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# DISTRIBUTION OF *BRECHMORHOGA* CLUBSKIMMERS (ODONATA: LIBELLULIDAE) IN THE GRAND CANYON REGION, SOUTHWESTERN USA

Lawrence E. Stevens[1] and Richard A. Bailowitz[2]

ABSTRACT.—We examined the distribution of *Brechmorhoga mendax* and *B. pertinax* (Libellulidae) in northern Arizona and southern Nevada. *Brechmorhoga mendax* occurs widely throughout the Southwest and in Arizona up to the Mogollon Rim, and up the Colorado River from the west to at least River Mile 132 (downstream from Lees Ferry, Arizona) at elevations of 110–1460 m. In Grand Canyon it occurs along small to large tributaries and on the mainstream at elevations below 650 m. The only previously reported locality for *B. pertinax* in the United States is in southeastern Arizona, where it was presumed to be accidental. We report *B. pertinax* along 5 small, perennial tributaries emanating from Redwall Formation aquifer springs on the south side of central Grand Canyon. Those springs habitats may be threatened by regional groundwater depletion. *Brechmorhoga pertinax* appears to be somewhat more stenotolerant in its habitat requirements than *B. mendax*, a finding in keeping with these differences in range. The presence of isolated populations of *B. pertinax* in Grand Canyon is an example of a Neotropical influence on the fauna and indicates biogeographic corridor and refuge functions of this large, deep canyon.

*Key words: biogeography,* Brechmorhoga, *Colorado River, Grand Canyon, isolated populations, Neotropical, Odonata, springs.*

*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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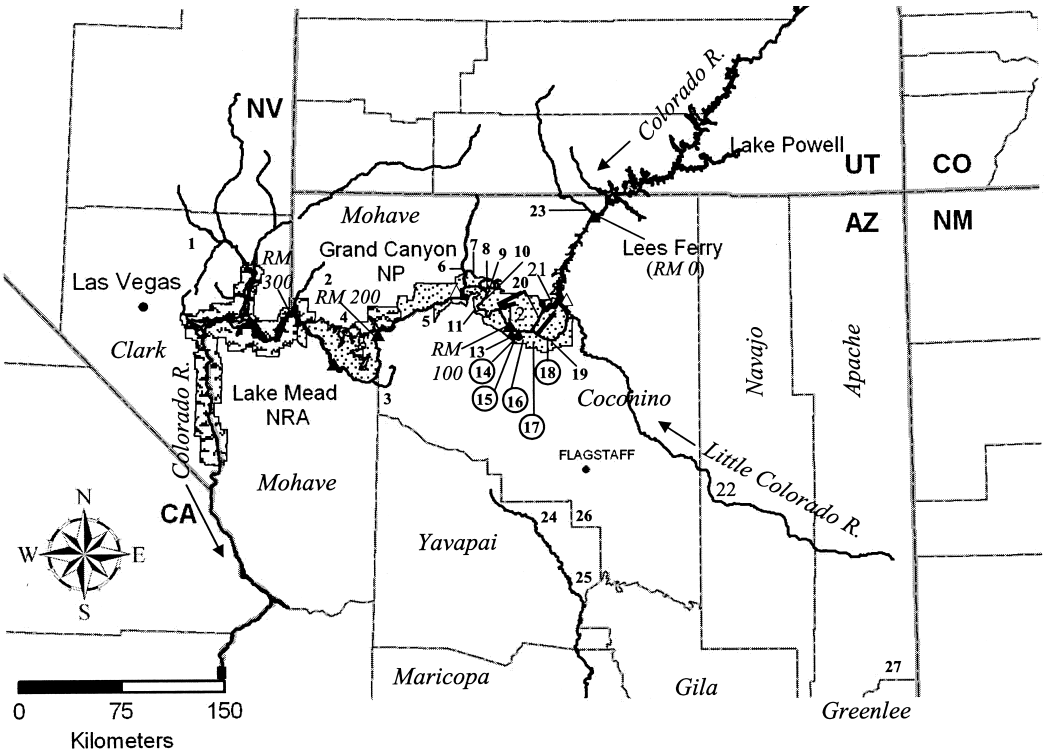


Fig. 1. Map of the Grand Canyon region. Distances along the Colorado River are indicated (by convention) in river miles (RM) downstream from Lees Ferry, AZ (RM 0). Small numbers indicate sampling localities listed in Table 1. Localities for *Brechmorhoga mendax* are not circled. Those for *B. pertinax* are encircled, and all occur in a small area in Grand Canyon National Park.

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

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.

| Site | Site name | State | County | Land unit | Elevation (m) | Elevation (ft.) | Detections | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | *B. mendax* | *B. pertinax* |
| 1 | Muddy R. | NV | Clark | FWS | 430 | 1411 | X | 0 |
| 2 | Tassi Spr. | AZ | Mohave | LMNRA | 400 | 1312 | X | 0 |
| 3 | Diamond Cr. | AZ | Coconino | GCNP | 420 | 1378 | X | 0 |
| 4 | Spring Cyn. Spr. | AZ | Mohave | GCNP | 460 | 1509 | X | 0 |
| 5 | Lower Havasu Cr. | AZ | Coconino | GCNP | 570 | 1870 | X | 0 |
| 6 | Kanab Cr. | AZ | Mohave | GCNP | 580 | 1903 | 0 | 0 |
| 7 | Deer Cr. | AZ | Coconino | GCNP | 650 | 2133 | 0 | 0 |
| 8 | Tapeats Cr. | AZ | Coconino | GCNP | 650 | 2133 | 0 | 0 |
| 9 | Stone Cr.* | AZ | Coconino | GCNP | 650 | 2133 | X | 0 |
| 10 | Galloway Cr. mouth | AZ | Coconino | GCNP | 650 | 2133 | X | 0 |
| 11 | Shinumo Cr. | AZ | Coconino | GCNP | 700 | 2297 | 0 | 0 |
| 12 | Crystal Cr. | AZ | Coconino | GCNP | 720 | 2362 | 0 | 0 |
| 13 | Boucher Cr. | AZ | Coconino | GCNP | 1000 | 3281 | 0 | 0 |
| 14 | Hermit Cr. | AZ | Coconino | GCNP | 1100 | 3609 | 0 | X |
| 15 | Monument Cr. | AZ | Coconino | GCNP | 1150 | 3773 | 0 | X |
| 16 | Garden Cr. | AZ | Coconino | GCNP | 1150 | 3773 | 0 | X |
| 17 | Pipe Cr. | AZ | Coconino | GCNP | 1150 | 3773 | 0 | X |
| 18 | East Grapevine Spr. | AZ | Coconino | GCNP | 1120 | 3675 | 0 | X |
| 19 | Cottonwood Cr. | AZ | Coconino | GCNP | 1120 | 3675 | 0 | 0 |
| 20 | Bright Angel Cr. | AZ | Coconino | GCNP | 740 | 2428 | 0 | 0 |
| 21 | Nankoweap Cr. | AZ | Coconino | GCNP | 860 | 2822 | 0 | 0 |
| 22 | Little Colorado R. | AZ | Coconino | GCNP | 820 | 2690 | 0 | 0 |
| 23 | Paria R. | AZ | Coconino | GCNRA | 940 | 3084 | 0 | 0 |
| 24 | Sycamore Cr. | AZ | Yavapai | SCWA | 1000 | 3281 | X | 0 |
| 25 | Verde R. at I-10 | AZ | Yavapai | CV | 1050 | 3445 | X | 0 |
| 26 | Oak Cr. | AZ | Coconino | CNF | 1460 | 4790 | X | 0 |
| 26 | East Verde R. | AZ | Gila | TNF | ca 1300 | 4265 | X | 0 |
| 27 | Blue R. | AZ | Apache | ANF | ca 1300 | 4265 | X | 0 |

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 *B. 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); Gila County on the East Verde River northeast of Payson (P. Savacevi, 29 June); 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

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°, W112.12668°), 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 $L \cdot s^{-1}$; 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 $\mu S \cdot cm^{-1}$; and mean field $CaCO_3$ varied from 187.5 to 301.7 $mg \cdot L^{-1}$ (J. Rihs, NPS hydrologist, Grand Canyon, written communication). In contrast, the streams supporting *B. mendax* varied rather widely in flow (up to 4359 $L \cdot s^{-1}$) and geochemistry (specific conductance may exceed 1120 $\mu S \cdot cm^{-1}$).

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*, *Foquieria 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 flaveria (*Flaveria mcdougallii*), which occupies a few remote springs in middle Grand Canyon (Phillips et al. 1987); endemic *Cicindela hemorrhagica arizonae* Wickham (Coleoptera: Cicindelidae), the range of which almost exactly overlaps that of *B. pertinax* (Stevens and Huber 2004); and endemic Grand Canyon rattlesnakes (*Crotalus viridis abyssus;* Reed and Douglas 2002). The rarity of refugial and endemic 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.

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## LITERATURE CITED

ALCOCK, J. 1989. The mating system of *Brechmorhoga pertinax* (Hagen): the evolution of brief patrolling bouts in a "territorial" dragonfly (Odonata: Libellulidae). Journal of Insect Behavior 2:49–62.

BECKEMEYER, R.J. 1996. First record of *Brechmorhoga mendax* from Kansas. Argia 8:29–30.

CORDOBA, A.A. 1994. Some observations on reproductive behavior in *Brechmorhoga vivax* Calv. (Anisoptera: Libellulidae). Notulae Odonatologicae 4:51–53.

DONNELLY, T.W. 2004. Distribution of North American Odonata, part II: Macromiidae, Corduliidae and Libellulidae. Bulletin of American Odonatology 8: 1–32.

GRAND CANYON WILDLANDS COUNCIL, INC. 2002. A hydrological 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 South Rim springs in Grand Canyon National Park: final report. Grand Canyon Wildlands Council Report, Flagstaff, AZ.

GUTIÉRREZ, R.N. 1995. Nayade de *Brechmorhoga pertinax* (Odonata: Libellulidae). Anales del Instituto de Biología Universidad Nacional Autonoma de Mexico Serie Zoología 66:181–187.

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 California. University of California Press, Berkeley.

NEEDHAM, J.G., M.J. WESTFALL, JR., AND M.L. MAY. 2000. Dragonflies of North America. Revised edition. Scientific Publishers, Gainesville, FL.

OBERLIN, G.E., J.P. SHANNON, AND D.W. BLINN. 1999. 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: Hemiptera). Great Basin Naturalist 36:221–226.

REED, R.N., AND M.E. DOUGLAS. 2002. Ecology of the Grand Canyon rattlesnake (*Crotalus viridis abyssus*) in the Little Colorado River Canyon, Arizona. Southwestern Naturalist 47:30–39.

STEVENS, L.E., AND R.L. HUBER. 2004. Biogeography of tiger beetles (Cicindelidae) in the Grand Canyon ecoregion, Arizona and Utah. Cicindela 35:41–67.

STEVENS, L.E., J.P. SHANNON, AND D.W. BLINN. 1997. Benthic ecology of the Colorado River in Grand Canyon: dam and geomorphic influences. Regulated Rivers: Research & Management 13:129–149.

SUBLETTE, J.E., L.E. STEVENS, AND J.P. SHANNON. 1998. Chironomidae (Diptera) of the Colorado River, Grand Canyon, Arizona, USA, I: systematics and ecology. Great Basin Naturalist 58:97–146.

U.S. GEOLOGICAL SURVEY. 2003. Dragonflies and damselflies (Odonata) of the United States: Odonata of Clark County, Nevada. Available on-line at http://www.npwrc.usgs.gov/resource/distr/insects/dfly/nv/toc.htm.

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