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The Relationship of the Abundance of *Saperda Inornata* and *Oberea Schaumii* (Coleoptera: Cerambycidae) in Large Trembling Aspen, *Populus Tremuloides*, to Site Quality

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THE RELATIONSHIP OF THE ABUNDANCE OF *SAPERDA INORNATA* AND *OBEREA SCHAUMII* (COLEOPTERA: CERAMBYCIDAE) IN LARGE TREMBLING ASPEN, *POPULUS TREMULOIDES*, TO SITE QUALITY[1]

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Saperda inornata Say and *Oberea schaumii* LeConte are cerambycids that inhabit the stems of trembling aspen, *Populus tremuloides* Michaux, root suckers and the twigs of larger trees. The biologies of those species in northern Wisconsin and Upper Michigan were reported by Nord *et al.* (1972a and 1972b). *S. inornata* oviposits on the cambium under horseshoe- or shield-shaped egg niches gnawed in the outer bark by the female. The term "egg niche," connotes an oviposition place prepared by the female using the mandibles and ovipositor (Linsley 1959). There are usually 2 or 3 egg niches at one level on the stem or twig, and a globose gall consisting of callus tissue forms there. The larvae feed in the cambial and callus tissue around the gall and require 1 or 2 years to complete development. The *O. schaumii* female gnaws an elongate, rectangular egg niche in the outer bark and deposits an egg on the cambium beneath it. The larva bores downward from the egg niche in the wood. Most individuals require 3 years to complete the life cycle; but some take only 2 years, while others take 4 years.

A survey designed to determine the importance of the egg niches and galleries of *S. inornata* and *O. schaumii* as infection courts of *Hypoxylon pruinatum* (Klotzsche) Cke. in large trembling aspen was begun in 1962 in Iron and Ontonogan Counties, Michigan. The data from that survey indicated that abundance of borers might be correlated with the site quality of the stand. Therefore in 1963 the survey was redesigned to detect differences in abundance between stands of different site quality. Since the redesign concerned only the selection of stands, not the sampling procedures used within the stand, most of the trees sampled in 1962 were incorporated into the redesigned survey.

The data collected in conjuction with the survey also make possible conclusions regarding the distribution of borer galleries within the crowns of large trees. Those results and a discussion of competition between *S. inornata* and *O. schaumii* are given in another paper (Nord and Knight, 1972a). The incidence of *H. pruinatum* in the galleries was reported by Nord and Knight (1972b).

METHODS

In the fall of 1962 and 1963 trembling aspen stands were sampled in 4 areas, one in Ontonogan County (I), one in Gogebic County (II), and 2 in Iron County (III and IV). In each area 3 stands differing in site quality were selected in as close proximity to each other as possible. The index of site quality used was the average total height of the dominant and codominant trees over their average age. Site index curves for trembling aspen prepared by Graham *et al.* (1963) were used to define 3 site quality classes as follows: good, 60 ft. or more (56+ ft.) at age 30 years; medium, 50 ft. (46 to 55 ft.) at age 30 years; and poor, 40 ft. (36 to 45 ft.) at age 30 years. A quick estimate of site class of a candidate sample

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stand was obtained by measuring the height and age of several dominant and codominant trees, computing the average height and age and referring to the site index curves of Graham *et al.* (1963). In selecting stands to be sampled, an effort was made to reduce variation due to variables other than site quality. Only stands between 20 and 50 years of age were used in order to reduce the variation due to age and to the size of sample branches. Some branches from large old trees were as big as whole crowns of small trees. Partially cut and low density stands were avoided as were stands smaller than 5 acres.

In each sample stand, 15 trees in 3 groups of 5 were selected and felled. The first sample tree in each stand was selected haphazardly, i.e. by walking into the stand and choosing a dominant or codominant tree. It and its 4 nearest neighbors constituted Group 1. Group 2 was located by pacing a distance of 2 chains from the center of Group 1 in an arbitrary direction which was chosen in order to miss roads, clearings, ecotones, etc. After pacing the 2 chains, the nearest dominant or codominant tree and its 4 nearest neighbors were designated as Group 2. Group 3 was located in a like manner, 2 chains from the center of Group 2.[3]

Each of the 15 sample trees was felled. Its branches were numbered starting with the lowest live branch and proceeding toward the top. Using a random numbers table, 10 branches were selected from each tree. The following data were recorded from each tree and sample branch:

Sample Tree
1. Total height
2. Diameter at breast height (4.5 ft. above ground) – DBH
3. Age (dominant and codominant trees only)

Sample Branch
1. Total length of the main branch (not including side branches) beyond a maximum diameter of 1.5 inches
2. Aspect in crown, (NE, SE, SW, NW)
3. Level in crown (lower or upper half of live crown)
4. Number of current (less than 3 years old) *S. inornata* galls and number of current (less than 4 years old) *O. schaumii* galleries
5. Number of old galls and galleries
6. Age and diameter of new oviposition sites
7. Number of hypoxylon-like cankers and number of cankers associated with borer galleries

In all, 150 branches were examined in each stand. Those 150 branches constituted the sampling unit and the number of *S. inornata* galls or *O. schaumii* galleries per 150 branches was used as the basis of comparison between the 3 site classes. The differences in abundance between site classes were tested by analysis of variance.

The average age of the dominant and codominant sample trees was used as an estimate of the average age of the stand. The average height and DBH of the stand was computed from measurements of 45 dominant and codominant trees, 15 in proximity of each of the 3 sample groups. A summary of average height, age, and DBH of each of the 12 sample stands is given in Table 1.

[3]A departure in procedure was made in the Site 50 stand, Area IV, to utilize data already gathered in 1962 in the disease survey. Fifteen trees were chosen randomly as sample trees from the 4 groups of 5 trees felled in 1962.

Table 1. Average height, age, and DBH* of trembling aspen stands surveyed for abundance of *S. inornata* and *O. schaumii.*

Area	Site Index	Average Height (ft.)	Average Age (yrs.)	Average DBH (in.)
I	S-40[†]	43	28	5.8
	S-50[†]	57	40	7.2
	S-60[†]	70	38	8.4
II	S-40	37	26	5.4
	S-50	54	34	6.9
	S-60	71	33	9.1
III	S-40	41	33	6.9
	S-50	59	38	7.6
	S-60	62	28	8.2
IV	S-40	45	38	7.7
	S-50[†]	67	48	10.0
	S-60	53	24	6.2

*Diameter at breast height (4.5 ft. above ground).

[†]Data taken in 1962, the remainder, in 1963.

RESULTS AND DISCUSSION

Summaries of the current and old *S. inornata* galls and *O. schaumii* galleries found in each sample stand, are given in Tables 2 and 3, respectively. Analyses of variance showed that there were no significant differences (P=0.95) between sites with respect to the number of currently active *S. inornata* galls, old galls, and the total number of galls. There were no significant differences (P=0.95) between sites with respect to the number of currently active *O. schaumii* galleries and old galleries. However, there were significant differences between sites with respect to total number of *O. schaumii* galleries. This result appears to be due mostly to the large number of current galleries in the poor site quality (Site 40) stand in Area I. There were no significant differences between any of the other sample stands with respect to total *O. schaumii* galleries.

The grand total for Site 40 stands in all categories except for the number of old *O. schaumii* galleries was greater than the grand totals for the Site 50 and Site 60 stands. However, not all individual Site 40 stand totals were greater. Many were about the same and some were less than the Site 50 and 60 stand totals. In other words, there was great variability among the individual stand totals. The variability in the number of linear feet of branch sampled is considered not sufficient to account for the variability in the number of galls and galleries found. There could be some confounding due to the data collection covering 2 years (Table 1); but since populations were so low (see below) during both years, the effect would probably not change the results.

The number of borers found in the crowns was small when compared to the amount of branch space available for oviposition. An average of 71.2 ft. of branch was sampled per tree. That figure is the total feet of branch, a figure which is much lower than the actual

Table 2. Number of current (C) and old (O) *S. inornata* galls found in stands of large trembling aspen differing in site quality (15 trees sampled in each stand, 1962 and 1963).

	Site Index								
	40		50		60		Total		Grand Total
Area	C	O	C	O	C	O	C	O	
I	23	44	20	41	9	35	52	120	172
II	14	44	6	10	4	20	24	74	98
III	19	56	5	27	16	42	40	125	165
IV	6	26	18	24	9	24	33	74	107
Total	62	170	49	102	38	121	149	393	542

space available to these insects. If the available space in the side twigs had been measured, the total available space in linear feet would have been several times the above figure. With that in mind, and the fact that the current gallery data represents 3 annual populations of *S. inornata* and 4 annual populations of *O. schaumii,*[4] the highest number of current *S. inornata* galls and *O. schaumii* galleries per sample tree (ten branches) was 6 and 4, respectively. Furthermore, 93.9% of the trees had 2 or fewer current *S. inornata* galls and 94.4% had 2 or fewer current *O. schaumii* galleries. Almost half of the tree samples contained no current galleries. Thus there was no indication that any of the populations sampled had been able to exploit the available space and food supply in a stand or even 1 tree.

It is still possible that some clones of aspen, because of a genetic trait, may be more attractive to ovipositing females or may provide a more favorable environment for the

Table 3. Number of current (C) and old (O) *O. schaumii* galleries found in stands of large trembling aspen differing in site quality (15 trees sampled in each stand, 1962 and 1963).

	Site Index								
	40		50		60		Total		Grand Total
Area	C	O	C	O	C	O	C	O	
I	28	11	13	7	8	13	49	31	80
II	21	6	11	6	8	9	40	21	61
III	12	15	8	12	7	16	27	43	70
IV	10	14	7	12	13	10	30	36	66
Total	71	46	39	37	36	48	146	131	277

[4]The category "current galleries" includes all currently active galleries plus those inactive galleries judged to be no more than 2 years old in the case of *S. inornata* and 3 years old for *O. schaumii.* Since *S. inornata* has a 1 or 2 year life cycle (Nord *et al.* 1972b), "current galleries" includes 3 annual populations -- those from eggs laid in the present year and those from eggs laid in the 2 previous years. Similarly, in the case of *O. schaumii,* which usually has a 3 year life cycle (Nord *et al.* 1972a), "current galleries" includes 4 annual populations.

larvae. Knight (1963) found significant differences between clones in the number of *O. schaumii* galleries and *S. inornata* galls; but, because the variability was so great between trees and the number of trees sampled from each clone was small (2), he did not consider the averages for individual clones to be valid. In the present study, groups of sample trees were not chosen according to clone, so an anlaysis to detect clonal differences could not be made. However, as stated above, no tree appeared to be unusually heavily infested (i.e. unusually susceptible based on number of galleries in relation to the amount of space available). Since the populations of both species were low, it is doubtful whether any detectable clonal differences would have been valid had an analysis been possible. The occurrence of genetically resistant clones is probable but they may be rare. According to Postner (1954) and Brammanis (1963) none of the many hybrid poplars tested in Europe have shown any significant genetic resistance to *S. populnea* L., a species with similar habits to *S. inornata.*

The reasons for the low borer populations were not investigated in this study. Grimble and Knight (1970, 1971) found that various mortality factors, such as parasites, predators, adverse weather and possibly pathogens take a high toll.

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