

BIOLOGY OF *CICINDELA* PURITANA, THE PURITAN TIGER  
BEETLE: DISTRIBUTION AND ABUNDANCE, 1988 TO 2005,  
HABITAT ECOLOGY, AND THE STATUS OF THE GROVE POINT  
POPULATION

Final Draft Report

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177 Admiral Cochrane Dr.  
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INTRODUCTION:

The primary objective of this study is to bring together most of the important biological information on the Puritan Tiger Beetle (PTB), including past reports, unreported data and new studies conducted in 2005, particularly a study of its distribution and abundance at Grove Point.

*Cicindela puritana* is an inhabitant of sandy water edge habitats with an unusual disjunct historic distribution along the Connecticut River in New England and along the Chesapeake Bay shoreline of Maryland. It was listed as a Threatened Species in 1989 as a result of its limited distribution and abundance and its extirpation from nearly all of its range along the Connecticut River in New England. Currently, it is found at 3 widely separate locations: at 2 adjacent sites in Connecticut and one in Massachusetts, along the western shoreline of the Chesapeake Bay in Calvert County, Maryland and at the mouth of the Sassafras River in Maryland's Eastern Shore. The Connecticut River populations have fluctuated greatly in abundance over the past 15 years without a pattern of decline. However, the Calvert and Sassafras metapopulations have declined dramatically and somewhat progressively since the early to mid- 1990's.

from various were to are to resurvey adult numbers of adult *C. puritana* within approximate 50 meter sections along the whole shoreline at the Grove Point site, and to evaluate the habitat quality for adults and larvae of this species within these same sections. The impetus for this study is the proposed shoreline modification activity at this site and how this might affect the

population of *C. puritana* there. The Calvert County population has fluctuated greatly from peak numbers of over 9,000 in 1998 and 1988 to less than 3000 in the past three years. The Sassafras metapopulation has declined from a total of 2755 adults in 1992 to 630 or less from 1999 to 2005. The Grove Point population had over 1000 adult in several years, most recently in 1996; numbers have ranged from 452 to 78 since that year. Causes of these declines are not know, but progressive growth of vegetation on parts of the cliff face and possible narrowing of the shoreline are possible causes. This species is adapted to changing conditions such as cliff erosion, but higher or widespread erosion could cause population declines.

## METHODS:

Previous studies and surveys of the Calvert and Sassafras metapopulations of the Puritan Tiger Beetle since 1988 have provided important insights to some of the habitat features required by this species. On the basis of this work it has been determined that the following are key indicators of suitable habitat for *C. puritana*:

1. Sandy beaches are used by adults which forage for small arthropod prey and scavenge along the wet shoreline where food is most abundant. Beaches of 1-2 or meter width (above high tide) seemed preferred but narrower beaches of -1 to 2 meters, such as occur and many sites are also used. Adults move onto the cliff bases at high tide
2. High (30-50' or more) vertical or terraced cliffs free of vegetation are used as oviposition sites for adults and are thus the larval habitat. Only the strata on the cliffs that consist of high sand content (over 80%) and soft in texture are suitable for oviposition. In Calvert the strata with these characteristics is usually only a thin layer at the top of the cliffs, while at the Sassafras sites, it may be lower and occur much of the cliff face. Cliff strata that are higher in clay or marl or with a high pebble content are unsuitable, often because they are also dry.
3. Larger sites or shoreline/cliff sections of over 500 meters are better, possibly because during periods of erosion or habitat disruptions, some of the site will remain suitable to sustain the population.
4. Adults numbers are relatively easy to survey, while larvae are not, and are also a convenient indicator of suitable sections of habitat at a site. Adults are highly vagile and capable of dispersal, but seem to be very localized within those parts of a site that also contain suitable larval habitat. Adults apparently move by short flights onto the cliff face, possibly at night, where they oviposit.
5. Observations at several sites (Calvert Beach, Scientists Cliffs, Little Cove Point) have clearly indicated beetles disappear for areas where the cliff face becomes heavily vegetated (over 80%) or when a dense band of vegetation develops at the cliff base. Progressive growth of vegetation at most of these sites has been caused by shoreline stabilization projects (groins or revetments).

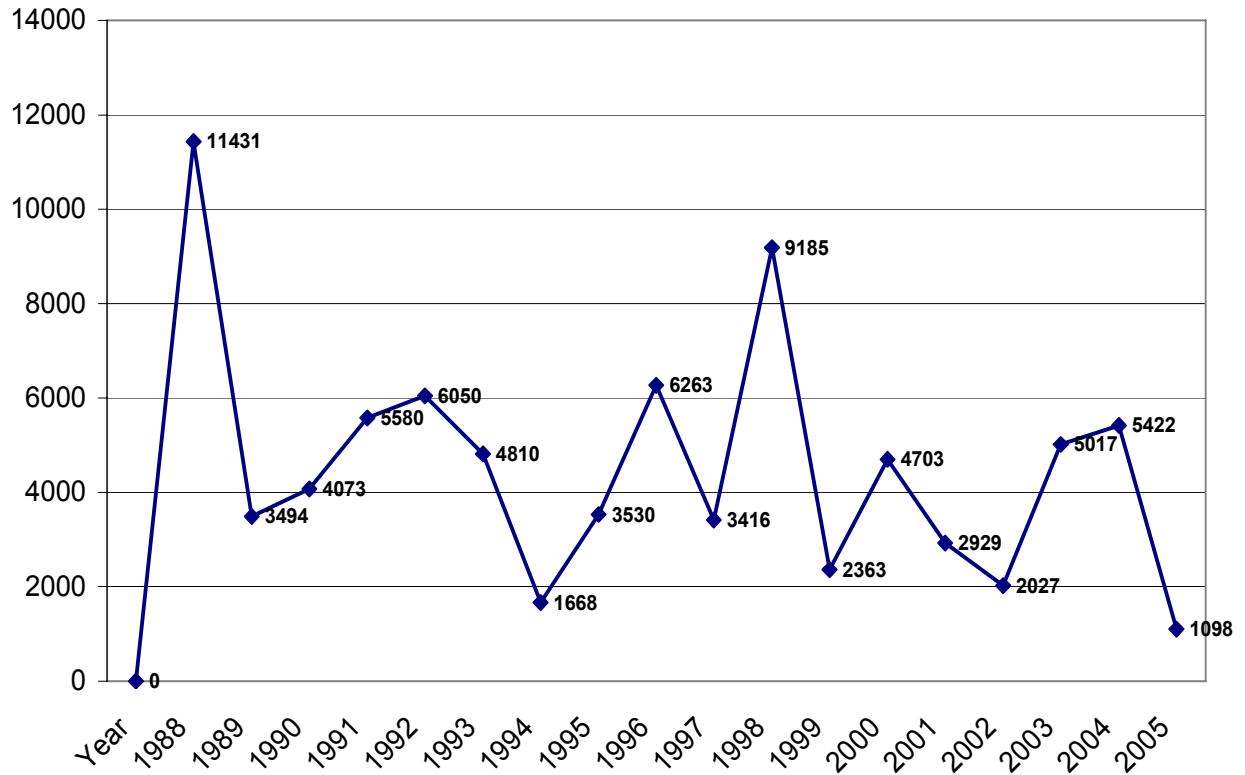
Habitat parameters measured at Grove Point include: beach width (in meters), beach surface texture (percent sand), accumulated beach debris (mostly woody vegetation), cliff face vegetation (% cover), and cliff face quality (abundance or suitable sandy substrate). On the

basis of these measurements, qualitative grades for the beach and cliff face and an overall habitat grade were determined for each of the approximate 50 m sections. Details of the sampling and replicate measurements will be described in the final report. Adult counts within each section were made 3 times per day ( at least 30 minutes apart) on July 12, 15 and 19. These dates are at or just beyond peak population periods for the species. The maximum count is included in Table 1 and considered the best indicator of population size and habitat suitability.

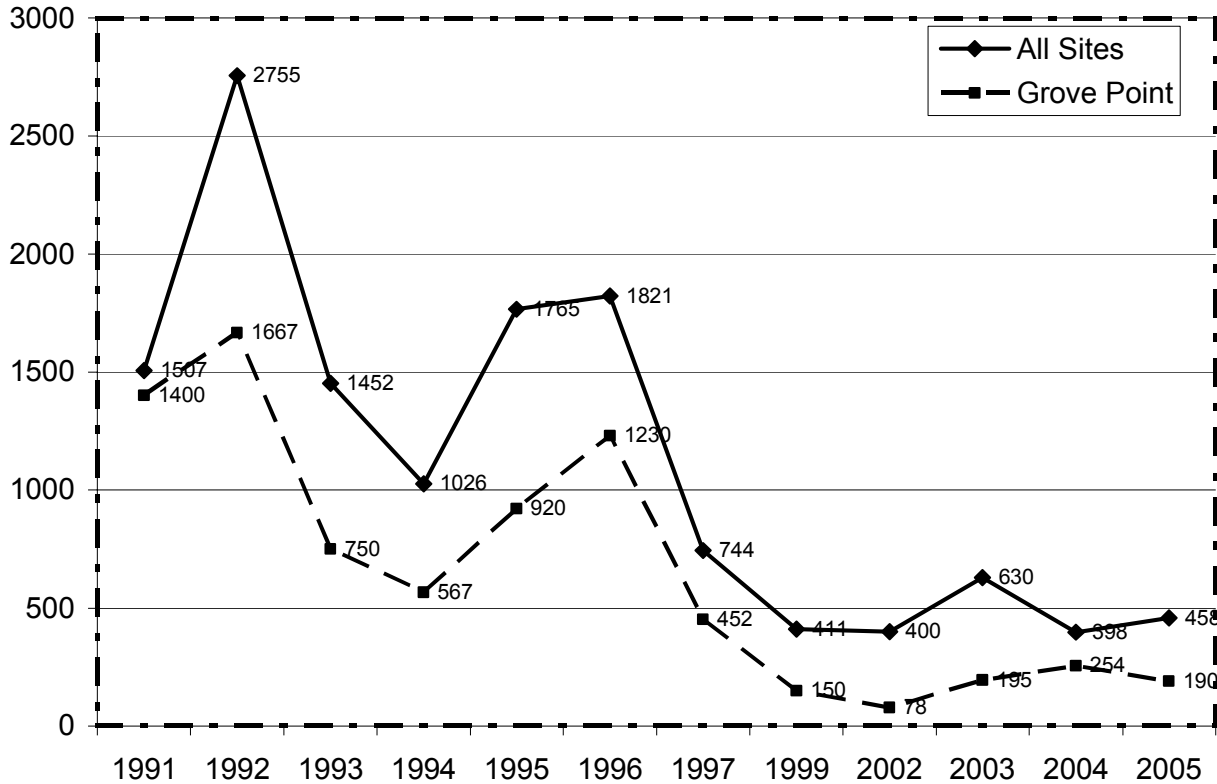
## RESULTS AND DISCUSSION:

Distribution and Population Trends: In New England, a small population of the PTB occurs at one site in Hampshire Co., MA and as a metapopulation at three nearby sites in Middlesex County, CT. In Maryland, there are two metapopulations on opposite sides of the Chesapeake Bay. The Sassafras metapopulation consists of 8 subpopulations, with the largest by far being the Grove Point Populations. In Calvert County the metapopulation is considerable larger in beetle numbers and includes 8 subpopulationa, with 3 or more considered to be large (mean abundance of over 500 adults). Both of the Maryland metapopulations have fluctuated dramatically since annual surveys were started in 1988, but also have exhibited a pattern of progressive decline since about the mid-1990's (Figures 1 and 2).

**Fig. 1. Numbers of Adult *C. puritana* counted at all Calvert County Sites, 1988 to 2005**



**Fig. 2. Counts of Adult *C. puritana* at Grove Point and all Sassafras River Sites, 1991-2005**



**Causes of Declines:**

Habitat Requirements. The habitat where the PTB is found in Maryland is considerably different from its habitat along the Connecticut River. In the latter, it now occurs and historically occurred primarily near bends of the river where there were significant accumulation of sandy beaches. Adults forage on these beaches during the day and apparently oviposit on the upper beaches where larvae are found (USFWS 199). In both Calvert County and the Eastern Shore of Maryland the habitat is characterized by mostly narrow sandy beaches (typically 5 m or less beach above high tide levels) that are adjacent to high bluffs or cliffs. Adult females move high onto the cliff face, possibly at night to oviposit and establish the larval habitat. These differences in ecology but, more importantly, the results of mtDNA analysis suggest that these at two are distinct forms and should have separate conservation status (Vogler et al. 2000).

Importance of Habitat Size. If all other characteristics of a site are equal, then larger sites are better for supporting larger numbers and better survival of populations of *C. puritana*, and surveys suggest a correlation between large size sites and larger populations (Knisley 1987). Although all PTB sites vary in habitat quality, the annual surveys indicate a general pattern of

large sites supporting larger populations. This is expected since more adult and larval habitat would be available at large sites. In addition, larger sites should increase the viability and long term survival of populations both because larger populations are less subject to extinction from genetic bottlenecks and stochastic events, but also because larger sites are more likely to have sections unaffected during periods of severe habitat perturbations resulting from natural or human related disturbance. For example, storm events and other erosional events commonly cause the breakdown of the cliff habitat where larvae occur, resulting in loss of some or all of a larval cohort in these sections (but also creating new suitable habitat for recolonization). Similarly, erosion can cause shoreline narrowing or accumulation of trees and other debris on the beach, making it unsuitable for adults. In larger sites, other sections are likely to be unaffected by these disturbance and can sustain the population and produce individuals for dispersal and recruitment when these disturbance subside.

Small populations, however, are important for providing corridors and connectivity for dispersal along the linear shoreline habitats of the PTB. They also could produce at least small numbers of adults which could disperse, recolonize and add genetic diversity, and thus increase the viability of the metapopulation.

Is there a minimal size of habitat for the PTB?

#### THREATS:

Vegetation encroachment

Detailed habitat data is presented in Table 1 and discussed here by grouping adjacent 50 meter sections along the length of the shoreline based ownership. The grading system used considers that grades A and B are suitable habitat, C is marginal, and D and E are unsuitable habitat for the species. These combined sections and an evaluation of the habitat within them are as follows:

Section 1. Girl Scout Camp-South. This is the southern most part of the site starts at the no-cliff beach at the boat launch area (way point 19) and goes north to section 25. It includes **all unsuitable habitat** (overall grades of E to C) primarily because the cliffs are dry and lower in sand content. There is also considerable cliff vegetation, and beach rubble. No adults were found in this section in 2005

Section 2. Girl Scout Camp-North. This section includes points 26 to 29 and includes habitat of minimal suitability (or a small amount of suitable habitat) at point 26-27 to very good habitat quality (**grade B, B+**) at points 26 to 29. This section is high in quality because of a significant amount of larval cliff habitat (soft, yellow-rust sand) and adequate beach width and quality. A peak of **42 adults** were found in this section in 2005.

Section 3. Private Ownership?. This section between the boundary of the GSA camp and Clark-Taylor includes the best habitat (**grade A**) at Grove Point, points 29-31. It is the highest quality because of the larger amount of ideal cliff strata and suitable beach characteristics. A peak of **123 adults** were found in this section in 2005.

Section 4. Clark Taylor. This short section, point 31-32, includes a short length of good habitat (**grade C+**) because only a small part of the cliff is suitable. A peak of **11 adults** was found here in 2005.

Section 5. Intermediate Action Zone. This section includes 32-36 is about 100 meters long and is between the two proposed revetment sections. Overall is includes mostly unsuitable habitat with only a small section of marginal habitat (**grade C**). Only **2 adults** were found in this site in 2005.

Section 6. North Revetment Site, This nearly 300 m section at Grove Point, points 36-37 includes a small portion of good habitat (**grade B-**) in the northern part of the site. A peak number of **12 adults** were present here in 2005.

The overall results of this study (some not included here) indicate that the best habitat for *C. puritana* is primarily restricted to the northern part of the GSA camp shoreline and the adjacent private ownership section south of the Clark-Taylor Properties. This area includes 165 (or 87%) of 190 adults at Grove Point. It is probable that the proportion of suitable habitat and total larvae in this best section is higher than indicated by adult numbers.

Table 1. Habitat Parameters Along the Grove Point Shoreline. Most sections (18-40) are @ 50 meters  
Habitat quality grade is based on amount of suitable cliff and beach habitat and adult numbers.

	Max.	Mean	Mean	Overall					%	%	
	# C.pur	# 3 dates	# C. pur	Habitat	Cliff	Beach	Beach	Beach	Cliff	Beach	
	2005	2005	2004	Grade	Grade	Grade	Width	Rubble	Veg	Sand	Site Characteristics
18	0	0/0/0									
19	0	0/0/0		E	E	E					SE end adjacent to GSA boat area,
20	0	0/0/0		E	E/D	d	0.5	High	32	88	Low, dry cliffs, beach rubble
21	0	0/0/0		E	E/D	C	1.2	High	15	93	
22	0	0/0/0		D	D	C	1	Mod	8	88	
23	0	0/0/0		D	D	D	0.5	High	22	45	to
24	0	0/0/0		C	C	B	1.3	Low	26	87	be
25	0	0/0/0		C	C-	B	0.8	Mod	6	92	completed
26	8	0/0/0		C/B	C/B	C	1.3	Mod	40	95	
27	8	6/8/03		B	B/A	C	1.2	M/H	28	83	
28	26	26/15/18		B+	B+	B	1.5	M/L	28	97	
29	66	66/45/59		A	A	B	1.6	Low	23	98	
30	57	34/57/44		A	A	B	1.2	Low	27	96	
31	11	4/8/11		B	B-	B	1.3	Low	30	83	
32	2	0/0/2		C	C	B	0.8	Mod	35	65	

33	0	0/0/0		<b>E</b>	E	D	0	High	100	na	
34	0	0/0/0		<b>C</b>	D+	B	0.8	Low	46	82	
35	0	0/0/0		<b>C</b>	C	C	0.5	M/H	23	38	
36	12	12/9/05		<b>B-</b>	B-	C	1.2	Mod	29	97	
37	0	0/0/0									
38	0	0/0/0									
39											
40											

CAPTIONS FOR PHOTOGRAPHS:

1. GSA property near south end of site showing dry and unsuitable cliff habitat.
2. GSA property near south end showing continuation of dry cliffs and with heavy shoreline debris and grave;/rock on beach, unsuitable habitat.
3. Northern part of GSA property showing marginal habitat; cliffs have some suitable habitat but much has heavy vegetation cover; some *C. puritana* here.
4. Northern part of GSA property showing very good soft sand cliff substrate suitable as larval habitat; upper cliffs fairly heavily vegetated which is probably limiting larval habitat space.
5. North end of GSA property showing large breakdown section which includes suitable high sand content substrate.
6. Excellent habitat in area between GSA and Clark-Taylor with large band of soft sand substrate in middle and upper layer and good sandy beach. Lower gray stratum is probably not suitable.



7. Transition area of limited habitat at Clark-Taylor property, suitable larval habitat but only small section of it; cliff vegetation may be limiting.
8. Area between two revetment sites (Chesapeake Haven) showing section of suitable cliff habitat in upper layer; other parts of site with less suitable cliff; fairly heavy pebble content on much of beach
9. Chesapeake Haven site showing limited area of potential suitable habitat (upper stratum) with soft high sand content.
10. Chesapeake Haven site showing suitable beach habitat and probable area of larval cliff habitat in upper stratum and beyond view to right of photo.