Species: Northern Barrens Tiger Beetle (*Cicindela patruela*)
Global Rank: G3
State Rank: S2S3
State Wildlife Action Plan: Immediate Concern Species
Climate Change Vulnerability: Not Vulnerable / Presumed Stable
Confidence: Very High

Habitat (adapted from NatureServe 2008 and Pearson et al. 2006):

The Northern Barrens Tiger Beetle is specific to sandy/coarse gravel or eroding sandstone substrates throughout its range. It may have more specialized habitat requirements within a given geographic region. The associated plant community is usually pine barrens or open mixed or deciduous (mainly oak) woodlands and shrublands; the beetle utilizes patches of open ground, such as along trails, on outcrops, scree or talus slopes, or on ridge summit openings dominated by lichens and dry mosses. In much its range *Cicindela patruela* is associated with coarse grained sand or eroding sandstone. Larvae construct burrows in open patches of stabilized and compact sandy soils, often associated with mosses, lichens, and other low vegetation. Populations are typically scattered and low density; small individual colonies can occur on sites less than a hectare, but populations typically function as metapopulations across a forested landscapes of 100 or more hectares with scattered patches of suitable habitat.

Threats (adapted from NatureServe 2008):

The main threat to this species is habitat destruction due to development, deforestation, and fire suppression (ecological succession may eliminate some habitats). Most authors mention that this species will occupy little-used forest roads. Heavy use of these by ATVs or other motorized vehicles, and improvements to remote sandy roads on state lands could impact occurrences in some locations. More research is needed to determine the extent to which sandy roads and are breeding areas, and the threat potentially posed by the use and maintenance of such roads.

Main factors Contributing to Vulnerability Rank:

The main factors contributing to climate change vulnerability are large scale changes in the amount and seasonality of soil moisture, the physical habitat specificity of the Northern Barrens Tiger Beetle, and the importance of human activities for the creation (e.g. soil disturbance) or the loss (e.g. succession as a result of fire control) of suitable habitat. A mitigating factor is the ability of adults to disperse relatively easily through suitable habitat, and the likelihood that natural disturbances (e.g. fire) and alternative energy development (e.g. natural gas) will increase the amount of potential habitat for this species.

The regions of Pennsylvania where *Cicindela patruela* is known to occur has experienced slightly lower than average precipitation variation in the past 50 years, making populations somewhat vulnerable to future changes in precipitation. Increased summer

soil droughts are predicted by climate models, and could lead to an increase in the amount and severity of forest fires (Shortle et al. 2009). This species is fairly well adapted to fire, and forest fires could benefit the species by creating new habitat and setting-back succession. Adults emerge in the spring (typically late April to June) and again from mid August into September (late summer eclosions may be sporadic). Adults may be able to escape fires, and the larval life cycle is two years meaning there are always larvae present and somewhat protected in burrows in the substrate (NatureServe 2008, Pearson et al. 2006). For these reasons the Northern Barrens Tiger Beetle was ranked as 'Somewhat less vulnerable' in regards to reliance on a specific disturbance regime (fire) that is expected to increase in frequency, severity, or extent with climate change and would increase the species' habitat quality.

Right-of-way infrastructure supporting alternate energy sources such as wind energy and natural gas are expected to create many acres of disturbed land in forested habitats. Under certain conditions of soil, bedrock, moisture, and aspect, newly disturbed lands could become potential habitat for *Cicindela patruela*. Recent collection sites indicate that disturbed right-of-ways such as powerline rows, logging access roads and pipelines, oil and gas well openings, etc. can provide suitable habitat. Right-of-ways may assist the species in finding suitable disturbed sites as they become naturalized with mosses, lichens, and other low vegetation. Maintaining a forest matrix around disturbed areas is important, as is preventing access to access roads and disturbed areas by ATVs and other vehicular traffic. Frequent road usage and improvement could be harmful (NatureServe 2008), particularly to the larvae as they develop in burrows in sandy soils. Infrastructure development may not require considerable planning and management in order to maximize the potential benefit for this species, therefore predicted impact of land use changes was ranked as 'Decrease Vulnerability'.

Predicted sensitivity to changes in temperature and precipitation, moisture, or hydrological regime on a microhabitat scale are certain to be important factors. This species is well adapted to hot microhabitats (eroded sandstone clearings). But details on the optimal range and seasonality of soil temperature and moisture for the development of larvae and pupae are not known. Therefore for the CCVI these microhabitat temperature and moisture were ranked as 'Unknown' which leads to an overall rating of 'Presumed Stable/Not Vulnerable'. Selecting 'Somewhat Increases Vulnerability' for these two factors did not lead to a change in overall vulnerability rating.

The following research is recommended to better assess the current status of the Northern Barrens tiger beetle and the potential effects of climate change:

- More surveys to document the distribution and abundance of this species in Pennsylvania. Long-term viable populations are likely metapopulations based on the low density and scattered nature of occurrences (NatureServe 2008). Mark-recapture studies can help determine movement patterns.
- Long term monitoring of the disturbance regime in occupied habitats to provide insight into microhabitat requirements and limits, combined with information on population stability or decline. In managed areas utilizing prescribed fire, timing and

numbers of burn units should be examined in reference to effects on the beetle populations.

- Studies on the temperature and moisture microhabitat preferences and limits of adults and larvae. 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 stabilized and compact sandy substrates.

Migration and Movements (adapted from NatureServe 2008): Quantitative information on tiger beetle movements in barrens and shrubland habitats are few and mostly anecdotal. However tiger beetles of these habitats are known to be good colonizers capable of flying a few kilometers (apparently sometimes at night).

Literate Cited:

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