

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 (Pearson et al. 2006).

Distribution of this species is limited to 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 its 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.

#### Current 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), and loss of riparian forest.

#### Main factors Contributing to Vulnerability:

The 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. This makes populations somewhat vulnerable if precipitation patterns become more extreme in the future (CCVI section C2bi). 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 many individuals, but diminished populations generally survive. 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.

Whether or not there will be suitable habitat nearby to colonize is a pertinent question. Many populations have become isolated because of historical loss of habitat due to dam construction. Climate change may increase incentives for building/enlarging dams for hydroelectric power or water storage. It is not clear how much more dam development would occur on stream reaches supporting populations of Appalachian tiger beetles.

Tiger beetles are adapted to specific thermal and hydrological conditions, therefore, changes in these conditions are likely to impact basic tiger beetle biology (Pearson and Vogler 2001). 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.

Related to temperature and moisture microhabitats along mountain streams is the decline of eastern hemlocks (*Tsuga canadensis*) in Pennsylvania. 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*). Hemlock woolly adelgid 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 hemlock woolly adelgid. The range and abundance of hemlock woolly adelgid is moving in a northerly and westerly direction (Shortle et al. 2009). Cooler mountainous areas will gradually become more hospitable to overwintering hemlock woolly adelgid as climate change produces milder winters. For this reason the factor 'Dependence on other species to generate habitat' effect on vulnerability was rated as 'Somewhat increase', as loss of Eastern hemlock is expected to affect the temperature and moisture conditions of mountain streams and their riparian zones.

An additional global climate change related threat is natural gas extraction and its associated impacts on forest integrity, water quality, and its potential impact on climate change itself.

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, and should include protection from off-road vehicle use. Continued research and treatment of hemlock woolly adelgid 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 hemlock woolly adelgid 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. Non-native species such as Norway spruce should be avoided.

*Dispersal and movements:* Appalachian tiger beetles tend 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 m 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).

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