HUNGERFORD'S CRAWLING WATER BEETLE SURVEY AND RELOCATION PROTOCOL (JUNE 2024)

Purpose

This document provides background and guidance for conducting surveys for Hungerford's crawling water beetle (*Brychius hungerfordi*; HCWB) throughout its Michigan range. HCWB is a federally endangered species (59 FR 10580). The objective of these guidelines is to establish, with a reasonable level of confidence, whether HCWB is present in a proposed project area and/or to document status of known sites. Accurate survey data are needed to provide the U.S. Fish and Wildlife Service (Service) with sufficient information to assess the effects of certain activities and ensure compliance with the Endangered Species Act (ESA). In addition, survey data will support an accurate assessment of the species' status. These guidelines also describe relocation procedures to follow when projects may result in short term adverse effects to HCWB.

To conduct surveys for HCWB in accordance with these guidelines, the surveyor must contact the Service and may need to obtain a permit under section 10(a)(1)(A) of the ESA. The Michigan Department of Natural Resources should also be contacted to determine whether a state permit is needed under Part 365, Endangered and Threatened Species, of the Michigan Natural Resources and Environmental Protection Act (1994 PA 451).

This document is designed to assist researchers studying HCWB and to assist projects with a federal nexus (funded, authorized, or carried out by a federal agency) gain information to reach a determination for HCWB under section 7 of the ESA. Projects without a federal nexus are also welcome to use this guidance. Under section 7 of the ESA, if the project proponent believes that HCWB will not be exposed to any consequence of the action, then a no effect determination would be appropriate for HCWB. No consultation is required for projects with no effects to listed species or critical habitat, and the Service does not provide written concurrence for no effect determinations. Project proponents do not need to conduct a survey to make a no effect determination, though the Service recommends habitat assessments or HCWB surveys are conducted in streams that may contain suitable habitat. More information about section 7 project review can be found on the Midwest Region Section 7(a)(2) Technical Assistance Website.

Background

General Description of HCWB Habitat

In general, HCWB occurs in areas of perennial streams characterized by cool temperatures (during summer months, June through August, typically 12º C to 25º C), moderate to fast stream flow (typically 3 to 20 cfs), good stream aeration, and alkaline water conditions (pH typically 7.2 to 8.4) (Wilsmann and Strand 1990, Service unpublished data 2002-2024). While other water chemistry data is extremely limited (4-5 data points) and any interpretations of this data must be made with this limitation in mind, it can still be informative. At occupied sites, dissolved oxygen has ranged from 7.77 – 8.53 mg/L, specific conductivity has ranged from 223.8 – 340 µS/cm, and turbidity has ranged from 0.26 – 3.14 NTU (Service unpublished data 2020 - 2024). Stream

substrate at occupied sites typically consists of cobble, gravel, rocks, or woody debris with sand, and adult beetles are generally found at depths of a few inches to a few feet (Wilsmann and Strand 1990; Service unpublished data 2002-2024). Populations of HCWB are often found downstream from culverts, beaver and natural debris dams, and human-made impoundments. They are often found in plunge pools created below these structures, as well as in riffles and other well-aerated sections of the stream.

The hydrology of a site appears to be important for this species. HCWB seems to prefer seasonal streams that have some groundwater input. These streams do not dry up completely, but the water level can drop considerably (e.g., several feet in the East Branch of the Maple River) (Vande Kopple and Grant 2004). As the water levels drop, damp river-edge sand becomes exposed in the summer and fall (Vande Kopple and Grant 2004). This microhabitat may be important for the pupation stage of the beetle's life cycle.

Presence of filamentous green algae appears to be important in determining suitable habitat for the species. Both adults and larvae are commonly found in association with several species of algae. Adults appear to be generalists in their food choice, feeding on algae including *Chara*, *Cladophora*, and *Dichotomosiphon*, and as well as the epiphytic diatom *Cocconeis* (Grant and Vande Kopple 2009). The diet of adults may also change seasonally (Grant and Vande Kopple 2003). Larvae appear to prefer the algae *Dichotomosiphon tuberosus* (Grant and Vande Kopple 2009). *Dichotomosiphon*, although widespread, is not common. Its presence may be an important factor in determining the distribution of HCWB (Grant and Vande Kopple 2009). Not only is it a possible source of food, but algae may also be important for other reasons (e.g., cover, oxygen source, etc.).

In the best studied population in the East Branch of the Maple River, adult HCWB can be found in two different microhabitats—in cobble near the edge of pools, or in association with filamentous algae in riffles (Scholtens 2002). The first microhabitat is characterized by low flows, with filamentous green algae growing on the cobbles in low mats. Most individuals in the East Branch of the Maple River occur in this type of microhabitat. Beetles occur under the cobbles and are not visible from above without moving the cobbles. In the second microhabitat, beetles occur in algal beds that are found on sandy areas immediately downstream of *Chara* beds (which are indicative of groundwater inputs). Beetles at these sites apparently live in and on the algal beds, rather than under the cobbles, and can be observed from above on the algae or sand surface. Algae found in these areas include *Chara, Cladophora,* and *Dichotomosiphon*. Observers using a diving mask or glass-bottomed bucket can occasionally view beetles in this type of habitat. Relatively few individuals are seen in this type of microhabitat, and numbers at these microsites are generally low (Scholtens 2002). Example photos of HCWB habitat are available in this document, though HCWB are also found in habitat that is not pictured.

Description of HCWB

HCWB is a member of the Haliplidae family. All members of the Haliplidae (collectively known as haliplids) are aquatic, with all active life history stages spent in water (Pennak 1953, Roughley and Larson 1991). Adults are small (3-5 mm) in length. Haliplids are distinguished from other families by hind coxal plates that meet along the midline and completely cover 2 or 3 basal

abdominal segments, concealing the base of the hind legs (Merritt et al. 2019). The expanded hind coxal plates function to store air under the elytra. The Haliplidae includes three genera in North America—*Brychius*, *Haliplus*, and *Peltodytes*. The keys in *An Introduction to the Aquatic Insects of North America* (Merritt et al. 2019) are highly recommended for identifying aquatic beetles and the adults and larvae of Haliplidae. An identification sheet for HCWB is included in this document, which can be printed and laminated for use in the field.

Adult HCWBs are small, with an average body length of 3.8-4.3 mm. They have a distinctive elongated and streamlined body shape, adapted for swimming or crawling in water (Holmen 1987). They are yellowish-brown in color with irregular dark markings and longitudinal stripes on the elytra (hardened outer wings), each of which is comprised of a series of fine, closely spaced and darkly pigmented indentations. HCWB larvae are light yellowish brown with cylindrical bodies that taper to a hooked tail. They are stiff-bodied and possess short legs with five-segments and single tarsal hooks (Strand 1989).

Distribution of HCWB

HCWB is known to occur in 14 streams range-wide: 12 streams in northern Michigan and 2 streams in Ontario, Canada. In Michigan, HCWB is known to occur in the East Branch of Maple River and Carp Lake River in Emmet County; East Branch of Black River, Van Hetton Creek (also known as Van Hellon and Van Helen Creek), and Stewart Creek in Montmorency County; Canada Creek in Montmorency and Presque Isle Counties; Mullet Creek in Cheboygan County; North Branch of Boyne River in Charlevoix County; Middle Branch of Big Creek and an unnamed tributary of East Branch Big Creek in Oscoda County; Portage Creek in Kalkaska and Crawford Counties, and Robinson Creek in Roscommon County (Figure 1). In Ontario, Canada, HCWB is known to occur in the Rankin River and Saugeen River. It was previously found in the North Saugeen River, but now appears to be extirpated from this stream, and has not been detected there since 2001 (COSEWIC 2011). It is unknown whether HCWB has a wider distribution or if the species' status is stable, increasing or decreasing. Species of *Brychius* tend to be highly localized and difficult to collect. Even when present, it is possible to sample an area and collect no specimens (Mousseau 2004; Grant et al. 2011).

Additional surveys are necessary to determine the extent of HCWB's distribution. There is reason to believe HCWB may be more widely distributed than the streams where it has been previously documented, and since 2022 two new populations of the species have been discovered. The types of streams inhabited by this species do not appear to be rare. In fact, streams similar to those in which the species is found appear to be common in northern Michigan and other surrounding states. Discoveries since the listing of the species in 1994 expand the species range outside of the Port Huron moraine, which may have implications for its historical biogeography. Previous survey efforts have been primarily limited to northern Michigan within the Port Huron moraine (Vande Kopple pers. comm. 2018).

Figure 1. Known distribution of HCWB in the United States

In addition, the species may occupy a wider range of suitable habitat than we currently understand. The distribution of the species prior to its discovery in 1952 is not known. To determine the historical distribution, collections were examined for HCWB specimens (Mousseau 2004), leading to discovery of HCWB specimens collected in St. Clair County, MI.

The St. Clair County record is that of two HCWB larvae which were collected in the St. Clair River in 1983 by Pat Hudson (Hudson et al. 1986) and were confirmed as HCWB (R. Roughley, pers. comm., 2004). This record is curious because the St. Clair River is dissimilar to known sites and would not be classified as suitable habitat based on our current understanding of the species. Survey attempts in 2002 were unsuccessful in locating HCWB larvae in the St. Clair River (P. Hudson, Great Lakes Science Center, U.S. Geological Survey, pers. comm., 2002). It is possible that these individuals washed downstream and did not reflect a resident population of HCWB. A few of the sites with known populations have less typical habitat. For example, habitat at Van Hetton Creek is atypical compared to other previously known locations, and the creek channel is composed of sand overlain with a thin layer of detritus (Grant et al. 2000). Typically, higher silt loads eliminate algae and makes a site unsuitable. The East Branch of the Black River site is the most atypical of all Michigan sites. It is much deeper, faster, and wider than the other sites (R. Strand, pers. comm., 2003). In April 2011, a larva was collected from the North Branch Boyne River, a stream that typically has colder water temperatures than other known sites (Grant et al. 2011). Additional surveys are needed to determine the extent of occupancy in this stream and surrounding areas and should target areas wherever the water is slightly warmer and where *Dichotomosiphon* beds are found.

Most areas of Michigan have not been surveyed for HCWB. While we are generally recommending this survey protocol be applied to more typical HCWB habitat, surveys throughout the state that key Haliplidae beetles to genus (instead of to family) could help clarify the species' distribution and habitat requirements. If Haliplidae beetles are discovered during other macroinvertebrate surveys and surveyors do not feel confident in identifying down to genus, they can submit photographs to the Service (see contact information). As new sites are discovered, new information about HCWB's distribution helps the Service accurately evaluate the species' status.

Habitat Assessment Protocol

Qualifications

Assessments done to determine if habitat is present involve little in-water work and pose little risk to HCWB. Therefore, a permit is not required to assess habitat. Assessors should be able to identify suitable HCWB habitat for adult and larval life stages and have documentation of their experience.

Assessment technique

Habitat assessments should be conducted at any perennial stream where in-water work is being conducted within the watersheds known to be occupied by HCWB that may contain suitable habitat. A map of streams in the current range of HCWB that may have suitable habitat is included in this document. This information is also available as a spatial layer online at the

Michigan Ecological Service's webpage. Since the species may occupy a wider range of suitable habitat than we currently understand, habitat assessments may be conducted at any flowing perennial body of water.

Habitat assessments are best conducted from May through October to ensure accurate measurement of water characteristics, though can be conducted at any time of year when habitat features are visible. Assessments should consist of a general habitat assessment, considering both quality and extent of available habitat. Assessors should note the physical features of the site, such as substrate (including percent sand, detritus, and cobble), bank vegetation, aquatic vegetation, the presence of woody debris, and the presence of algae. Assessors should make special note of the presence of any *Chara*, *Dichotomosiphon*, or other filamentous green algae at the site. Habitat features should be marked on a sketched map or aerial image of the site. Assessors should also measure water characteristics like temperature, flow rate, and pH. If the appropriate tools are available, assessors may also take additional measures that could capture other aspects of HCWB habitat, such as dissolved oxygen, conductivity, turbidity, and water chemistry data. Assessors may find it helpful to use the provided habitat assessment form. Pictures should be taken throughout the habitat assessed, with a special focus on any microhabitats that may be suitable for HCWB. While determining if habitat is suitable, keep in mind that season and rainfall will affect many water characteristics, and not all habitat features must be present for a stream to be suitable for HCWB. Following the assessment, please submit your data, along with any maps or pictures, to the Service.

Be sure to adhere to your agency or organization's safety standards in relation to aquatic field work and apply all appropriate safety measures. Also ensure you have landowner permission for site access, as appropriate, before conducting habitat assessments. If visiting multiple sites, make sure to follow appropriate decontamination procedures to prevent the spread of invasive species. More information about decontamination to prevent the spread of aquatic invasive species can be found at: https://www.michigan.gov/invasives/take-action/decontamination-training.

HCWB Survey Protocol

Qualifications

Survey work done incorrectly can cause unnecessary injury or mortality of HCWB and result in surveys that are not valid. To conduct surveys for HCWB within a mile of a known occurrence, individuals must operate under a valid section 10(a)(1)(A) recovery permit and have met the following qualifications prior to obtaining their section 10 permit:

- Training in the ability to identify suitable HCWB habitat for adult and larval life stages
- Demonstrate and document ability to identify HCWB and other closely related species
- Under supervision of a qualified surveyor, demonstrate understanding and experience with proper survey technique
- Documentation of experience (including hours of training or field experience)
- Familiarity with section 10 permit requirements including survey reporting requirements and special conditions
- Familiarity with HCWB conservation measures and Best Management Practices

- A bachelor's degree in wildlife management, entomology, wildlife ecology, biology, or a similar field, or have worked in one of these fields for at least 10 years

If you are unsure if a permit is necessary for your survey, please refer to the flowchart at the end of this document or contact the Service (see contact information).

Survey technique

Surveys for HCWB are targeting adult beetles and should occur **May through October** (Grant et al. 2002). The level of effort required will depend on the quality and extent of suitable habitat. Begin with a general habitat assessment, considering both quality and extent of available habitat. For road crossing (e.g., culvert or bridge replacement) projects, assess the extent and quality of habitat within the in-stream area of disturbance.

For detection/non-detection surveys, systematically search the area of potential habitat using the survey techniques described below. Working in tandem with a partner, fully cover the area of suitable habitat. Generally, two or three experienced surveyors can adequately cover a 500 ft^2 area of good HCWB habitat in 30 minutes to an hour; it may take longer for people with less experience in conducting HCWB surveys. The important thing to consider when evaluating sufficient effort is the presence of suitable microhabitat. If the microhabitat is not suitable, it does not need to be surveyed for HCWB. We recommend surveyors use the provided survey data form or a similar format to record data and submit the information to the Service.

Surveys for adults are typically conducted by creating a rapid current over the site to dislodge the beetles from their substrate and then capturing them in a dip net (Hinz, Jr. and Wiley 1999, Scholtens 2002, Vande Kopple and Grant 2004). Use an aquatic D-net to vigorously sweep the water just above the bottom of the stream. The vigorous sweeping motion will create a current that will help capture HCWB in the net. Empty the net contents streamside into a white enamel pan filled with stream water for identification and examination of the beetles. Magnifying tools are helpful in making identification. Capturing a photo using a camera with a macro lens or a smartphone with camera and zoom capabilities can also aid in identification. After identification and photo documentation, release any individuals unharmed at the capture site. You may remove small amounts of vegetation with your net but try not to significantly disturb algae beds.

This technique of disturbing the water and not significantly disrupting the substrate is preferred, as it is less destructive to the habitat and has a lesser risk of crushing the beetles. Additional methods of surveying that do not significantly disrupt the substrate may also be suitable. For example, some surveyors have found it useful to place a kick net downstream while sampling to catch some of the macroinvertebrates missed with D-nets. This technique can work well in some locations without causing much additional disturbance to substrate, though may require 3 surveyors (Theisen pers. comm. 2024). Alternative survey approaches should first be discussed with the Service. We do not recommend kick net sampling methods that involve significant substrate disturbance in any area where you think HCWB may occur. If you unexpectedly find HCWB in an area when using kick net sampling, immediately stop and contact the Service (see contact information).

Photo document new occurrences using a digital camera or smartphone with a clear image of the HCWB to allow for confirmation. Make sure to include photos with your permit report (see permit conditions for details). Voucher specimens are not generally necessary and are not allowed without prior authorization in your permit. HCWB are relatively hardy and should not be harmed using approved techniques and caution. However, accidental injury may occur, and if so, should be immediately reported to the Service (see contact information).

Surveys should be conducted before stream disturbing activities or in-water work in areas of suitable habitat within one stream mile of a known occurrence. Surveys or appraisals may also be recommended in other areas of suitable habitat within the range of HCWB. The flowchart at the end of this document can help you determine if a survey or appraisal is recommended for your project area. In areas of suitable habitat within one stream mile of a known occurrence, at least two surveys must be completed at least one month apart to demonstrate probable absence. At sites where HCWB has been previously documented, an additional level of effort may be required to determine if HCWB is extirpated from a location unless significant habitat alteration has occurred.

Be sure to adhere to your agency or organization's safety standards in relation to aquatic field work and apply all appropriate safety measures. Also ensure you have landowner permission for site access, as appropriate, before conducting surveys. If visiting multiple sites, make sure to follow appropriate decontamination procedures to prevent the spread of invasive species. More information about decontamination to prevent the spread of aquatic invasive species can be found at: https://www.michigan.gov/invasives/take-action/decontamination-training.

Relocation

Relocation efforts will typically be required when HCWB is present at a project site and available conservation measures are not sufficient to avoid take or adverse effects. For example, a culvert replacement project may result in short-term disturbance below a road crossing. Any HCWB that remain in the area could be crushed or dislodged from the substrate during construction. Prior to construction, collecting and moving HCWB to nearby suitable habitat within the same stream segment can minimize any adverse effects as a result of the proposed project. No HCWB may be moved without prior authorization from the Service. Relocation of HCWB will require authorization through section 7 consultation (for federally funded projects) or issuance of a section 10 permit. You should seek landowner permission prior to relocating HCWB to another property.

Generally, the protocol for relocation and surveys is the same in terms of technique. The level of effort for relocation, however, will be greater, to increase the likelihood that all beetles in the action area are removed from the area of disturbance. Thoroughly cover the entire extent of suitable habitat, with repeated sweeps in the same area to attempt to collect all beetles that are present. Place any HCWB in plastic centrifuge tubes, or a pail/bucket with a secure lid, filled with stream water. Secure the lid and place in shade until survey efforts are complete. If you choose to collect any other macroinvertebrates, ensure they are placed in a separate container from any HCWB. Continue searching all available habitat in the action area until no HCWB are found for at least 30 minutes (assuming three surveyors). Complete the relocation form or a

similar data sheet with all requested information, including an accurate count of the number of HCWB collected and relocated.

Collected HCWB should be released within four hours to the relocation site, although additional time may be allowed for large populations or unusual circumstances. HWCB are resilient, and adults have survived in collection tubes for more than two days. Returning them to the stream as quickly as possible, however, is recommended to reduce stress and harassment.

Relocation sites must be identified in advance and should be the nearest suitable habitat that is outside of the area of disturbance. In selecting a suitable relocation site, look for presence of algae, overwintering sites, and suitable substrate. Generally, these sites will be within 0.5 mile of the capture site, upstream or downstream of the collection site and outside of the project's area of impact. Sites must be approved by the Service in advance, per the section 7 consultation and/or permit terms and conditions. Complete the relocation form or a similar data sheet and submit to the Service as required by your consultation or permit. Following relocation, monitoring will be required as terms and conditions of the biological opinion and/or permit. Follow all reporting and monitoring requirements as specified.

Contact Information

For more information, you may contact the Service:
U.S. Fish and Wildlife Service
Michigan Ecological Services Field Office
2651 Coolidge Road, Suite 101
East Lansing, MI 48823
Phone: (517)-351-2555
Email: eastlansing@fws.gov

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Personal Communications

Vande Kopple, R. University of Michigan, Ann Arbor, Michigan, Professor Emeritus. Electronic communication 2018.

Theisen, N. Huron Pines, Gaylord, Michigan. Electronic communication 2024.

Streams in the Current Range That may Contain Suitable HCWB Habitat

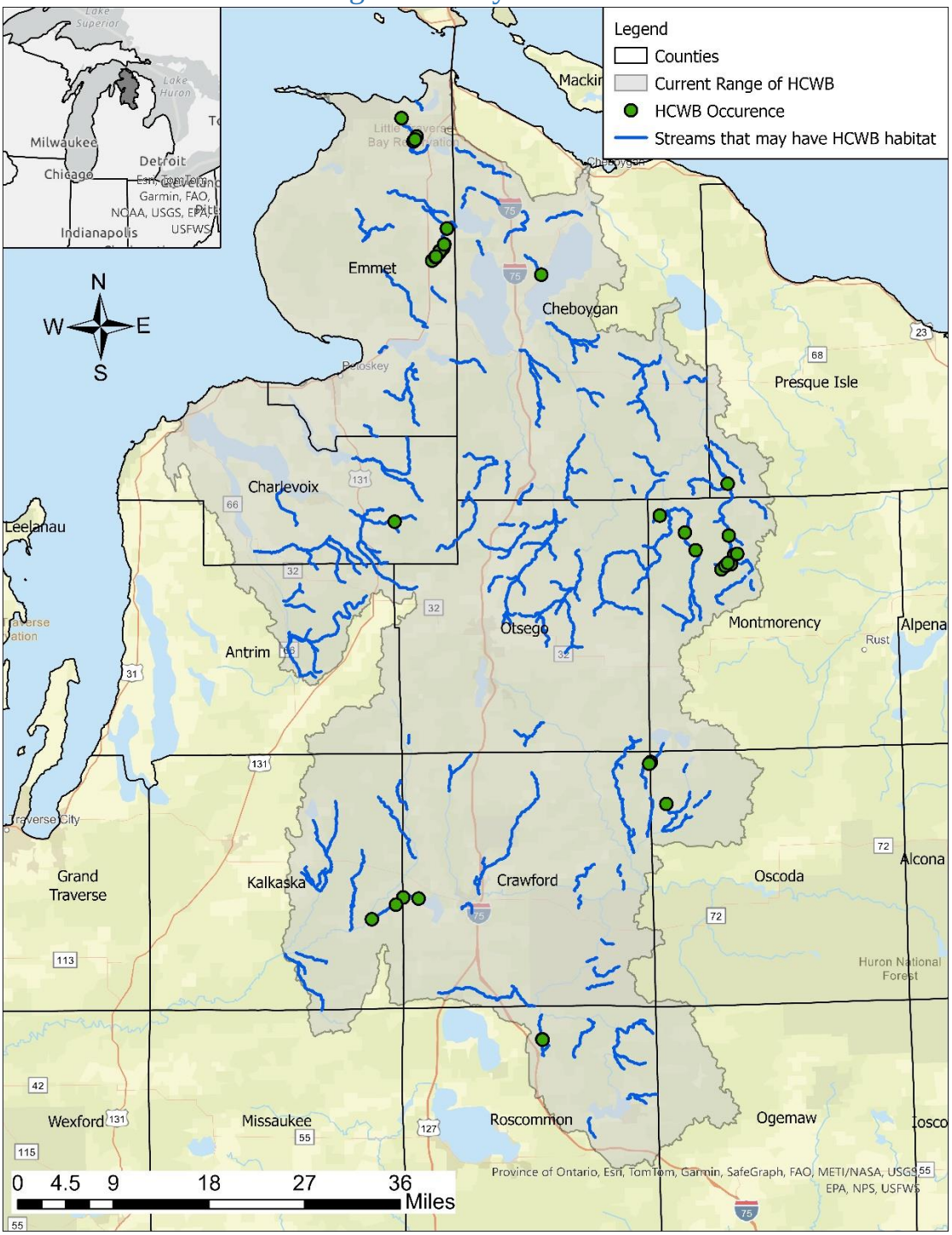
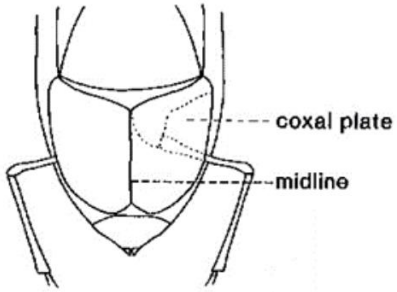


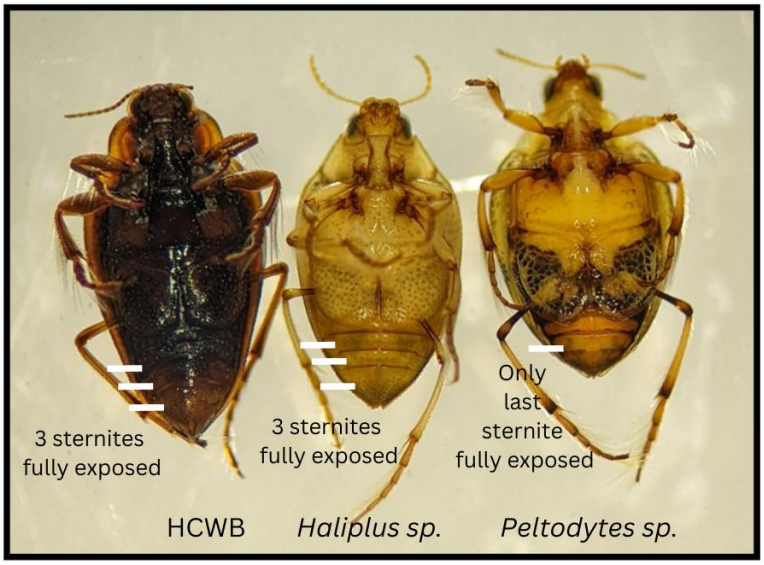
Figure 2. Streams in the current range of HCWB that may contain suitable habitat. Suitability is based on average July temperature, baseline flow, network catchment soil permeability, and a habitat model. Additional streams not shown on this map may also contain suitable habitat for HCWB. These streams are also available as spatial layers online at the Michigan Ecological Service's webpage. For additional information or to receive this information in another format, contact michelle_kane@fws.gov.

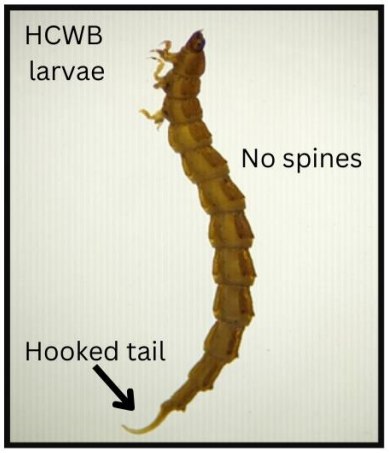
Hungerford's Crawling Water Beetle (*Brychius hungerfordi*; HCWB) Identification

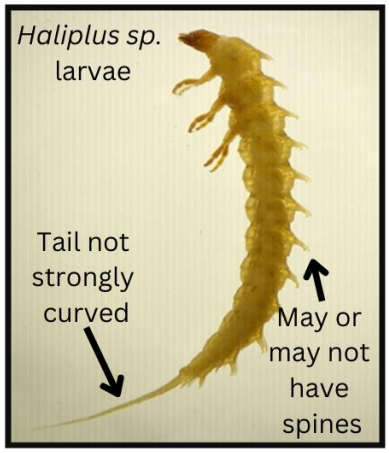
Color is not a good indicator of species

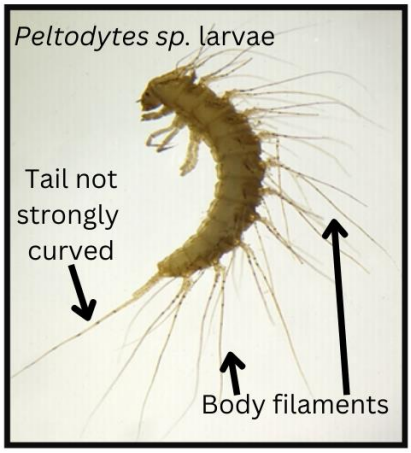


Species in the Haliplidae family (HCWB, *Haliplus sp.*, *Peltodytes sp.*) have expanded hind coaxal plate. Figure from Merritt and Cummins 1984, used with permission









Other Beetles

Dytiscidae sp. *Dytiscidae sp.* *Peltodytes sp.* *Haliplus sp.* *Gyrinidae sp.*

Hydrophilidae sp. *Hydrophilidae sp.* *Elmidae sp.* *Elmidae sp.* *Elmidae sp.*

Additional HCWB Photos

Algae Indicative of HCWB Habitat

Dichotomosiphon Dichotomosiphon Chara Cladophora

Thanks to Bob Vande Kopple, Elizabeth Stieber (EGLE), Nick Thiesen (Huron Pines), FWS, and creative commons images from Macroinvertebrates.org, iNaturalist, and UK beetles for use of their images.

Example Photos of HCWB Habitat

All photos were taken at sites known to be occupied by HCWB and were submitted to the Service during 10(a)(1)(A) permit reporting. Habitat not pictured here may also be suitable for HCWB.

HCWB Habitat Assessment Form

***Brychius hungerfordi* (HCWB) Habitat Assessment Form** Typical HCWB habitat has the following characteristics: Perennial stream with groundwater input; Cool summer (Jun -Aug) temperatures 12°C – 25°C; moderate to fast stream flow 3 – 20 cfs; good stream aeration; slightly alkaline water, pH 7.2 – 8.5; substrate of cobble, gravel, rocks, and/or woody debris with sand; plunge pools or riffles; and algae, particularly Chara, Cladophora, and Dichotomosiphon. Please note streams do not need to meet all criteria to support HCWB. Please contact the Michigan Ecological Services Field Office for assistance if you are unsure if habitat exists at your site.

Site/Stream Name:					
Date:		Start Time:		End Time:	
Observers:					
Watershed:			County:		
Location, description:					
GPS coordinates:					
Physical Water Characteristics					
Water temp (C):		Est. Stream Flow (cfs):			
Dissolved Oxygen (mg/L):		pH:			
Turbidity (NTU):		Conductivity:			
Algae and Aquatic Plants					
Dichotomosiphon present:		Chara present:			
Other filamentous algae:					
Aquatic plants present:					
Substrate					
	Sand	Detritus (CPOM)	Cobble/Rocks		
Pool:					
Riffle:					
Woody Debris Present? Note size/amount					
Bank Description					
Cover adjacent to stream:	Open	Partial Shade	Full shade		
Habitat Description:					
Dominant Plants:					
Notes:					

Attach a sketch map or marked up aerial image denoting significant habitat features of the site. Also attach pictures taken during the survey.

HCWB Survey Form

***Brychius hungerfordi* (HCWB) Survey Form**						
Site/Stream Name:						
Date:		Start Time:		End Time:		
Observers:						
Watershed:			County:			
Location, description:						
GPS coordinates:						
Invertebrates						
Total HCWB:		Adults:		Larvae:	#HCWB/personhour:	
Ephemeroptera:			Trichoptera:			
Plecoptera:			Odonata:			
Other Invertebrates:						
Physical Water Characteristics						
Water temp (C):		Est. Stream Flow (cfs):				
Dissolved Oxygen (mg/L):		pH:				
Turbidity (NTU):		Conductivity:				
Algae and Aquatic Plants						
Dichotomosiphon present:		Chara present:				
Other filamentous algae:						
Aquatic plants present:						
Substrate						
	Sand	Detritus (CPOM)	Cobble/Rocks			
Pool:						
Riffle:						
Woody Debris Present? Note size/amount						
Bank Description						
Cover adjacent to stream:	Open	Partial Shade	Full shade			
Habitat Description:						
Dominant Plants:						
Notes:						

Attach a sketch map or marked up aerial image denoting significant habitat features of the site. Also attach pictures of any HCWB observed.

HCWB Relocation Data Form

Project Name:_____

Project Description:_____

Action Agency/Proponent:_____

Survey team (list all names):_____

Permittee:_____ Permit No:_____

Date of collection: _____ Start Time:_____ End Time: _____

Number of adult HCWB found: _____ Number of larval HCWB found: _____

Water Temp (C): _____ Estimated Flow (cfs): _____ Algae present: _____

DO (mg/L):_____ pH:_____ Conductivity:_____ Turbidity(NTU):_____

Substrate info:_____

GPS/location of collected HCWB: _____

Section 7 complete for relocation?: Yes_____ No_____

Release site pre-approved by Michigan Ecological Services Field Office? Yes_____ No_____

Release site name:_____

Release site location (GPS), include map below: _____

Water Temp (C): _____ Estimated Flow (cfs): _____ Algae present: _____

DO (mg/L):_____ pH:_____ Conductivity:_____ Turbidity(NTU):_____

Substrate info:_____

Surrounding habitat description:_____

Time of release:_____ Number of HCWB released:_____

Comments/notes/maps:

HCWB Survey Flowchart