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Northeastern Beach Tiger Beetle
(Cicindela dorsalis dorsalis)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Virginia Field Office
Gloucester, Virginia

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5-YEAR REVIEW

Species reviewed: Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*)

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5-YEAR REVIEW OF
Northeastern beach tiger beetle / *Cicindela dorsalis dorsalis* (Say)

1.0 GENERAL INFORMATION

1.1 Reviewers

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1.2 Methodology Used to Complete This Review

This 5-year review was conducted as an individual effort by the lead endangered species biologist for the northeastern beach tiger beetle at the Virginia Field Office (VAFO). Much of the new data and information regarding the species' population status and habitat quality data used in this review originated from internal survey reports. VAFO works annually with the Virginia Department of Conservation and Recreation, Division of Natural Heritage to obtain up-to-date information on occurrences, threats, and recovery activities. Other institutions and individuals that have conducted research on this species were also contacted. This review summarizes and evaluates past and current conservation efforts, current threats, and scientific research and surveys related to the species. All pertinent literature and documents on file at the VAFO were used for this review.

1.3 Background

1.3.1 Federal Register notice announcing initiation of this review: 73 FR 3991-3993 (January 23, 2008)

1.3.2 Listing history:

FR notice: 55 FR 32088-32094
Date listed: August 7, 1990
Entity listed: Subspecies
Classification: Threatened

1.3.3 Associated rulemakings: None

1.3.4 Review history: The northeastern beach tiger beetle was included in a cursory 5-year review of all species listed before 1991 (56 FR 56882, November 6, 1991). Otherwise, no status assessment or 5-year review has been conducted for this species since its 1990 listing.

1.3.5 Species' Recovery Priority Number at start of review: 6
This designation corresponds to a subspecies with a high degree of threat and low recovery potential.

1.3.6 Recovery plan:

Name of plan: Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis*) Recovery Plan
Date issued: September 1994

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment Policy

2.1.1 Is the species under review a vertebrate? No. As the species is an invertebrate, the 1996 Distinct Population Segment (DPS) policy does not apply.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? The species has an approved plan containing recovery criteria; however, not all of the recovery criteria are objective and/or measurable.

2.2.2 Adequacy of recovery criteria:

2.2.2.1 Do the criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? No. Information used to develop the criteria in the recovery plan is now deemed incomplete in terms of number of known occupied sites, abundance, and connectivity of these sites. The population-based criteria in the plan may be inadequate with regard to the maintenance of a metapopulation and movement among sites that may be necessary for persistence of the species.

2.2.2.2 Are all relevant listing factors addressed in the recovery criteria? Not all. Factors A and D (habitat alteration and inadequate regulatory mechanisms) are addressed through site protection criteria. Factor B (overutilization) is not relevant to recovery. Factor C (disease and predation), may be relevant in regard to reintroduction efforts in terms of avian predation being limiting, is not addressed. Factor E (other), including pollution and human effects on larvae, is not addressed.

2.2.3 Recovery criteria as they appear in the recovery plan and how each criterion has or has not been met: The primary objective of the northeastern beach tiger beetle recovery plan is to "*restore this species to a secure status within its historical range, thereby enabling its removal from the Federal list of endangered and threatened wildlife and plants.*" The criteria for delisting, as stated in the recovery plan, are:

1. <u>At least three populations have been established and permanently protected within each of the four designated Geographic Recovery Areas (GRA) covering the historical range of the subspecies in the Northeast, with each GRA having one or more sites with large populations (peak count ≥ 500 adults) with sufficient protected habitat for expansion and genetic interchange.</u>

   The four GRAs described in the recovery plan for the northeastern portion of the beetle's range are:

   GRA-1 <u>Coastal Massachusetts and Islands</u>
   There are currently two occupied sites in GRA-1: Martha's Vineyard and Monomoy National Wildlife Refuge (NWR). Only the refuge site is considered protected, and the population at that site is newly created from beetles translocated from Martha's Vineyard.

   GRA-2 <u>Rhode Island, Block Island, and Long Island Sound</u>
   There are no occupied sites in this GRA.

   GRA-3 <u>Long Island, NY</u>
   There are no occupied sites in this GRA.

   GRA-4 <u>Sandy Hook to Little Egg Inlet, NJ</u>
   There are no occupied sites in this GRA.

   As indicated, none of these GRAs has met the criteria for recovery as called for in the recovery plan.

2. <u>At least 26 populations are permanently protected at extant sites distributed among the five Chesapeake Bay GRAs as follows:</u>

   GRA-5 <u>Calvert County, MD - four large populations</u>
   Only one of the four occupied sites in this GRA can be considered a "large population," and it is not a protected site.

GRA-6 Tangier Sound, MD - two large (≥ 500 adults) populations
There are only two occupied sites in this GRA. They both meet the requirements to be considered large populations, and they are both protected. This is the only GRA that meets the requirements called for in the recovery plan.

GRA-7 Eastern Shore of Chesapeake Bay, VA - four large populations, four others
As of 2005 (year of the last survey), there are twelve sites that can be classified as large populations; however, only two are classified as protected: Parker's Marsh and Savage Neck, both owned by Virginia Department of Conservation and Recreation . As for sites occupied with "other" sized populations, only two sites are protected from development; they are: Kiptopeake State Park and Wise Point (Eastern Shore of Virginia NWR).

GRA-8 Western Shore of Chesapeake Bay (Rappahannock River north), VA - three large populations, three others
As of 2008, there are four occupied sites that meet the recovery plan criteria of a large population; however, none can be classified as protected. There is one "other" sized population in this GRA that is considered protected (i.e., Hughlett Point, owned by VADCR).

GRA-9 Western Shore of Chesapeake Bay (Rappahannock River south), VA - three large populations, three others
As of 2008, there are two occupied sites that meet the recovery plan criteria of a large population, only one of these can be considered protected (i.e., New Point Comfort, owned by Mathews County and The Nature Conservancy (TNC)). There is one "other" sized population in this GRA that is considered protected (i.e., Bethel Beach, owned by VADCR).

3. Life history parameters (including population genetics and taxonomy), human impacts, and factors causing decline are understood well enough to provide needed protection and management.

This criterion is subjective. Although research conducted on life history parameters and factors causing decline has provided sufficient information to aid in making management decisions, it is unclear if current information is sufficient to address all management needs and provide sufficient protection. Section 4.0 (Recommendations for future actions) identifies additional information necessary to provide adequate management and protection.

The U.S. Fish and Wildlife Service (Service) funded a Population Viability Analysis (PVA) for the Chesapeake Bay populations of the tiger beetle. The purpose of the PVA was to compare management strategies, not to estimate extinction probabilities *per se* (Gowan and Knisley 2001). The PVA divided populations throughout the Bay

into GRAs and compared six management strategies. Modeling showed that without increased protection of the most important tiger beetle populations, the extinction probability within each GRA over the next century is high (Gowan and Knisley 2001). The PVA concludes that protection of 25-50 subpopulations is necessary to reduce extinction risk for the tiger beetle throughout the Bay (Gowan and Knisley 2001). The difficulty lies in selecting sites that assure adequate geographic coverage (Gowan and Knisley 2001). Populations must be large enough to be self-sustaining and must account for dispersal among populations.

4. There exists an established, long-term management program in all states where the species occurs or is reintroduced.

   This criterion has not been met.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Information obtained since the species' listing in 1990, and particularly since the northeastern beach tiger beetle recovery plan was approved in 1994, is discussed below. The discussion is supplemented where necessary with information obtained prior to listing.

Survey data gathered in the Chesapeake Bay from 1998-2002 (Knisley and Hill 1998, 1999; Knisley 2001, 2002) indicate that beaches with a length of at least 100 meters (328 feet), a width of at least 2 m (6.5 ft), and an adult population of at least 30, serve as breeding sites. Optimal tiger beetle habitat is a beach greater than 5-8 m (16-26 ft) wide (C.B. Knisley, Randolph Macon College, pers. comm. 1994). Preference for beaches between 2.5-6 m (8-20 ft) was found to be statistically significant, and beetles are rarely found on beaches less than 2 m (6.5 ft) wide (Drummond 2002). Adult and larval beetles are typically found on highly dynamic beaches with back beach vegetation, and they prefer long, wide beaches that have low human and vehicular activity, fine sand particle size, and a high degree of exposure (Knisley *et al.* 1987). Though not statistically significant, Drummond (2002) found indications that the beetles prefer beaches with slopes 6.5 degrees and greater.

Although narrow beach width is frequently the reason for lack of larvae, there are instances where larvae have variable densities or are absent on wide beaches. Knisley (1997b) found that the larvae are rare on sites with less than 5 degrees slope. Knisley (1997b) found that larval densities were highly variable relative to sand particle size, and that larvae are rare at sites with greater than 60% coarse sand (defined as the percentage of sand particles too large to sieve through the 100-size mesh sieve) (Knisley 1997b).

Drummond (2002) found that the adults occupied beaches with 40-80% coarse sand, with preliminary data indicating that the beetle is found on beaches with a narrow range of bulk density (2.25-2.75 grams/cubic centimeter) (Drummond 2002). Bulk density may impact beetle distribution in two ways: (1) stability of larval burrows, and (2) prey base availability (Drummond 2002). Bulk density is known to also affect microarthropod abundance and type (Blair *et al* 1994). Little is known about the precise types of microarthropods eaten by the larvae of *C. d. dorsalis,* and lack of prey base may explain why the beetles are not found in certain areas.

Preliminary work indicates a correlation between the extent of shallow water fronting the beach and the number of tiger beetles present (i.e., the more sand bars, the more beetles) (Drummond 2002). A beetle with sedentary larvae is susceptible to wave impacts, and work by Rosen (1980) showed that the greater the shallow zone fronting a beach, the lower the wave energy. There appears to be no beach aspect preference for the beetle (Drummond 2002).

Recent information on the beetle's biology and life history is based on studies of the beetle in the Chesapeake Bay region. It is unclear if conclusions drawn from the Bay sites apply to sites found on the Atlantic coast in the northern portion of the beetle's range.

2.3.1.2 Abundance, population trends, demographic features and/or trends:

Rhode Island, Connecticut, and New York: At listing, the beetle was considered to be extirpated from Rhode Island, Connecticut, and New York (Long Island) (U.S. Fish and Wildlife Service 1994), and it is unclear if potential habitat for the tiger beetle may exist at any of the historical sites along the Atlantic Coast. The only population known to be extant along the Atlantic Coast is in southeastern Massachusetts, at Martha's Vineyard. The highest number of adult beetles observed at Martha's Vineyard was 2,300 in 2005, but the population declined to 1,000 in 2006. Although the evidence is not conclusive, this population appears to be stable (S. von Oettingen, U.S. Fish and Wildlife Service, pers. comm. 2006, 2008).

Massachusetts: Another population along the Atlantic Coast known to be extant until recently occurred at the Westport site in southeastern Massachusetts. This population was discovered in 1994 (152 adults observed) but had declined to 10 adults in 1995 and to 2 adults in 2001. The tiger beetle has not been seen there since 2001 and is likely extirpated from this site (S. von Oettingen, pers. comm. 2001, 2008). An attempt to establish a new population at Monomoy, in Chatham, Massachusetts, was initiated in 2000 with the translocation of larvae from Martha's Vineyard (Nothnagle 2001). Subsequent translocations occurred in 2001 (34 instars), 2002 (33 instars), and 2003 (23 instars) (Davis 2007). In 2006, 90 adult beetles were counted; numbers dropped to 19 in 2007 but rebounded to 179 in 2008 (Davis 2007, S. von Oettingen, pers. comm. 2008). The status of this population is uncertain.

New Jersey: In 1994, larvae collected from multiple sites in Virginia were released at two different sites on Sandy Hook in the National Park Service's Gateway National Recreation Area, New Jersey. In summer 1995, adults were documented at both sites, and mating and foraging were observed (A. Scherer, U.S. Fish and Wildlife Service, pers. comm. 1996). In autumn 1995, first instar larvae were documented; a result of reproduction from the reintroduced beetles. During autumn 1995, 367 additional larvae from Virginia were translocated (Knisley *et al.* 2001). During autumn 1995 and the subsequent winter of 1995/1996, severe erosion occurred and some tiger beetle sites became completely eroded. In 1996, little larval activity was documented and no further reintroduction took place. In spring 1997, 486 larvae from the Chesapeake Bay were released at Sandy Hook; during that summer, 178 adults were documented (Knisley *et al.* 2001). In April 1999, 585 larvae were translocated, and 260 adults were counted in July (Knisley *et al.* 2001). In 2000, 554 larvae were translocated in April, and 720 adults were counted in July (Knisley *et al.* 2001). The population increased to 749 adults counted in 2001, but the adult numbers dropped to 142 in 2002, 50 in 2003, and 2 in 2005 (A. Scherer, pers. comm. 2004, 2008). In 2006, an additional 480 larvae were released at Sandy Hook and 28 adults were observed in July. Only 2 adults were observed in the reintroduction area in 2007 (National Park Service 2007). No adult tiger beetles were observed during surveys in 2008 (A. Scherer, pers. comm. 2008). Following a continued decline that started in 2001 at these New Jersey sites, the beetle may now be extirpated in New Jersey (C.B. Knisley, Randolph Macon College, pers. comm. 2008).

Maryland: The tiger beetle populations in Maryland have declined and many of the occupied sites show a trend toward extirpation (C.B. Knisley, pers. comm. 2008). Between 1988 and 1993, the northeastern beach tiger beetle was documented at 10 sites in Calvert County, Maryland (U.S. Fish and Wildlife Service 1994). There have been many consecutive years of surveys documenting the tiger beetle only on the following four sites in Calvert County: Scientific Cliffs, Western Shores/Calvert Beach, Flag Ponds, and Calvert Cliffs (C.B. Knisley, pers. comm. 2008). Western Shores/Calvert Beach and Flag Ponds are the only remaining populations, and Flag Ponds has experienced a major decline (only two adult beetles observed in 2008) and may be extirpated soon (C.B. Knisley, pers. comm. 2008). Scientist Cliffs had a sizeable viable population for over five years but then gradually declined to none. The only site that shows a marginally stable population over the years is the Western Shores/Calvert Beach site, but its trend is showing a gradual decline in numbers from a high of 4,198 adult beetles counted in 1991 to 623 counted in 2005 (Knisley 2005b). The two tiger beetle sites in Maryland outside Calvert County, Maryland (Janes and Cedar Islands), have shown steady (Cedar Island - 1,095 beetles in 2004, and 1,298 in 2005) or increasing numbers (Janes Island - 369 beetles in 2004, and a significant increase to 2,476 in 2005) (Knisley 2005b).

Virginia: In 1999, 2002, and 2005, the Service funded comprehensive adult surveys along the eastern shoreline of the Chesapeake Bay in Virginia. The 1999 survey found 32,143 adult tiger beetles at 35 sites (Knisley and Hill 1999), the 2002 survey found 33,469 adult tiger beetles at 31 sites (Knisley 2002), and the 2005 survey found 38,498 adult tiger beetles at 36 sites on the Eastern Shore (Knisley 2005a). During the 2005

survey a new site (Church Neck) was discovered with 2,297 adults. Since 2005, there have been surveys conducted only at sites owned by VADCR, TNC, and the Service, and they indicate a relatively stable level of abundance for the eastern side of the Bay.

In 1998 and 2001, the Service funded comprehensive larval and adult tiger beetles surveys along the western shoreline of the Chesapeake Bay in Virginia. In 1998, 71 sites were surveyed and 26,685 adult tiger beetles were found on 63 sites (Knisley and Hill 1998). In 2001, 33,611 adult tiger beetles were found on 65 sites (Knisley *et al.* 2001). In 2003, Hurricane Isabel hit the Chesapeake Bay area and caused major impacts on the western shoreline. In 2004, the Service completed a survey of the western shoreline to determine what effect Hurricane Isabel may have had on the beetle. The 2004 survey found 12,183 adult tiger beetles (a 63 percent decline in numbers) at 57 sites. All beetles and habitat were lost at eight sites. In 2005, a survey found 19,397 adult tiger beetles at 58 sites. The 2005 survey showed that, while beetles at a number of sites were recovering slowly, other sites still showed no adults present, possibly indicating that all instar stages had been lost during the 2003 hurricane.

In 2006, Hurricane Ernesto made landfall in Virginia and again caused major impacts to beetle habitat on the western shoreline. In 2007, as a result of information from landowners along the Potomac River indicating that Hurricane Ernesto had caused major changes to the shoreline, the Service undertook a survey of this area to evaluate the impacts to the beetle and its habitat. The survey found that Hurricane Ernesto had caused a second major impact to beetle habitat along this shoreline area in a 4-year period (U.S. Fish and Wildlife Service 2007). The 2008 survey of the western shoreline of the Chesapeake Bay found 9,933 adult beetles (approximately 30 percent of the numbers observed in the 2001 survey) at 52 sites (M.R. Drummond, U.S. Fish and Wildlife Service, pers. observ. 2008).

The surveys indicate very little change in overall beetle numbers for the eastern shoreline of the Chesapeake Bay, but it is evident that the western shoreline has experienced greater fluctuations in numbers, presumably due to the recent stochastic storm events. Historically, there has been a higher level of human shoreline modifications on the western shore of the Chesapeake Bay than the Eastern Shore (Knisley and Hill 1999). However, over the past 5 years, there has been an increase in construction on the Eastern Shore with a number of housing developments, golf courses, and commercial businesses to support the growth (M.R. Drummond, pers. observ. 2008).

The 1994 recovery plan identified multiple populations within each GRA. New information on beetle movements and population dynamics suggests that rather than conserving areas to support discrete populations, the concept of metapopulations is more appropriate. The GRAs outlined in the recovery plan can serve as reasonable historic divisions between metapopulations separated by geographic features. Individual populations may be extirpated but can be recolonized from other populations as long as suitable habitat remains. As available habitat sites are lost, the metapopulations may become fragmented and suffer genetic isolation and reduced resilience.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

Northeastern beach tiger beetles in the Chesapeake Bay and Massachusetts are currently physically and genetically isolated from each other. Vogler *et al.* (1993) examined genetic variation in these populations. They found that the isolated Martha's Vineyard population and Chesapeake Bay populations had very low genetic variability. "The Martha's Vineyard population can be further distinguished by the presence of an allozyme allele . . . that has not been observed in the Chesapeake Bay beetles" (U.S. Fish and Wildlife Service 1994). "Thus, although populations from these two areas represent the same subspecies, they should be considered as separate conservation units (Vogler and DeSalle 1994)" (U.S. Fish and Wildlife Service 1994). Additional genetic work supports treating the Massachusetts population as a distinct group from the Chesapeake Bay populations with regard to species recovery and management (Vogler and Goldstein 1997).

2.3.1.4 Taxonomic classification or changes in nomenclature:

There has been no change in nomenclature since the species was listed.

2.3.1.5 Spatial distribution, trends in spatial distribution, or historic range:

The extent of the beetle's historical range has not changed significantly. The northernmost extent of its range is still Massachusetts (the island of Martha's Vineyard and a translocation site at Monomoy NWR), and its southernmost occurrence remains in southeast Virginia (Plum Tree NWR and Grandview Beach, City of Hampton). The beetle is considered extirpated from Rhode Island, Connecticut, New York (Long Island), and New Jersey. The attempt to reestablish a viable self-sustaining population in New Jersey by translocating beetles from Virginia sites has failed. The sites located on the western shoreline of the Chesapeake Bay (both Maryland and Virginia) are in decline or are extirpated (M.R. Drummond, pers. observ. 2008). Six of the ten Maryland sites are extirpated (Knisley 2005b), and twelve sites in Virginia have been extirpated (M.R. Drummond, pers. observ. 2008). Prior to 2003 (before Hurricane Isabel), there were two metapopulations of beetles in Virginia (one on the western shoreline from New Point Comfort north to the Potomac River, and the second along Virginia's eastern shore of the Bay). Habitat loss from shoreline hardening, natural erosion, and stochastic storm events has fragmented the western shoreline metapopulation. While total numbers of beetles along the eastern shoreline of the Bay show a stable metapopulation, a number of sites show declining numbers and loss of available habitat (M.R. Drummond, pers. observ. 2008). The declining sites are offset by two "super" sites that support the majority of the beetle numbers for the eastern shore (Parkers Marsh with 12,554 adults, and Savage Neck with 8,619 adults in 2005) (Knisley 2005a).

The overall trend for the beetle's distribution is a decreasing number of occupied suitable sites and fragmentation of large, contiguous areas of occupied habitat (M.R. Drummond, pers. observ. 2008). This could result in the creation of multiple smaller population

segments separated by unsuitable habitat, leading to increased isolation and reduced gene flow (M.R. Drummond, pers. observ. 2008, Vogler and Goldstein 1997).

2.3.1.6 Habitat or ecosystem conditions:

There remains little suitable habitat within the beetle's former Atlantic coastline range, and this part of the range is under increasing development pressure and human activity use levels. Survey efforts by the Service within both the Maryland and Virginia portion of the Chesapeake Bay have documented a decline in the amount of suitable habitat, and an increasing threat from habitat loss due to stochastic storm events and shoreline modifications.

2.3.2 Five-factor analysis:

2.3.2.1 Factor A. Present or threatened destruction, modification or curtailment of habitat or range:

As stated in the recovery plan (U.S. Fish and Wildlife Service 1994) the greatest threat to the tiger beetle remains the destruction and disturbance of natural beach habitat from shoreline development and beach stabilization structures. Erosion within the Chesapeake Bay is a natural phenomenon resulting from rising sea levels and prevailing winds. However, this process has been exacerbated by beach development activities that interfere with natural beach dynamics and longshore sand transport. Beach stabilization structures such as groins, jetties, rip-rap revetments, and bulkheads, which are designed to reduce erosion, may interrupt and capture sand from longshore transport and build up the beach around the structure, but they prevent sand from moving to the down-drift shoreline. Bulkheads and rip-rap typically result in reflection of wave energy back onto the forebeach, which ultimately narrows the beach and steepens the profile. Such changes in the beach profile can occur over periods of one to thirty years. These structures also prevent the back beach from supplying sand to the forebeach and concentrate wave energy at the ends of the bulkhead or revetment, resulting in erosion at these points (Knisley and Hill 1994).

One of the greatest threats to beetle habitat is shoreline hardening by the placement of rip-rap. Over the years, while doing beetle surveys, the Service has observed numerous times that if a single property owner installs rip-rap in an attempt to stabilize their shoreline, adjacent properties are adversely affected. As a result of the adverse impacts, adjacent landowners often also install rip-rap or similar structures. Over time, as each landowner adds rip-rap, the sandy beach becomes hardened. The hardening impacts the longshore movement of sand, and the sand bank is further depleted as erosion is halted and sand moves offshore into deeper channels. The long-term (50+ years) impacts of this scenario are unknown, but in the short term the Service has observed the complete loss of beetle habitat fronting this type of shoreline hardening (M.R. Drummond, pers. observ. 2008).

Knisley (1997a) conducted 3 years (1994-96) of research on the effects of shoreline stabilization structures on the distribution and abundance of the tiger beetle. A total of 24 sites were surveyed for adult and larval beetles in Virginia. The sites were classified into one of the following categories: natural beach, narrow beach, groins, groins/bulkheads, and rip-rap revetments. The mean number of adults and larvae and beach width were greatest at natural beaches. Larval densities were found to be the highest on natural beaches, and they declined as the width and quality of the site declined. No larvae were found on sites with rip-rap revetments. Natural beaches and those with sand deposition supported the greatest number of larval and adult tiger beetles. Bulkheads and revetments had the greatest negative impact on tiger beetles. Even though larvae were found at some bulkhead sites and at other modified or narrow sites, they likely have higher winter mortality than those at natural beaches. Because of a 2-year life cycle, larvae are more likely to survive two falls and winters of erosion and beach narrowing when more beach width is available.

Beach nourishment may be destructive to larvae and may render beach habitat unsuitable for subsequent larval recruitment and development (Knisley 1991). However, deposition of dredged material may also create habitat in some cases (Knisley 1997a). Dredged sand was placed south of Cape Charles in Northampton County, Virginia, in 1987, and the site increased from 700-800 adults to well over 2,000 in 1993 (Knisley undated proposal, Knisley 2002). Although the addition of sand may actually maintain the habitat in the long term, it is likely that its immediate effects include some larval mortality through crushing, smothering, or inability to dig out and resume normal activities (U.S. Fish and Wildlife Service 1994). Sand deposition could also have indirect negative effects on food (amphipod) availability (U.S. Fish and Wildlife Service 1994). The short- and long-term effects of beach nourishment on larvae need to be investigated. Since larvae seem to be very specific in their microhabitat distribution, sand particle size or other physical aspects of the microhabitat (*e.g.*, slope, profile), may be critical (U.S. Fish and Wildlife Service 1994).

Natural limiting factors include winter storms, beach erosion, flood tides, and hurricanes (Stamatov 1972). Larvae are probably more vulnerable to habitat disruption than adults (Knisley *et al.* 1987), and, similar to other tiger beetle species, larval survivorship is low due to natural enemies and other limiting factors; for instance, only about five percent of the first instar larvae of several Arizona species reached adulthood (Knisley 1987b). Habitat disturbances can further reduce survivorship (Knisley *et al.* 1987) and eliminate suitable habitat (due to shoreline modification), and, when combined with natural mortality factors, could reduce populations to the point of extirpation (Knisley 1987b).

2.3.2.2 Factor B. Overutilization for commercial, recreational, scientific, or educational purposes:

In 1996, an individual was fined for collecting beetles from the Martha's Vineyard, Massachusetts site. This is the only known case of collection since listing.

2.3.2.3 Factor C. Disease or predation:

There are no known diseases. Predation threats from insect or bird predators have not been fully studied. There is speculation that the failed translocation attempt at Sandy Hook, New Jersey, may have been the result of events that forced a large concentration of birds from adjacent land fills to relocate to the park. It is uncertain if the sharp decline in beetle numbers was a direct result of avian predation or if the birds' presence could have indirectly affected the beetles' ability to breed. This threat does not appear to be increasing.

2.3.2.4 Factor D. Inadequacy of existing regulatory mechanisms:

The species' habitat needs (stable sandy beaches) have brought it into direct competition with human use and shoreline stabilization projects. When a shoreline modification project affects areas below mean high water, a U.S. Army Corps of Engineers (Corps) permit is required. If a project is above this line and no Corps permit is required, the landowner only has to meet the local requirements for construction. The quality of regulatory mechanisms to protect the beetle from shoreline projects that do not require a Corps permit varies among localities. Some localities in Virginia have wetlands boards which hold the public to strict guidelines, while others do not. Some of the localities in Virginia are also strict about protecting the primary dunes. There have been a number of circumstances where individuals have undertaken construction without a Corps permit or have done something beyond the approved permit, and there has been no corrective action taken (M.R. Drummond, pers. observ. 2008).

2.3.2.5 Factor E. Other natural or manmade factors affecting its continued existence:

Threats to the northeastern beach tiger beetle also include pollution and pesticides (Knisley *et al.* 1987, Knisley and Hill 1989, Knisley and Hill 1990, U.S. Fish and Wildlife Service 1994). Oil slicks and use of pesticides for mosquito control may have contributed to the decline of this species (Stamatov 1972). Most of the large northeastern beach tiger beetle populations in Maryland and many of those in Virginia are subject to oil spills and beach erosion (U.S. Fish and Wildlife Service 1994).

Adult foraging, mating, and ovipositioning can be disrupted by human activity (Knisley *et al.* 1987). However, larvae are likely more affected, as they spend most of their time at the tops of their burrows waiting for prey and may be disturbed by even relatively minor activities such as vibrations, movement, and shadows (Knisley *et al.* 1987).

Knisley and Hill (1990) examined the effects of visitor use of Flag Ponds, a park in Maryland, on the tiger beetle. As human use increased, no reduction in the population of adult tiger beetles was found. However, human impacts appeared to result in the lack of newly emerged adults on the public beach. Larval survivorship was significantly lower on the beach area with the greatest amount of human use. Experimental areas that were firmly stomped, to simulate increased foot traffic, resulted in a 50-100 percent reduction

in numbers of active larvae (Knisley and Hill 1989). In addition, 25 percent of the burrows did not reopen within 10 days of stomping, suggesting that larvae may have been dead (Knisley and Hill 1989). Negative effects of foot traffic apparently involve compaction or disruption of burrows or direct injury to larvae. Because larvae occur in the intertidal zone, burrows can be easily compacted or collapsed by vehicles or high levels of human activity (Knisley *et al.* 1987).

The use of off-road vehicles (ORV) is one of the most significant factors in the decline of the tiger beetle in New England (S. von Oettingen, pers. comm. 2008). Impacts from ORV use may also preclude the establishment of new populations or reintroductions to northern sites. In the Chesapeake Bay, ORV use is not an issue.

2.4 Synthesis

The northeastern beach tiger beetle's historic range was from Massachusetts to Virginia. It is now found only in the Chesapeake Bay of Maryland and Virginia, and on two sites in Massachusetts. The beetle is restricted to sandy beaches in areas subject to stochastic storm events, high shoreline development pressure, and human use. Surveys have documented a decline in beetle numbers over most of the beetle's range. The western shoreline of the Chesapeake Bay (both Maryland and Virginia) shows a large decline in numbers and amount of available habitat. The continued increase in threats from human development, the specificity of its habitat requirements, and the length of time spent as larvae occupying the intertidal zone of a beach make the beetle highly susceptible to changes in beach habitat and vulnerable to extirpation.

Originally the beetle was proposed for listing as endangered, and since its listing, more occupied sites have been identified, but the Service has also documented a decline in numbers of beetles and occupied habitat rangewide. Table 1 outlines the current status and threats to beetles throughout their range. Overall, the northeastern beach tiger beetle is facing serious and growing threats to its continued existence throughout its range. This, in conjunction with declining numbers through most of its range, indicate that the beetle is endangered across its entire range.

3.0 RESULTS

3.1 Recommended Classification: Reclassify to endangered.

Rationale: The beetle's numbers have declined and continue to decline (see Table 1). Also, much of the habitat that has been lost or has been severely degraded as the direct result of development/shoreline modifications, and this threat is continuing to increase.

3.2 New Recovery Priority Number: Retain as 6

Rationale: *Cicindela dorsalis dorsalis* remains subject to a high degree of threat, a low recovery potential, and is a subspecies.

3.3 Listing and Reclassification Priority Number: 6

Rationale: *Cicindela dorsalis dorsalis* is subject to a high magnitude of threats due to development, stochastic events, and a continued loss of available habitat. The threat is non-imminent but is increasing.

Table 1. Summary of current tiger beetle threats and status throughout its range.

GRA	State(s)	Status / Threats	Outcome
1	MA	Habitat loss and declining numbers	- Westport, MA occupied site extirpated - Martha's Vineyard numbers appear to be stable - Monomoy NWR translocation may be failing
2 & 3	RI, NY	Extirpated	- At listing extirpated from RI and NY
4	NJ	Extirpated	- Sandy Hook, NJ translocation sites extirpated
5	MD – Calvert County	Habitat loss	- 6 of 10 occupied sites extirpated, habitat lost or in very poor condition - 2 of 4 remaining sites with <5 beetles in 2005, these sites have marginal habitat - The 2 primary sites (Scientist Cliffs and Western Shores/Calvert Beach) have declined in numbers >75 percent since 2003
6	MD - Tangier Sound	Stable	- Both sites (Janes and Cedar Islands) are stable or may be increasing
7	VA – Eastern Shore	Habitat loss and declines in many populations	- Total beetle numbers stable - 55 percent of beetles found on 2 of 35 occupied sites in 2005 (Parker's Marsh, Savage Neck) - 4 occupied sites extirpated (habitat gone) - 12 occupied sites showing declining numbers and available habitat
8 & 9	VA – western shoreline	Habitat loss and declining numbers	- Since 2001 there has been a 20 percent loss in occupied sites (12 of 58 occupied sites) - The majority of occupied sites show evidence of habitat loss as a result of Hurricane Isabel and Ernesto - Total numbers declined 70 percent since 2001 - Since 2001, the 8 largest sites that support approximately 50 percent of the total beetles in 2001 have declined by 78 percent

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The recommendations for future actions are organized into three categories.

Recommendation: revise current recovery plan

The 1994 recovery plan for the northeastern beach tiger beetle should be revised for the following reasons: (1) More detailed information has been gathered about threats, habitat, and populations that would inform a revised recovery strategy; (2) The use of GRAs should be evaluated and changes made to fit the Service's use of Recovery Units created for species that use a metapopulation strategy; and (3) Recovery criteria need to be modified to more explicitly address abatement of threats, and actions need to be adjusted accordingly.

Recommendations for specific research and data needs

1) Develop a survey protocol to ensure consistent monitoring of populations.

2) Determine land ownership of sites, and evaluate methods to improve long-term protection for those areas.

3) Continue surveys (by staff and/or contract) to monitor population and habitat trends to obtain a better understanding of the beetle's status and metapopulation structure. These data will also be needed to assist the Service with project consultations.

4) Expand genetic work to further evaluate the four subspecies of *C. dorsalis,* and to compare the beetles within the Chesapeake Bay to those in Massachusetts. This information will assist in understanding the metapopulation structure of this species over time.

5) Evaluate the potential effects of sea level rise on tiger beetles, and develop appropriate management strategies to address this potential threat.

6) Evaluate the geomorphology of the Atlantic Ocean sites using the same parameters used for the Chesapeake Bay sites. This data is needed to evaluate and compare the habitat criteria of the Atlantic sites to those in the Chesapeake Bay.

7) Conduct rangewide assessment of available and potential habitat and shoreline alterations/ hardening that have occurred to date.

8) Implement a prey base study for the larval stage of the beetle. The goal of such a project would be to obtain an understanding of what the larval stage prey base is and whether there are factors that could limit the prey base availability and in turn impact beetle survival and productivity.

Recommendations for conservation actions

1) Work with the local governments to ensure that permitting authorities are aware of the beetle and the threats to it from shoreline projects.

2) Work with the Corps to improve understanding of shoreline projects that are being implemented on the Chesapeake Bay without proper permits and consultation.

3) Work with the Corps and shoreline erosion experts to design appropriate shoreline stabilization methods that will not eliminate beetle habitat.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR STATUS REVIEW of Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*)

Current classification: Threatened

Recommendation resulting from the 5-Year Review: Reclassify to Endangered

Review conducted by: Michael Drummond, Virginia Field Office

FIELD OFFICE APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

Approve Karen L. Mayne Date 9/3/2008
Karen L. Mayne
Supervisor, Virginia Field Office

REGIONAL OFFICE APPROVAL

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 3/19/09
Acting Regional Director, Northeast Region