	**5**	0	0%
Cowlitz	**10**	0	0%
Clark	**5**	0	0%
Total	**97**		
Agriotes lineatus Trap Placement and Results			
County	# of Trap Sites	Positive Sites	% Positive
Whatcom	**25**	**11**	**44%**
Skagit	**20**	0	0%
Snohomish	**9**	**8**	**89%**
King	**15**	0	0%
Pierce	**5**	**2**	**40%**
Thurston	**5**	0	0%
Lewis	**5**	0	0%
Cowlitz	**10**	0	0%
Clark	**5**	0	0%
Total	**99**		

Figure 6. *Agriotes obscurus* Trap Sites and Results

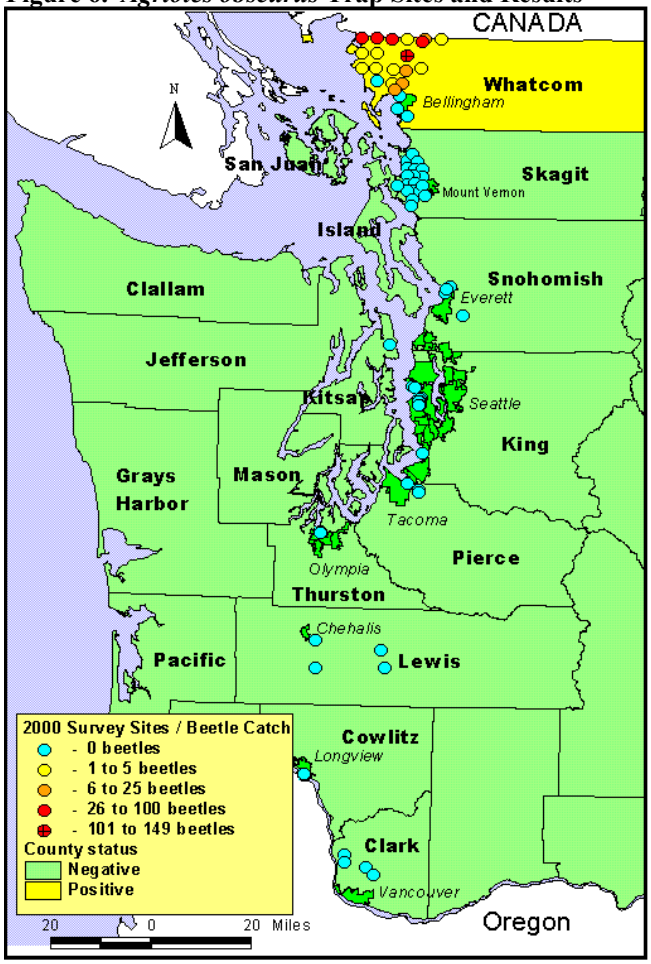
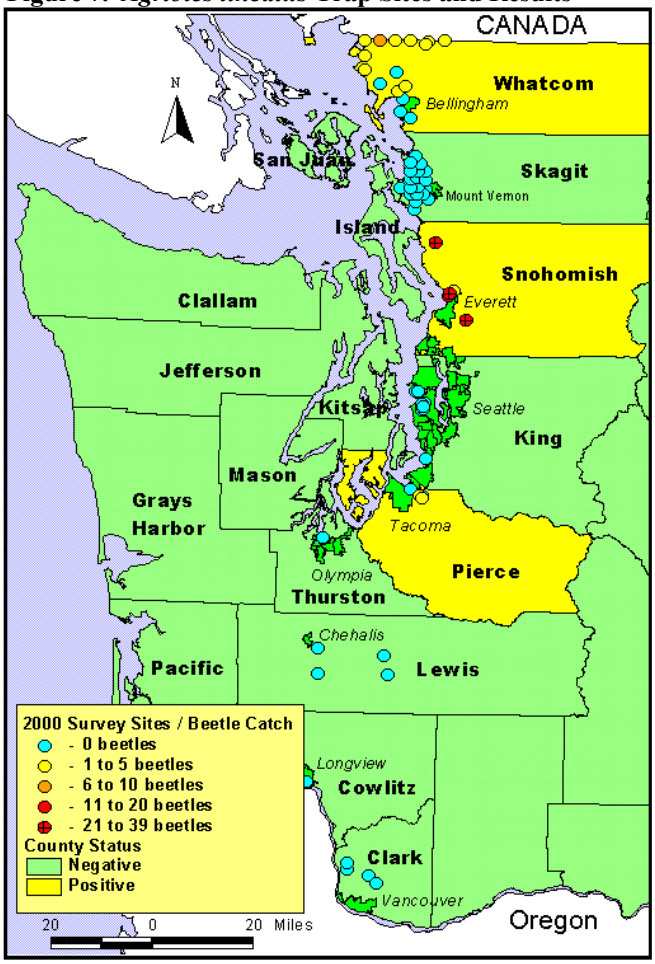


Figure 7. *Agriotes lineatus* Trap Sites and Results



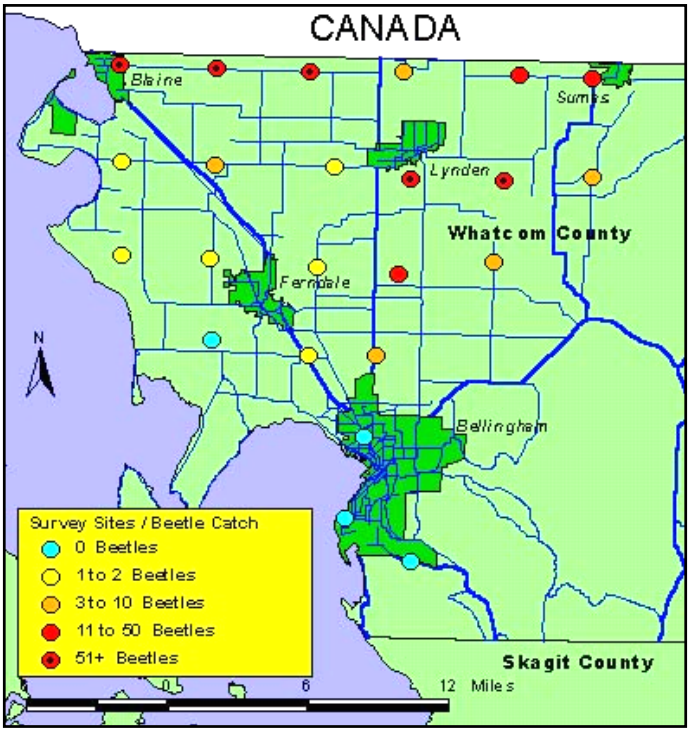
Project Results and Discussion (Cont.)

Due to the limited resources available for this survey, unavoidable variation of trapping intervals throughout the survey coverage area, and other significant variables, very little quantitative evaluation of survey data is possible. When trapping began in mid to late April, adult *Agriotes obscurus* and *A. lineatus* were already present, and adult activity continued only until June. Variation in adult emergence phenology across the survey area was also likely, further complicating quantitative significance of the survey data.

Agriotes obscurus (L.) was collected in only one county, Whatcom (see Figure 6), where catch data showed the highest populations along the northern county area bordering on Canada and near Lynden (Figure 8). At these sites, traps captured between 68 and 91 adult *A. obscurus* during 7-day trapping intervals in late April. A total of 19 sites (of 27) in Whatcom county were positive (70%) for *Agriotes obscurus*.

Agriotes lineatus (L.) was captured in three Puget Sound area counties; Whatcom, Snohomish, and Pierce (see Figure 7). Catch data showed the beetle to be similarly widespread in Whatcom County (not figured here), found at 11 of 27 sites, with an average of 2.6 beetles per positive trap. However, the highest trap catches and proportion of sites positive was in Snohomish county, where 8 of 9 trap sites were positive and average per positive trap was 13.25 beetles.

Figure 8. Whatcom County *Agriotes obscurus* Survey Sites



During the course of this survey and the 2000 agricultural season, certified seed potato production in Whatcom County was examined for notable wireworm damage or the presence of wireworm larvae, a routine seasonal inspection activity that is part of the certification process.

There was an extended growing season this year because of extremely wet weather conditions. Field planting began 14 May and continued to 1 July. (Normally planting starts 1 May.) Harvest began 1 September and continued to 25 October.

A total of 1,447 acres of seed potatoes were entered for certification in Whatcom County this year, consisting of 166 separate field lots.

Each potato field lot is visually inspected at least twice during the growing season, which includes pulling a limited amount of plants and inspection of the whole plant. This season, no life stages of wireworm or wireworm damage to tubers or seed pieces were observed during this process.

At harvest, each lot was inspected at least once while being unloaded from the truck and piled into storage. During these inspections, only 4 field lots were found to have damage associated with wireworm in less than 1/2 of 1% of tubers. The tuber damage observed was generally consistent with levels observed over the last 20 years and is considered "incidental" and not economically significant.

Pre-plant pesticides for insect control are normally not applied. The exception to this would be the occasional use of soil fumigants to control high population levels of plant parasitic nematodes when necessary. During the growing season, growers generally apply insecticides (Monitor or Thiodan) on a 14-day interval for aphid control.

Project Results and Discussion (Cont.)

These observations suggest that seed potato production in the infested areas of Whatcom County is not currently experiencing notable increasing or otherwise significant economic damage from the *Agriotes* species detected in this survey.

The disparate collections of *A. lineatus* in this survey, occuring in three counties separated by counties without collections, suggest the possibility of a disjunct population of that species in parts of the Puget Sound area. However, significantly more survey sampling is needed than was available for this survey to make that determination. The extent of collections that were recorded in this survey, occuring as far south as the Fife area in Pierce County, clearly demonstrates that A lineatus is currently established in areas outside of the previously known infested areas of British Columbia. Whether the detected populations in Snohomish and Pierce Counties represent natural spread from British Columbia or are the result of independent introductions was not determined in this preliminary survey. It is entirely possible that both A obscurus and A lineatus occur much more widely than Western British Columbia and the Puget Sound area in Western Washington, and may be present in other areas of North America outside of the Pacific Northwest.

Pertinent Literature

USDA APHIS 1978 , LINED CLICK BEETLE Agriotes lineatus (L.) and A WIREWORM Agriotes obscurus (L.) in PESTS NOT KNOWN TO OCCUR IN THE UNITED STATES or of Limited Distribution, No..5 in Series, USDA Cooperative Plant Pest Report, 3(48-52):731-734, 1978

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Vernon, B. 1998 New ways to manage European wireworms. In BC Pest Monitor, Vol. 6 No. 1, January 1998 British Columbia Ministry of Environment, Lands and Parks, currently posted to the internet @ http://www.env.gov.bc.ca/epd/ipm/docs/pest10.html

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