Distribution of *Brechmorhoga* clubskimmers (Odonata: Libellulidae) in the Grand Canyon region, southwestern USA

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Brechmorhoga mendax (Hagen 1861) and B. pertinax (Hagen 1861) are the only 2 libellulid clubskimmer dragonfly species reported in the United States (Needham et al. 2000, Donnelly 2004). Brechmorhoga mendax is found across the southern plains and southwestern United States, from South Dakota to Arkansas, west to northern California, and south into Mexico (Beckemeyer 1996, Needham et al. 2000, Manolis 2003, Donnelly 2004). It has been reported throughout Arizona, except in Yuma County in the southwestern corner of the state and in the northeast in Navajo and Apache Counties. It has been reported from the Virgin River drainage in southwestern Utah and southeastern Nevada, and in central Grand Canyon (Donnelly 2004). In contrast, B. pertinax is very rare or accidental in the United States: the only previous record to our knowledge is a single specimen taken by M. Westfall at John Hands Campground in the Chiricahua Mountains, Cochise County, Arizona, on 25–26 June 1958. Brechmorhoga pertinax’s range extends south through Mexico, Guatemala, Nicaragua, and Costa Rica (Gutiérrez 1995, Needham et al. 2000). Here we report a more limited distribution of B. mendax in Arizona and several highly isolated populations of B. pertinax along small, perennial, spring-fed streams emanating from the south side of Grand Canyon in northern Arizona.

METHODS

We collected numerous adult Odonata during biological inventories of >300 aquatic habitats across the 3500 m elevation gradient in Coconino, Mohave, and Yavapai Counties, and in and around Grand Canyon in northern Arizona over the past decade (Fig. 1). These inventories focused on water sources, particularly springs, the several dozen perennial streams that are tributaries of the Colorado River, as well as natural and anthropogenic ponds, lakes, and reservoirs (Stevens et al. 1997, Grand Canyon Wildlands Council 2002, 2004, RAB and LES unpublished data). By convention, distances along the Colorado River in Grand Canyon are measured in miles from Lees Ferry in Coconino County at the upstream end of Grand Canyon.

Specimen identities were verified by RAB, with the northern phenotype of B. pertinax distinguished from B. mendax on the basis of

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several features: (1) a darker, more slender form; (2) dark interpleural and metapleural stripes that are fused along the entire margins; (3) divergent white spots on abdominal segment 7; (4) male hamules that are straighter (not as curved as a question mark); (5) lack of metepisternal pale stripes; and (6) a dark metallic blue labrum and epicranium, with brown at the rear of the head (Needham et al. 2000).

The abdomen:hindwing length ratio of *B. mendax* has been described as being >1 and that of *B. pertinax* <1. However, in some of our *B. pertinax* specimens, the abdomen is longer than the hindwing, and this characteristic appears to be unreliable.

**RESULTS AND DISCUSSION**

Our inventories yielded 20 adult *Brechmorhoga* specimens from the Grand Canyon region and numerous visual observations across a wide array of habitats in northern Arizona. Specimens are housed in the invertebrate collection of the Museum of Northern Arizona, Flagstaff.

*Brechmorhoga mendax* is reported to be widely distributed on and around the southern Colorado Plateau and the lower Colorado River. Our data reveal that *B. mendax* exists from 110 m to 1460 m elevation in this region and flies from at least 22 April to at least 20 October (Table 1, Fig. 1). This species exists along the Colorado River and its tributaries from Parker, Arizona, north to southern Nevada and northwestern Arizona. It occurs at Warm Springs and along the upper Muddy River (Clark County, NV; U.S. Geological Survey 2003), as well as the lower Virgin River (Utah; Donnelly 2004), both of which are tributaries to the Colorado River. It occurs in Arizona in Mohave County at Tassi Spring in Grand Wash (RM 285) in Lake Mead National Recreation Area. Its range in Grand Canyon extends upstream in Mohave and Coconino Counties, into lower Diamond
Creek (RM 225) and Spring Canyon (RM 204; and probably the larval specimens identified to genus by Oberlin et al. 1999), and into central Grand Canyon at least to RM 132, but it has not been detected in upper Grand Canyon. We and our colleagues also detected *Brechmorhoga mendax* in Coconino County along lower Sycamore Creek in Sycamore Canyon Wilderness Area (12 km N of Clarkdale; LES, 9 Sept.) and along Oak Creek up to an elevation of 1450 m (C. Olsen, 14 July; L. Haury, 2 August); Greenlee County along the Blue River (D. Danforth, 20 July); and Yavapai County in the Verde River drainage along the southern margin of the Colorado Plateau, from Camp Verde at the Interstate 17 bridge (29 Aug), at elevations of 1000–1050 m (LES). Reports of this species in northeastern Arizona have yet to be substantiated: the only localities in Arizona’s northeastern counties are in drainages that flow southward in the White Mountains in the Salt-Gila River basin.

*Brechmorhoga mendax* is riparian in its adult stages, rarely straying from the moderately swift-flowing water of small to large streams throughout its range. It patrols relatively large (>50 m long) territories along these often heavily vegetated streams, and it occurs in low densities along the highly regulated Colorado River in Grand Canyon (e.g., RM 132, 600 m elevation; LES, 17 August 2004).

*Brechmorhoga pertinax* occurs in Central America, and northward to east central Sonora and along the east side of the Sierra Madre Occidental in Mexico. In Grand Canyon this species has been detected at 5 perennial, spring-fed tributaries on the south side of the Colorado River, from RM 81 to RM 95 (all localities in Coconino County) at elevations of 1720–1990 m (LES). Reports of this species in northeastern Arizona have yet to be substantiated: the only localities in Arizona’s northeastern counties are in drainages that flow southward in the White Mountains in the Salt-Gila River basin.

Table 1. *Brechmorhoga* sampling sites and distribution in the Grand Canyon region. Land management units: ANF—Apache National Forest; CNF—Coconino National Forest; CV—Camp Verde, AZ; FWS—U.S. Fish and Wildlife Service; GCNP—Grand Canyon National Park; GCNRA—Glen Canyon National Recreation Area; LMNRA—Lake Mead National Recreation Area; SCWA—Sycamore Canyon Wilderness Area (Prescott National Forest); TNF—Tonto National Forest. Numbers indicate collection site localities (Table 1). “X” designates an observation or collection; “0” designates no *Brechmorhoga* detection; asterisk indicates specimen observed by LES.

<table>
<thead>
<tr>
<th>Site</th>
<th>Site name</th>
<th>State</th>
<th>County</th>
<th>Land unit</th>
<th>Elevation (m)</th>
<th>Elevation (ft.)</th>
<th>Detections</th>
<th>B. mendax</th>
<th>B. pertinax</th>
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<td>1</td>
<td>Muddy R.</td>
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<td>Clark</td>
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<td>3609</td>
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850–1150 m (Table 1, Fig. 1). It flies from at least 19 July until at least 21 October, a flight range far longer than the 25 June–3 July previously reported by Needham et al. (2000). Our farthest upstream record in the Colorado River drainage was from East Grapevine Spring on the Tonto Trail (N36.04279°, W112.01381°) at 1120 m elevation. No Brechmorhoga were detected at apparently suitable habitat 5 km east in the Cottonwood Creek drainage, despite intensive collecting efforts there from 2000 to 2003. Brechmorhoga pertinax occurred west of Grapevine Creek in 4 other perennial spring-fed creeks with runout streams >100 m, including Pipe Creek (N36.07316°, W112.10249°), Indian Gardens (N36.08005°, W112.12665°), Monument Creek (N36.06290°, W112.17489°), and Hermit Creek (N36.08207°, W112.21489°). The springs supporting these streams are threatened by regional groundwater extraction on the Coconino Platform, south of Grand Canyon.

The relatively fast-flowing runs and small pools in streams at which B. pertinax was detected are geomorphically and geochemically consistent with descriptions of its larval habitat in Central America (Gutiérrez 1995). The small streams supporting B. pertinax in Grand Canyon were rather similar in flow and water chemistry: flows were typically small, averaging 0.04–19.3 L·s⁻¹; mean water temperature ranged from 14.7°C to 18.0°C, except for East Grapevine Spring, which averaged 11.1°C and is more variable; pH varied from 7.5 to 8.4; mean specific conductance ranged from 393 to 1037 μS·cm⁻¹; and mean field CaCO₃ varied from 187.5 to 301.7 mg·L⁻¹ (J. Rihs, NPS hydrologist, Grand Canyon, written communication). In contrast, the streams supporting B. mendax varied rather widely in flow (up to 4359 L·s⁻¹) and geochemistry (specific conductance may exceed 1120 μS·cm⁻¹).

Although both the larval and adult habitats seem appropriate and sampling has been intensive, Brechmorhoga were not detected at East Boucher Spring or “Erhart Spring” in Boucher Canyon (RM 96), immediately west of Hermit Creek. Also, Brechmorhoga have yet to be detected along north side tributaries of the Colorado River in central and eastern Grand Canyon, including Nankoweap (RM 53), Bright Angel (RM 88), Crystal (RM 98), Shinumo (RM 109), Tapeats (RM 134), Deer (RM 136), or Kanab (RM 143) Creeks, except a visual observation by LES at Stone Creek (RM 132) in August 2004. Water chemistry, climate and flow changes, fidelity of Brechmorhoga to the stream habitats of their larval stages, adult territorial and reproductive behavior (Alcock 1989, Cordoba 1994), sampling effort, and the vagaries of colonization for this rather low-vagility, relatively stenotolerant species may account for its apparently restricted distribution in Grand Canyon.

Biogeographically, Grand Canyon’s aquatic and wetland invertebrate fauna reflects a minor Neotropical influence. With this report, Brechmorhoga pertinax joins the ranks of Ochterus rotundus (Hemiptera: Ochteridae; Polhemus and Polhemus 1976) and Polypedilum (Tripodura) obelos Sublette and Sasa (Diptera: Chironomidae; Sublette et al. 1998) as Neotropical aquatic invertebrates with disjunct ranges extending from Guatemala or southern Mexico into isolated microhabitats in Grand Canyon. The extent and duration of isolation of Grand Canyon B. pertinax from Mexican populations remains to be determined through genetics analyses. However, the persistence of B. pertinax and other rare aquatic and wetland plant and invertebrate populations may be jeopardized by the depletion of deep aquifers and the dewatering of Grand Canyon springs (Grand Canyon Wildlands Council 2002, 2004).

Grand Canyon has been recognized as an important corridor of desert habitat through an otherwise inhospitable, high-elevation landscape, but its biogeographic function as a refuge for isolated or endemic taxa is only recently becoming apparent. The Colorado River and its tributaries serve as a partial range corridor through the high-elevation Colorado Plateau for numerous desert riparian species. The range of B. mendax extends partway upstream through Grand Canyon, a range similar to that of several common desert plant species including Yucca whipplei, Foquienia splendens, Ferocactus cylindraceus, and Larrea tridentata (Phillips et al. 1987). In contrast, B. pertinax populations in the United States appear to be restricted to a few remote spring-fed stream refugia with relatively uniform water quality at slightly higher elevations in central Grand Canyon.

Other Grand Canyon taxa displaying a similar refugial response to this landscape include the following: the previously mentioned, highly
restricted *Octerus rotundus* (Polhemus and Polhemus 1976); endemic McDougall’s flava-
*ria* (*Flaveria mcdougallii*), which occupies a few remote springs in middle Grand Canyon
(Phillips et al. 1987); endemic *Cicindela hem-
orrhagica arizonae* Wickham (Coleoptera: *Cicindelidae*), the range of which almost exactly
overlaps that of *B. pertinax* (Stevens and Huber 2004); and endemic Grand Canyon rattle-
snakes (*Crotalus viridis abyssus*; Reed and Douglas 2002). The rarity of refugial and en-
demic taxa has been attributed to Pleistocene-
Holocene climate changes and the limited
time this region has existed as desert habitat
(Stevens and Huber 2004), but this hypothesis
may need revision as additional refugial taxa
are identified in Grand Canyon. Overall, the
discovery of isolated *B. pertinax* populations in
Grand Canyon is consistent with an emerging
understanding of invertebrate biogeography
and conservation issues in this large, deep
canyon ecoregion.

**ACKNOWLEDGMENTS**

This project was partially funded by Grand
Canyon Wildlands Council, Inc. and National
Park Service Contract WPF-230, through the
Arizona Water Protection Fund. We particu-
larly thank John Rihs, NPS hydrologist, for
project support. We extend our gratitude to
Margaret Erhart, Terry Griswold, Loren Haury,
Krissy Killoy, Eric North, and Bianca Perla for
enthusiastic field assistance during inventories. We thank Sandy Upson and Douglas Danforth for taxonomic advice. Chris Brod (Spatial Science Solutions, LLC) provided invaluable assistance with georefer-
encing and map preparation. We thank Boris
Kondratieff and 2 anonymous reviewers for
helpful editorial comments.

**LITERATURE CITED**

ALCOCK, J. 1989. The mating system of *Brechmorhoga per-


CORDOBA, A.A. 1994. Some observations on reproductive


**GRAND CANYON WILDLANDS COUNCIL, INC. 2002. A hydro-
logical and biological inventory of springs, seeps and
ponds of the Arizona Strip, final report. Arizona
Department of Water Resources, Water Protection
Fund, Phoenix.**

______. 2004. Biological inventory and assessment of ten

GUTIÉRREZ, R.N. 1995. Nayade de *Brechmorhoga pertinax*
(Odonata: *Libellulidae*). Anales del Instituto de Bio-

HAGEN, H.A. 1861. Synopsis of the Neuroptera of North
America, with a list of the South American species. Smithsonian Miscellaneous Collections 4:1–347.

MANOLIS, T. 2003. Dragonflies and damselflies of Califor-

Dragonflies of North America. Revised edition. Sci-
entific Publishers, Gainesville, FL.

Watershed influence on the macroinvertebrate fauna
of ten major tributaries of the Colorado River through
Grand Canyon, Arizona. Southwestern Naturalist 44:
17–30.

PHILLIPS, B.G., A.M. PHILLIPS III, AND M.A. SCHMIDT-
BERNZOTT. 1987. Annotated checklist of vascular
plants of Grand Canyon National Park. Grand Canyon
Natural History Association Monograph 7. Grand
Canyon, Arizona.

POLHEMUS, J.T., AND D.A. POLHEMUS. 1976. Aquatic and
semi-aquatic Heteroptera of Grand Canyon (Insecta:

Grand Canyon rattlesnake (*Crotalus viridis abyssus*)
in the Little Colorado River Canyon, Arizona. South-

tiger beetles (Cicindelidae) in the Grand Canyon

Benthic ecology of the Colorado River in Grand
Canyon: dam and geomorphic influences. Regulated

Chironomidae (Diptera) of the Colorado River, Grand
Canyon, Arizona, USA. 1: systematics and ecology:
Great Basin Naturalist 58:97–146.

U.S. GEOLOGICAL SURVEY. 2003. Dragonflies and dam-
selflies (Odonata) of the United States: Odonata of
www.npwrc.usgs.gov/resource/distr/insects/dfly/nv/
toc.htm.

Received 8 June 2004
Accepted 3 November 2004