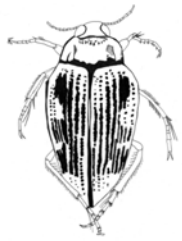
Hungerford's crawling water beetle
(Brychius hungerfordi)



5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Midwest Region
East Lansing Field Office
East Lansing, Michigan

5-YEAR REVIEW

Species reviewed: Hungerford's crawling water beetle *(Brychius hungerfordi)*

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5-YEAR REVIEW
Hungerford's crawling water beetle (HCWB) *(Brychius hungerfordi)*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office: Midwest Region
Carlita Payne, 612-713-5339

Lead Field Office: East Lansing Field Office, 517-351-2555
Carrie Tansy, Biologist
Craig Czarnecki, Field Supervisor

1.2 Methodology used to complete the review:

In coordination with the Midwest Region – Ecological Services staff, the East Lansing Field Office solicited information from the public through a *Federal Register* notice (70 FR 41424). To complete the Review, we relied on the recovery plan because it is the most recent collection of information on the species and has undergone prior peer review, and evaluated all information and data that has become available on the species since its listing in 1994.

1.3 Background

1.3.1 FR Notice citation announcing initiation of this review:
70 FR 41424 (July 19, 2005)

1.3.2 Listing history:

Original Listing
FR notice: 59 FR 10580
Date listed: March 7, 1994
Entity listed: Species
Classification: Endangered

1.3.3 Associated rulemakings: none

1.3.4 Review History:

September 28, 2006: Approved Recovery Plan for Hungerford's Crawling Water Beetle (71 FR 57003) (USFWS 2006c). The *Federal Register* notice of availability summarized the species' status, distribution, and recovery objectives described in the approved recovery plan.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 5 (high degree of threat; low recovery potential)

1.3.6 Recovery Plan

Name of plan: Hungerford's Crawling Water Beetle (*Brychius hungerfordi*) Recovery Plan
Date issued: September 27, 2006
Dates of previous revisions, if applicable: none

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

__✓__ **No**.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

_✓_ **No.** The species has an approved recovery plan, but the recovery criteria are interim because further research is necessary to make them fully measurable.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

The recovery plan for Hungerford's crawling water beetle (USFWS 2006a) reviews additional information available on the biology and habitat of this species.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

There are six streams range-wide with known populations of HCWB. Throughout the known range, we have very limited information on the

abundance, population trends, and demographic features and trends of HCWB.

The East Branch of the Maple River represents the best-studied and largest known population of the species. Prior to listing, White (*in litt.* 1987) estimated the population at the type locality (Robinson Road) between 200 and 500 individuals. The population appears to have remained stable in the years since listing. In July 2001, a three day mark-release-recapture (MRR) study was conducted in another pool of the East Branch. Beetles were marked with a small dot of paint on their elytra and released back at the site of capture. Calculations estimated this population at approximately 1,052 beetles (Grant et al. 2002).

Population estimates are not available for the other occupied HCWB sites. Only small numbers of adult beetles have been found at four of the five Michigan sites.

Population demography of HCWB has not been examined at any site. These factors are essential to understanding how HCWB may persist over time. The Recovery Plan identifies several recovery actions that will help us assess demographic features and trends.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

There is no information on genetics, genetic variation, or trends in genetic variation for HCWB.

2.3.1.4 Taxonomic classification or changes in nomenclature:

The taxonomic status of HCWB has not changed. A recent investigation into the taxonomy and classification of Nearctic species of *Brychius* revealed that there are three valid species of *Brychius* in North America, including *B. hungerfordi, B. hornii, and B. pacificus* (Mousseau and Roughley 2007).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

HCWB is currently known to occur in six streams, range-wide. Five of these locations are in northern Michigan (Figure 1), and the sixth occurs in Ontario, Canada. Surveys of other streams with habitat similar to known sites have been conducted in other areas of northern Michigan, Ontario, Wisconsin, and Minnesota but have failed to reveal additional populations of HCWB (USFWS 2006a).

The historical distribution of this species prior to its discovery in 1952 is not known. A recent examination of museum collections led to the discovery of HCWB specimens, reportedly collected in Cheboygan and St. Clair Counties, Michigan (Mousseau 2004). The Cheboygan County specimens, collected by Stuart Neff in 1953, did not contain specific locality information. It is likely that the specimens came from the East Branch of the Maple River, which lies on the border of Emmet and Cheboygan counties, and were actually collected in Emmet County.

The Great Lakes Science Center (U.S. Geological Survey) reported finding two *Brychius* larvae in 1983 in the St. Clair River (St. Clair County) (Hudson et al. 1986). This remains a curious record, as the St. Clair River represents a vastly different habitat than we would expect to be suitable for HCWB, based on our current understanding of the species. Surveys in 2002 were unsuccessful in locating HCWB adults or larvae in the St. Clair River (P. Hudson, Great Lakes Science Center, USGS, pers. comm. 2002).

At the time of listing, HCWB was known to occur at only three isolated locations in Michigan and Canada (USFWS 1994). Since listing, HCWB has been discovered in three additional streams in northern Michigan. The species is currently thought to be extant at all known sites, with the exception of the possible St. Clair River occurrence. The species appears to be stable in at least two of the six occupied streams. The current status of remaining occurrences is not known.

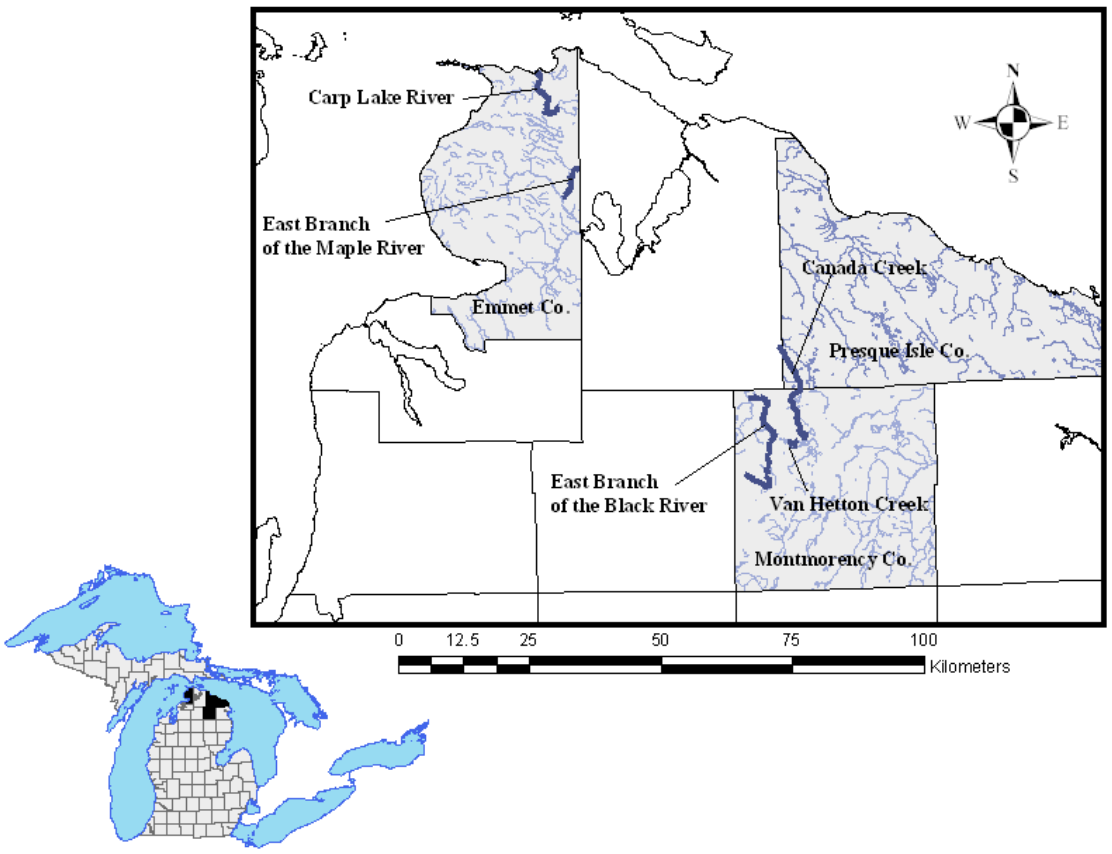

Figure 1. Stream segments in Michigan where HCWB is known to occur.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Populations of HCWB are 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. In general, HCWB occurs in areas of streams characterized by moderate to fast stream flow, good stream aeration, inorganic substrate, and alkaline water conditions (Wilsmann and Strand 1990). The adult beetles are generally found at depths of a few inches to a few feet in streams that are relatively cool (15º C to 25º C) (Wilsmann and Strand 1990). 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. Additionally,

the presence of 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.

In summary, despite some research examining habitat and microhabitat components, the habitat requirements of the species are not fully understood. It is uncertain what habitat characteristics are important for all life stages of this species. In general, the types of streams inhabited by this species do not appear to be rare. The species appears to prefer environmental conditions found downstream of culverts, beaver dams, and similar structures; however, the species may also have a broader range of suitable habitat. In this case, their distribution may be limited by dispersal or another factor (e.g., appropriate food, pupation sites). Alternatively, the species may be a glacial relict that has been rare since the last glaciation.

2.3.1.7 Other:

Prior to 2005, there were no records of flight for any species of *Brychius*. Many species of Haliplidae are capable of flight, although flight records are rare (Holmen 1987). In 2005, Dr. Brian Scholtens (College of Charleston, pers. comm. 2005) reportedly observed an adult HCWB flying from his hand. Flight is likely rare for this species, as this was the first record of flight in HCWB despite many hours of observation. Flight in HCWB would provide a means of dispersal to distant suitable habitats.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Although we do not completely understand the habitat requirements of this species, disturbance to areas where this species occurs may result in loss or degradation of habitat and may disrupt normal behavior patterns such as breeding, feeding, or sheltering. Specific threats may include beaver control, beaver activity, dredging, stream pollution, stream-side logging, channelization, bank stabilization, and impoundment.

The significance of beaver in creating and maintaining HCWB habitat is not known. At some sites, beaver impoundments may be important to maintaining the habitat of HCWB (Wilsmann and Strand 1990). If so, removal of beaver dams upstream from current HCWB populations is a threat to the beetle. The upstream side of a beaver dam (i.e., the impoundment) is not suitable habitat, however, so beaver may create more harm than good in some areas.

Many known HCWB sites occur below culverts at road-stream crossings, which may result in multiple threats. Poorly designed or deteriorating road crossings may result in excessive erosion and subsequent sedimentation into the stream. Clearing or cleaning of ditches or culverts may also affect water quality and habitat, if not done properly (Hyde and Smar 2000). Culverts may also serve as a barrier to upstream dispersal within the stream (Vaughan 2002). In addition, culverts can serve as an entry point of pollutants that accumulate from water that runs off roads and into roadside ditches. The effect of pollution on HCWB is not known. Accidental spills on the roadway (such as gasoline or chemical spills) may also pose a threat.

Road work and culvert removal or bridge construction may impact HCWB. In-stream projects, such as culvert removal projects, will result in considerable disturbance downstream. In some cases, these projects may have short-term adverse effects but may have overall beneficial effects through reduction of erosion and sedimentation in the stream. For example, at the Oliver Road site in the Carp Lake River, the undersized twin culverts were removed in the fall of 2006 and replaced with a timber bridge. Formal consultation was concluded on this project in June 2006 (USFWS 2006b). The new timber structure was designed with input from HCWB experts in an effort to maintain the flow velocity and existing stream dynamics below the Oliver Road site. Following the project construction stage, the indirect effects are expected to include a possible overall benefit to the habitat by decreasing the amount of sediment entering the stream. The suitable habitat currently at the site may be enhanced by reducing the threats associated with sedimentation.

At other sites where greater numbers of beetles occur (e.g., East Branch of the Maple River), the overall habitat benefits of some stream-crossing improvement projects may not outweigh the effects of the disturbance to HCWB during culvert removal and construction activities. Each project must be evaluated on a case-by-case basis to evaluate the potential risks and benefits to HCWB.

Logging in the riparian zone is another possible threat to this species; it can cause significant modification of habitat and increase erosion and the sediment load into the stream (Strand 1989). Alterations of stream habitat that may result in destruction of suitable HCWB habitat include dredging for stream bed modification, channelization, and bank stabilization. Bank stabilization may result in overall habitat improvement if done carefully.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Research efforts have involved mostly capture and release rather than collecting, and the few collections that have been made are housed in appropriate museums. Because rare insects are often considered valuable to amateur collectors, there is the possibility that illegal collections could occur. The collection threat for haliplid beetles, however, is probably minimal.

2.3.2.3 Disease or predation:

The listing rule states that although little is known about disease and predation, there are no indications that they may be contributing to the decline of HCWB (USFWS 1994). Other haliplids are preyed upon by fish, waterfowl, amphibians, and other aquatic insects (Hickman 1931). The greatest predators of all species of *Brychius* are most likely fish (Hickman 1931). Water column and surface feeders such as brown trout, common shiner, dace, and white sucker, as well as bottom feeders such as darters and sculpins, may feed on HCWB (White 1986, Strand 1989, Wilsmann and Strand 1990).

There is no information available on the impacts of predation on HCWB; thus, the significance of this threat is unknown. Other haliplids are preyed upon by insectivorous fish, and it seems likely that adult or larval HCWB would also be a potential food source to certain fish species. Thus, stocking of those insectivorous fish species in occupied streams may result in increased predation of HCWB. Under its current fish production and stocking program, the State of Michigan does not stock insectivorous fish in habitats known to be occupied by HCWB (T. Hogrefe, Michigan Department of Natural Resources, pers. comm. 2006). Future research should examine the extent to which predation occurs and is a threat to this species.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Prior to listing under the ESA, HCWB was listed as endangered under Michigan's Endangered Species Act (Public Act 203 of 1974, as amended), which provided for some protection of the species. The State's endangered species statute, implemented by the Michigan Department of Natural Resources, includes a take prohibition; thus, any taking of this species, including harassment, is unlawful without a state permit. The streams occupied by this species are also protected by Federal and state law. The Michigan Department of Environmental Quality implements section 404 of the Federal Clean Water Act. This section allows Michigan to regulate placement of fill material in waters of the United States and permits for the discharge of pollutants into navigable waters. Streams in Michigan are also protected by the Natural Resources and Environmental Protection Act (Inland Lakes and Streams, Part 301 of Act 451 of 1994).

Listing under the ESA offers additional protections to this species, primarily through the recovery and consultation processes.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Certain types of fish management activities may pose a threat to the species (USFWS 1994) although other forms of fish management may be beneficial. Specifically, fish management activities that result in creation, maintenance, or enhancement of suitable HCWB habitat may be beneficial to the species. Conversely, activities that result in the elimination of suitable HCWB habitat may pose a threat. For example, removal of a dam or culvert (e.g., to allow fish passage) immediately upstream of a known site may, in some cases, eliminate suitable HCWB habitat (as discussed above). Some actions may have contemporaneous positive and negative impacts that must be weighed very carefully.

The use of lampricides for the control of sea lamprey is a potential concern for HCWB. Sea lamprey larvae live in many Great Lakes tributaries and transform to parasitic adults that migrate to the Great Lakes and kill fish. Lampricides are chemicals used to reduce populations of sea lamprey to levels that lessen the impact to Great Lakes fishery resources.

The Carp Lake River and portions of the Maple River not known to be occupied by HCWB have been treated with the lampricides 3-trifluoromethyl-4-nitrophenol (TFM) and 2'5-dichloro-4'-nitrosalicylanilide (niclosamide). In order to evaluate potential effects of lampricide to HCWB, the U.S. Fish and Wildlife Service's Marquette Biological Station contracted with USGS Upper Midwest Environmental Sciences Center in LaCrosse, Wisconsin, to examine the toxicity of TFM to HCWB using a surrogate species (Boogaard and Kolar 2004). Results of tests done on con-familial surrogate species, *Haliplus* spp., provide the best available information on potential effects to HCWB. Results of the initial phase of this study indicate that it is unlikely that TFM at environmentally relevant concentrations would cause mortality of HCWB adults or larvae. However, it is possible that some HCWB adults may exhibit behavioral avoidance when exposed to TFM (Boogaard and Kolar 2004). This may lead to an increase in drift or the beetles may leave the water in order to avoid the chemical.

In 2004, the FWS conducted a formal section 7 consultation on the use of lampricides in the Carp Lake River (USFWS 2004). The FWS concluded that the lampricide TFM is likely to cause harassment and possibly harm to Hungerford's crawling water beetle. During the section 7 consultation, the action agency (USFWS, Sea Lamprey Control) agreed to avoid treating areas of the stream where the best known population of

Hungerford's occurs (i.e., Gill Road crossing). The only occupied portion of the stream that was treated with TFM is at the Oliver Road site, where only one beetle has been found in recent years despite many hours of surveying. The FWS also agreed to minimize concentrations of TFM at the Oliver Road site. Lampricide treatment usually occurs every three to five years.

The effects of electrofishing on HCWB are not known. Electrofishing is used to assess fish populations in streams. Some studies have indicated an increase in drift of other stream insects due to electricity (Bisson 1976; Elliott and Bagenal 1972; Mesick and Tash 1980; Taylor et al. 2001); however, this has not been examined in HCWB. Through informal section 7 consultation, FWS sea lamprey assessment crews have agreed to avoid electrofishing in suitable habitat in occupied streams in order to ensure their assessment activities do not adversely affect HCWB. Further investigation is needed to examine the extent of use of this technique in occupied streams by other agencies and programs, and the potential for harm to HCWB.

Human disturbance within the stream may be a threat to HCWB. Areas of a stream where there are high levels of disturbance caused by fishing and recreation are not likely to be suitable for HCWB. Human activity could result in habitat disturbance as one walks through the stream or inadvertent crushing of individuals by stepping on them. Although this is a potential threat, there are no known occupied sites with excessive human disturbance due to fishing or recreation.

The existence of only five small, geographically isolated populations of HCWB increases the potential for extinction from stochastic events such as human caused or natural environmental disturbances. Small isolated populations are more likely to be destroyed by chance environmental and demographic events than larger widespread populations (Shaffer 1981). For this species, stochastic events could destroy an entire population and, in some cases, a significant percentage of the known individuals. Small population size and restricted range also makes HCWB vulnerable to genetic isolation (Meffe and Carroll 1997). The limited gene pool may lead to decreased fitness (Meffe and Carroll 1997). There have been no studies examining population viability or genetic diversity of this species.

Climate change may constitute a significant new threat for the HCWB. According to the Intergovernmental Panel on Climate Change (IPCC) (2007), "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." In the Great Lakes region, the climate will likely grow warmer and probably drier overall during the 21st century (Kling et al.

2003). Although average annual precipitation may increase slightly by the end of the century, seasonal precipitation cycles are predicted to become more extreme. Winter and spring rains are likely to increase, amplifying the magnitude of spring floods, especially if the floods coincide with snowmelt when soils are still frozen. Summer rains are also expected to decrease by up to 50 percent, causing a general drying of watersheds, especially during summer and autumn, due to less rainfall, warmer temperatures, and higher rates of evaporation. Stream responses to these changes will vary, but alteration of aquatic habitats, disruption of the timing of fish and insect life cycles, and a reduction in primary and secondary productivity are possible (Kling et al. 2003).

2.4 Synthesis

Presence has been documented in a few additional locations within the previously known range since listing. Numbers of beetles at these sites, however, are typically very small (only one or a few beetles found periodically). Of the six occupied streams, only one has consistently had large numbers.

Although there are only a few known occurrences, additional survey efforts would likely result in new occurrences. In general, species of *Brychius* are typically localized and difficult to collect (Mousseau 2004). The adults are very small and inconspicuous, and tend to hide under cobbles and in vegetation along the bottom. As a result, some surveys may not have detected the species when it is, in fact, present. In any case, survey work since listing has not been extensive, but the beetle has been discovered in three additional streams and in a greater extent of known streams. Although there are a number of similarities among the occupied sites, many have unique habitat characteristics. In fact, it is uncertain what characteristics are important to determine suitable habitat for this species, as some sites are markedly different (see USFWS 2006a for more information). The variations described for occupied sites hint that the species may not be restricted to a narrow range of habitat characteristics.

Threats to this species include stream modification, logging in riparian areas, and certain types of fish management activities. In spite of a considerable list of potential threats, very few documented adverse events are known to have occurred to this species since its discovery (1952) or since listing (1994). Nevertheless, the existence of only six small, geographically isolated occurrences seems to be a major threat to this species by increasing the risk of extinction due to stochastic events. Additional information about this species is needed to better understand threats and factors limiting this species.

At this time, the greatest threat to recovery of this species remains the lack of information on ecology and natural history. Additional information is needed on resource requirements and microhabitat preferences, life history (e.g., diet, demographics, and location, timing and duration of larval, pupal, and adult stages,

oviposition location and timing), and population dynamics. This information will allow us to better assess threats, identify additional recovery actions, and develop measurable recovery criteria.

No new information is available to suggest this species' status has changed since listing, and its long-term status appears to be stable. There is little information on this species, including information on life history, ecology, population biology, and habitat requirements; but, it appears that this species has not declined since discovery and listing. The small numbers of this species, its limited distribution, and continuing threats indicate that Hungerford's crawling water beetle warrants endangered status.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
_✓__ No change is needed

3.2 New Recovery Priority Number: no change

Brief Rationale: The recovery priority number for the Hungerford's crawling water beetle is 5, based on a high degree of threat and a low recovery potential. These factors have not changed.

3.3 Listing and Reclassification Priority Number: Not Applicable

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Revise the Recovery Plan once objective measurable criteria can be developed (current criteria are interim).

- Implement the highest priority recovery actions identified in the recovery plan.
  - Conduct research on life history, population dynamics, and habitat requirements, as outlined in recovery plan.
  - Conduct additional surveys and monitor existing sites.
  - Develop and implement site conservation plans for each site to address threats.
  - Define and protect areas of essential habitat.
  - Confirm threats to the species.
  - Investigate genetic heterogeneity and population viability.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Hungerford's crawling water beetle (*Brychius hungerfordi*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change is needed

Appropriate Recovery Priority Number: 5
Appropriate Listing/Reclassification Priority Number, if applicable: ____

Review Conducted By: Carrie Tansy

FIELD OFFICE/REFUGE APPROVAL:
Lead Field Supervisor/Refuge Manager, Fish and Wildlife Service

Approve _____ Date 8/24/09
Craig A. Czarnecki, Field Supervisor

The lead Field Office/Refuge must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead Field Office/Refuge should document this coordination in the agency record.

REGIONAL OFFICE APPROVAL:
Acting **Lead Assistant Regional Director, Ecological Services, Fish and Wildlife Service**

Approve _____ Date 8/28/09

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. Written concurrence from other regions is required.

Cooperating Regional Director, Fish and Wildlife Service

Signature Not applicable Date _____ Concur ____ Do Not Concur