U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Cicindela marginipennis*

COMMON NAME: Cobblestone tiger beetle

LEAD REGION: Region 5

DATE INFORMATION CURRENT AS OF: 11/30/2018

STATUS/ACTION

X Species assessment - determined either we do not have sufficient information on threats or the information on the threats does not support a proposal to list the species and, therefore, it was not elevated to Candidate status

N/A Listed species petitioned for uplisting for which we have made a warranted-but-precluded finding for uplisting (this is part of the annual resubmitted petition finding)

N/A Candidate that received funding for a proposed listing determination; assessment not updated

N/A New candidate

N/A Continuing candidate

N/A Listing priority number change
Former LPN: ___
New LPN: ___

N/A Candidate removal: Former LPN: ___

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
___ F – Range is no longer a U.S. territory.
___ I – Insufficient information exists on taxonomy, or biological vulnerability and threats, to support listing.
___ M – Taxon mistakenly included in past notice of review.
___ N – Taxon does not meet the Act's definition of "species."
___ X – Taxon believed to be extinct.

Date when the species first became a Candidate (as currently defined): N/A

Petition Information:
___ Non-petitioned
_X_ Petitioned; Date petition received: April 20, 2010
90-day substantial finding FR publication date: September 27, 2011
12-month warranted but precluded finding FR publication date: N/A

FOR PETITIONED CANDIDATE SPECIES:
a. Is listing warranted (if yes, see summary of threats below)? No
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? N/A
c. Why is listing precluded? N/A

PREVIOUS FEDERAL ACTIONS:
On April 20, 2010, we received a petition dated April 20, 2010, from the Center for Biological Diversity (CBD) requesting that 404 aquatic, riparian, and wetland species from the southeastern United States be listed as threatened or endangered and critical habitat be designated for these species under the Act. The cobblestone tiger beetle (CTB) was one of the 404 petitioned species. On September 27, 2011, we published a 90-day finding that the petition presented substantial scientific or commercial information indicating that the listing of the cobblestone tiger beetle may be warranted (76 FR 59836). A subsequent complaint for not meeting the statutory petition finding deadlines was filed by CBD on August 5, 2016. Per a court approved settlement agreement, we agreed to send a 12-month petition finding for the CTB to the *Federal Register* by September 30, 2019.

ANIMAL/PLANT GROUP AND FAMILY: Insects, Carabidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: United States: Maine, New Hampshire, Vermont, Massachusetts, New York, New Jersey, Pennsylvania, West Virginia, Indiana, Ohio, Kentucky, Alabama, and Mississippi. Canada: New Brunswick.

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: United States: Maine, New Hampshire, Vermont, New York, New Jersey, Pennsylvania, West Virginia, Indiana, Ohio, Kentucky, and Alabama. Canada: New Brunswick.

LAND OWNERSHIP: The cobblestone tiger beetle is a wide-ranging species. It occurs on both public and private land; however, given the scale of the best available survey data we are unable to provide an accurate percentage of occupancy on any specific land-type.

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LEAD BIOLOGIST CONTACT: Fred Pinkney, Biologist, (410) 573-4544, fred_pinkney@fws.gov

BIOLOGICAL INFORMATION

The *Species Status Assessment Report for the Cobblestone Tiger Beetle—November 2018, Version 1.0* (SSA Report) is a summary of the information assembled and reviewed by the U.S. Fish and Wildlife Service (Service) and incorporates the best scientific and commercial information available for this species. Excerpts of the SSA Report are provided in the sections below. For more detailed information, please refer to the SSA Report (Service 2018, entire).

Species Description
Adult CTBs (see figure 1) are approximately 11 to 14 millimeters (mm) (0.4 to 0.6 inches (in)) in length and have large mandibles used to capture prey. The elytra (hardened forewings) are a dull olive with a cream-colored border. The abdomen is a bright red-orange that is exposed when the elytra are spread (Pearson *et al.* 2006, p. 133; Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2008, p. iv).

Figure 1. Adult cobblestone tiger beetle (USFWS photo).

Taxonomy
The CTB is a member of the Order Coleoptera, Family Carabidae, and subfamily Cicindelinae.

In the disjunct southern populations of Alabama, individual CTBs tend to be larger and browner than those in the northeastern populations (Pearson *et al.* 2006, p. 133). This has led some to think these populations could represent a subspecies (Holt 2017; Knisley 2017). These relationships will be evaluated as part of a preliminary rangewide population genetic analysis, funded by the Service, which will be completed by the end of 2019 and will assess whether the Alabama populations are the same species or a subspecies. The study will investigate measures of intra-specific diversity, population structure, and geographic variation. Pending the results of the study and for the purposes of this 12-month finding, we accept the current nomenclature of a single species (*Cicindela marginipennis*).

Habitat/Life History

The CTB can be found on both shoreline cobble bars and cobble islands (Acciavatti 2001, p. 2). In the U.S., the CTB occurs along rivers where the currents are strong enough to scour shorelines and mid-channel bars, creating and maintaining cobble bars (Allen and Acciavatti 2002, p. 6). Periodic scouring by high flows also prevents the establishment of dense vegetation on the riverine cobble bars. The CTB occurs in similar habitat along the shorelines of Grand Lake in New Brunswick (COSEWIC 2008, p. v).

The majority of occupied sites are on cobble bars associated with islands. CTB habitat usually consists of cobblestones and coarse gravel with small patches of sand (COSEWIC 2008, p. 8), as well as areas of loose, mixed-size cobbles (Hudgins *et al.* 2011, p. 315). Although cobble is a crucial component of CTB habitat, cobble size itself does not have a significant relationship with occupancy (Kritsky *et al.* 2009, p. 141).

Vegetation is an important component of CTB habitat, although plant species composition, structure, and density parameters will vary throughout the species' range. In general, vegetation observed at occupied sites was found to be sparse and low growing with low species richness (Ward and Mays 2011, p. 16; Environment Canada 2013, p. 11; Normandeau Associates Inc. 2016, p.16).

The CTB life history is not well known, but is described as being similar to other diurnal summer-active tiger beetle species. The species likely has a 2-year life cycle with the potential for a 3-year cycle in northern parts of its range (Knisley 2018a). For example, eggs laid late in the season or larvae with limited food or reduced activity due to weather, may take an additional year to develop (Knisley 2018a). Emergence of adults varies by location and temperature (Vermont Fish and Wildlife Department (VTFWD) 2011, p. 5), but generally occurs in late June with peak abundance in early to mid-July (Acciavatti 2001, p. 9). Adults then engage in mating and egg laying activities until early September (Allen and Acciavatti 2002, p. 26). Adults do not live past their first summer (Hudgins 2010, p. 68).

After mating, females most likely deposit single fertilized eggs in mid-summer in open sandy areas between cobblestones (Hudgins 2010, p. 69). Based on the traits of other tiger beetle species, it is likely that the CTB can lay 10 to 20 eggs per day (COSEWIC 2008, p. 14). Most likely, the CTB larvae dig burrows in open stretches of moist sand in the upper beaches above the strand of cobble. There, the larva use ambush tactics to feed on small insects and spiders (COSEWIC 2008, p. 13). Larvae are known to anchor themselves to the walls of their burrows and wait for prey to come within striking distance, seizing the prey with sickle-shaped mandibles (Valenti and Gaimari 2000, p. 3).

Tiger beetles may have multiple larval stages (instars). Generally, the newly hatched larvae (first instars) transition to larger larvae (second instars) within the same season. For 2-year life cycles, the second instar will over winter the first year. The following summer, the second instar molts into a larger larvae (third instar). The third instar over winters (year 2), entering a pupal stage the following summer where it remains immobile in the pupal cell until emerging as an adult (Webster 2018).

The CTB larval stages have not yet been taxonomically described (Normandeau Associates Inc. 2016, p. 18; Knisley 2018a). Some survey reports document two larval cohorts in the late spring before pupation, and suggest that the CTB has a 2-year life cycle (Acciavatti 2001 pp. 8–9). There is some uncertainty about this given that the larvae have not been described and observations could have been of larvae from another co-occurring species (e.g., the bronzed tiger beetle (*C. repanda*)).

Adult CTBs are usually found in sparsely vegetated, scoured shorelines, often close to the water's edge in areas of moist sand or silt (Hudgins *et al.* 2011, p. 315; Environment Canada 2013, p.11). The females of most tiger beetle species have species-specific requirements for soil moisture, temperature and substrate type for their egg laying habitats (Brust *et al.* 2006, p.252). Although the specific parameters for egg laying habitat are not known for the CTB, we recognize that there must be soil moisture, sand grain size and thermal limitations to their habitat requirements. Preferred habitat for larval burrows has not been identified because the larval stages have not been described taxonomically, and CTB burrows cannot be distinguished from other tiger beetle species at this time. We assume that the CTB larval burrows occur in the moist, sandy interstitial spaces between cobbles, above the mean high water mark.

Table 1 provides a summary of the cobblestone tiger beetle's life history needs based on the best available information.

Table 1. Life history and resource needs of the cobblestone tiger beetle.

Life Stage	Resources and/or circumstances needed for individuals to complete each life stage	Resource Function*	Information Source
All life stages	• Sparsely vegetated island or shoreline cobble bars of 1,750 to 76,100 sf • Naturally maintained ecosystem with seasonal flood or ice scour events to maintain sparse vegetation, generally less than 10% cover • Lack of invasive non-native vegetation • Unembedded cobble substrate with interstitial sand – 6 to 30 percent suitable sand component	B, F, S, D	Normandeau Associates Inc. 2016, p. 16 Environment Canada 2013, p. 11 Hudgins *et al.* 2011, p. 311 Nothnagle 1995, p 8
Fertilized eggs – early summer	• Sufficient soil moisture on substrate in which eggs are oviposited and for hatching	B	Normandeau Associates Inc. 2016, p. 16 Environment Canada 2013, p. 11 Hudgins *et al.* 2011, p. 311 Nothnagle 1995, p 8
Larvae (1st, 2nd and 3rd Instars) – summer/fall/ winter	• Minimal long-term inundation (less than 12 days) • Adequate food availability	B, F, S	Pearson *et al.* 2006, p. 177

Life Stage	Resources and/or circumstances needed for individuals to complete each life stage	Resource Function*	Information Source
Pupae and Adults - summer	• Adequate food availability	B, F, S, D	Normandeau Associates Inc. 2016, p. 16 Environment Canada 2013, p. 11 Hudgins *et al.* 2011, p. 311 Nothnagle 1995, p 8
* B=breeding; F=feeding; S=sheltering; D=dispersal			

Historical and Current Range/Distribution

To assess the CTB's distribution and population parameters within its range (see historical and current range sections below), we used analytical units (AUs). The AU methodology is summarized below, for a more in-depth discussion of the (AUs), please refer to the 2018 SSA Report (Service 2018, entire).

Analytical Units

The AUs correspond to the USGS 10-digit Hydrologic Unit Code HUC (HUC10) watershed that comprises a river reach (part of a larger basin) and its tributaries for the United States' CTB populations, and the National Hydro Network (NHN) watershed units for the Canadian CTB populations. We determined that the HUC10 and NHN geographic level of analysis would be at an appropriate scale to map CTB populations without providing sufficient detail to pinpoint occupied locations, thus preventing unwanted collection of CTBs or habitat vandalism. HUC10 units were also small enough that we could identify site-specific stressors affecting CTB populations. In a few cases, the data provided for CTB occurrences were insufficient to determine the HUC unit in which the species was found (e.g., Kentucky, Mississippi). The AUs for those locations were assigned at the county level. The Canadian NHN units are larger than the HUC10 units, but there was no other equivalent geographic unit available for our analyses of Canadian populations. With respect to describing specific CTB sites, we use the words "site" and "location" interchangeably as the specific area where CTBs have been documented. If at least one CTB was found in a survey, it is defined as an occurrence.

There are a total of 45 AUs throughout the range, with 27 considered to be extant (including the 2 unknowns) and 18 considered to be historical or extirpated (see table 2).

Table 2. Presence/Absence Status of the CTB Analytical Units

State/ Province	Extant AUs	Historical/Extirpated AUs	Status Unknown AUs
Alabama	Mill Creek/Cahaba River, Upper Cahaba River, Soapstone Creek/Alabama River	Weoka Creek/Coosa River	
Indiana	Pipe Creek/Whitewater River	East Fork Whitewater River	
Indiana/Ohio	Whitewater River		
Kentucky	McCreary County		
Maine	Lower Carrabassett River, Middle Carrabassett River		
Massachusetts		Lower Deerfield River	
Mississippi		Clay County, Tombigbee River/ Lowndes County	
New Hampshire	Upper Pemigewasset River, Middle Pemigewasset River		
New Hampshire/Vermont	Mill Brook-Connecticut River, Vernon Dam- Connecticut River		
New Jersey/ Pennsylvania		Lower Delaware River Upper Delaware River	Raymondskill Creek/Delaware River, Flat Brook/Delaware River
New York	Outlet Silver Lake/Genesee River, Cold Creek/Genesee River, Caneadea Creek/Genesee River, Cattaraugus Creek, Headwaters Cattaraugus Creek	Saw Mill River/Hudson River	
New York/ Pennsylvania		Middle Delaware River	
Ohio	Taylor Creek/Great Miami River	Kinnikinnick Creek/Scioto River, Ralston Run/Paint Creek, Headwaters Todd Fork	
Ohio/West Virginia	French Creek/Ohio River	Little Sandy Creek/Ohio River Little Hocking River/Ohio River	
Pennsylvania	Allegheny River	Susquehanna River (0205030510), Susquehanna River (0205030617), Middle Schuylkill River	
Vermont	Winooski River, White River, Rock River - West River		
West Virginia		Upper Monongahela River	
New Brunswick, CA	01AO000 (Grand Lake) 01AJB00 (Saint John River)		

It is difficult to ascertain with certainty whether a population is extirpated or historical. We considered a time frame of approximately 10 generations equating to approximately 20 years (for a 2-year life cycle) for our frame of reference when determining whether a CTB site is extant, historical, or extirpated. If there were no CTB observations during surveys conducted over the past 20 years, we considered that there was little likelihood that the species was present. Accordingly, we considered the following rankings (in part following the NatureServe definitions (NatureServe 2018)):

- a population is considered to be extant if CTB were documented at least once within the last 20 years;
- a population is considered unknown if it is not known whether the lack of CTB observations in one or more surveys conducted within the last 20 years is due to population extirpation or low detectability;
- a population is considered to be historical (Possibly Extirpated per NatureServe definition) if its presence has not been verified in the past 20 years despite exhaustive searches; the only known occurrences were destroyed; or if it had been extensively and unsuccessfully looked for and not found; and
- a population is considered to be extirpated if it has not been located despite intensive searches of historical sites and other appropriate habitat, and there is virtually no likelihood that it will be rediscovered.

In the absence of consistent surveys and site-specific data for the CTB, and the difficulties associated with distinguishing extirpated versus historical sites, we combined these categories into a single extirpated/historical category.

Survey data vary widely due to different monitoring objectives and methods since there is no standardized survey protocol for the species at this time. Extant population surveys have recorded CTB numbers ranging from 1 to 5 individuals to over 100 individuals. Most surveys have not provided a population estimate. In general, most populations are considered to be small and estimated to rarely exceed 60 individuals at a site with the exception of locations in Alabama (Holt 2018b), Maine (Mays and Ward 2013), and Canada (COSEWIC 2008).

There is very little information on population demographics for the CTB. Many of the tiger beetle taxa demographics are based on a metapopulation structure, most likely due to the dynamic environments in which they are found (e.g., river shorelines, high energy coastal beaches) (Omland 2009, NatureServe 2018). Because the CTB cobble bar habitat is found in hydrologic regimes that undergo periods of intense scouring or flooding that create, maintain, and occasionally destroy the habitat, we considered this species to need a metapopulation structure to persist. Metapopulations are "systems of local populations connected by dispersing individuals" (Hanski and Gilpin 1991, entire).

Based on dispersal distances of other tiger beetle species moving between populations or to suitable habitat, and a review of the distance between extant populations located linearly on the same waterbody (river or Grand Lake), we observed that most CTB populations were within a 5-mile Euclidean distance of one another. Discussions with cobblestone tiger beetle experts solidified our determination that populations within a 5-mile Euclidean distance should be considered members of a metapopulation (Frantz 2018). Local extirpations and recolonizations of habitat patches should be considered normal within a functioning metapopulation (Knisley 2018). It is likely that the most resilient CTB populations function as a metapopulation, with more resilient metapopulations being spatially distributed so that a localized catastrophic event does not affect an entire metapopulation.

Historical Range/Distribution

The historical range of the CTB has been recorded from New Brunswick, Canada into the United States with populations in Maine, New Hampshire, Vermont, Massachusetts, New York, New Jersey, Pennsylvania, West Virginia, Indiana, Ohio, Kentucky, Alabama, and Mississippi. Historical presence in the U.S. has been recorded in 40 HUC10 watersheds and 3 counties (see figure 2).

Current Range/Distribution

Current distribution records (last 20 years) show occupation of 24 of the 40 historical HUC10s and 1 of the 3 counties (see figure 2). There are extant populations in two NHN watersheds in Canada. Populations reported from Mississippi (two counties) and Massachusetts (one HUC10) are considered extirpated due to the documented loss of previously occupied habitats (Tennessee Valley Authority 2006, p. 30; MassWildlife 2017). Two AUs (Flat Brook-Delaware River and Raymondskill Creek-Delaware River) have zero beetle observations in the last 7 years, despite multiple surveys. These AUs are still considered extant populations, but they are designated as "unknown" because it is not known if the lack of observations is due to population extirpation or low detectability.

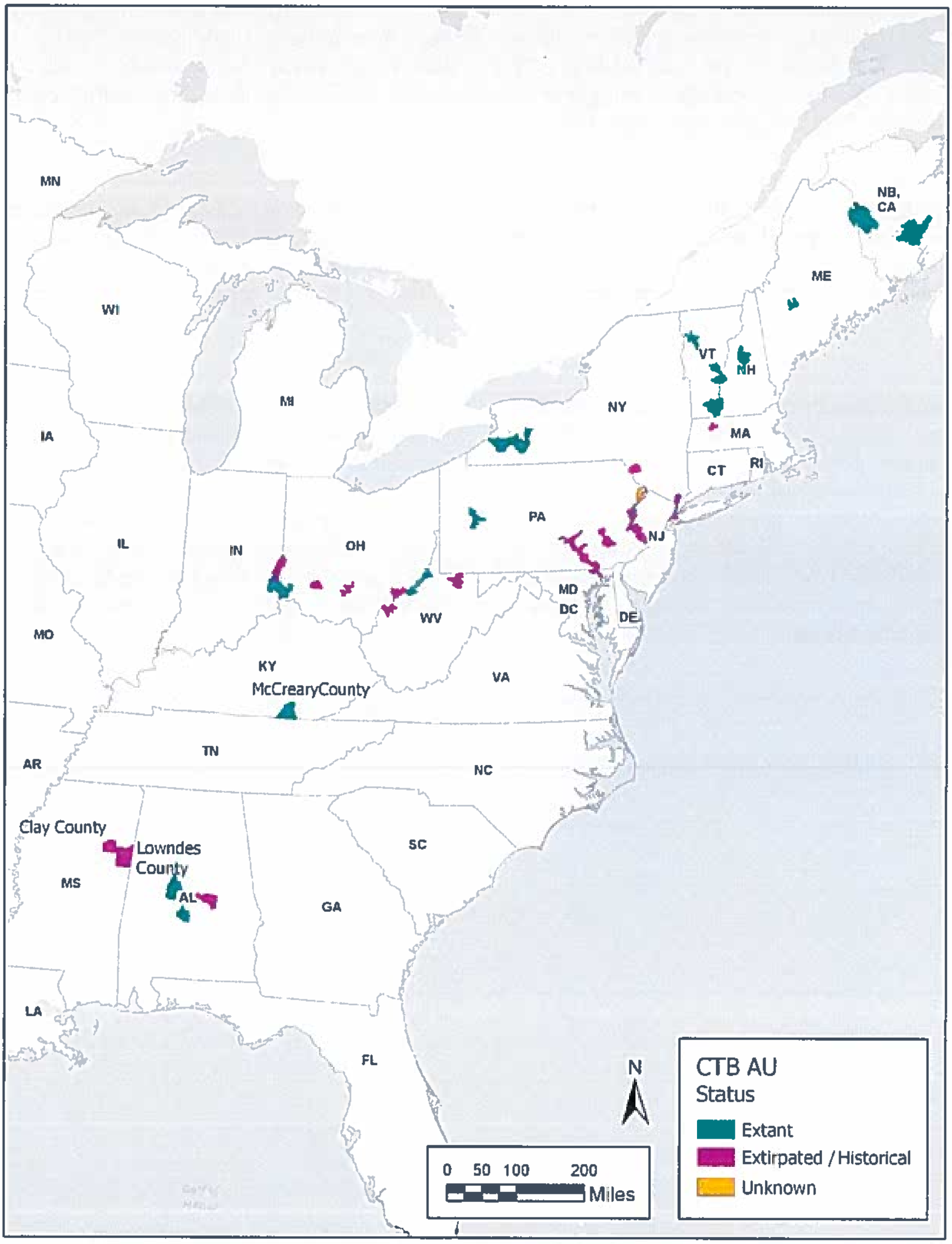

Figure 2. Extant and historical or extirpated CTB AUs: entire range

SUMMARY OF THE ABOVE BIOLOGICAL INFORMATION

The cobblestone tiger beetle has been recorded from New Brunswick, Canada into the U.S. with populations in Maine, New Hampshire, Vermont, Massachusetts, New York, New Jersey, Pennsylvania, West Virginia, Indiana, Ohio, Kentucky, Alabama, and Mississippi, in riverine or shoreline habitats with cobble substrates. While there is no overall population estimate of the cobblestone tiger beetle, the best available information indicates the species may function with a metapopulation structure, as the cobble bar habitat is found in hydrological regimes that undergo periods of intense scouring or flooding that create, maintain, and occasionally destroy the habitat. The species is currently known to be extant in 25 of 45 historically occupied AUs; an additional 2 AUs are classified as uncertain, but are presumed to be extant.

THREATS

We define "threat" as any action or condition that is known to or is reasonably likely to negatively affect individuals of a species. This includes those actions or conditions that have a direct impact on individuals, as well as those that affect individuals through alteration of their habitat or required resources. The mere identification of "threats" is not sufficient to compel a finding that listing is warranted. Describing the negative effects of the action or condition (i.e., "threats") in light of the exposure, timing, and scale at the individual, population, and species levels provides a clear basis upon which to make our determination. In determining whether a species meets the definition of an "endangered species" or a "threatened species," we have consider the factors under section 4(a)(1) and assessed the cumulative effect that the threats identified within the factors—as ameliorated or exacerbated by any existing regulatory mechanisms or conservation efforts—will have on the species now and in the foreseeable future.

SUMMARY OF THREATS

For a detailed discussion of the influences on viability and current and future conditions of the CTB, please see the SSA Report (Service 2018, Chapters 3 to 5). The following is a summary of that information.

Our analysis of the past, current, and future influences on what the CTB needs for long-term viability revealed five primary influences affecting the viability of the species: changes in hydrology (dams and riverbank stabilization), habitat loss and degradation (through development, sand and gravel mining, and recreation), water quality, effects of small population size, and effects from climate change. Based on the best available information, we did not find that collection, disease, or predation are having a population- or species-level effect on the CTB. Summarized below are the five primary influences, as well as the conservation efforts and synergistic/cumulative effects that we evaluated.

Changes in Hydrology

The CTB is almost exclusively found on cobble bars in flowing, riverine environments with the exception of two metapopulations found on cobble shorelines at Grand Lake, New Brunswick. A natural hydrological regime maintains CTB habitat through seasonal flood events (e.g., spring freshets) by reducing vegetation, nourishing the substrate with suitable cobble, gravel and/or sand, preventing the establishment of invasive species, and providing suitable conditions for prey. The primary driving forces for river and lake hydrology effects to the CTB and its habitat are precipitation and for northern sites, ice formation. Spring scour, including ice scour, spring freshet and spring flooding may be necessary in maintaining suitable habitat by removing encroaching vegetation or preventing the establishment of invasive plant species (Environment Canada 2013, p. 11). Ice scour has been a common occurrence in the northern areas of the range (Nothnagle 1995, p. 16; COSEWIC 2008, p. 9; Mays and Ward 2013, p. 7). The Grand Lake shoreline habitat is maintained by wave action during spring flooding and a lack of summer flooding (COSEWIC 2008, p. 9). Effects of dam operations and riverbank stabilization may influence the hydrology of CTB sites.

Dam operations

Alteration of the natural hydrological system through the construction and operation of dams may have serious consequences for the riparian ecosystem. Dams may range in size from small historical, nonfunctioning mill dams on streams to low-head hydropower dams on streams or rivers of varying sizes to huge, power generating facilities on large rivers. The impact of dams is dependent on the size and flow of the river as well as the flows released by a dam, the type and size of a dam, and if there are multiple dams on the river that have cumulative impacts to the riverine ecosystem (Foundation for Water and Energy Education (FWEE) 2018, p. 2). Ten of the 25 known extant AUs in the United States (40 percent) and 1 Canadian AU are directly influenced by dams managed for hydropower (6), navigation (3), water supply (1), and flood control (1).

Peaking hydropower dams generate electricity by releasing more water during periods of high power demand, either daily (in the evening at the end of the workday) or seasonally (during the summer when air conditioners are running) (FWEE 2018, p. 3). These operations raise and lower water levels in dam impoundments and water levels in the river below the dam. Water levels will fluctuate to varying degrees depending on the electricity demands and/or the hydropower license prescription. These fluctuations have a number of effects: riverine habitats may be flooded or exposed for extended periods of time on a daily basis, riverbanks may experience increased erosion, natural sediment transport or deposition may be affected, and the potential establishment of invasive plant species may be increased (FWEE 2018, p 3; Magilligan and Nislow 2005, p. 2).

If flow conditions result in extended periods of inundation at CTB sites, adults, pupae, and larvae (and their habitat) will be affected (MassWildlife 2017; Nelson 2017; Franz 2018; Knisley 2018b). The effects of such prolonged inundation of CTB habitat will vary depending on timing and duration. It is possible that larvae may float and land on dry, suitable habitat; however, if dry land is not encountered, then larvae will drown (Brust *et al*. 2006, pp. 257–261). Habitat inundation that occurs during winter or spring high flows when the CTB larvae are senescent and adults are absent may have limited effects. The CTB larvae might be able to withstand a few weeks of inundation during the winter but not during the summer. During summer when CTB adults and larvae are active, inundation of 24 hours or more may reduce the time larvae and adults spend feeding or reduce the number/density of available prey (Nelson 2017). Prolonged inundation of habitat when larvae, pupae, and adults are present could delay larval development from one instar stage to another (Knisley 2018b), decrease larval rate of survival, prevent pupae from emerging as adults, and increase competition for space and prey between the CTB and other tiger beetles that are present. Inundation on a daily basis or over a period of time during the beetle's active season, when larvae, pupae and adults are present, could limit the extent of habitat that is available to these life stages. Limited exposure (one to several days) to inundation is unlikely to affect larvae (Pearson *et al.* 2006, p. 177), but they may experience mortality or indirect impacts from prolonged inundation (Frantz 2018) during their active season (June through September) due to decreased oxygen levels when they are in their burrows.

At least two CTB occurrences (Mill Brook - Connecticut River and Vernon Dam - Connecticut River AUs) are known to have been impacted by a change in the flow regime of an upriver hydropower dam. In Massachusetts, the single CTB population located on the main stem of the Connecticut River was documented as being present through 2007. In the mid-2000s, the Turner's Falls hydropower dam immediately upriver of the population significantly increased the frequency and duration of water releases for power generation; summer flows submerged the entire cobble bar on an almost daily basis in late afternoons and evenings (MassWildlife 2017). Subsequent CTB surveys conducted in 2012, 2013, 2014, and 2017 failed to document any individuals (Nelson 2017). The habitat is considered to be unoccupied as a result of consistent flooding that completely inundated adult and larval habitat during critical life history periods (Nelson 2017). In addition to the Massachusetts population, the Winooski River population in Vermont is presumed to have been extirpated due to changes in the flow regime of a hydropower dam located approximately 7 miles upstream of that population (VTDFW 2011, p. 9). However, the impacts of managed flows may change through time as a result of the implementation of the regulations requiring the relicensing of hydropower dams (von Oettingen 2018a; Grader 2018). For example, the Federal Energy Regulatory Commission process has the potential to minimize project related effects to CTB habitat or improve habitat conditions within projected affected areas (von Oettingen 2018a).

There is evidence that other CTB populations were extirpated during the early part of the 20th century as dams were built throughout the northeast and mid-Atlantic states. In West Virginia, at least two populations are believed to have been extirpated due to the construction of locks and dams. A CTB population on the Monongahela River was lost once a series of locks were constructed after 1905 and habitat was inundated (Frantz 2018). A second possible occurrence may have been destroyed once Cheat Lake was created after a dam was built in 1926 (Frantz 2018). In the Southeast, at least one population on the Coosa River in Alabama is believed to have been extirpated due to the construction of the dam at Jordan Lake (Holt 2018a).

Riverbank stabilization

Natural bank erosion is important for sediment transfer to create or enhance riparian habitat and may modulate changes in channel morphology and pattern (Florsheim *et al.* 2008, p. 520). Increased erosion from river flow management of dams or resulting from increased storm intensity can adversely impact the riparian system if large quantities of fine sediments are released or the river channel morphology is altered. Often, the anthropogenic response to erosion, whether significant or otherwise, is to stabilize banks with hard structures to limit land loss or protect infrastructure. Geomorphic and ecological effects to the riparian ecosystem from the impacts of channel bank infrastructure (riprap, gabions or concrete lining) may be considerable (Florsheim *et al.* 2008, pp. 523–524). Hard bank structures increase velocities along banks affecting riverbank vegetation, reducing channel complexity, and homogenization of near-bank flow velocity may occur. There may also be a loss of access to side channels, a loss of natural bank substrate, and limitation of geomorphic adjustments depending on the type and area of bank stabilization. Hard structures may ultimately lead to greater erosion events downriver or locally (Florsheim *et al.* 2008, p. 524). Ultimately the aquatic habitats associated with the river may be significantly degraded or lost altogether.

We have no information to suggest additional dams will be built within the species' range, but hydrologic operations of existing dams may change in the future. Some changes may be necessitated by alterations in flow regimes resulting at least in part from climate change. The riparian ecosystem in which CTB habitat occurs evolved in a natural system of seasonal floods, ice scour, erosion, and accretion. The CTB habitat appears to be largely dependent upon the flow regimes that allow for spring flooding or ice scour and preclude prolonged inundation of adult or larval CTB habitat. Dams that alter the natural flow regime may reduce the size of metapopulations, resulting in isolated populations or extirpation. Anthropogenic activities including dams, impoundments, and channel bank infrastructure affect the balancing forces that maintain the river channel geomorphology, ultimately degrading or destroying sensitive riparian habitats.

Habitat Loss and Degradation
The CTB may experience habitat loss and degradation resulting from urbanization and construction, sand and gravel mining and recreation.

<u>Urbanization and construction</u>: Urbanization could affect CTB habitat through runoff of fine-grained sediments from the watershed (especially from construction sites) with deposition and accumulation on the cobble bars, especially those situated along the river banks (as opposed to island cobble bars). Increased sediment deposition would adversely impact egg laying and larval habitat by altering the suitable grain size and providing a substrate for vegetation, likely increasing vegetation density. Moreover, as infrastructure and development increase in the vicinity of riverbanks, the likelihood of bank stabilization affecting shoreline cobble bars increases, although impacts to island cobble bars may be less likely. For a more detailed analysis of how rates of urbanization are projected to change within the CTBs AUs, please refer to chapter 3 of the SSA report (Service 2018).

<u>Sand and gravel mining</u>: Sand and gravel mining is conducted in stream channels, stream terrace deposits, and on flood plains across the United States (Langer 2003, p. 5). Whether or not these operations result in adverse impacts on stream ecosystems and CTB habitat depends on the nature of the operation. Mining operations can remove suitable cobble and sand habitat at the species' location and change the hydrology of the riverine system, which can affect downstream locations. There are no known current in-stream sand and gravel mining operations occurring near extant CTB habitats. We do not have any information to suggest that sand and gravel mining will increase in the future.

Recreation: Driving an All-Terrain Vehicle (ATV) through CTB habitat can directly affect the population by compacting cobble substrate, reducing or eliminating larval burrows, and crushing adults, pupae, and larvae. The ATVs can indirectly affect CTB habitat quality through substrate disturbance, which can be a vector for the spread of invasive plants.

Use of ATVs were identified as a threat to one of the largest Grand Lake (New Brunswick) CTB sites, although evidence of impacts has varied over the years (COSEWIC 2008, p. 12). In 100-meter transect surveys conducted in 2004 and 2005, 26 and 31 CTB individuals were detected, respectively (COSEWIC 2008, p. 20). This area had no evidence of ATV use during those years. In July and August 2007, this same area was re-surveyed with only nine and three CTB individuals observed respectively, and evidence of ATVs (i.e., tire tracks, ruts, soil compaction, and damaged plants) was documented (COSEWIC 2008, p. 12). At two other CTB sites in Grand Lake, which were visited in 2007 and did not have documentation of ATV use, CTB populations had not changed since previous surveys, which suggests that a decline was restricted to the site with ATV use. However, detectability during surveys could have affected count data making the overall significance of ATV impacts uncertain. Although there may be larval destruction resulting from ATV use, the colonizing nature of CTBs could allow for populations to recover quickly with the removal of ATVs if the habitat has not been seriously degraded.

Cobble bar habitat may also be disturbed by people walking on it, which can cause soil compaction and collapse of larval tunnels (COSEWIC 2008, p. 20). The extent to which this occurs depends on the accessibility of the sites (i.e., whether burrows are in locations where people walk and the intensity of the recreational use). River sites may be adversely impacted by recreational boating, as island sites are made more accessible for pedestrian recreation. For example, sections of the Genesee (New York) and Pemigewasset Rivers (New Hampshire) have become popular destinations for rafting, kayaking, and tubing (Hudgins *et al.* 2011, p. 315; von Oettingen 2018b) due to their shallow nature, steady flows, and accessibility for stopping off at cobble bars.

Water Quality

Water quality stressors can adversely affect CTB populations through alteration of habitat or direct toxicity to CTBs or their prey. Of primary concern are excess nutrients and silt deposits on CTB habitats, which could enhance vegetative growth by fertilizing plants or providing more suitable substrate for plant growth (COSEWIC 2008, p. 19). Siltation from excess sediment loading could also alter the preferred mix of grain size and unembedded cobble (see SSA Report section 2.4), making habitat unsuitable for the CTB. Sources of sediment include residential runoff, forestry and mining operations, agricultural practices, construction sites, stream bank erosion, and in-stream disturbances (EPA 2002).

To evaluate the stressor of water quality to CTB habitats, we relied upon each state's Clean Water Act 303(d) list of impaired waters as a standard approach for gathering water quality data. We reviewed maps of the 303(d) listed water bodies in relation to the CTB AUs and river reaches. None of the identified listings are for nutrients and sediments, which can directly alter CTB habitat. Other impairments are attributed to pH, dissolved oxygen saturation, *E. coli* or bacteria, and temperature. Of these, low dissolved oxygen and bacterial impairments may be related to nutrient and/or sediment inputs. Thus, low dissolved oxygen and bacteria may be connected to possible adverse effects on CTB habitat from nutrients and sediment loading. These low dissolved oxygen and bacteria listings occur in the Upper and Middle Pemigewasset River, Winooski River, White River, and French Creek - Ohio River AUs. It is uncertain whether impairments for pH or temperature (unless it was at or approaching a lethal level) would adversely impact CTB habitat.

Canadian provinces do not have impaired waters lists analogous to the 303(d) listings. For rivers, a Water Quality Index is calculated based on comparisons of chemical contaminant concentrations, nutrients, and pH with Guidelines for Freshwater Aquatic Life (New Brunswick Department of Environment 2007, p. 1). The most recent Watershed Summary for the Saint John River is based on 2003-2006 Water Quality Index data and comparisons with guidance values for nutrients, pH, E. coli, and dissolved oxygen. None of the 30 water quality monitoring sites in the watershed exceeded the guidance value for nitrate (New Brunswick Department of Environment 2007, p. 1). No data were provided on suspended sediments or total suspended solids.

All Saint John River CTB sites are adjacent to agricultural areas that are largely potato farms with about 25 percent agricultural land use (Kidd *et al*. 2011, p. 32). Evidence of agricultural runoff at a CTB island site near Hartland, New Brunswick was documented during an August 2005 survey (COSEWIC 2008, p. 19). Cobblestones along the island shoreline and adjacent river bank were coated with a layer of organic material and the air smelled strongly of poultry manure. It was uncertain whether this was a chronic or acute problem, as there was less evidence of agricultural runoff at this site during the 2006 and 2007 surveys (COSEWIC 2008, p. 19). No similar Watershed Summary was identified for Grand Lake, although nutrients of unknown origin appear to be a concern. A Public Health Advisory issued for Grand Lake on July 15, 2015 for blue-green algal blooms is still in place (Government of New Brunswick 2018a, p. 1). However, CTBs are extant in this area.

Effects of Small Population Size
There are no population estimates for the majority of CTB sites and surveys indicate that most populations are estimated to be small, rarely exceeding 60 individuals at a site. Population estimates were completed for the two Canadian AUs using data from surveys completed in 2007 and 2008. A combined total of 488 beetles were estimated for 2 of 3 Grand Lake localities (01AO000), and 4,487 beetles for the 4 Saint John River localities (01AJB00). These estimates were based on 2- or 3-day mark, release, and recapture studies using the Lincoln Index (COSEWIC 2008, p. 16). Small populations may be vulnerable due to a lack of genetic diversity; however, we have no information regarding genetic diversity of the CTB. According to Knisely (2017), the CTB is genetically adapted to colonize habitat patches, which could indicate that small population size is less of a concern, especially within metapopulations. Lack of biological and demographic data hinders our ability to understand small population effects, but we theorize that the impacts are limited in comparison to environmental stressors that affect habitat quality.

Effects of Climate Change

Under both Representative Concentration Pathway (RCP) 4.5 and RCP 8.5, average annual temperatures are projected to increase across all U.S. states with CTB AUs (Vose *et al.* 2017, p. 196). In the northern and midwestern U.S. states and New Brunswick, Canada, annual temperatures are projected to increase by mid- and late century. The projected increases in winter temperatures for the northern states could affect the timing of river and lake freeze-up and breakup. Higher water and air temperatures in the fall and spring could combine to delay the time of first ice-formation (fall) and advance the time of first ice break-up (spring). Thus, there are predictions for increased springtime flooding. In the South, there will also be increases in annual temperature, but slightly less in magnitude than in the Midwest and Northeast. More intense and extended summer drought is predicted throughout the range, with the most extreme conditions in the Midwest and South.

Projected changes in winter and summer temperature; winter, spring, and summer precipitation; the frequency and intensity of extreme precipitation events; the duration and intensity of spring and summer flooding; and the intensity and duration of drought may all affect the CTB and its habitat. Increased temperatures may harm the CTB if its thermal limit is exceeded or indirectly through changes in precipitation patterns (e.g., rain vs. snow) and extent and frequency of ice scour. In addition, heat and drought in the summer could result in desiccation of larvae. Information on many of these indicators was incomplete at the AU level.

In the winter and spring, the altered hydrology would affect the maintenance of cobble habitat (unembedded substrate with 6- to 30-percent sand and sparse vegetation). Changes in channel morphology as a result of flooding and sedimentation processes may cause CTB habitat degradation by altering or eliminating cobble bars or changing the cobble bar structure (size of cobble, interstitial sand). The projected decrease in ice scour in the northern portion of the CTB range, one factor that maintains sparse vegetation, could result in more vegetation taking hold and decrease the suitability of the habitat for larvae. Extended spring flooding with prolonged inundation could also be detrimental to larval survival.

Prolonged extreme heat, particularly in the southern areas of the CTB range, could approach the thermal tolerance limit for the CTB potentially resulting in reduced productivity, increased susceptibility to predation or mortality of larvae or pupae. Prolonged and more intense drought would adversely affect the CTB at several life stages. Laboratory research with hairy-necked tiger beetle (*Cicindela hirticollis*) larvae (another tiger beetle species found along riverine and coastal shorelines) demonstrated that these larvae select soils with surface moisture levels of 7-percent to 50-percent saturation to dig new burrows and avoided digging burrows in soils with lesser moisture content (Brust *et al.* 2006, p. 251, 256). Soil desiccation could prevent larvae from burrowing or adults from ovipositing. In addition, larvae may be unable to avoid desiccation during the drought periods.

The extent to which extreme storms will result in floods that will harm CTB habitat through prolonged inundation is uncertain. These storms are projected to occur in areas that are also projected to undergo drought. The rapid changes in water levels may result in more movement of bed and bank sediment that could be disruptive to cobble bar habitats.

Four states (New York, West Virginia, Pennsylvania, and Maine) have conducted climate change vulnerability analyses for at-risk species, including the CTB. New York State categorized the CTB as "not vulnerable/presumed stable" in terms of its vulnerability to climate change up to the year 2050 (Schlesinger et al. 2011, p. 3, 19). This means that "[a]vailable evidence does not suggest that abundance and/or range extent within the geographical area assessed will change (increase/decrease) substantially by 2050. Actual range boundaries may change." Confidence for the category was rated as very high (Schlesinger *et al.* 2011, p. 41). West Virginia and Pennsylvania ranked CTB as "moderate vulnerable," which means the species' abundance and/or range extent within the geographical area is likely to decrease by 2050 (Byers and Norris 2011, p. 15; Furedi *et al.* 2011, p. 10). Maine ranked the CTB as having "medium vulnerability" to the effects of climate change, meaning that climate change is likely to have an intermediate impact on the species' range and/or population size in Maine within the next 50 to 100 years. The reviewers' confidence in the rating was low because of the limited distribution of the species in Maine, and the uncertainty regarding hydrology needs and threats (Whitman *et al.* 2018, p. 58).

Conservation Efforts

There are no species-specific actions or strategies dedicated to CTB conservation. The species benefits from general conservation strategies that are outlined in State Wildlife Action Plans (SWAPs) and when it occurs on conservation or public lands that are protectively managed for natural resources.

The CTB is designated a Species of Greatest Conservation Need (SGCN) (USGS 2018b) based on information provided in SWAPs. Six states and New Brunswick, Canada have listed the CTB and afford the species varying degrees of protection under state endangered species acts. Some states track the species based on the NatureServe rankings despite it not being listed under state endangered species laws (e.g., WV and AL). The NatureServe rankings are described on a five-point scale from critically imperiled (S1) to secure (S5) (NatureServe 2018). Nine States and New Brunswick, Canada rank the CTB as S1 (critically imperiled), which is defined as "at very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors" and two states rank the CTB as S2 (imperiled), which is defined as "at high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors."

No SWAPs have identified site-specific conservation measures for CTB populations; however, there are common threads in most SWAPs that provide general conservation measures for listed species that are applicable to CTB conservation (table 7). These recommendations include: increase surveys, monitoring, and research to fill population and life history data gaps (most SWAPs); maintenance or restoration of natural riparian processes such as bank dynamics, channel meanders and flood regimes (AL, VT); prevention of substrate compaction from vehicular or recreational traffic (AL, NH, VT); minimization of point and nonpoint source (e.g., agricultural) pollution; avoidance of hard structures for bank stabilization; development of management plans to improve land use practices (OH); site conservation through acquisition and/or easements (MA, VT); maintenance of riparian system connectivity (PA); and implementation or enforcement of applicable laws and regulations protecting the CTB habitat (MA, PA).

The Northeast Association of Fish and Wildlife Agencies recognizes the species as a Northeast Regional Species of Greatest Conservation Need for those states in which it occurs. The regional designation highlights the status of the species and promotes the design and implementation of regional conservation strategies for the species. To date, no state or regional conservation plan addressing the CTB has been prepared.

Occupied CTB sites in six states have some form of land protection that either includes CTB extant populations or lands that are adjacent to the cobble bars on which the species occurs. There may be some protected lands in Canada associated with the two Grand Lake CTB metapopulations, but additional information was not available at the time of the SSA. In the United States, most sites are primarily in public ownership, although a few are under easement to a nongovernmental organization. Management of protected lands varies across locations. This includes sites that are specifically managed for biodiversity (AL, NH, VT, WV; four locations in total) or managed for multiple purposes that could include extractive activities such as mining or logging (AL, NH, NJ, NY, VT; eight locations). The remaining populations are not managed under any particular mandate (AL and NY; two locations). None of these sites are specifically managed to maintain or enhance CTB populations at this time. Opportunities may exist for coordinating with the landowners to identify conservation measures to protect existing populations. These measures could include vegetation and recreational management, prohibiting extraction activities that could degrade or destroy habitat, or increasing protective buffers around existing populations through additional land conservation.

Synergistic/Cumulative Effects
Many stressors are closely linked to the ability of the hydrological regime to maintain the cobble bar community. Sedimentation, vegetation density, and river flow all greatly impact the cobble bar presence and quality that is necessary for CTB populations. Fine sediment deposition allows for increased growth of vegetation, which reduces the availability of interstitial spaces used by the CTB for their multiple life cycle stages. River flow is especially important as it can greatly impact sediment deposition and transport as well as vegetation growth. Dams and locks are the most notable impacts on river flows that may negatively affect CTB habitat.

<u>Threats Summary</u>
Our analysis of the past, current, and future influences on what the CTB needs for long-term viability revealed that there are two influences that pose the largest risk to the viability of the species. These risks are primarily related to changes in the natural hydrological regime and the effects of climate change. Our review of the 303(d) impaired waters list revealed that none of the identified listings are for nutrients and sediments, which can directly alter CTB habitat. Collection of CTBs has not been documented as being a concern for most of the populations, and we have no evidence that it has led to a decline or extirpation of any of the sites. Recreational impacts (through ATV use) have been documented in three AUs; however, we do not have information to indicate that these impacts are currently affecting the CTB at a species level. Disease, predation, and sand and gravel mining do not appear to be occurring at a level that affects the species overall.

Current Condition and the 3Rs (Resiliency, Redundancy, and Representation)
We evaluated the current condition of the CTB and considered what it needs to maintain viability by characterizing the biological status of the species in terms of its resiliency, redundancy, and representation. Resiliency describes the ability of a species to withstand stochastic disturbance (arising from random factors). Redundancy describes the ability of a species to withstand catastrophic events. Representation describes the ability of the species to adapt to changing environmental conditions over time.

We chose to assess CTB resiliency within each AU using a combination of habitat and demographic metrics that are most relevant to the species' biology and influencing factors, and for which we had available information to consider. Habitat metrics consisted of substrate/sedimentation, suitable scour/vegetation density, and managed flows. These metrics were categorized based on best available data and weighted based on ecological significance to determine the overall habitat metric score. The demographic metrics were an AU population category (evaluated using a combination of CTB count data and persistence data) and a metapopulation category (evaluated using the geographic range of the metapopulation and the number of populations within a metapopulation). Similar to the habitat metrics, the overall demographic score was determined by categorizing each AU according to the best available information on that metric and weighting it according to ecological significance. Both the overall habitat scores and overall demographic scores were used to determine the overall resiliency score of each AU. The overall resiliency score is similar to the overall habitat and overall demographic score in that each category has a corresponding score that is then weighted. Because of the CTB's ability to recolonize suitable habitat and the amount of uncertainty associated with the demographic metrics, we weighted the overall habitat metric more heavily than the overall demographic metric (i.e., 1.5 vs 1, respectively). These scores were then added and divided by 2.5 to determine the overall resiliency score (rounding non-whole numbers up if they exceeded a 0.5 threshold). The scores were then used to assign the appropriate overall resiliency category of High (greater than (>)2.5), Moderate (1.5 - 2.4), or Low (0 - 1.4). For a detailed description of our habitat and demographic metrics, please refer to the SSA (Service 2018, Chapter 4 and Appendix A).

There are 13 AUs with a High resiliency category, 9 AUs with a Moderate resiliency category, and 3 AUs with a Low resiliency category (see figure 3). Two AUs along the Delaware River are considered Status Unknown due to negative survey data from 2012, 2014, 2016, and 2017. The CTB has been found within both of these AUs within the last 20 years indicating they could be extant populations, however, CTB has not been observed since 2001 (Raymondskill Creek-Delaware River) and 2011 (Flat Brook-Delaware River). Due to the non-standardized survey methodology and the cyclic nature of the CTB life cycle, we do not have enough information to consider these AUs extirpated. Eighteen of the 45 AUs (40 percent) found in the historical range are considered to be historical or extirpated. All 18 of the historical/extirpated AUs are located within the U.S. For the 25 extant AUs with known status, AUs with a designation of Low resiliency comprise 12 percent, Moderate resiliency comprise 36 percent, and High resiliency comprise 52 percent of the population. Although the majority of the extant AUs received a designation of High, the loss of 40 percent of the historical AUs led us to designate the overall CTB current resiliency as Moderate.

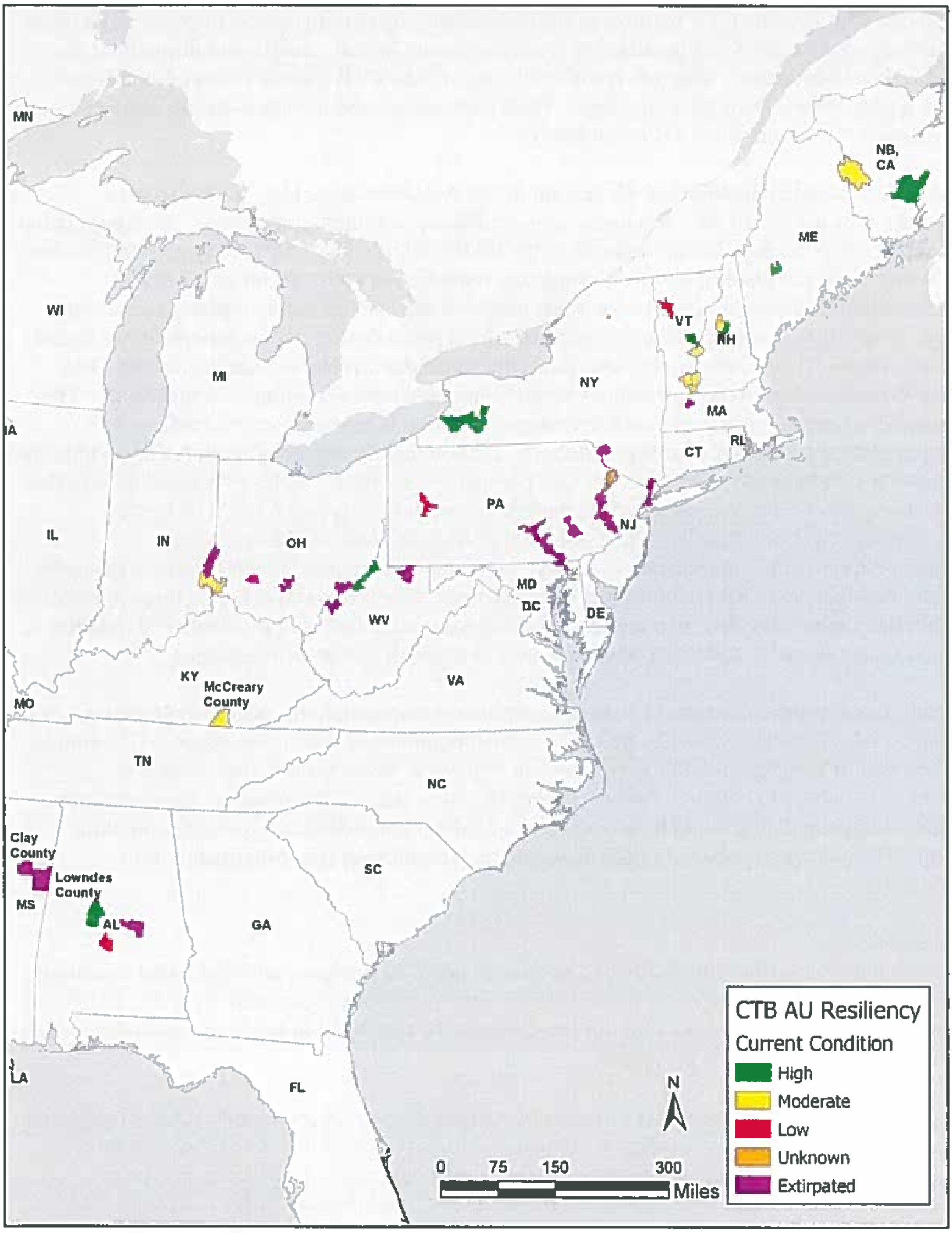

Figure 3. CTB Current Condition Resiliency Categories–Rangewide

Redundancy
To ensure viability, the CTB requires multiple resilient populations spread throughout its range. Evidence suggests that CTB populations were once more broadly distributed throughout the species' historical range. Whereas the overall range of the CTB has not changed significantly, it has lost populations throughout its range. Both populations and metapopulations were examined within each AU to identify CTB redundancy.

Within the historical distribution, 40 percent of the AUs have been lost. With this loss, distribution of the extant AUs has become more disjunct throughout the range. Metapopulations are important to the population structure of the CTB, and it is likely that many populations were lost with the loss of historical AUs. Despite the reduction in AUs, we found 16 extant metapopulations throughout the range, most of which are located in the northern part of the range. Four of these metapopulations span two AUs and there are two metapopulations found within a single AU in Canada. In New York, the Caneadea Creek-Genesee River and Cold Creek-Genesee River AUs represent a single metapopulation containing 23 populations. The Headwaters Cattaraugus Creek and Cattaraugus Creek AUs also represent a single metapopulation consisting of five populations. Although only one population resides within the Headwaters Cattaraugus Creek AU, the one population is within 5 miles of a population within the Cattaraugus Creek AU, creating a metapopulation that spans two AUs. The Lower Carrabassett River and Middle Carrabassett River AUs in Maine make up a single metapopulation with 11 populations. Lastly, the metapopulation in New Hampshire spans the Middle Pemigewasset River and Upper Pemigewasset River AUs and contains three populations. Within the Grand Lake AU, two metapopulations were identified and are labeled "01AO000 (Grand Lake "north")" and "01AO000 (Grand Lake "south")" for differentiation.

Overall, 6 out of the 27 extant AUs do not support a metapopulation. Although 40 percent of the historical AUs have been lost, the presence of metapopulations within the extant AUs could be an indicator of habitat availability, which is an important factor for this species as it is genetically adapted to colonize habitat patches (Knisley 2018). The number of populations within a metapopulation could be an indicator of habitat conditions and overall population health. The average number of populations per metapopulation is approximately four populations.

Representation
Representation describes the ability of a species to adapt to changing environmental conditions over time and is characterized by the breadth of genetic and environmental diversity within and among populations. Representation for the CTB can be described in terms of variability among latitudes and physiographic provinces.

We assessed the CTB range under different physiographic provinces to understand whether the species has a wide capacity to adapt to varying geological conditions. Each physiographic province has a characteristic geomorphology, and often specific subsurface rock type or structural elements. Although overall the physiographic regions may differ with respect to ecosystem types, geomorphology, and climate, it is clear that the basic habitat requirements do not vary.

The historical CTB range spans from Canada to Alabama, encompassing seven physiographic provinces: with populations representing the New England, Saint Lawrence Valley, Piedmont, Valley and Ridge, Appalachian Plateaus, Central Lowland, and Coastal Plain. Distribution has since become patchy in the central portions of the range with the extirpation of 17 AUs. The CTB has lost all of its representation in the Piedmont physiographic provinces and many of the AUs representing the Central Lowland province accounting for a combined loss of 8 AUs. The New England province maintains 79 percent of the historical AUs and accounts for some of the largest metapopulations throughout the range. Although there have been some extirpations in the other represented provinces, more than half of the AUs are still present in the New England, Saint Lawrence Valley, Appalachian Plateaus, and Coastal Plain provinces. The status of AUs within the Valley and Ridge physiographic province are unknown.

As evaluated through hydrological systems, latitudinal variability, and physiographic provinces, the current distribution of the CTB reflects some loss in historical representation. The current CTB range remains in five of the seven historical physiographic provinces to varying extent, from the far northern United States and Canada to the far southern United States. Based on this, it is likely that the species maintains some adaptive potential and variability amongst its populations against catastrophic events.

Future Condition

We developed three future plausible scenarios to assess the future viability of the CTB in terms of the 3Rs. All scenarios forecast future conditions for 2050 and 2080.

Scenario A is a continuation scenario in which the influencing factors are projected to change in a similar manner as in the present day. Climate change is projected under RCP 8.5. Scenario B is a scenario in which the influencing factors change on a trajectory that is different than the continuation scenario, largely due to conservation actions that may partially counteract some projected adverse effects and a lesser climate change projection (RCP 4.5). Scenario C is a scenario in which some of the influencing factors would change to a greater extent than under Scenario A, largely due to a lack of conservation actions. We recognize that not all influencing factors have negative impacts and that CTB habitat and populations are affected by multiple factors, some of which may affect habitats in a positive manner, others in a negative manner.

In some cases, the projected changes are the same for all three scenarios. For example, four AUs (Soapstone Creek, Whitewater River, Raymondskill Creek-Delaware River and Flat Brook-Delaware River) were identified as having the greatest increase in urban land use between 1997 and 2020. These four AUs also have the largest projected increases in urban land use in 2060 compared with 1997 (about 15 percent; Wear 2011, p. 1 and excel spreadsheet). The increase in urbanization in all other AUs with extant populations or Unknown Status is between 0.5 and 6.1 percent. We conclude that urbanization should be included as an influencing factor in these four AUs only, but that there is no rationale for preparing different projections for each of the three scenarios.

Under Scenario A, the recent changes and trends affecting CTB habitat and populations extend with the same trajectory through the two forecast periods. For example, climate change would continue along the RCP 8.5, which we conclude in section 3.5 would be the most likely scenario for changes through the middle of the 21st century. In the northern part of the range, CTB habitat would be affected such that the decrease in scour due to ice flow and an increase in intensity and duration of precipitation events could alter or eliminate cobble bars. Throughout the range, and especially in Alabama, Ohio, and Indiana, increased intensity and duration of summer drought could reduce soil moisture, adversely affecting the ability of larvae to construct burrows (for example). The trends in urbanization for each of the AUs continue along the same path. For the Grand Lake sites there are no predictions regarding the extent of future shoreline development (New Brunswick Forest Planning and Stewardship 2018).

Under Scenario A, no additional conservation measures would be initiated and CTB sites would continue to be surveyed on an ad hoc basis. There would be no changes in the management of the dams by revising current flow management efforts to be more protective of CTB habitats and populations. Protection from recreational activities would continue on the current ad hoc basis. With Scenario B, these changes and trends occur on a lower trajectory than Scenario A. Climate change would be forecast to proceed along the RCP 4.5 scenario, taking into account the refined projections of global temperature change proposed by Brown and Caldeira (2017, p. 47). Whereas proceeding along RCP 8.5 is more likely, RCP 4.5 is still plausible and is used in the Fourth National Climate Assessment (Hayhoe *et al.* 2017, pp. 135-149). Thus, under Scenario B, in the future forecasts for 2050 and 2080, temperature increases would be less and drought would be less severe and shorter than is projected under Scenario A. Similarly, the projected changes in ice scour and resultant effects on CTB habitat would occur at a slower rate.

Under Scenario B, conservation actions would be implemented that would help to maintain or improve CTB habitats and populations. These actions would include those listed as "common threads" in the SWAPs and include the minimization of point and nonpoint pollution through use of Best Management Practices; maintenance and restoration of riparian areas and system connectivity; increased surveys, monitoring, and research to fill population and life history gaps; and avoidance of hardened bank stabilization measures. Additional activities would include use of conservation easements and/or land acquisition to protect existing populations. Translocation of nearby populations to restored habitats would be conducted as part of a conservation strategy, if warranted. The three New York City water supply reservoirs that may have adversely affected the Raymondskill Creek-Delaware River and Flat Brook-Delaware River AUs (and possibly several extirpated/historical sites) would be managed to benefit aquatic species including the CTB. Dam relicensing decisions would result in implementation of flows that are beneficial to CTB and these benefits would be in place for 40 to 50 years.

With Scenario C, changes are projected to occur that would be detrimental to CTB habitats and populations compared with Scenarios A and B. The climate change scenario would be RCP8.5 with projected changes identical to Scenario A. Dam management for power needs, flood control, or water supply would not address CTB conservation needs. As was the case for Scenario A, there would be no additional conservation measures initiated and CTB sites would continue to be surveyed on an ad hoc basis. There would be a decline in actions (such as enforcement or signage) aimed to protect habitats from the effects of recreational activities. Other actions or lack of actions under Scenario C that could be detrimental to CTB habitats, include bank stabilization with hardened materials in response to increased bank erosion, and a failure to control point and nonpoint source pollution. In short, recommended actions that could be implemented as conservation measures would not be implemented. Thus, the stressors associated with nearby land use would continue without regulatory or voluntary measures.

We set time steps of our assessment of the future condition of the CTB to 2050 and 2080 because this timeframe represents multiple CTB generations (e.g., a 2-year cohort life history) and because the available data allow us to reasonably predict the potential significant effects of stressors within the range of the CTB during this timeframe.

Table 3 summarizes the number and corresponding percentage of AUs in each resiliency condition category.

Table 3. Resiliency Condition Categories of CTB AUs for Current Condition and Future Scenarios A, B, and C

Resiliency Category	**Current Condition AUs**	**Scenario A AUs 2050**	**Scenario A AUs 2080**	**Scenario B AUs 2050**	**Scenarios B AUs 2080**	**Scenario C AUs 2050**	**Scenario C AUs 2080**
High	13 (29%)	10 (22%)	7 (16%)	14 (31%)	15 (33%)	4 (9%)	1 (2%)
Moderate	9 (20%)	12 (27%)	14 (31%)	8 (18%)	14 (31%)	17 (38%)	18 (40%)
Low	3 (7%)	2 (4%)	2 (4%)	5 (11%)	5 (11%)	1 (2%)	2 (5%)
Historical /Extirpated	18 (40%	21 (47%)	22 (49%)	18 (40%)	11 (25%)	23 (51%)	24 (53%)
Unknown	2 (4%)	0	0	0	0	0	0
Total	45	45	45	45	45	45	45

Scenario A

Resiliency
Under Scenario A, the number of AUs in the High and Low resiliency categories are predicted to decrease in 2050 and 2080, while the number of AUs in the Moderate and Historical/Extirpated resiliency categories are predicted to increase by 2080. The predicted changes in the Moderate category are due to six High resilient AUs dropping to Moderate by 2080 with one Moderate predicted to become Historical/Extirpated.

Redundancy
Under Scenario A, we predict that six AUs in High resiliency condition will decline to a Moderate condition by either 2050 or 2080 potentially affecting 29 percent of metapopulations in the Northern and Southern areas of the range. We predict that two AUs, Flat Brook-Delaware River and Raymondskill Creek-Delaware River, will be extirpated by 2050 and that two additional AUs, Winooski River and Rock River-West River, will become extirpated by 2080, reducing the range by 7 percent by 2050 and 14 percent by 2080. The loss of these populations

is likely to make the CTB slightly more vulnerable to stochastic disturbance events, especially in Vermont and Pennsylvania, where all of the projected extirpations occur. Winooski River and Rock River-West River AUs both currently contain metapopulations consisting of two populations each, and both have a geographic range of less than 1 mile. Extirpation of these AUs leads to a 10-percent reduction in metapopulations throughout the range.

Representation
Given our measure of representation for the CTB, which is described in terms of variability among hydrologic systems, latitudes, and physiographic provinces, we predict that the CTB will continue to demonstrate representation at the end of our time horizon (2080). Although four AUs are predicted to become extirpated by 2080, the species' distribution is not expected to significantly contract (7 percent by 2050, 14 percent by 2080). However, under Scenario A, the CTB will show a slight decline in physiographic province representation by 2080. With the extirpation of Winooski River, Flat Brook Creek-Delaware River, and Raymondskill Creek-Delaware River, there is a projected loss of representation in the St. Lawrence Valley and Valley and Ridge physiographic provinces by 2050. By 2080, there will be a reduction in representation within the New England province with the loss of Rock River - West River AU.

Scenario B

Resiliency
For Scenario B, the effect of conservation actions and a lower climate pathway (RCP 4.5 vs. 8.5) will maintain higher resiliency categories in many of the analytical units. We predict that the number of AUs in the High resiliency category, currently 13, will increase to 15 by 2080. We predict that the number of AUs in the Moderate resiliency category, currently 9, will decline to 8 by 2050 and increase to 14 by 2080. This can be attributed to AUs moving to the High category as they become more resilient due to improving habitat conditions (potentially as a result of conservation actions) or movement to the Low Category if conservation actions were not implemented or not completed in time to increase the AU resiliency.

By 2080, we predict that High, Moderate, and Low resilient categories will increase, primarily as a result of population introduction/augmentations in historical/extirpated sites. For example, we predict the Mill Brook–Connecticut River population to improve to High in 2050 and remain High in 2080, if habitat is restored as a result of favorable flow regimes from beneficial FERC relicensing negotiations. The Upper Pemigewasset River AU is predicted to improve to High in 2080. The Upper Pemigewasset River AU, which currently has only one population, is predicted to expand under favorable natural processes as additional habitat may be created and colonized by CTB. The two AUs with Unknown status under current conditions, Flat Brook–Delaware River and Raymondskill Creek–Delaware River, are predicted to have Low resiliency in 2050 and 2080. These AUs persist as a result of conservation measures implemented through Scenario B, and the lower adverse climate impacts under RCP 4.5. We also predict that conservation measures under Scenario B will result in the restoration of seven extirpated AUs by 2080, either through translocation of genetically suitable individuals from nearby populations or possibly through captive propagation.

Redundancy
Under Scenario B, we predict that the CTB will improve its redundancy over our time period. The AUs that currently have High resiliency will continue to have High resiliency in 2080. We also predict that seven currently extirpated AUs will be restored by 2080, due to conservation efforts, resulting in a 26-percent increase in the number of AUs. The restored AUs are located in the Northern, Central, and Western areas of the range.

Representation
Under Scenario B, we predict that the CTB will continue to demonstrate representation at the end of our time horizon (2080). The CTB will continue to exhibit hydrologic system variability within the majority of its range, and will continue to have latitudinal variability and physiographic province representation across its range with no predicted extirpations of AUs. Seven currently extirpated AUs will be restored by 2080 due to conservation efforts. These restorations will increase representation in four physiographic provinces: New England (increasing by two AUs), Piedmont (one AU), Appalachian Plateau (one AU), and Central Lowland (two AUs), resulting in all seven historical provinces being represented by 2080.

Scenario C

Resiliency
We predict that, under Scenario C, the effects of climate change under RCP 8.5, a lack of conservation actions, and activities such as dam reconstruction or changes to dam flow regimes will result in further adverse impacts to many CTB AUs. The number of AUs in the High resilient category, currently 13, will decline to 4 by 2050 and to only 1 (Grand Lake, New Brunswick) by 2080. We predict an increase over the number of Moderate AUs under the Current Condition for both 2050 and 2080, primarily as a result of High resilient AUs declining in resiliency.

Extirpation risk increases in this scenario. Two of the three AUs in the Low resiliency category under current conditions are predicted to become extirpated by 2050 (Winooski River and Allegheny River) and the third, Soapstone Creek-Alabama River, is predicted to be extirpated by 2080. Both of the AUs currently in the Unknown category become extirpated by 2050. The total number of extirpated AUs increases under Scenario C from the current count of 18 to 23 by 2050 and 24 by 2080.

Redundancy
Under Scenario C, we predict that 9 to 11 AUs in a current High resiliency condition will decline to a Moderate condition by either 2050 or 2080, reducing resiliency of 48 percent of the range. We predict that five AUs will be extirpated by 2050 and one additional AU, Soapstone Creek-Alabama River, will be extirpated by 2080 causing a 19-percent range reduction by 2050 and 22-percent reduction by 2080. These extirpations occur in the Northern, Central, and Southern areas of the range. Of the extirpated sites, two of the AUs are metapopulations, consisting of two populations each and a geographic range of less than 1 mile. The loss of these AUs causes a 10-percent decline in metapopulations throughout the range. This decline in condition, as well as the loss of several AUs, is likely to make the CTB more vulnerable to stochastic disturbance

events, especially in Vermont and Pennsylvania.

Representation
Under Scenario C, we predict that the CTB will demonstrate a lower level of representation at the end of our time horizon (2080). The CTB will continue to exhibit hydrologic system variability with AUs, and will continue to have latitudinal variability; although with the predicted extirpation of six AUs by 2080, the species' distribution is expected to contract (22-percent reduction in range). The CTB will show a decline in physiographic province representation by 2050 with the loss of one AU in the Appalachian Plateau and one AU in the New England province. By 2080, representation will decline further with the loss of one AU in the Coastal Plain province. All representation within the St. Lawrence Valley and Valley and Ridge provinces will be lost by 2080.

Summary of Future Condition
We used the best available information to describe the future viability of the CTB in terms of resiliency, representation, and redundancy. To capture the uncertainty associated with the degree and extent of potential future conditions and their impacts on the CTB, each of the 3Rs were assessed using three plausible future scenarios. The CTB faces risks from the operation and construction of dams, the effects of climate change, and loss or destruction of habitat (resulting from development, bank stabilization activities, recreational impacts, and invasive vegetation). These risks play a large role in the future viability of the CTB. If AUs lose resiliency, they are more vulnerable to extirpation, with resulting losses in representation and redundancy.

Overall, we have found that Scenario A shows a continuation of CTB viability trends in resiliency, representation, and redundancy. The AUs continue to slowly decline in condition and become more disjunct throughout their distribution and more metapopulations are lost. Scenario B shows an increase in CTB viability trends with the recovery and restoration of several AUs. This recovery extends the currently occupied AUs into a more contiguous distribution and encourages the development of metapopulations. Scenario C shows a significant decrease in CTB viability with the quick decline of High condition AUs and a larger number of extirpations, relative to the other scenarios. The effects of this decline are similar to Scenario A; however, the impacts are seen more quickly and are more drastic within the projected time period.

For the future scenarios, there are uncertainties in climate pathways RCP 8.5 and RCP 4.5 and how changes in climate indicators affect AUs. For Scenario B, there is no way to reliably estimate how many conservation actions will be applied and how effective they will be in maintaining or improving resiliency for particular AUs or in restoring populations to previously occupied locations. Similarly, for Scenario C, the impacts of a lack of conservation actions or the implementation of adverse actions is unknown. Thus, the trajectories and projections of resiliency status under each scenario may be overestimated (status rated too high) or underestimated (status rated too low).

FINDING
<u>Standard for Review</u>
Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set

forth the procedures for determining whether a species meets the definition of "endangered species" or "threatened species." The Act defines an "endangered species" as a species that is "in danger of extinction throughout all or a significant portion of its range," and a "threatened species" as a species that is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The Act requires that we determine whether a species meets the definition of "endangered species" or "threatened species" because of any of the following factors:

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;
(B) Overutilization for commercial, recreational, scientific, or educational purposes;
(C) Disease or predation;
(D) The inadequacy of existing regulatory mechanisms; or
(E) Other natural or manmade factors affecting its continued existence.

Summary of Analysis

The biological information that serves as the basis for our finding is presented in detail in our SSA Report for the CTB (Service 2018, entire) and is summarized above under the **BIOLOGICAL INFORMATION** section of this Species Assessment Form. In our SSA, we evaluated all threats to the CTB, which fall under Factors A, C, and E of section 4(a)(1) of the Act and include the following: habitat loss, fragmentation, and degradation from hydrological changes (i.e., dam operations and riverbank stabilization), urbanization, sand and gravel mining, and changes to water quality (Factor A); impacts of small and isolated populations (Factor E); and the effects of climate change (Factors A and E). We also evaluated existing regulatory mechanisms (Factor D) for the CTB in the context of relevant threats; however, there are relatively few regulatory mechanisms with conservation measures that specifically target the CTB. In addition, we evaluated the impacts of collection (Factor B) on the CTB.

To make the determination whether the CTB warrants protection as an endangered or threatened species under the Act, we evaluated the current factors and the species' potential future viability given projections of future factors (taking into account the risk factors and their effects on individuals and populations). As described below, we first evaluated whether the CTB is in danger of extinction throughout its range (an endangered species). Second, we evaluated whether the CTB is likely to become in danger of extinction throughout its range within the foreseeable future (a threatened species). Third and finally, we considered whether the CTB is an endangered or threatened species in a significant portion of its range.

Is the CTB an Endangered Species Throughout all of its Range?

We used the best available scientific and commercial data to evaluate the current viability (and thus risk of extinction) of the CTB to determine if it meets the definition of an endangered species. Our review of this information indicates that, despite the threats influencing the CTB, in its current condition, there is representation (i.e., occupancy) across the majority of the CTB's historical range. Although there has been a reduction in range with the apparent extirpation of the species from 18 AUs, the species is still found across 25 AUs, which are found in the northeast, central, and southeast United States and eastern Canada. The risk of extinction is extremely low given that these 25 AUs are spread across 5 of the 7 historical physiographic provinces (indicating significant current representation). Of these 25 AUs, 22 (88 percent) are in the high or moderate resiliency category, indicating a strong ability to withstand environmental or demographic stochastic events. Additionally, there remain 16 metapopulations (an assemblage of populations within 5 miles of each other) within 19 AUs throughout the range of the CTB, further indicating strong resiliency and redundancy. The species maintains a significant ability to withstand catastrophic events and adapt to changing environmental conditions. The continued persistence of occupied AUs across the species' range provides sufficient resiliency, redundancy, and representation to sustain the species beyond the near term. Thus, we conclude that the CTB is not in danger of extinction throughout all of its range and does not meet the definition of an endangered species.

Is the CTB a Threatened Species Throughout all of its Range?
Under the Act, a threatened species is any species that is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The foreseeable future refers to the extent to which the Secretary can reasonably rely on predictions about the future in making determinations about the future conservation status of the species (U.S. Department of the Interior, Solicitor's Memorandum, M–37021, January 16, 2009). A key statutory difference between a threatened species and an endangered species is the timing of when the relevant threats would begin acting upon a species such that it may be in danger of extinction, either now (endangered species) or in the foreseeable future (threatened species).

In considering the foreseeable future as it relates to the status of the CTB, we considered the relevant risk factors (threats/stressors) acting on the species and whether we could draw reliable predictions about the status of the species in response to these factors. We considered whether we could reliably predict any future actions that might affect the status of the species, recognizing that our ability to make reliable predictions into the future is limited by the variable quantity and quality of available data about effects to the CTB and its response to those effects. *The foreseeable future timeframe we identified is a period between 2050 to 2080.* This timeframe overlaps multiple CTB life-cycles and considers the impacts of stressors, such as the dam relicensing process and the effects of climate change that may change over time. Significant uncertainties regarding the possible trends, interactions, and ultimate effects of the various stressors across the range of the CTB reduce our confidence in making longer term projections under Scenarios A, B, and C. Therefore, we consider 2050 to 2080 to be a reasonable timeframe for the foreseeable future for the CTB, as we find it to be a timeline within which we can make reasonable inferences from the best available data.

When reviewing the three future scenarios, we do not find that any one scenario completely captures the future condition of the CTB or its habitat, so we take them all into consideration. Under Scenario A, CTB resiliency in six AUs is predicted to decline from high to moderate by 2080 and one moderate AU is predicted to become extirpated. In 2080, 7 AUs are predicted to be in the high resiliency category and 14 AUs are predicted to be in the moderate resiliency category. Four additional AUs are predicted to be extirpated by 2080. Under Scenario B, the species' resiliency is expected to improve across its range by 2080, primarily due to the influence of conservation actions that maintain or improve habitat or reintroduced the species into historical AUs. In 2080, 15 AUs are predicted to be in a high resiliency category and 14 are predicted to be in a moderate resiliency category. Eleven AUs are predicted to be extirpated, as reintroduction efforts under Scenario B have resulted in 7 historical AUs having CTB populations. Under Scenario C, the effects of climate change (under RCP 8.5) combined with a lack of conservation actions and changes in dam flow regimes will result in reduced CTB resiliency within the AUs. By 2080, one AU is predicted to be in a high resiliency category and 18 AUs are predicted to be in a moderate resiliency category. Under Scenario C, six additional AUs are predicted to be extirpated.

Although we do not conclude that the species will expand its range or that all the identified threats will be ameliorated into the future, we also do not find it is reasonable to conclude that all the threats will continue unabated and get worse. The majority of CTB historical habitat loss is believed to have been caused by dam construction, which is not considered a future threat. While dam management is an ongoing threat, we have the proven ability to better manage dams now so as to minimize this threat. For example, during the FERC relicensing process for the upper Connecticut River dams, the applicant conducted surveys for CTB; the information gathered may be used to develop recommended changes to project operations to increase the amount of time and area that occupied CTB habitat is available on a daily basis during critical life history stages. The current and future threats, in particular the effects of climate change, do not seem to significantly undermine the species' viability over the provided scenarios and timelines.

We do not find there is a significant risk that the CTB will become in danger of extinction within the foreseeable future. Given the multiple scenarios run across two time frames (i.e., 2050 and 2080), we do see increasing risk over time and changing contexts. However, even over the longest timeframe (2080) and worst case scenario (Scenario C), there are predicted to be 19 AUs in high or moderate resiliency, 14 metapopulations, and a distribution across 4 physiographic provinces. Upon reviewing the three plausible future scenarios, there is not substantial variation across most of the timeframes and scenarios, which indicates that this species has substantial ability to adapt to environmental change, withstand catastrophic events, and persist through stochastic events at the population level.

The future scenarios all retain the 3Rs to a sufficient degree such that the species will not be in danger of extinction in the foreseeable future. The large range and multiple AUs that the CTB inhabits provides for redundancy, so that loss of the entire species from a catastrophic event is not likely. Further, the species will have between 14 (Scenarios A and C) and 16 (Scenario B) metapopulations that are spatially distributed so that a localized catastrophic event is unlikely to affect the entire population. The species will continue to exhibit high or moderate resiliency in AUs that are spread across the species' range; depending on the future scenario, between 19 AUs (Scenario C) and 29 AUs (Scenario B) are predicted to be in high or moderate resiliency in 2080. Finally, the species will exhibit representation by continuing to occur across its range in various physiographic provinces to maintain ecological and (presumably) genetic diversity. Thus, our analysis of the future reveals a low risk of extinction in the foreseeable future.

Based on the current condition and distribution of the species, the continued presence of resources to meet the species' needs, and our consideration of the species' continued redundancy, resiliency, and representation, we conclude the CTB is currently and likely to remain at a sufficiently low risk of extinction such that it is not in danger of extinction throughout all of its range (i.e., endangered), and is not likely to become so in the foreseeable future (i.e., threatened).

What is the Determination of Status Throughout A Significant Portion of the CTB's Range?
Under the Act and our implementing regulations, a species may warrant listing if it is in danger of extinction or likely to become so in the foreseeable future throughout all or a significant portion of its range (SPR). Where the best available information allows the Services to determine a status for the species rangewide, that determination should be given conclusive weight because a rangewide determination of status more accurately reflects the species' degree of imperilment and better promotes the purposes of the Act. Under this reading, we should first consider whether the species warrants listing "throughout all" of its range and proceed to conduct a "significant portion of its range" analysis if, and only if, a species does not qualify for listing as either an endangered or a threatened species according to the "throughout all" language.

Having determined that the CTB is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range, we now consider whether it may be in danger of extinction or likely to become so in the foreseeable future in an SPR. The range of a species can theoretically be divided into portions in an infinite number of ways, so we first screen the potential portions of the species' range to determine if there are any portions that warrant further consideration. To do the ''screening'' analysis, we ask whether there are portions of the species' range for which there is substantial information indicating that: (1) the portion may be significant; and, (2) the species may be, in that portion, either in danger of extinction or likely to become so in the foreseeable future. For a particular portion, if we cannot answer both questions in the affirmative, then that portion does not warrant further consideration and the species does not warrant listing because of its status in that portion of its range. We emphasize that answering these questions in the affirmative is not a determination that the species is in danger of extinction or likely to become so in the foreseeable future throughout a significant portion of its range—rather, it is a step in determining whether a more detailed analysis of the issue is required.

If we answer these questions in the affirmative, we then conduct a more thorough analysis to determine whether the portion does indeed meet both of the SPR prongs: (1) the portion is significant and (2) the species is, in that portion, either in danger of extinction or likely to become so in the foreseeable future. Confirmation that a portion does indeed meet one of these prongs does not create a presumption, prejudgment, or other determination as to whether the species is an endangered species or threatened species. Rather, we must then undertake a more detailed analysis of the other prong to make that determination. Only if the portion does indeed meet both SPR prongs would the species warrant listing because of its status in a significant portion of its range.

At both stages in this process—the stage of screening potential portions to identify any portions that warrant further consideration and the stage of undertaking the more detailed analysis of any portions that do warrant further consideration—it might be more efficient for us to address the "significance" question or the "status" question first. Our selection of which question to address first for a particular portion depends on the biology of the species, its range, and the threats it faces. Regardless of which question we address first, if we reach a negative answer with respect to the first question that we address, we do not need to evaluate the second question for that portion of the species' range.

For the CTB, we chose to evaluate the status question (i.e., identifying portions where the CTB may be in danger of extinction or likely to become so in the foreseeable future) first. To conduct this screening, we considered whether the threats are geographically concentrated in any portion of the species' range at a biologically meaningful scale. We examined the following threats: hydrological changes, habitat loss and fragmentation, the effects of climate change, and the effects of small and isolated populations, including cumulative effects. We found no concentration of threats in a portion of the CTB's range at a biologically meaningful scale.

If both (1) a species is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range and (2) the threats to the species are essentially uniform throughout its range, then the species could not be in danger of extinction or likely to become so in the foreseeable future in any biologically meaningful portion of its range. For the CTB, we found both: the species is not in danger of extinction or likely to become so in the foreseeable future throughout all of its range, and there is no geographical concentration of threats so the threats to the species are essentially uniform throughout its range. Therefore, no portions warrant further consideration through a more detailed analysis, and the species is not in danger of extinction or likely to become so in the foreseeable future in any significant portion of its range. Our approach to analyzing SPR in this determination is consistent with the court's holding in *Desert Survivors v. Department of the Interior*, No. 16-cv-01165-JCS, 2018 WL 4053447 (N.D. Cal. Aug. 24, 2018).

<u>Conclusion</u>

Our review of the best available scientific and commercial information indicates that the CTB is not in danger of extinction (endangered) or likely to become endangered within the foreseeable future (threatened), throughout all or a significant portion of its range. Therefore, we find that listing the CTB as an endangered or threatened species under the Act is not warranted at this time.

RECOMMENDED CONSERVATION MEASURES

The following are conservation measures that may provide benefits to the CTB:

- Vegetation and recreational management;
- Managing extraction activities that could degrade or destroy habitat; and
- Increasing protective buffers around existing CTB populations through additional land conservation.

We request that you submit any new information concerning the status of, or threats to, the CTB to our New England Ecological Services Field Office (see **ADDRESSES** section of the Federal Register Notice for the 12-month finding) whenever it becomes available. New information will help us monitor this species and encourage its conservation. If an emergency situation develops for the species, we will act to provide immediate protection.

COORDINATION WITH STATES

While conducting our SSA for the CTB, we sent out a data request to all the States within the species' range. We received information from the following States: Alabama, Indiana, Kentucky, Maine, Massachusetts, Mississippi, New Jersey, New Hampshire, New York, Ohio, Pennsylvania, and Vermont. Information provided by our State partners included distribution, threats, and general status of the species.

A draft of the SSA Report was provided to all of the States within the species' range, and we received comments from Kentucky, Maine, and Massachusetts.

We did not receive comments on our SSA Report from the other States within the species' range.

LITERATURE CITED

See the references cited section of the Species Status Assessment for the Cobblestone Tiger Beetle (*Cicindela marginipennis*), version 1.0, dated November 2018.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: ______________________________ June 18, 2019
Regional Director, Fish and Wildlife Service Date

Concur: ______________________________ 9-16-19
Principal Deputy Director, U.S. Fish and Wildlife Service,
Exercising the Authority of the Director, U.S. Fish and Wildlife Service
Date

Do not concur: ______________________________ ______________
Principal Deputy Director, U.S. Fish and Wildlife Service,
Exercising the Authority of the Director, U.S. Fish and Wildlife Service
Date

Director's Remarks:

Date of annual review: November 2018
Conducted by: Northeast Regional Office