Species: Appalachian Tiger Beetle (*Cicindela ancocisconensis*)
Global Rank: G3
State Rank: S1
State Wildlife Action Plan: Immediate Concern Species
Climate Change Vulnerability: Moderately Vulnerable
Confidence: Very High

Habitat:

Adult Appalachian Tiger Beetles are found on sand bars, shaded beaches, gravel areas, and sparsely vegetated dry sandy openings along forested rivers. Larvae live in burrows dug in the sandy-loam soils of upper flood plains, often removed some distance from the water's edge

Distribution of the this species is limited to low mountain rivers in hilly areas of the eastern U.S. and southeastern Canada. Historical data indicate that the Appalachian Tiger Beetle was formerly more widely distributed, occurring as far west as Indiana or Illinois. It is rare or missing from most of it's former range along the Ohio River (Pearson et al. 2006). In Pennsylvania this tiger beetle is known from one clean, cold, mountain stream watershed in the Appalachian Mountain Section of the Ridge and Valley Physiographic Province. There is much suitable habitat in Pennsylvania, further surveys are needed to look for additional populations of *C. ancocisconensis*.

Threats:

The most significant threats to the Appalachian Tiger Beetle are: alteration and destruction of habitat from impoundments and other alterations of stream channels; water quality degradation (primarily from urbanization, agriculture, pesticides and other chemicals); loss of riparian forest.

Main factors Contributing to Vulnerability Rank:

Appalachian Tiger Beetle is a terrestrial beetle specializing in stream scour habitats. Species vulnerability to climate change is linked to factors expected to change natural stream hydrology and disturbance regimes. Regions of Pennsylvania where the Appalachian Tiger Beetle occurs have experienced slightly lower than average precipitation variation in the past 50 years, making populations somewhat vulnerable to future changes in precipitation. Shifts in precipitation patterns are expected to create higher winter and spring flows and more frequent and severe floods (Shortle et al. 2009). This could be particularly problematic for the air-breathing larvae living in burrows at the edges of the floodplain. But these events can also create new habitat. According to NatureServe (2008) "As with other tiger beetles survival may be substantial if inundation is only for a few days and the habitat is not physically demolished. Long term inundation would eradicate an occurrence. Floods surely kill a lot of individuals but occurrences generally survive them. However this could be jeopardized by either low areas of occupancy or small numbers. Acciavatti et al., 1992 report an instance where this species survived, and may have benefited from, a "devastating flood". Thus flooding of known sites should not be assumed to eradicate them. River dynamics may be an important habitat factor." A mitigating factor is the ability of adults to disperse relatively easily along stream corridors to colonize newly created habitat.

Based on existing data, species vulnerability to climate change was most strongly captured under 'Physical Habitat Specificity' and 'Dependence on a specific disturbance regime'. Both of these were rated as 'Somewhat Increases Vulnerability' based upon guidance provided by NatureServe (2009). 'Predicted sensitivity to changes in temperature' and 'Predicted sensitivity to changes in precipitation, moisture, or hydrological regime' on a micro scale are also certain to be important factors. Selecting 'Somewhat Increases Vulnerability' for these two factors leads to an overall vulnerability rating of 'Extremely Vulnerable'. However these factors were ranked as 'Unknown' which leads to an overall rating of 'Moderately Vulnerable'. There is no data regarding the specific moisture and temperature preferences of this species particularly in the larval stage at a microhabitat level. Therefore it is not possible to predict the how climate change might affect Appalachian Tiger Beetle adults and larvae in their favored microhabitats. Climate change will likely alter the seasonality and range of moisture and temperatures experienced by this species, but more research is needed to determine whether the effects would be generally positive, negative, or neutral:

- Long term monitoring of hydrologic regime on occupied stream reaches to provide insight into microhabitat requirements and limits, combined with information on population stability or decline.
- More surveys to document the distribution and abundance of this species in Pennsylvania. Long-term viable populations are general metapopulations (NatureServe 2008). Local extinctions may be natural for a species adapted to a dynamic habitat, but if occupied habitats are isolated and populations are small, there is greater likelihood of permanent extinction without recolonization at those sites.
- Studies on the temperature and moisture microhabitat preferences and limits of adults and larvae. This species is associated with sand and gravel scour zones on cool, forested, mountain stream watersheds. Adult tiger beetles utilize hot microhabitats as needed to maintain body temperatures just below their lethal limits of 39ºC when actively running and flying (Pearson et al. 2006). Lower body temperatures can make it difficult for tiger beetles to escape predators, chase mates, or catch prey. However higher body temperatures can place them at risk for water imbalances, reduced gamete production, and general metabolism problems, so they utilize cooler microhabitats as needed to prevent overheating (Pearson et al. 2006). Microhabitat also is an important variable for development of larvae, who presumably have an ideal range of temperature and moisture within their protective burrows placed in sandy and gravelly substrates.

Related to temperature and moisture microhabitats along mountain streams is the decline of Eastern hemlocks (*Tsuga canadensis*) in Pennsylvania. The Eastern hemlock is a keystone species that cools streams and streamside habitats. Widespread decline and death of hemlocks, especially in warmer parts of its range, is attributed to pests including the hemlock woolly adelgid (*Adelges tsugae*), or HWA. HWA is expected to increase with climate change. Hemlocks are more likely to succumb under the stress of a pest infestation when combined with other environmental stressors such as drought (Parker and Skinner 2005). Summer soil moisture droughts are anticipated to increase with increasing temperatures (Shortle et al. 2009). Hemlock mortality is currently most severe in southeastern Pennsylvania where milder winters allow successful overwintering by the HWA. The range and abundance of HWA is moving in a northerly and westerly direction (Shortle et al. 2009). Cooler mountainous areas will gradually become more hospitable to overwintering HWA as climate change produces milder winters.

Additional global climate change related threats include: construction of dams on mountain streams for water storage or hydroelectricity; natural gas extraction and its associated impacts on forest integrity and water quality.

Some of the current and projected threats could be mitigated with removal of dams where they are not critical to energy production, water storage, or protection of infrastructure. Protection and expansion of riparian buffers around medium to large streams and rivers is critical. Continued research and treatment of HWA is needed to try to protect hemlocks and the vital ecological role they play in maintaining cold water stream habitats. Plantings of replacement evergreen species not susceptible to HWA may be needed as an emergency measure to protect streams. Spruces and pines native to the northeastern United States should be used in such situations. Nonnative species such as Norway Spruce should be avoided.

Migration and Movements: *C. ancocisconensis* tends to be patchily distributed, perhaps moving along a stream system to find new river scour habitats that form after floods. Colonies are usually small and located within 60 meters of the water's edge, with rare reports of occurrences in wet sandy areas up to 2.5 km from the nearest water (Pearson et al. 2006).

Literature Cited:

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