Harrison, Audrey B. and R. Edward DeWalt. 2017. Distribution of *Hydroperla fugitans* (Plecoptera: Perlodidae) with notes on diet. *Illiesia*, 13(11):104-110. https://doi.org/10.25031/2017/13.11

http://zoobank.org/ urn:lsid:zoobank.org:pub:F5A250A7-0AE7-4658-BF0D-31055480AAF7

DISTRIBUTION OF *HYDROPERLA FUGITANS* (PLECOPTERA: PERLODIDAE) WITH NOTES ON DIET

Audrey B. Harrison[1] and R. Edward DeWalt[2]

[1] Department of Biology, University of Mississippi, University, Mississippi, U.S.A. 38677.
[1] US Army Engineer Research & Development Center, Vicksburg, Mississippi, U.S.A. 39180.
E-mail: audreybharrison@gmail.com

[2] University of Illinois, Prairie Research Institute, Illinois Natural History Survey, Champaign, Illinois, U.S.A. 61820.
E-mail: dewalt@illinois.edu

ABSTRACT

Collection records are compiled and the known distribution for *Hydroperla fugitans* (Needham and Claassen, 1925) is presented. A 2007 sampling effort in the Lower Mississippi River yielded eight *H. fugitans* larvae, providing the opportunity to assess the diet of this large river inhabitant, which includes larval Hydropsychidae (Trichoptera) and Chironomidae (Diptera), as well as Oligochaeta.

Keywords: Plecoptera, large rivers, *Hydroperla fugitans* (Needham and Claassen, 1925), distribution, diet

INTRODUCTION

Hydroperla fugitans was first described as *Perla fugitans* by Needham and Claassen (1925) from two male specimens collected in Austin, Texas. Frison (1935) described *Hydroperla harti* and noted its restriction to large rivers, commenting "Its distribution suggests that there is probably some idiosyncrasy in the life history of this species which restricts it to very large rivers." Frison also noted that this species was possibly closely related to *P. fugitans*. Ricker (1952) synonymized the two species, including *Hydroperla* as a subgenus of *Isogenus*, which was later returned to *Hydroperla* by Illies (1966). Three other species, *H. crosbyi* (Needham & Claassen, 1925), *H. phormidia* Ray & Stark, 1981 and *H. rickeri* (Stark, 1984) are known, and keys to adults and larvae were published by Ray & Stark (1981) and Nelson (1996).

Larvae and adults of *H. fugitans* have primarily been collected from large rivers throughout the Mississippi River basin, although only sporadically because of the difficulty in sampling these habitats. It is unknown what life history adaptation constrains this species to large rivers, but larvae and adults of *H. fugitans* have primarily been collected in the Mississippi, lower Ohio, and lower Missouri rivers and larger tributaries thereof.

Currently, large river habitats are in danger of losing many of their specialized fauna due to changes in water quality and habitat availability, underscoring the need for documenting

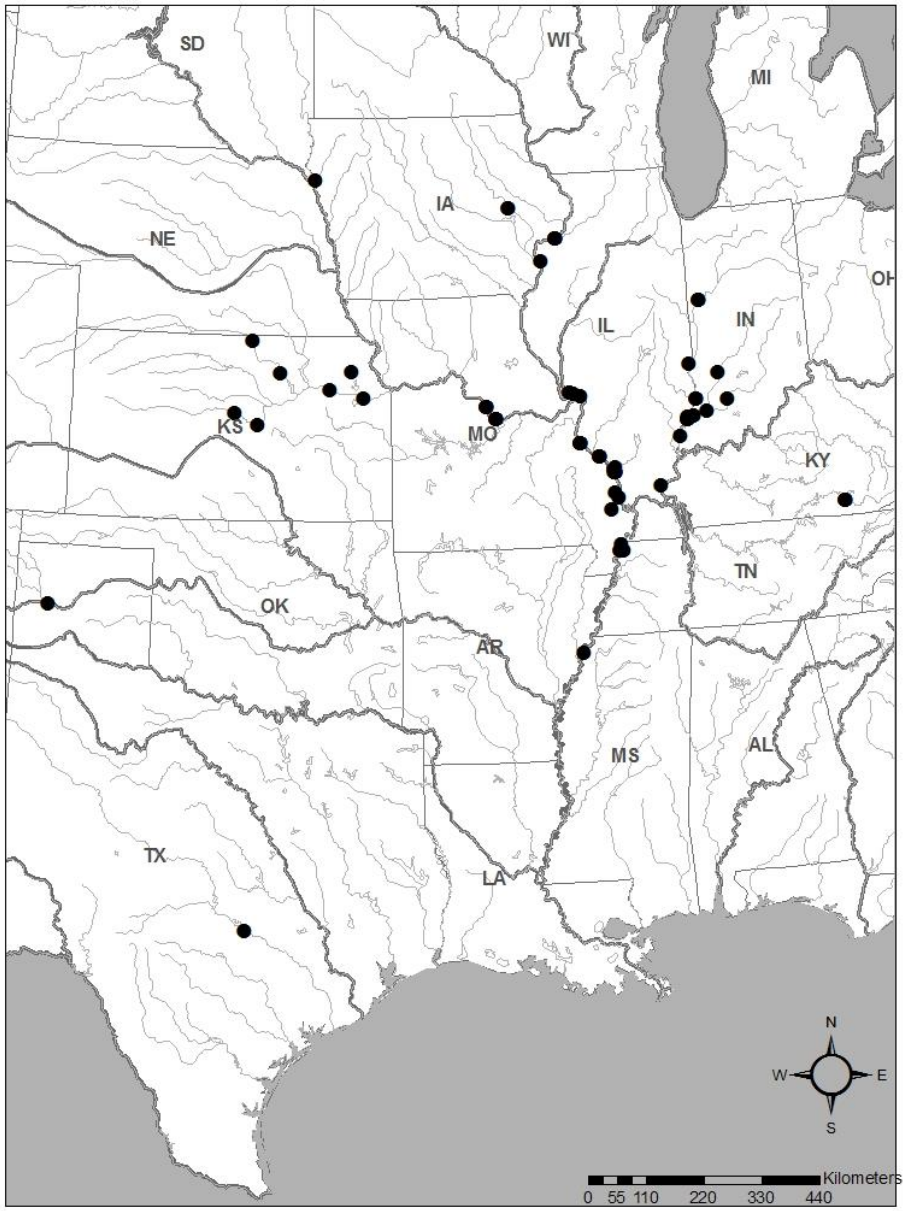

Fig. 1. Known distribution of *Hydroperla fugitans* (Perlodidae).

occurrences and distributional patterns, in order to guide conservation efforts (Harrison & Morse 2012, Harrison et al. 2017, McCafferty 1991, Pracheil et al. 2013). Recent donations of specimens by Kenneth W. Stewart and Stanley W. Szczytko (both recently deceased) brought most *H. fugitans* specimens to Illinois Natural History Survey (INHS). Digitized specimen data from these two collections and historical and new specimen records already at the INHS present an opportunity to summarize past and present distributional information for *H. fugitans*.

In addition, the recent discovery of a series of larvae collected by the US Army Corps of Engineers from the Mississippi River, near Tunica, Mississippi in 2007, presents an opportunity to preliminarily assess larval diet of this species. No published data on the diet of the larvae are available, other than mention of it being carnivorous based on mouthpart morphology (Frison 1935). An understanding of the trophic ecology of this species could aid in specimen location and microhabitat conservation.

MATERIALS AND METHODS

Distribution records. Specimen records were aggregated from the INHS at the University of Illinois, from the University of Kansas (SEMC), from published literature, and from specimens collected through routine benthic trawling by members of the Environmental Laboratory of the US Army Engineer Research and Development Center, Vicksburg, Mississippi. Most specimens from the Stewart and Szczytko donations to the INHS turned out to be loans from the INHS approximating three decades old, all prior to that institution's loan digitization efforts. Consequently, many of the specimen records presented here have never been available to assess distribution.

The Stewart and Szczytko specimens and their labels were imaged on a standard jig that regionalized specimens from each of several types of labels, the catalog number, and metadata about the digitization event. Counts of individuals and transcription of label data were transcribed into a Microsoft Excel spreadsheet while examining an image. These data were normalized into standard fields and imported into the INHS Insect Collection database. Records without accompanying GPS coordinates were georeferenced using ACME Mapper 2.1 (http://mapper.acme.com) and approximate GPS coordinates assigned. An export of these data were obtained in Excel spreadsheet format and mapped using ArcMap 10.5. These specimen data are available from the INHS databases (http://wwx.inhs.illinois.edu/collections/insect) or may be downloaded from this paper in modified Darwin Core Archive format as a CSV file.

Diet assessment. Eight larval specimens from the Tunica, Mississippi location were measured for body length (anterior end of head to posterior end of tergum 10), dissected using micro-scissors, and prey items removed from the alimentary tract. Taxa were gently rinsed of mucous and visually sorted to family. Chironomidae were slide mounted in Canada balsam and examined using a compound microscope. Each prey item was identified to the lowest possible taxon, dependent on specimen condition, using appropriate keys (Epler 2001, Merritt et al. 2008). Prey items were vouchered with the *H. fugitans* specimens in the Bill P. Stark Collection (BPSC).

Hydroperla fugitans (Needham and Claassen)

http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:859

Perla fugitans Needham and Claassen, 1925:85. Holotype ♂ (Cornell University Collection (CUIC)), Austin, [Travis Co.] Texas (Holotype missing since 1941, Szczytko & Stewart 1977)
Hydroperla harti: Frison, 1935:423.
Isogenus (*Hydroperla*) *fugitans*: Ricker 1952:104.
Hydroperla fugitans: Illies 1966:363.

Published records: USA: AR, Unknown locality (Ricker 1952); **IL, Clark Co.** (DeWalt & Grubbs 2011), **Madison Co.** (Frison 1935), **Mercer Co.** (Frison 1935), **Monroe Co.** (Frison 1935), **Jackson Co.** (Frison 1935); **Jersey Co.** (Frison 1935), **Randolph Co.** (Frison 1935, Poulton & Stewart 1991); **Rock Island Co.** (Frison 1935), **Pope Co.** (DeWalt & Grubbs 2011), **Wabash Co.** (DeWalt & Grubbs 2011); **IN, Fountain Co.** (DeWalt & Grubbs 2011, Ricker 1944), **Greene Co.** (DeWalt & Grubbs 2011), **Knox Co.** (DeWalt & Grubbs 2011), **Martin Co.** (DeWalt & Grubbs 2011), **Posey Co.** (Grubbs 2004); **IA, Linn Co.** (Heimdal & Birmingham 2006); **KS, Douglas Co.** (Stewart & Huggins 1977), **Ellsworth Co.**(Stewart & Huggins 1977), **Jefferson Co.** (Stewart & Huggins 1977), **Wabaunsee Co.** (Stewart & Huggins 1977); **KY, McCreary Co.** (Tarter et al. 2015); **MO, Boone Co.** (Kondratieff 2004), **Cape Girardeau Co.** (Battle et al. 2007), **Scott Co.** (Poulton & Stewart 1991); **OK,** Unknown locality (Szczytko & Stewart 1977); **TN, Lake Co.** (Frison 1935); **TX,**

Oldham Co. (Kondratieff 2004), Travis, Unknown locality (Needham & Claassen 1925).

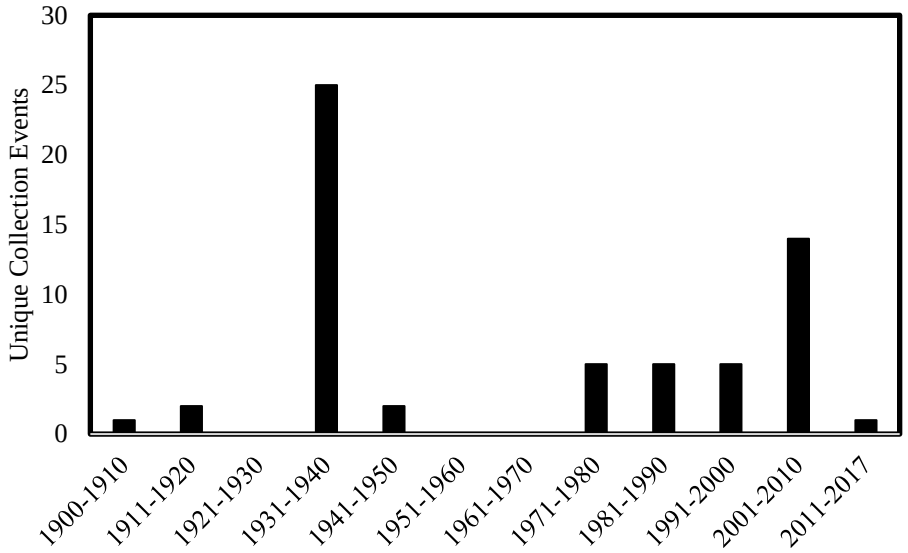

Fig. 2. Unique site/date collection records for *Hydroperla fugitans* by decade since 1900.

New records: USA: AR, (Lee Co.) Mississippi River, Mhoon Bend, 34.7372 -90.4643, 6 March 2007, US Army ERDC-EL Fish Ecology Team, 8 larvae; **IL**, (Alexander Co.) Mississippi River, Thebes, 25 April 2001, D. Webb, 2 exv; (Lawrence Co.) 5 km N Lawrenceville off IL-33, 38.7214 -87.5146, R.E. DeWalt, 1♀ 1 larva 1 exv; (Jackson Co.) Grand Tower, 38.641 -89.515, 20 March 1981, 1 larva, M. Klutho; (Jersey Co.) Principia College, Elsah, 29 April 1943, C.L. Remington, 1♂; (Wabash Co.) Wabash River, Grand Rapids at RR Tressel above IL-15, sweep, 38.40135 -87.75403, 20 June 2007, R.E. DeWalt; Wabash River, Mt. Carmel, 8 April 1939, Frison & Burks, 4♂ 2 ♀2 exv; **IN,** (Knox Co.) Cunningham's Ferry, 15 April 1977, A.V. Provonsha, D. Morihara, A.A. Alabi, 1 ♀, 1 exv; (Posey Co.) New Harmony at IN-68, 38.1294 -87.942, 20 June 2007, R.E. DeWalt, 4 exv; **IA,** (Woodbury Co.) Missouri River, Sioux City at Argosy Casino Limo Parking, 42.48495 -96.39503, 1 larva; **KS,** (Clay Co.) Clay, 2.6 mi W of Center, Jct KS-15 & US-25, Republican River, 39.37975 -97.17532, 15 March 1986; (Ellsworth Co.) 1.8 mi S, 1.8 mi E, Smoky Hill River, 38.53139 -97.70332, 16 March 1986; (Republic Co.) Republic, 1 mi S, 1.1 mi W, Republican River, 39.90952 -97.84776, 17 November 1981; **MO,** (Boone Co.) Missouri River at Easley, 38.80225 -92.3803, 7 March 1998, BCP & FL, 3 larvae; (Callaway Co.) Missouri River, Cedar City at boat launch nr US-63 on wingdam, 39[8].58876 -92.1795, 20 February 2010, R.E. DeWalt, 5 larvae; **TN,** (Lake Co.) Mississippi River, Cates, Opposite Island No. 10, 36.45656 -89.46654, 8 April 1939, H.F. Schoof, 1 larva.

RESULTS AND DISCUSSION

A total of 94 collection records are available from the supplemental CSV file attached to this article. Among these records are 42 unique locations, only two of which (one Arkansas and an Oklahoma location) could not be georeferenced (Fig. 1). The majority of *H. fugitans* specimens were collected from the Mississippi River Basin, with only the holotype male, allotype female, and one paratype being collected outside the basin (Austin, Texas) (Needham & Claassen 1925). This series is probably from the Colorado River, a direct tributary to the Gulf of Mexico. It is possible that

Table 1. Diet contents of eight *Hydroperla fugitans* larvae collected in the Mississippi River near Tunica, Mississippi (Lee Co., AR).

Specimen	Body Length (mm)	Class/Family	Diet Contents Subfamily/Genus	Quantity
1	17	Hydropsychidae	*Hydropsyche* spp.	2
		Chironomidae	Chironomini undet.	1
2	13.5	No prey items		0
3	12	Chironomidae	*Polypedilum* sp.	1
			Tanytarsini undet.	1
4	17.5	Hydropsychidae	*Hydropsyche* spp.	2
		Chironomidae	*Dicrotendipes* sp.	1
			Rheocricotopus sp.	1
			Polypedilum sp.	1
			Orthocladiinae undet.	2
5	10	Hydropsychidae	*Potamyia flava*	1
		Chironomidae	*Orthocladius* spp.	2
			Paratanytarsus sp.	1
		Oligochaeta		1
6	13	Hydropsychidae	*Potamyia flava*	1
7	12.5	Hydropsychidae	*Hydropsyche* sp.	1
8	7	Chironomidae	Orthocladiinae undet.	1

the type locality was recorded in error, given the apparent restriction to major rivers within the Mississippi River Basin. Szczytko & Stewart (1977) relayed from the Cornell University Insect Collection (CUIC) that the holotype and presumably the rest of the series was lost, but recent metadata suggest that all or part of the series is contained on three slides in the collection (http://cuic.entomology.cornell.edu/insects/view/1062644). A second recent record from the Texas Panhandle originates from the Canadian River, a tributary of the Arkansas River, part of the Mississippi River basin (Kondratieff 2004).

Collections of this species commenced in the decade of 1910-1920 with just a few records in the Mississippi River of southern Illinois (Fig. 2). Twenty-five unique collections occurred in the 1930s from several locations of the Mississippi River from Rock Island, Illinois to Scott County, Missouri (probably from the Mississippi River), to Tiptonville, Tennessee, also probably from the Mississippi River, coinciding with the description of *H. harti* (Frison 1935). Late in the decade it was also collected from the Wabash River at Mt. Carmel, Illinois, and from the Cumberland River of Kentucky. Few records are available from 1940 through 1970. In the 1970s several specimens were collected from four Kansas counties (Stewart & Huggins 1977) and one from Knox County, Indiana. Joining these relatively newer records are those from the Missouri and Cedar rivers of Iowa (Heimdal & Birmingham 2006, DeWalt unpubl. data), the Ohio, Wabash, and White rivers in Illinois and Indiana (DeWalt & Grubbs 2011), the Missouri and Mississippi rivers in Boone, Calloway, and Cape Girardeau counties of Missouri (Battle et al. 2007, Poulton unpubl. data, DeWalt unpubl. data), and the Canadian River of Oldham County, Texas (Kondratieff 2004).

From the records at our disposal, it is difficult to assert that *H. fugitans* has declined in distribution over the past several decades. They may still be taken in most of their historical strongholds and are particularly abundant in parts of the Missouri River in Missouri and the Wabash and White river drainages of Indiana and Illinois. They may,

however, have been lost from some middle Mississippi River reaches since several recent visits there have not produced specimens. Locations visited within the last decade include: East Dubuque, Rock Island, Alton, and Chester in Illinois and Burlington in Iowa (DeWalt unpubl. data).

Dissection of eight larvae collected by trawling sand/gravel habitat in the Lower Mississippi River near Tunica, Mississippi, confirms the predaceous feeding habit of this species (Table 1). The most commonly observed prey items were larval Hydropsychidae (Trichoptera) and Chironomidae (Diptera). Most of these prey taxa are known to attach themselves to the substrate, where they are engulfed by *Hydroperla* larvae. It is still unclear what physiological factors restrict this species to large rivers. Its habitat includes some of the largest rivers inhabited by stoneflies, dramatically increasing the difficulty of finding specimens. Sampling in habitats (coarse substrates in high flows) where these prey items are frequently collected may help target *Hydroperla* larvae. These habitats include sand/gravel bars, wing dams, and areas with coarse woody debris, such as secondary channels. Future cooperation with state and federal agencies that have large research vessels may be an effective method for taxonomists to assess the status of large river inhabiting stoneflies, as well as other large river invertebrate specialists.

ACKNOWLEDGEMENTS

This study was partially funded by a National Science Foundation Collections in Support of Biological Research grant (NSF CSBR, DBI 14-58285) awarded to R. Edward DeWalt. Collection of the Mississippi specimens included in this study was funded by the US Army Corps of Engineers, Mississippi Valley Division, as part of routine monitoring for young riverine sturgeon. We are grateful to Dr. Bill Stark for review of earlier versions of this manuscript.

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Submitted 22 August 2017, Accepted 30 October 2017, Published 27 November 2017

Hosted and published at the University of Illinois, Illinois Natural History Survey, Champaign, Illinois, U.S.A.

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Digitale Literatur/Digital Literature

Zeitschrift/Journal: Illiesia

Jahr/Year: 2017

Band/Volume: 13

Autor(en)/Author(s): Harrison Audrey B. , DeWalt R. Edward

Artikel/Article: Distribution of Hydroperla fugitans (Plecoptera: Perlodidae) with notes on diet 104-110