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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: CERAMBYCIDAEN) IN LARGE TREMBLING ASPEN, POPULUS TREMULOIDES, TO SITE QUALITY

John C. Nord and Fred B. Knight

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 conjunction 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

1Research partially supported by the North Central Forest Experiment Station, U. S. Forest Service, USDA. The field work was done on the Ottawa National Forest.

2Respectively: Southeastern Forest Experiment Station, U. S. Forest Service, USDA, Athens, Georgia 30601, and School of Forest Resources, University of Maine, Orono, Maine 04473.
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.

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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*.

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

*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).

<table>
<thead>
<tr>
<th>Site Index</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>C</td>
<td>O</td>
<td>C</td>
<td>O</td>
</tr>
<tr>
<td>I</td>
<td>23</td>
<td>44</td>
<td>41</td>
<td>9</td>
</tr>
<tr>
<td>II</td>
<td>14</td>
<td>44</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>III</td>
<td>19</td>
<td>56</td>
<td>27</td>
<td>5</td>
</tr>
<tr>
<td>IV</td>
<td>6</td>
<td>26</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>170</td>
<td>49</td>
<td>102</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Site Index</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>C</td>
<td>O</td>
<td>C</td>
<td>O</td>
</tr>
<tr>
<td>I</td>
<td>28</td>
<td>11</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>II</td>
<td>21</td>
<td>6</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>III</td>
<td>12</td>
<td>15</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>IV</td>
<td>10</td>
<td>14</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>46</td>
<td>39</td>
<td>37</td>
</tr>
</tbody>
</table>

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 analysis 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.

LITERATURE CITED


Nord, J. C., and F. B. Knight. 1972a. The distribution of *Saperda inornata* and *Oberea schaumii* (Coleoptera: Cerambycidae) within the crowns of large trembling aspen, *Populus tremuloides*. Great Lakes Entomol. 5:28-32.

———. 1972b. The importance of *Saperda inornata* and *Oberea schaumii* (Coleoptera: Cerambycidae) galleries as infection courts of *Hypoxylon pruinautom* in trembling aspen, *Populus tremuloides*. Great Lakes Entomol. 5:87-92.

