WEB-MONITORING FORCE EXERTED BY THE SPIDER
WAITKERA WAITAKERENSIS (ULOBORIDAE)

The purpose of this study is to determine if the resting force expressed by the primitive, orb-weaver *Waitkera waitakerensis* (Chamberlain 1946) is similar to that of the orb-weaver *Uloborus glomosus* (Walckenaer 1841) and less than that of the triangle-weaver *Hyptiotes cavatus* (Hentz 1847) (Opell 1987a). This is important because Opell (1987a) used *U. glomosus* to represent orb-weavers in a study which concluded that triangle-web spiders exert more force on a horizontal resting line than do orb-weavers.

I chose the monotypic genus *Waitkera* for this study because it is one of the two most primitive members of the uloborid clade that is a sister clade of the larger assemblage that includes *Uloborus*, *Hyptiotes*, and *Miagrammopes* (Coddington 1990). Unlike members of the other primitive orb-weaving genus *Tangaroa*, which are very small (Opell 1983), *W. waitakerensis* is similar in size to the aforementioned genera (Table 1). Like members of these genera, this species has a well developed tracheal system, characterized by tracheae that pass through the pedicel and enter the legs (Opell 1979, 1987b), a pattern considered plesiomorphic for the family Uloboridae. Like *U. glomosus*, *W. waitakerensis* hangs beneath the hub of its web with legs extended, while it waits for prey to strike its web (Opell pers. obs.). Therefore, although *U. glomosus* and *W. waitakerensis* are phylogenetically distant, there are no morphological or behavioral features that suggest their resting forces should greatly differ.

Following the methods described by Opell (1987a), I used a glass needle strain gauge to measure the resting forces expressed by adult female *W. waitakerensis*. This species is found only on New Zealand’s north island (Opell 1979), where I studied two populations, one in a city park in Hamilton (sample size 36) and another from the Waitakere Mountains near Piha (sample size 19). I recorded the temperature at which each force measurement was taken and the live weight of each spider. These data were compared with those of adult female *U. glomosus* and *H. cavatus*, as measured by Opell (1987a).

Using a Shapiro-Wilk W-statistic, I first determined if the resting forces of each population or species were normally distributed. If they were, I used a *t* test (*t*) to compare means; if they were not, I used a Wilcoxon 2-sample test (*W*). Except for the temperature at which force measurements were taken, all values from the Hamilton and Piha populations of *W. waitakerensis* were similar (Weight: *t*, *P* = 0.178; Force: *t*, *P* = 0.267; Force/weight: *W*, *P* = 0.212). Mean temperatures were very similar (22.44 ± 1.44 °C and 23.00 ± 0.00 °C, respectively) and their statistical difference (*W*, *P* = 0.031) is attributable to the uniform temperature at which the Piha population was measured. Therefore, the following comparisons combine the values of the two *W. waitakerensis* populations.

Table 1 compares the absolute and weight-specific resting forces of the three species. The mean resting force of *W. waitakerensis* is greater than that of *U. glomosus* (*t*, *P* = 0.016) but did not differ from that of *H. cavatus* (*t*, *P* = 0.052). The weight-specific resting force of *W. waitakerensis* was 0.25 × 10⁻⁵ N/mg greater than that of *U. glomosus* (*W*, *P* = 0.004) and 0.77 × 10⁻⁵ N/mg less than that of *H. cavatus* (*W*, *P* = 0.0001). The mean temperatures at which the resting force of *U. glomosus* and *H. cavatus* were measured were nearly identical (Table 1) and that at which *W. waitakerensis* was measured was only 2.5 °C lower. Therefore, it is unlikely that temperature

<table>
<thead>
<tr>
<th></th>
<th><em>Uloborus glomosus</em></th>
<th><em>Waitkera waitakerensis</em></th>
<th><em>Hyptiotes cavatus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Live weight (mg)</td>
<td>9.93 ± 4.65 (45)</td>
<td>8.92 ± 2.52 (55)</td>
<td>6.76 ± 3.05 (42)</td>
</tr>
<tr>
<td>Resting force (10⁻² Newtons)</td>
<td>1.07 ± 0.30 (40)</td>
<td>1.21 ± 0.26 (57)</td>
<td>1.34 ± 0.37 (42)</td>
</tr>
<tr>
<td>Resting force/live weight (10⁻³ N/mg)</td>
<td>1.21 ± 0.29 (40)</td>
<td>1.46 ± 0.41 (55)</td>
<td>2.23 ± 0.69 (42)</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>25.0 ± 0.7 (45)</td>
<td>22.6 ± 1.2 (57)</td>
<td>25.2 ± 0.9 (42)</td>
</tr>
</tbody>
</table>
The observed differences had a major influence on the observed differences in resting forces. The weight-specific resting force expressed by \textit{W. waitakerensis} is intermediate between and statistically different from those of the orb-weaver \textit{U. glomosus} and the triangle-weaver \textit{H. cavatus}. However, the weight-specific forces of the two phylogenetically distant orb-weaving uloborids are more similar to one another than either is to that of \textit{H. cavatus}. This upholds Opell's (1987a) conclusion that triangle-web uloborids that actively monitor their webs express more web-monitoring force than do orb-weaving uloborids that hang from the hubs of their webs while waiting for prey to strike. However, the fact that \textit{W. waitakerensis} expresses greater weight-specific resting force than \textit{U. glomosus} may indicate a trend toward the reduction of web-monitoring forces within orb-weaving uloborids. Support for this is found in the reduced tracheal systems of members of the higher orb-weaving uloborid genera \textit{Daramuliana}, \textit{Octonoba}, \textit{Philoponella}, \textit{Ponella}, \textit{Purumitra}, and \textit{Zosis} (Opell 1979, 1987b).

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\section*{LITERATURE CITED}


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