Conservation Assessment
for
Greenbrier Cave Amphipod (Stygobromus emarginatus)

(Photo From: Holsinger, Baroody and Culver, 1976)

USDA Forest Service, Eastern Region

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This Conservation Assessment was prepared to compile the published and unpublished information on Stygobromus emarginatus. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject community and associated taxa, please contact the Eastern Region of the Forest Service Threatened and Endangered Species Program at 310 Wisconsin Avenue, Milwaukee, Wisconsin 53203.

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EXECUTIVE SUMMARY

The Greenbrier cave amphipod is designated as a Regional Forester Sensitive Species on the Monongahela National Forest in the Eastern Region of the Forest Service. The purpose of this document is to provide the background information necessary to prepare a Conservation Strategy, which will include management actions to conserve the species.

The Greenbrier cave amphipod is a relatively widespread obligate subterranean crustacean known from over 30 localities in a multiple county area along the front of the Appalachian Plateau and the Appalachian Valley and Ridge of eastern West Virginia and western Maryland.

NOMENCLATURE AND TAXONOMY

Classification: Class Crustacea
Order Amphipoda
Family Crangonyctidae
Emarginatus Group

Scientific name: Stygobromus emarginatus (Hubricht)

Common name: Greenbrier cave amphipod

Synonyms: Synpleona emarginata
Stygonectes emarginata

This species was described by Hubricht (1943) as Synpleonia emarginata from Organ Cave, Greenbrier Co., West Virginia. The species was redescribed and moved to the genus Stygonectes by Holsinger (1967). The species was moved to the genus Stygobromus with the synonymy of Synpleonia and Stygonectes (Karaman, 1974; Holsinger, 1977). In the monograph of eastern U.S. Stygobromus species, Holsinger (1978) provided a complete synonymy, photograph, diagnosis and one plate of illustrations to supplement the previous work (Hubricht, 1943; Holsinger, 1967) on Stygobromus emarginatus.

Stygobromus was previously placed in the Family Gammaridae (Holsinger, 1972), but Bousfield (1973; 1977) and Holsinger (1977) subdivided this large, heterogeneous family into a number of smaller families. The proper placement of the genus Stygobromus is in the Family Crangonyctidae (Holsinger, 1977).

DESCRIPTION OF SPECIES

Stygobromus emarginatus is an eyeless, unpigmented amphipod crustacean that appears white or straw-colored in life and reaches a length of about 11.2mm in males, 14mm in the largest females. Identification of this species requires laboratory dissection and

examination of slide-mounted appendages under a compound microscope by a specialist in amphipod taxonomy.

LIFE HISTORY

This amphipod has been sampled through all seasons, with females with setose brood plates (indicating reproductive maturation) ranging in size from 8.5 to 13.5 mm present only during spring and summer collections (Holsinger, 1978). Ovigerous females are known only from a collection made in August in Court Street Cave, Greenbrier Co., West Virginia (Holsinger, 1967).

HABITAT

This species is an obligate subterranean species. Holsinger (1978) reported that Stygobromus emarginatus was predominantly an inhabitant of small, gravel-bottom cave streams. A secondary habitat was reported as pools fed by ceiling drips or seepage water. One collection from a spring was also noted.

DISTRIBUTION AND ABUNDANCE

This species is relatively widespread for a subterranean amphipod, with a range reported by Holsinger (1978) of 274 kilometers, from Monroe County, West Virginia northeast along the Appalachian Valley & Ridge to Garrett County, in western Maryland.

RANGEWIDE STATUS

Global Rank: G3 vulnerable; G3 typically includes species known from between 21-99 sites. Holsinger (1978; and unpublished sites, personal communication 2001) reported the amphipod from over 30 localities. Most of the collections were small, consisting of 1-2 specimens, but some consisted of 20 or more specimens, indicating that the amphipod can be found in significant numbers in at least some localities.

West Virginia State Rank: S3 vulnerable; S3 typically includes species known from between 21-99 sites within the state. All of the sites reported by Holsinger (1978) but one (in adjacent Maryland) were from West Virginia.

POPULATION BIOLOGY AND VIABILITY

A series of papers on species interactions between the amphipods Stygobromus emarginatus, Stygobromus spinatus, Gammarus minus and the isopod Caecidotea holsingeri in caves of the Greenbrier Valley in West Virginia have are summarized by Culver (1982). These papers used laboratory experiments in artificial streams, bowl habitats, etc. to explore the population biology of Stygobromus emarginatus as well as the other species with many interesting results.

In experimentation concerning the metabolic rates of cave versus spring populations, Culver and Poulson (1971) found no evidence in support of cave populations having lower metabolic rates than those in springs. The evidence indicated that the populations were not food limited in nature (Culver, 1971).

Using artificial streams for experiments (Culver, 1971), gravel interstices and the undersides of rocks were found to be the primary refugia from strong current in Appalachian cave stream communities, as well as a place to feed and hide from predation by salamanders. Washout rates from artificial streams were found to be a density dependent phenomenon indicating competition as a factor. In bowl experiments, avoidance behavior was displayed between animals of the same or different species. Stygobromus emarginatus was found to out compete the isopod Caecidotea holsingeri for rocks (Culver, 1970).

Culver (1982) stated that one of the most universal results of competition was niche separation. In caves where the troglophilic amphipod Gammarus minus was present, Stygobromus emarginatus was excluded from riffles by competition and was found only in tiny seepage stream infeeders. Culver (1976) reported that the intensity of competition between species pairs decreased with the presumed length of isolation in caves. Species pairs like Stygobromus emarginatus/Stygobromus spinatus or Stygobromus emarginatus/Caecidotea holsingeri were felt to have been isolated in caves for a long time, explaining their ability to coexist in the same cave stream riffle. Species pairs in which the animals were less adapted to the cave environment were unable to remain together in the same habitat.

POTENTIAL THREATS

Due to the presence of Stygobromus emarginatus in the restricted cave environment, it is susceptible to a wide variety of disturbances (Elliott, 1998). Caves are underground drainage conduits for surface runoff, bringing in significant quantities of nutrients for cave communities. Unfortunately, contaminants may be introduced with equal ease, with devastating effects on cave animals. Potential contaminants include (1) sewage or fecal contamination, including sewage plant effluent, septic field waste, campground outhouses, feedlots, grazing pastures or any other source of human or animal waste (Harvey and Skeleton, 1968; Quinlan and Rowe, 1977, 1978; Lewis, 1993; Panno, et al 1996, 1997, 1998); (2) pesticides or herbicides used for crops, livestock, trails, roads or other applications; fertilizers used for crops or lawns (Keith and Poulson, 1981; Panno, et al. 1998); (3) hazardous material introductions via accidental spills or deliberate dumping, including road salting (Quinlan and Rowe, 1977, 1978; Lewis, 1993, 1996).

Habitat alteration due to sedimentation is a pervasive threat potentially caused by logging, road or other construction, trail building, farming, or any other kind of development that disturbs groundcover. Sedimentation potentially changes cave habitat, blocks recharge sites, or alters flow volume and velocity. Keith (1988) reported that pesticides and other harmful compounds like PCB's can adhere to clay and silt particles and be transported via sedimentation.

Impoundments may detrimentally affect cave species. Flooding makes terrestrial habitats unusable and creates changes in stream flow that in turn causes siltation and drastic modification of gravel riffle and pool habitats. Stream back-flooding is also another potential source of introduction of contaminants to cave ecosystems (Duchon and Lisowski, 1980; Keith, 1988).

Smoke is another potential source of airborne particulate contamination and hazardous material introduction to the cave environment. Many caves have active air currents that serve to inhale surface air from one entrance and exhale it from another. Potential smoke sources include campfires built in cave entrances, prescribed burns or trash disposal. Concerning the latter, not only may hazardous chemicals be carried into the cave environment, but the residue serves as another source of groundwater contamination.

Numerous caves have been affected by quarry activities prior to acquisition. Roadcut construction for highways passing through national forest land is a similar blasting activity and has the potential to destroy or seriously modify cave ecosystems. Indirect effects of blasting include potential destabilization of passages, collapse and destruction of stream passages, changes in water table levels and sediment transport (Keith, 1988).

Oil, gas or water exploration and development my encounter cave passages and introduce drilling mud and fluids into cave passages and streams. Brine produced by wells is extremely toxic, containing high concentrations of dissolved heavy metals, halides or hydrogen sulfide. These substances can enter cave ecosystems through breach of drilling pits, corrosion of inactive well casings, or during injection to increase production of adjacent wells (Quinlan and Rowe, 1978).

Cave ecosystems are unfortunately not immune to the introduction of exotic species. Out-competition of native cavernicoles by exotic facultative cavernicoles is becoming more common, with species such as the exotic milliped Oxidus gracilis affecting both terrestrial and aquatic habitats

With the presence of humans in caves comes an increased risk of vandalism or littering of the habitat, disruption of habitat and trampling of fauna, introduction of microbial flora non-native to the cave or introduction of hazardous materials (e.g., spent carbide, batteries). The construction of roads or trails near cave entrances encourages entry.

SUMMARY OF LAND OWNERSHIP AND EXISTING HABITAT PROTECTION

The caves inhabited by this species are a mixture of federal, state and privately owned lands. Big Springs Cave, Tucker Co., West Virginia is owned by the Monongahela National Forest. General Davis Cave, Greenbrier Co., West Virginia is owned and gated by The Nature Conservancy.

SUMMARY OF MANAGEMENT AND CONSERVATION ACTIVITIES

There are no species specific management programs being conducted for Stygobromus emarginatus.

The existing (1985) Monongahela Land and Resource Management Plan does not provide management direction for caves although they are being considered in the Forest Plan revision currently underway. A Forest Plan Amendment in progress for Threatened and Endangered Species will include management for the caves on the forest.

RESEARCH AND MONITORING

Holsinger, et. al. (1976) reported on a bioinventory of West Virginia cave fauna that encompassed collections from 190 caves in 14 counties. Most of what is known about the distribution of Stygobromus emarginatus in the area of the Monongahela National Forest was gathered during that long term project.

RECOMMENDATIONS

Retain on list of Regional Forester Sensitive Species.

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