



STONEFLY SEX GONE AWRY: AN ATTEMPTED MATING BY A *PERLINODES AUREUS* (SMITH) MALE WITH A *PTERONARCYS CALIFORNICA* NEWPORT MALE

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ABSTRACT

A male of the Perlodidae genus *Perlinodes* attempted to mate with a male of the Pteronarcyidae genus *Pteronarcys* and they became attached. The specimens were captured but they were still unable to disengage because of the large terminal dorsal appendages of the *Perlinodes aureus* (Smith) male. This type of unnatural mating behavior may be the result of misidentification based on the similar size of the *Pteronarcys californica* Newport male with that of a *Perlinodes* female. Such attempts probably occur at low levels in nature but are seldom observed because the individuals are able to separate naturally.

Keywords: Plecoptera, stoneflies, mating, Perlodidae *Perlinodes*, Pteronarcyidae *Pteronarcys*, Washington, USA

INTRODUCTION

While searching for stonefly adults at the Touchet River near Dayton, Washington on April 8, 2012 a surprise occurred. This site had been visited earlier when several adults of *Perlinodes aureus* (Smith 1917) were collected. Since this is a relatively rare species, another visit was scheduled. Field collecting was being made by hand from the side of a building, near where the river flows under US Highway 12, when it was observed that there were two stoneflies hooked together. They were captured while still alive and photographed (Fig. 1). After further examination, it was noted that the pair consisted of two males which belonged to different genera in two different families. The specimen on top was indeed a male of

P. aureus but the large specimen on the bottom represented a *Pteronarcys californica* Newport 1848 male. The stoneflies were allowed to move about freely overnight but they were unable to disengage. Finally, the specimens were preserved so that the attempted mating could be documented.

Although, Zeigler (1990) reported attempted mating in the laboratory between males of *Pteronarcella badia* (Hagen 1874) with females of *Isogenoides zionensis* Hanson 1949, simultaneously emerging species at the Conejos River, Colorado, mating attempts where males of different species became connected have not been recorded. This study reports this event and attempts to explain how and why it occurred.



Figs. 1-2. Adult males of *P. aureus* and *P. californica* joined in unnatural copulation behavior. 1. Males alive with *P. aureus* male riding on back of *P. californica* male. 2. Males exhibiting natural color, showing connection between *P. aureus* dorsal and *P. californica* ventral, soon after preservation.

MATERIALS AND METHODS

Photographs of the stoneflies were taken in the field, while they were connected to each other but still alive, using a Nikon D 300, SLR camera with a 105mm macro lens and flash attachment. Close examination of the dead, preserved adults, was made using a Wild M-8 stereo microscope at Brigham

Young University. Photographs of the preserved specimens both attached and separate were made with an Olympus SZX12 microscope, an MTI 3ZCCD camera and Olympus Micro Suite software. The two male specimens studied are deposited at the Monte L. Bean Museum, Brigham Young University, Provo, Utah, USA.



Figs. 3-4. Male abdomens of *P. aureus* and *P. californica* preserved in 70% ETOH. 3. Males connected with *P. californica* dorsal and *P. aureus* ventral. 4. Males slightly disconnected showing position of attachment on *P. californica* sternum 9.

RESULTS AND DISCUSSION

Material examined: USA: Washington, Columbia County, Touchet River, Dayton, 8 April 2012, R.L. Newell, *Perlinodes aureus* 1♂ and *Pteronarcys californica* 1♂.

Results

Examination indicated that the *P. aureus* male had inserted its 10th tergal processes over the posterior margin of sternum 9 of the *P. californica* male (Fig. 2). Apparently the hooks at the tip of the processes had

become lodged in place so that they could not be disconnected (Figs 3-4). Consequently, when the two males tried to disengage they were unable to do so. This unnatural connection between the two males

was facilitated by the hooks on tergum 10 of the *P. aureus* male (Fig. 6). In addition, the introduction of the hooks by the *P. aureus* male caused an autohemorrhage reaction to occur in the *P. californica*



Fig. 5. Male abdomens completely disconnected with *P. californica* dorsal and *P. aureus* ventral, showing male genitalia of both species. Fig. 6. Male genitalia of *P. aureus* in lateral view, showing details of dorsal terminalia: large forked process on tergum 7, anterior; lateral hooked processes on tergum 10, posterior. Specimen collected at Cold Creek, south of Sierraville, California.

male as described by (Benfield 1974). A large amount of fluid, that turned white in alcohol, covered the area around the unnatural connection so that the details of the actual connection were somewhat obscured (Figs. 3-5).

In the laboratory, constant pressure was applied to the genital area where the specimens were connected and they finally became uncoupled. It was then possible to confirm that it was indeed the hooked tips on the lateral processes of tergum 10 of the *P. aureus* male that had caused the males to remain connected. They had become embedded over the posterior margin of the subgenital plate of the *P. californica* male (Fig. 4). Once the males became disconnected, it was clear that the large forked projection on tergum 7 of the *P. aureus* male was not primarily involved in the unnatural coupling (Fig. 5).

Discussion

It is not uncommon to find large stoneflies in the families Perlidae and Perlodidae congregated into small masses as they try to mate. These aggregations are made up of individuals of both sexes but usually consist of few females and multiple males. Stewart (2001) discussed searching behavior as related to drumming behavior as a way for individuals of the same species to find each other for mating. Aggregation is a related aggressive behavior for mate finding and these masses usually consist of individuals of a single species, although sometimes more than one species is represented. These aggregations tend to occur in hidden places where the stoneflies are not easily observed. Such places include: crevices in bridges or in corners under the bridge proper, depressions under large rocks, indentations below large leaves, compacted vegetation or under overhanging banks and in depressions under loose bark. To date no studies have shown the existence of identification contact sex pheromones in Plecoptera so how individuals of the same species find each other to aggregate is not completely known but drumming may likely play and important initiating role.

Several colleagues were willing to provide examples of aggregation that they have encountered during years of collecting stoneflies in the field. It is always interesting to observe these masses of large stoneflies often piled on top of each other.

Perlidae

Acroneuria carolinensis (Banks): White Run, near Spruce Knob, West Virginia (Baumann and Kirchner)

Agnentina capitata (Pictet): Chagrin River, Ohio (Baumann and Kirchner)

Calineuria californica (Banks): Truckee River, California (Stewart)

Claassenia sabulosa (Banks): Gunnison River, Colorado (Stewart)

Doroneuria baumanni Stark and Gaufin: Wahkeena Falls, Oregon (Stark)

Hesperoperla pacifica (Banks): Battle Creek, California (Baumann and Stark)

Paragnetina immarginata (Say): Little Kanawha River, West Virginia (Kirchner and Kondratieff)

Paragnetina media (Walker): Salmon River, near Watertown, New York (Baumann and Kondratieff)

Perlodidae

Frisonia picticeps (Hanson): Little White Salmon River, Washington (Baumann and Kondratieff)

Helopicus subvarians (Banks): New River, West Virginia (Clark)

Isogenoides colubrinus (Hagen): Colorado River, Rifle, Colorado (Kondratieff)

Megarcys signata (Hagen): Mill Creek, near Salt Lake City, Utah (Baumann)

Megarcys subtruncata Hanson: Little Salmon River, Washington (Baumann and Kondratieff)

Setvena wahkeena Stewart and Stanger: Wahkeena Falls, Oregon (Stark)

Skwala americana (Klapálek): Bear Creek, below Alpine Meadows, California (Baumann)

While most of the species listed above were found in aggregates of a single species, it should be noted that *M. subtruncata* and *F. picticeps* were found together at the Little White Salmon River, in Washington and *D. baumanni* and *S. wahkeena* were collected together at Wahkeena Falls, Oregon. In addition, *Soliperla campanula*, in the family Peltoperlidae, was also present in the mass at the Oregon locality. It is not uncommon to find several species of stoneflies emerging at the same time in a given locality and sometimes it is possible to observe several adult species emerging on the same rock. However, to be included in the above listing, the individuals needed to be present in a mass where they were touching or crawling on each other.

Notes. While it is not uncommon for insects of different species to attempt to mate, these occurrences are seldom successful in nature and are poorly documented, especially between males of species belonging to different families. In the aquatic insect orders, the most common occurrence of somewhat random attempted mating is found in the dragonflies and damselflies. Since, Odonata do not fertilize internally, it is easy for the male of one species to hook a male of another genus or species and attempt to mate. That is why odonatologists use the term tandem when referring to specimens collected together in flight instead of saying that they are a mating pair (Paulson 2009).

Another factor to consider is that the two males of this study were not able to disengage from each other. If this connection would have continued in nature, they would not only have been unable to successfully mate but they would have probably died as well. This is an outcome that parallels the situation that occurs in the Mammalian family Cervidae where males sometimes get their antlers intertwined, as they fight for females, so that both antagonists eventually die (Messier and Crête 1985).

ACKNOWLEDGEMENTS

The following colleagues shared their collecting experiences where they have observed aggregations of large stonefly adults of the families Perlidae and Perlodidae in the process of attempting to secure a mate: Shawn M. Clark, Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah; Ralph F. Kirchner, Huntington District Corps of Engineers, Water Quality Section, Huntington, West Virginia; Boris C. Kondratieff, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, Colorado; Bill P. Stark, Department of Biological Sciences, Mississippi College, Clinton, Mississippi and Kenneth W. Stewart, Department of Biological Sciences, University of North Texas, Denton, Texas. Muriel Longstaff helped take the color pictures of the dead insects and the figure plates were prepared by Randal Baker both at the Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah.

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Received 19 September 2012, Accepted 17 October 2012, Published 29 October 2012