External Structure of the Putative Stridulatory Apparatus of the Fungus Beetles, Dacne japonica and D. picta
(Coleoptera: Erytulidae)\(^1\)

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(Received 18 September 1995)
(Accepted 24 January 1996)

Key words: Erytulidae, stridulation, binding patch

*D. japonica* and *D. picta* are serious pests of the shiitake mushroom (*Lentinus edodes*) (OHYA, 1992, 1993). Although several beetles are often found on a single mushroom, apparently as a result of olfactory attraction (OHYA, 1992, 1993), their intra-specific communication on the mushroom has not been clarified. Since CHIJHJO (1969) described that Japanese male *Dacne* usually had a pair of stridulatory files on the vertex, sound may play an important role in their communication. As both species coexist for a certain period (OHYA, 1992, 1993), inter-specific sound communication is also possible.

Possible sound-producing organs of erytulid beetles have been described before CHIJHJO (1969). GORHAM (1896) first reported that an erytulid beetle, *Episcapha stridulans*, possessed a pair of longitudinal stridulating files on the vertex. ARROW (1924) suggested that these files were scraped by a sharp transverse ridge within the pronotal cavity. He found another potential sound-producing apparatus in this family composed of elytral and wing denticulated patches. In a review ARROW (1924) stated that the "vertex-pronotal" apparatus was common among smaller erytulids, including *Dacne* spp., whereas the "elytra-wing" apparatus was found in most species within the family.

HAMMOND (1979), however, quoted ARROW's (1924) description on the "elytra-wing" apparatus, claiming that it was the "binding-patch" to fix the wings beneath the elytra and doubted its sound producing ability.

I used scanning electron microscopy (SEM) to confirm the existence of these apparatus in *D. japonica* and *D. picta* and discuss their sound producing function.

**MATERIALS AND METHODS**

The SEM specimens for *D. picta* adults were randomly selected from cultures (see OHYA and ISEDA, 1990). *D. japonica* specimens were first generation adults that emerged from shiitake mushrooms collected in the field in April. Individuals were carefully dissected under a binocular microscope and cleaned using an ultrasonic washer (Sharp UC-6100). The cleaned parts were then passed through an ethanol series (70%, 90%, 100%) for dehydration. The dehydrated organs were then dried in a desiccator. These materials were mounted and gold-coated using an ion-sputter (JEOL-1100). They were observed and photographed by SEM (JEOL JS-840 and JA-840A).

**RESULTS AND DISCUSSION**

**Vertex-pronotal apparatus**

In both species, only males had a pair of longitudinal files on the vertex (Figs. 1, f and 2A), as both ARROW (1924) and CHIJHJO (1969) suggested for this genus. The files could be distinguished between the anterior fine (Fig. 2A, f) and posterior robust (Fig. 2A, r) teeth with a transverse zone in the middle. Teeth, that measured more than 5.0 \(\mu\)m in interval, are defined as robust in Table 1. The females of both species lacked files (Fig. 2B). A composition of fine and robust files was also seen in *Estigmena chinensis* (Gahan, 1900), although the significance of this bimodal fashion is not known.

There were no significant differences between right and left sides in any measured features of files (Table 1). The longitudinal lengths, the numbers of teeth, and the intervals between the teeth were significantly different between species in the fine files, whereas, in the robust files, only the numbers of teeth and the intervals between the teeth were significantly different between species. These differences between *D. japonica* and *D. picta* males appear to enable the two species to discriminate each other in terms of the duration or the frequency of syllables in the chirps.

The front border of the pronotum in males of both

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Table 1. Longitudinal length of the files, number of teeth on the files, and interval between teeth of the files on the vertex of male *Dacne japonica* and *D. picta*

<table>
<thead>
<tr>
<th></th>
<th>Length (µm)</th>
<th>Number of teeth</th>
<th>Interval between teeth (µm)</th>
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</thead>
<tbody>
<tr>
<td><strong>Fine file</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>left</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>j</em></td>
<td>104.0 ± 10.7&quot;</td>
<td>48.2 ± 2.5&quot;</td>
<td>2.2 ± 0.3&quot;</td>
</tr>
<tr>
<td><em>p</em></td>
<td>152.3 ± 8.1</td>
<td>77.6 ± 7.1</td>
<td>2.0 ± 0.1</td>
</tr>
<tr>
<td>right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>j</em></td>
<td>102.3 ± 14.6&quot;</td>
<td>46.3 ± 3.1&quot;</td>
<td>2.2 ± 0.2&quot;</td>
</tr>
<tr>
<td><em>p</em></td>
<td>150.8 ± 11.0</td>
<td>76.8 ± 5.4</td>
<td>2.0 ± 0.1</td>
</tr>
<tr>
<td><strong>Robust file</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>left</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>j</em></td>
<td>220.6 ± 23.1</td>
<td>9.8 ± 0.9&quot;</td>
<td>22.7 ± 2.1&quot;</td>
</tr>
<tr>
<td><em>p</em></td>
<td>208.1 ± 16.3</td>
<td>7.8 ± 0.4</td>
<td>26.8 ± 1.1</td>
</tr>
<tr>
<td>right</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>j</em></td>
<td>225.8 ± 23.7</td>
<td>10.2 ± 0.4&quot;</td>
<td>22.4 ± 2.8&quot;</td>
</tr>
<tr>
<td><em>p</em></td>
<td>207.5 ± 16.5</td>
<td>7.8 ± 0.4</td>
<td>26.8 ± 0.9</td>
</tr>
</tbody>
</table>

*j. D. japonica, p. D. picta.* Each figure represents mean ± S.D. (*n* = 10, unless otherwise indicated, *n* = 8 and *n* = 9). There are no significant differences between left and right in both fine and robust files of the same species (*p* > 0.05 by the 2 tailed WILCOXON test). There are significant differences between specific pairs in each column (" *p* < 0.01, *p* < 0.05 by a 2-tailed MANN-WHITNEY’s U-test).

![Fig. 1. Schematic drawing of putative stridulatory apparatus of Dacne. Left: undersurface of left clytron showing a baso-lateral binding patch (b), a medio-lateral binding patch (m), and an apico-sutural binding patch (s). Right: a male without elytra, left wing and appendages showing anterior parts of fine files (f) on the vertex, ridges (r) on the front bilobed border of the pronotum, a binding patch on the metepimeron (mm), a binding patch on the basal abdominal laterosternum (l), and a sub-cubital binding patch (c) on a folded wing. Thus composing vertex-pronotal apparatus, f-r; elytra-wing apparatus, s-c; and elytra-abdominal apparatus, b-mm and m-l.](image)

species was slightly bilobed (Fig. 1, f). There was a sharp ridge (Fig. 2C, rdg) on the edge of each lobe corresponding in position to each file on the vertex, as in Arrow's (1924) descriptions in other Erotyliidae and Languriidae and Chitajo's (1969) descriptions in Japanese Erotyliidae.

The ridge may scrape the pair of files to produce chirps in males. Since only males have this apparatus, the sounds expected to be produced by the apparatus must play an important role in courtship behavior. *Elytra-wing apparatus*

The elytra-wing apparatus was confirmed in both
and sub-cubital binding patches (c) on wing. E) Apico-sutural binding patch at the posterior suture of undersurface of right elytron of *D. picta* female and its enlargement in the middle (F). G) Detail of sub-cubital binding patch (D, c) on wing of *D. picta* female (posterior to the left). All pictures except G were arranged so that the anterior parts point to the top. Scales: 100 μm for A, B, D and E, 10 μm for C, F and G.

Fig. 2. Scanning electron micrographs of putative stridulatory organs of *Daene*, previously reported in other species or genera in the Erotylidae. Right half of the vertex of *D. japonica* male (A) and female (B); note that the male has files (f: fine, r: robust). C) Undersurface of the pronotum of male *D. japonica* at left lobate part opposing to the left file; a ridge (rdg). D) Ventral view of the posterior end of female *D. picta* showing apico-sutural binding patches (s) on undersurface of elytra.
Fig. 3. Scanning electron micrographs of *Dacne japonica* male showing newly-found putative stridulatory apparatus known as binding patches in other Coleoptera. A) Undersurface of left elytron showing a baso-lateral binding patch (b) and a medio-lateral binding patch (m). C) Enlargement of b. D) Enlargement of m. B) Left lateral view of pterothorax and abdomen showing binding patches on the metepimeron (mm) and on the basal abdominal laterosternum (l). E) Enlargement of mm. F) Enlargement of l. All pictures were arranged so that the anterior parts point to the left. Scales: 100 μm for A and B, 10 μm for C, D, E and F.

sexes of both species, as Arrow (1924) and Chūjō (1969) predicted in this family (Fig. 1). A semicircular patch (Figs. 1, s; 2D, s and 2E) was located at the posterior suture of the undersurface of each elytron and its fine structure consisted of arranged bead-like denticulations that were somewhat parallel (Fig. 2F). The opposing wing-patch (Figs. 1, c and 2D, c) also had a spiculate surface but was sparser (Fig. 2G). These structures corresponded exactly to what Hammond (1979) called “apico-sutural” and “sub-cubital” binding patches, respectively.

_Elytra-abdominal apparatus_

Both sexes of both species also had “elytra-abdominal apparatus” (Fig. 1). The apparatus was first re-
ported here in this family. It is, however, common in other families of Coleoptera as “lateral binding patches” (Hammond, 1979). It consisted of two pairs of opposing patches. The ones on the elytron were partially-fused denticulations located laterally, close behind the humeral protuberance on the undersurface (Figs. 1 and 3A). The anterior “baso-lateral binding patch” (Figs. 1, b and 3A, b) was opposed to binding patch on the metepimeron (Figs. 1, mm and 3B, mm) and the posterior “medio-lateral binding patch” (Figs. 1, m and 3A, m) was facing a binding patch on the basal abdominal laterosternum (Figs. 1, l and 3B, l).

Enlarged pictures show that the spiculae of these patches were always dense and arranged facing one way, but they differed in shape. That is, both spiculae on elytral patches were long and lobate (Figs. 3C and 3D), while the spiculae on the metepimeron and the basal abdominal laterosternum were denticular (Figs. 3E and 3F).

Sound producing ability of the binding-patches

Although the spiculae on the patches of both elytra-abdominal and elytra-wing apparatus were arranged parallel or facing one way, none of these patches bore distinct files. Hammond (1979) claimed that those patches, if without files, should be attributed to the binding-patches. Thus, these apparatus in Dacne should also be referred to primarily as binding-patches. However, since file-less patches can produce functional sound in Carabidae (Claridge, 1974) and in Geotrupidae (Winking-Nikolay, 1975), the same possibility still exists in Dacne japonica and D. picta.

ACKNOWLEDGEMENTS

I thank Dr. T. Fujii of the Forestry and Forest Products Research Institute for giving me instruction in SEM operation, Dr. K. Fujita of the same institute for statistical advice and Dr. T. Ueno of Kyushu University for the morphological terminology of binding-patches. I am grateful to Dr. S.A. Lawson of University of Tsukuba for assisting with the English.

REFERENCES


