CCNPP3COLA NPEmails

From: Harriet Nash
Sent: Thursday, January 15, 2009 12:36 PM
To: CCNPP3COL Resource
Cc: Thomas Fredrichs; Laura Quinn
Subject: FW: Calvert Cliffs tiger beetles
Attachments: puritanaatsassafrasnew.doc; Calvert2008finaltable7.xls; figure7ccnpp.jpg; md2005reportfinal.doc; mddorsandpurit1986to2004twotablesa.xls

-----Original Message-----
From: Duberstein, Corey A [mailto:corey.duberstein@pnl.gov]
Sent: Thursday, January 15, 2009 11:30 AM
To: Thomas Fredrichs; Harriet Nash
Cc: Laura Quinn; Parkhurst, Mary Ann
Subject: RE: Calvert Cliffs tiger beetles

Here are the attachments to go along with his email response.

corey

-----Original Message-----
From: Thomas Fredrichs [mailto:Thomas.Fredrichs@nrc.gov]
Sent: Thursday, January 15, 2009 4:17 AM
To: Harriet Nash; Duberstein, Corey A
Cc: Laura Quinn; Parkhurst, Mary Ann
Subject: RE: Calvert Cliffs tiger beetles

Harriet and Corey:

The attachments mentioned in the e-mail to Corey didn't come through with the message. If the studies sent by Prof. Knisley form part of the basis of the staff conclusions in the EIS, they should be included with the reference material placed in ADAMS.

Thanks,
Tom F.

-----Original Message-----
From: Harriet Nash
Sent: Wednesday, January 14, 2009 3:37 PM
To: CCNPP3COL Resource
Cc: Thomas Fredrichs; Laura Quinn
Subject: FW: Calvert Cliffs tiger beetles

-----Original Message-----
From: Duberstein, Corey A [mailto:corey.duberstein@pnl.gov]
Sent: Tuesday, January 13, 2009 4:57 PM
To: Knisley, C. (Barry)
Cc: Harriet Nash
Subject: RE: Calvert Cliffs tiger beetles

Thank-you Barry. Not often do I get to inquire about a listed species to somebody with the level of knowledge you have and it is very appreciated.

_____

Corey Duberstein
Scientist
Ecology Group

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-----Original Message-----
From: Knisley, C. (Barry) [mailto:bknisley@rmc.edu]
Sent: Tuesday, January 13, 2009 1:46 PM
To: Duberstein, Corey A
Subject: RE: Calvert Cliffs tiger beetles

Cory: Here is what I can provide in response.1. This is my own qualitative grading system of habitat suitability. As with most tiger beetles,habitat parameters are not easily quantified. With Puritana and others we have both adult habitat, the shoreline and larval habitat, the bluffs, so the arbitrary grading is based on adult presence and my knowledge of suitability of cliff habitat for larvae. But, there is imprecision to this since we cannot adequately survey the bluffs and determine what is truly larval habitat. ()We did a study this summer to try to get a better handle on this. The grading is initially based on adult presence, then re-scored based on how suitable the cliff substrate appears to be for larvae. Larvae are the key since they are confined to suitable habitat and yield the adults; adults seek out suitable cliff habitat, but can move away from it as they forage. Under this system, E would be clearly non-habitat for larvae, but there could be adults sometimes be found here, since they are quite mobile and freely move some distance from where their larval habitat was or from suitable egg laying bluffs. The northern portion of the shoreline nearest the loading dock has sometimes had a few adults, but there is, as best I can judge, no larval habitat there. This is also true ofor point 342, no larval habitat, but could be an occasional adult there (4 recorded), since potential larval habitat nearby (points 344, grade of C which would indicate apparent suitable habitat). A, B, and C would all be apparent suitable larval (and adult) habitat, ranging from apparently excellent to suitable), D would be marginal and E non-habitat.
2, I have attached 2005 report and the the 3rd one you requested. Do not have other one in electronic form, but these annual reports are all the same, so instead, I include a Table which will be in the 2008 report, soon done, which gives all puritana numbers within waypoint sections from 2004 to 2008 for all sites, including CCNPP. Attahced is a map of CCNPP with the standard waypoints, used each years. Note these are different from those my my 2006 CCNPP report.
3. Dorsalis required wide beaches without bluffs behind, usually, certainly true at most Calvert sites. Larvae for this species are in the back beach, so if beach less than 4-6 m wide, no habitat. The Bannisteria paper is minor, only reporting on survey results from VA.
Note in 2008 table the dorsalis results for Calvert. Also annual trends for dorsalis and puritana in Calvert. Serious decline in 2008 at the two remaining sites. Let me know if more questions.

C. Barry Knisley
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-----Original Message-----
From: Duberstein, Corey A [mailto:corey.duberstein@pnl.gov]
Sent: Tuesday, January 13, 2009 11:56 AM
To: Knisley, C. (Barry)
Cc: Harriet Nash
Subject: RE: Calvert Cliffs tiger beetles

Thanks for the prompt reply Barry. I would like to wrap up this BA and I was hoping you could reply via email without investing too much time and energy. Do you anticipate issues with the questions? If so, which would require additional time?

corey

-----Original Message-----
From: Knisley, C. (Barry) [mailto:bknisley@rmc.edu]
Sent: Monday, January 12, 2009 5:14 PM
To: Duberstein, Corey A
Subject: RE: Calvert Cliffs tiger beetles

Cory: I can try to answer these questions for you. How soon do you need them. Barry

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From: Duberstein, Corey A [corey.duberstein@pnl.gov]
Sent: Monday, January 12, 2009 6:27 PM
To: Knisley, C. (Barry)
Cc: Harriet Nash; Parkhurst, Mary Ann; Thomas.Fredrichs@nrc.gov
Subject: Calvert Cliffs tiger beetles

Dr. Knisley,

We have previously met at the Calvert Cliffs Nuclear Power Plant Site in spring 2008 when I was there with the NRC-PNNL team to conduct the site audit in preparation of the Unit 3 EIS process. I am now drafting a Biological Assessment for the USFWS concerning both the northeastern beach and the Puritan tiger beetles.

I have read your report (Current Status of Two Federally Threatened Tiger Beetles at Calvert Cliffs Nuclear Power Plant, 2006) furnished to Constellation. On page 2, you described 3 bases for the qualitative habitat assessment you performed. You then used a letter grading system (A to E), with A being optimal and E being non-habitat, for GPS points along the beach. Could you elaborate and put the B, C, D letters into context with respect to habitat variables? Also, it appears there were adult beetles present at a point (342) that was considered non-habitat (E grade). Is this of interest with respect to 'E' points being non-habitat?

Also, within your report are 3 references from 2005, 2 of which were drafted for the MdDNR:
1. Monitoring Cicendela puritana and C. dorsalis dorsalis in Maryland, 2004. Final report to Md DNR, 11p.

2. Distribution and abundance of Cicendela puritana and C. dorsalis dorsalis in Maryland, 2005. Final report to Md DNR, 12p.

The 3rd went to the USFWS:

3. Biological studies of the Puritan Tiger Beetle: distribution and abundance, 1998-2005, habitat ecology, and status of the Grove Point population.

Could you either provide .pdf's of these documents or provide contact information so that I can obtain them from the agencies?

About the northeastern beach tiger beetle, why are the beaches on the Calvert Cliffs site unsuitable for this beetle? Also, has the 1998 northeastern beach tiger beetle publication listed on your website http://faculty.rmc.edu/bknisley/public_html/main.htm been published? I am not familiar with Bannisteria.

Sincerely

_____

Corey Duberstein
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Hearing Identifier: CalvertCliffs_Unit3Cola_NonPublic_EX
Email Number: 1385

Mail Envelope Properties (21707AE0BEC04F4BB5502E2483D69D6A24978BCCEB)

Subject: FW: Calvert Cliffs tiger beetles
Sent Date: 1/15/2009 12:36:08 PM
Received Date: 1/15/2009 12:36:11 PM
From: Harriet Nash

Created By: Harriet.Nash@nrc.gov

Recipients:
"Thomas Fredrichs" <Thomas.Fredrichs@nrc.gov>
Tracking Status: None
"Laura Quinn" <Laura.Quinn@nrc.gov>
Tracking Status: None
"CCNPP3COL Resource" <CCNPP3COL.Resource@nrc.gov>
Tracking Status: None

Post Office: HQCLSTR02.nrc.gov

Files	Size	Date & Time
MESSAGE	7974	1/15/2009 12:36:11 PM
puritanaatsassafrasnew.doc	127042	
Calvert2008finaltable7.xls	77890	
figure7ccnpp.jpg	1049124	
md2005reportfinal.doc	93762	
mddorsandpurit1986to2004twotablesa.xls	44610	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

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

Report to: U. S. Fish and Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochrane Dr.
Annapolis, MD

From: C. Barry Knisley
Department of Biology
Randolph-Macon College
Ashland, VA 23005

Date: August 2, 2005

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 an 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 with (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

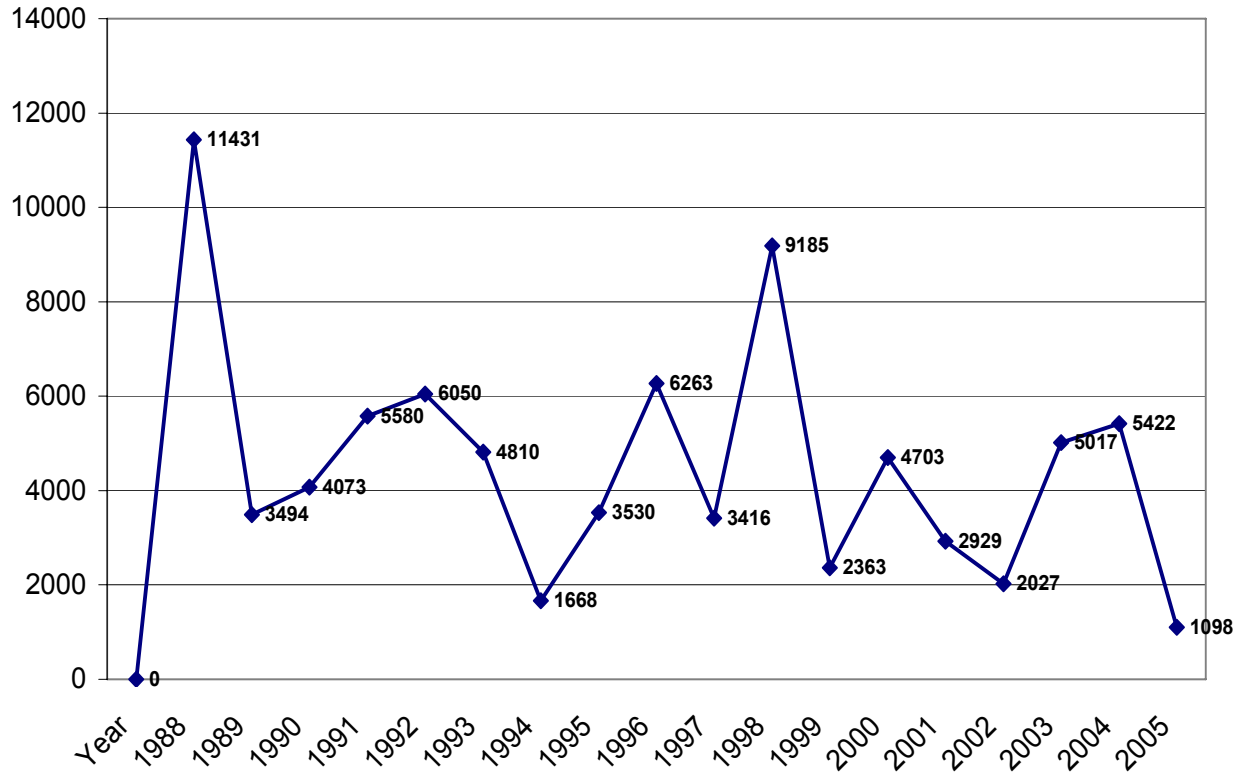
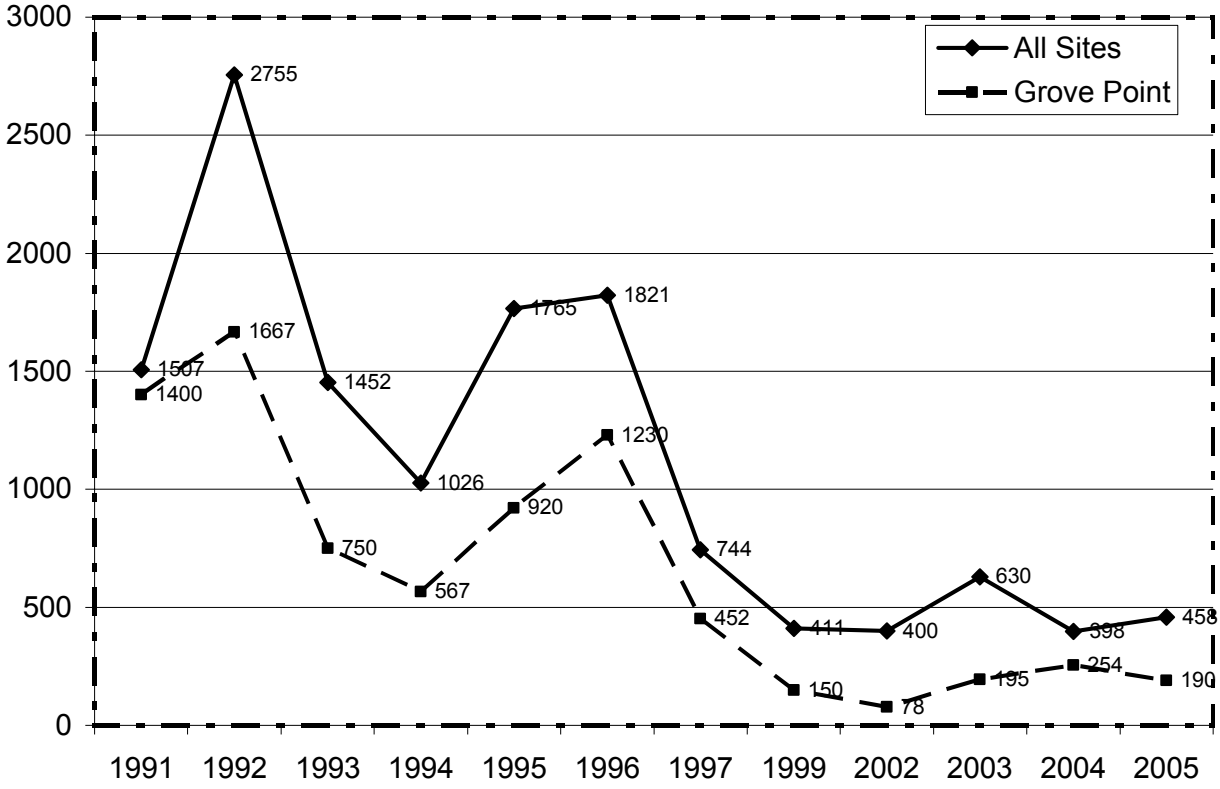


Fig. 2. Counts of Adult *C. puritana* at Grove Point and all Sassafras River Sites, 1991-2005



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 some 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.

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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		**E**	E	D	0	High	100	na		
34	**0**	0/0/0		**C**	D+	B	0.8	Low	46	82		
35	**0**	0/0/0		**C**	C	C	0.5	M/H	23	38		
36	**12**	12/9/05		**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.

Table 7. Numbers of adult C. puritana and C. d. dorsalis within sections of the shoreline at Calvert County Sites,
2004-2007. Map points correspond to points included on topographics maps in appendix of report

Map	2008	2007	2006	2005	2004	2008	2007	2006	2005	2004				
Points	C.dor	C.dor	C.dor	C.dor	C.dor.	C.pur	pur	pur	C.pur.	C.pur.		Shoreline Notes// bold is 2007 notes	LAT	LON
Randle Cliffs														
1	0	0	0	0	0	7	0	0	0	0		public beach area, then cliffs begin; **water level very high in 2005**	4282206.00	366690.00
2	0	0	0	0	0	0	0	0	0	0		start main area of tall cliffs, very narrow, no beach	4282170.00	366700.00
3	0	0	0	0	0	0	0	0	0	0		same	4282169.00	366702.00
4	0	0	0	0	0	3	2	2	4	8		New breakdown area in 2005	4282063.00	366728.00
5	0	0	0	0	0	2	3	5	3	3		same, small sections of sandy beach	4281983.00	366763.00
6	0	0	0	0	0	0	0	0	18	0		same	4281923.00	366766.00
7	0	0	0	0	0	4	3	4	0	0		1-2 m wide, poor beach habitat; cliffs ok	4281870.00	366783.00
8	0	0	0	0	0	1	3	2	0	5		start breakdown with wider beach	4281857.00	366740.00
9	0	0	0	0	0	0	1	0	0	0		same but no beach; new sandy breakdown, mid height cliffs, dry	4281746.00	366806.00
10	0	0	0	0	0	1	0	1	2	8		wide, 3-4 m beach patch, then narrow; dry cliffs, small patch of beach	4281654.00	366832.00
11	0	0	0	0	0	1	4	1	2	3		narrow, no beach, even at mid-tide	4281501.00	366838.00
12	0	0	0	0	0	4	5	3	2	0		beach ends, no beach accessible to south, all v. narrow; breakdown at end	4281333.00	366857.00
	0	0	0	**0**	**0**	**23**	**21**	**18**	**31**	**27**				
Camp Roosevelt														
13	0	0	0	0	0	0		0	0	0		Start at north end at stream entry, no cliffs then wood area, then tall dry cliffs		
14	0	0	0	0	0	0		0	0	0		South end of site		
				0	**0**	0		0	**0**	**0**				
Bayside Forest														
15	0	0	0	0	0			0	0	0		N of BF, at Plum Point, at yellow house with lawn ornaments	4274428.23	368278.79
16	0	0	0	0	0			0	0	0		start series of white houses and no cliffs, some houses damaged by Isabel ?	4274050.32	368201.05
17	0	0	0	0	0			0	0	0		few small groins, cliffs fully vegetated, low, then wooded cliffs, trailor park	4273717.98	368134.07
18	0	0	0	0	0			0	0	0		creek, rock rip-rap, road bed to beach,	4273392.07	368107.36
19	0	0	0	0	0			0	0	0		start high cliffs, no suitable strata	4273246.13	368085.87
20	0	0	0	0	0			0	0	0		dry cliffs, most with vegetation	4272931.63	368026.85
21	0	0	0	0	0	0	0	0	0	0		cliffs end, marsh, creek entry, then woods, then low cliffs	4272475.73	367933.77
22	0	0	0	0	0	0	0	0	0	0		poor low, vegetated cliffs, breakdown; main survey area here to south+D61	4272131.05	367894.37
23	0	0	0	0	0	0	0	0	0	0		very tall cliffs, thin section of soft strata	4271673.71	367901.97
24	0	0	0	0	0	0	0	0	0	0		tall cliff section, narrow beach, many C. repanda	4271513.65	367901.33
25	0	0	0	0	0	0	see	0	0	0		pier posts in water, then no cliffs, then hard, marl cliffs	4271207.36	367883.21
26	0	0	0	0	0	0	to	0	0	0		cliffs dry, many fallen trees, then veg. cliffs	4270886.91	367855.87
27	0	0	0	0	0	0	right	0	0	0		same	4270884.91	367855.84
28	0	0	0	0	0	0	0	0	0	0		no cliffs, woods, then low cliffs; many *C. hirticollis*	4270696.80	367846.63
29	0	0	0	0	0	0	0	0	0	0		low cliffs, field behind, most cliffs bare, 20-25' high	4270437.65	367844.09
30	0	0	0	0	0	0	3	3*	0	0		start cliffs, lots of trees down, equipment and tracks; many *C. hirticollis*	4270322.93	367847.95
31	0	0	0	0	0	5	9	3*	2	0		road access, no cliff section	4270138.63	367883.34
32	0	0	0	0	0	0	1	0	0	0		low bare cliffs, very wide beach (due to 2004 erosion)	4269824.88	367927.75
33	0	0	0	0	0	0	1	0	0	0		Bayside Forest: south end access, low cliffs, evidence of severe erosion, cutback	4269741.77	367925.50
			0	**0**	**0**	**5**	**14**	**6**	**2**	**0**		***Note that these numbers were incorrectly placed further north in previous reports**		
Warrior Rest														
N of 33a					0	0	0	3				Cliff section north of Parker Creek mouth	4266573	367708
33a			0	0		0	0	3	12			Far N end, start at beginning of cliffs, S edge of beach (no waypoint)	4266344	367687
33b			0			17	55	182					4266059	367729
34			0	0		96	48	34	13			Near N. end, no access for last 300 meters of cliffs habitat, severe erosion	4266119.45	367764.62
35			0	0		133	111	275	44			Good cliffs	4265995.33	367799.37
36			0	0		341	160	394	47			same; creek entry	4265795.36	367829.99
37			0	0		131	88	222	7			good cliffs, narrow beach	4265649.67	367873.71
38=39			0	0		240	171	275	31			continue tall cliffs; some vegetated cliff sections,	4265544.85	367896.40
			0	**0**		**958**	**633**	**1388**	**154**					
Scientists Cliffs														
40			0	0	0	22	25	0	6	26		**at creek entry and cove; last groin, tall cliffs begin**	4265331.95	367963.69
41			0	0	0	0	5	0	2	3		**narrow, no cliff habitat**	4265159.36	367995.99
42			0	0	0	0	4	0	2	0		**same, no cliff habitat, beach narrows**	4264839.36	368062.58
43			0	0	0	9	56	60	2	2		**wider beach 6-8 m; old or broken groins, end at creek entry, driveway to beach**	4264568.17	368130.93
44			0	0	0	25	18	8	4	16		**section of rip rap; same low, veg. cliffs**	4264327.43	368210.95
45			0	0	0	55	4	12	11	20		**same; new gabion in 2005**	4264219.09	368244.75
46			0	0	0	13	8	1	0	6		**continue groins, low or vege cliffs**	4263920.84	368332.12
47			0	0	0	11	10	9	0	0		**same, groins**	4263758.76	368380.74
Specific locales,"07): 2 at 8450, 2 at 8425, 6 at 8383, 3 at 8359, 1 at 8302, 4 at 8247, 18 at 8235(just S of stream channel); 56 from 8235 to 8200;														
1 at 8119, 3 at 8036, 5 from 8018 to 8000, 25 from 7980 to 7964, 7964 to 7946,														
12 from 7964 to to 7946, 135 from 7946 to 7896, 88 from 7896 to 7873, 160 from 7883 to 7829, 111 from 7829 to 7800, 48 from 7800 to 7770; quit no access														
48		0	0	0	0	0	0	1	8	20		**6 groins,gabion, creek entry, low vegetated cliffs, ORV tracks**	4263486.71	368474.83
49		0	0	0	0	0	0	0	0	0		**groins end, beach narrows; ORV tracks**	4263264.68	368571.49
50		0	0	0	0	0	0	0	0	0		**SC North, S end,public beach rock groin, 10-12 m wide beach; heavy beach use**	4263137.40	368636.56
51		0	0	0	0	0	0	0	2	0		**Start Scientist Cliffs South, beginning of north end, groins**	4263127.00	368621.00
52		0	0		0	1	2	4	0	5		**open face cliffs, groins; 3rd, 4th gabions**	4262981.00	368641.00
53		0	0		0	2	0	2	2	3		**semi-vegetative cliffs, groins; most veg. cliffs**	4262915.00	368665.00
54		0	0		0	3	3	19	9	8		**semi-vegetative cliffs, end of groins; wide with breakdown bank**	4262820.00	368708.00
55		0	0		0	7	16	18	16	12		**open face cliffs(last groin at 8715)**	4262758.00	368723.00
56		0	0	2	0	3	8	56	29	50		**open face cliffs near waterline,**	4262698.00	368749.00
57		0	0		0	34	34	18	12	12		**same**	4262638.00	368776.00
58		0	0		0	33	13	5	6	71		**same, cliffs ending**	4262564.00	368815.00
59		0	0		0	0				26		**rock groin and residence, no open cliffs,far south end**	4262435.00	368892.00
		0	**0**	**2**	**0**	**218**	**206**	**213**	**111**	**280**				
Western Shores/Calvert Beach														
60	0	0	0	1	0	0	0	0	0	0		north end of public beach	4261318.48	369396.39
61	0	0	1	0	0	0	0	0	0	0		narrow beach, ends at creek entry	4261219.24	369451.65
62	0	2	76	3	12	0	0	0	0	0		very narrow beach	4261067.20	369531.54
63	0	6	18	18	30	0	0	0	0	0		wider beach	4260966.85	369586.44
64	8	27	69	13	60	0	0	0	0	0		same, then beach narrows	4260854.48	369643.59
65	21	68	63	25	105	0	0	0	0	0		same	4260744.83	369690.67
66	48	27	103	20	43	0	0	0	0	0		same, but wider beach	4260660.75	369735.11
67	12	8	126	3	24	0	0	0	0	0		10-20 m wide beach, Phrag. On back, no cliffs	4260545.77	369802.17
68	7	26	103	52	13	0	0	10	0	0		vehicle tracks on beach, dense Phragmites on back, and at 2 creeks(2nd creek)	4260411.18	369867.78
69=70	0	74	8	4	25	3	0	2	10	0		cliffs low, recessed, Phragmites on beach, wide beach, end at first creek	4260233.24	369964.10
71=72	5	10	14	8	5	20	0	39	12	2		cliffs fully vegetated, trees on back beach	4260112.20	370042.84

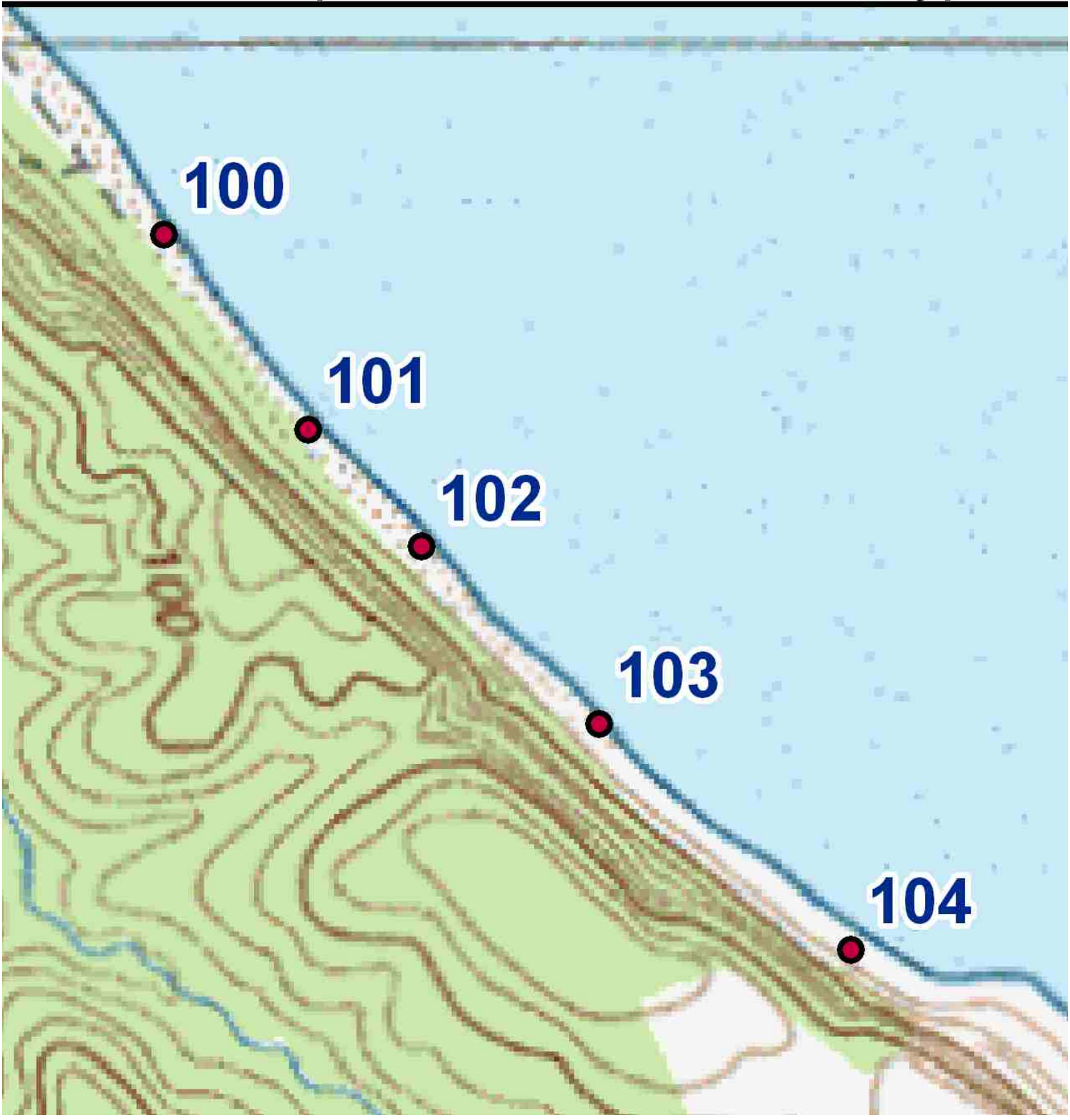
73	3	40	8	0	7	44	25	28	31	30		same but cliffs become heavily vegetated and lower	4259999.63	370105.24
74	0	5	0	0	0	120	26	18	22	135		beach narrows then widens, tree rubble, cliffs tall, most bare	4259891.53	370186.91
75	0	10	0	8	3	61	41	66	42	65		vegetated cliffs, become lower, v. wide beach (10-15 m), then narrows	4259813.51	370255.01
76	0	3	3	150	16	84	25	63	23	115		very tall, excellent cliffs, thick habitat band of soft sand; heavy shrubs at base	4259710.25	370353.16
77	18	138	14	240	70	150	47	88	35	95		wide beach,heavy Phragmites cover (60+%), heavy shrub cover at base of cliffs	4259618.35	370421.75
												Subtotals for Western Shores		
78	6	44	33	74	205	143	35	101	28	122		N end Calvert; lower cliffs, good beach, 10-12 m wide, end at creek entry	4259516.99	370518.71
79	29	98	32	3	8	100	5	150	17	315		continue good cliff habitat, then lower but good, end at large fallen tree	4259432.09	370593.61
80	2	23	25	1	0	100	16	247	11	260		excellent high cliffs with wide habitat band, 3-5 m wide beach	4259378.77	370644.76
81	2	36	3	0	0	16	32	68	1	96		start bare cliffs, soft ideal upper strata	4259341.01	370680.54
82	7	17	0	0	0		16	6	0	25		upper cliffs vegetated and recessed, lower part is marl, 2-4 m wide beach	4259297.40	370721.02
83	11	29	0	0	0		3	0	0	19		North most groin, then bare cliffs, narrow beach	4259252.57	370782.25
84	9	25	0	0	0		2	0	0	0		groin, cliffs fully vine covered, 5-7 m wide beach, new sand bags?	4259032.11	370983.60
85			0	0	0			0	0	0		Calvert Beach and WSE: Start at access, creek, start cliffs	4258960.66	371022.77
86			0	0	0			0	0	0		Calvert Beach South, cliffs, residential, groins	4258899.00	371078.00
87			0	0	0			0	0	0		cliffs, end of groins	4258760.00	371228.00
88			0	0	0			0	0	0		residential, end of cliffs, starts flat back-beach	4258650.00	371340.00
89			0	0	0			0	0	0		far south end, residential, at jetty,	4258458.00	371687.00
				78	214				57	837		Subtotals for Calvert Beach		
	188	**716**	**699**	**623**	**627**	**841**	**273**	**886**	**232**	**1279**				
Flag Ponds														
90		1	2	6	8	0	0	0	0	0		North end, natural area,, avg 15ft back-beach to lagoon, beach narrow to gone	4257143.00	372756.00
91		3	1	1	0	0	0	0	0	0		natural area,, practically no back-beach	4256999.00	372920.00
92		2	2	30	17	0	0	0	0	0		natural area,, avg 5-10ft back-beach	4256918.00	373018.00
93		10	26	40	23	0	0	0	0	0		natural area,, avg 15-20ft back-beach	4256860.00	373094.00
94		13	23	18	15	0	0	0	0	0		natural area, avg 40-50ft back-beach	4256775.00	373164.00
95		9	0	0	0	0	0	0	0	0		start natural area; new accretion point	4256690.00	373168.00
96		5	6	3	3	0	0	0	0	0		no cliffs, avg 10-15ft back-beach to grass dunes	4256595.00	373050.00
97		8	1	23	14	0	0	0	0	0		no cliffs, avg 10-15ft back-beach to grass dunes	4256419.00	373057.00
98			0	0	0	0	0	0	0	0		pier	4256265.00	373114.00
99			0	0	0	0	0	0	0	0		south of pier to boundary fence	4256260.00	373137.00
		51	**61**	**121**	**80**	**0**	**0**	**0**	**0**	**0**				
Calvert Cliffs Nuclear Power Plant														
100			0	No sur.	4	0		0	no	0		North beach, wide beach, avg 20ft back-beach, no cliffs	4256074.00	373233.00
101			0	in 2005	0	0		0	surv	0		same	4255928.00	373341.00
102			0		0	0		6		0		cliffs, avg 5ft back-beach	4255840.00	373426.00
103			0		0	0		0		0		cliffs, no back-beach	4255707.00	373559.00
104			0		0	0		3		0		same	4255538.00	373748.00
105			0		0	0		0		2		Start south of pier, main survey area, very rocky beach, no width, good cliffs	4254774.00	374636.00
106			0		0	0	6	6		0		same	4254697.00	374681.00
107			0		0	0	0	0		0		same	4254633.00	374786.00
108			0		0	8	2	7		6		same but wider beach	4254597.00	374818.00
109			0		0	10	43	13		44		wider sandy with shells beach (1-2 m)	4254527.00	374884.00
110			0		0	8	11	10		3		breakdown, rocky point, little habitat	4254412.00	374979.00
111			0		0	6	4	0		0		same, **all very rock and no beach habitat**	4254325.00	375085.00
112			0		0	4	0	0		0		same	4254288.00	375119.00
113			0		0	5	12	0		6		same but with sandy patches of beach; **narrow some rocky, some sand**	4254240.00	375146.00
114			0		0	11	36	6		18		arc beach, most sandy, 1-2 m	4254151.00	375163.00
115			0		0	24	23	36		28		same; **rock, gravel, sand, medium width big breakdown just to south**	4254053.00	375215.00
116			0		0	21	66	3		8		same	4253912.00	375341.00
117			0		0	4	28	0		0		point, rocky, no beach; **very marginal, most beetles at S end**	4253859.00	375397.00
118			0		0	21	45	19		6		start wide sandy beach, low cliffs	4253689.00	375475.00
119			0		0					0		end just to south, all hirticollis, no puritana habitat	4253617.00	375545.00
			0		**4**	**122**	**276**	**109**	**ns**	**121**				
Calvert Cliffs State Park														
201			0	0		228	3	20	0			Farthest N that can be accessed, rocky shoreline, no beach, even at low tide	4252322	376584
												N end of cliffs		6630
202			0	0		68	125	41	30			Here to north, very narrow, little beach habitat, but cliffs good	4251961	376687
												wider beach sections and good cliffs		6794
												start cliffs, no beach, inaccessible		6700
203			0	0		318	23	9	0			marsh and beach section, no habitat	4251855	376794
														6858
204			0	0		264	87	168	110			tall cliffs, tree rubble , narrow beach, then 4-5 m wide beach with most beetles	4251711	376896
														6906
												beach narrows, little or no width		6968
205			0	0		97	0	28	70			trail accessing beach, very narrow beach, dry cliffs, then good top cliff area	4251569	376987
206			0	0		46	5	8	0			marsh area and beach, no cliffs, no habitat	4251447	377087
207			0	0		475	29	30	11			very narrow beach, excellent cliffs	4251334	377139
208			0	0		67	7	8	10			arc beach, 0-1 m wide beach, then 2-3 m wide	4251150	377244
209			0	0		46	13	26	11			mid, tall cliffs, good, 2-4 m wide beach, end at Rocky Point	4250975	377300
210			0	0			0	0	0			south end of site, cliffs no beach		
			0	**0**		**1609**	**292**	**338**	**242**					
Cove Point														
120		0	0	0		0	0	0	0	0		Cove Point: start at north end, N of pier where beach starts; 2-3 m marsh behind	4250383.35	377646.58
121		0	0	0		0	0	0	0	0		same	4250335.94	377706.05
122		0	0	0		0	0	0	0	0		pier	4250264.84	377783.59
123		0	0	0	0	0	0	0	0	0		narrow arc beach, with water behind	4250207.16	377810.49
124		0	0	0	0	0	0	0	0	0		dense Phragmites behind, coarse sand, narrow beach, 0-2 m	4250130.76	377907.96
125		0	0	0	0	0	0	0	0	0		GPS tube about 8 m offshore, phragmites on beach	4250072.66	377977.31
126		0	0	0	0	0	0	0	0	0		narrow beach	4250005.28	378036.22
127		0	0	0	3	0	0	0	0	0		beach wider, 1-2 m then widens to 5-7 m	4249958.70	378129.25
128		0	0	0	8	0	0	0	0	0		wide beach, 6-10 m wide; still Phragmites behind	4249915.53	378260.68
129		0	0	0	0	0	0	0	0	0		start first trees on back of beach; 8-12 m wide	4249879.53	378359.20
130		0	0	0	0	0	0	0	0	0		same, beach wider	4249822.44	378523.70
131		0	0	0	0	0	0	0	0	0		very wide beach, 20+ m	4249762.29	378699.79
132		0	0	0	0	0	0	0	0	0		same, intertidal sand is soft	4249721.56	378854.50
133		0	0	0	0	0	0	0	0	0		same	4249668.66	379073.50
134		0	0	0	0	0	0	0	0	0		end at north end of lighthouse	4249605.74	379242.64
				0	**11**				**0**	**0**				
Cove Point Hollow														
135					0					0		no cliffs, residential cresent beach	4248963.00	378822.00
136					0					0		no cliffs, residential cresent beach	4248871.00	378750.00
137					0					0		no cliffs, residential cresent beach	4248652.00	378619.00
138					0					0		no cliffs, residential cresent beach	4248399.00	378519.00

139					0					0		vegetative cliffs, residential,	4248191.00	378473.00
					0					**0**				
Little Cove Point- July 6														
140			0	0	0	32	0	0	0	8		cliffs, avg 20ft back-beach to cliffs, end open cliffs at this point	4247990.00	378548.00
141			0	0	0	47	14	21	8	14		cliffs, avg 4ft back-beach	4247932.00	378543.00
142=143			0	0	0	0	0	0	0	0		Cove Point Lake/Cove Lake, cliffs; beach end of cliffs	4247859.00	378548.00
144			0	0	0	0	0	0	0	0		start revetment	4247767.00	378578.00
145			0	0	0	60	25	0	0	0		end revetment	4247655.00	378624.00
146			0	0	0	99	29	22	0	11		Bannister point, arc beach	4247591.00	378668.00
147			0	0	0	161	13	40	0	3		same	4247522.00	378667.00
148			0	0	0	67	61	39	53	7		start point, then arc beach,low but good cliffs, breakdown area	4247387.00	378696.00
149			0	0	0	19	85	24	17	30		same, then high cliffs; good cliffs, wide beach; **deck and stream entry**	4247283.00	378706.00
150			0	0	0	17	3	2	4	0		no cliffs, then low cliffs; **wood steps, terrace, rock revetment, set back**	4247164.00	378755.00
151			0	0	0	8	43	11	5	0		point, then narrow arc beach, cliffs get lower	4247096.00	378822.00
152			0	0	0	73	52	0	0	0		another point section, then arc beach, no cliffs	4246977.00	378853.00
153			0	0	0	59	73	24	23	5		same, point; breakdown; **4th, N most pipe on back; breakdown; N end balls**	4246798.00	378792.00
154			0	0	0	30	22	24	15	0		start point, no beach, good cliffs, break; drainage pipes on cliff **sand bags**	4246704.00	378742.00
155			0	0	0	3	15	26	4	16		same, medium cliffs, wide beach; **stream channel and steps**	4246584.00	378663.00
156			0	0	0	0	19	6	0	0		wider beach, low cliffs; hard cliffs	4246494.00	378601.00
157			0	0	0	77	27	11	6	2		same; **massive breakdown**	4246440.00	378572.00
158			0	0	0	21	5	90	9	4		same; breakdown, very high cliffs; **massive breakdown**	4246319.00	378518.00
159			0	0	0	46	23	33	22	6		mini-point, then recessed arc beach, narrow beach, good cliffs	4246233.00	378483.00
160			0	0	0	34	24	74	39	17		same,very high, good cliffs	4246147.00	378420.00
161			0	0	0	85	18	58	18	33		tree rubble but 1 m beach and good cliffs; breakdown	4246082.00	378376.00
162			0	0	0	8	29	36	15	22		same; **N end of balls**	4246018.00	378322.00
163			0	0	0	18	0	0	5	10		start good cliffs, 2 m beach, cliff terraced at top	4245951.00	378279.00
164			0	0	0	20	35	0	0	0		rock groin and rip rap (40 m long); **S end of revetment**	4245934.00	378254.00
165			0	0	0	6	0	0	4	8		start good cliff habitat; 1 m wide beach	4245870.00	378196.00
166			0	0	0	0	0	0	0	0		same	4245813.00	378153.00
167			0	0	0	0	0	0	0	0		wide beach, more groins; @ 12 total	4245723.00	378082.00
168			0	0	0	0	0	0	0	0		rock groins at south end of beach, then beach	4245646.00	378012.00
169			0	0	0	41	0	0	9	0		cliffs low, no habitat	4245561.00	377925.00
170			0	0	0	17	26	2	8	6		same, beach slightly wider	4245497.00	377878.00
171			0	0	0	53	14	40	14	13		eroded beach, tree rubble, but good cliffs; **N end of balls**	4245446.00	377834.00
172			0	0	0	15	85	32	20	36		S. end, start cliffs, 1-2 m beach, good cliff habitat	4245383.00	377774.00
			0	**0**	**0**	**1116**	**740**	**615**	**298**	**251**				
Cliffs of Calvert														
173			0	0	0	0	6	0	0	0		N end, rock pile, then small pond, no habitat	4245303.00	377719.00
174			0	0	0	0	0	0	0	0		no habitat; **breakdown and minipoint**	4245157.00	377615.00
175			0	0	0	0	0	0	0	0		same; **jus N of N end of balls**	4245058.00	377552.00
176			0	0	0	9	9	0	0	0		start creek and marsh with no beach, no habitat	4244953.00	377484.00
177			0	0	0	0	3	21	4	6		start good cliff habitat	4244878.00	377427.00
178			0	0	0	7	26	15	2	0		same	4244838.00	377392.00
179			0	0	0	52	51	0	0	0		lower cliffs, then vegetated cliffs; ***S end of balls***	4244759.00	377325.00
180			0	0	0	183	0	16	6	6		same	4244700.00	377281.00
181			0	0	0	31	34	8	0	18		wider beach, good cliff habitat	4244638.00	377236.00
182			0	0	0	154	20	24	11	3		continue good cliff habitat	4244609.00	377217.00
183			0	0	0	59	7	4	1	2		same	4244538.00	377166.00
184			0	0	0	175	14	13	1	5		same	4244504.00	377146.00
185			0	0	0	144		10	2	2		same	4244409.00	377075.00
186			0	0	0	13	0	0	0	0		same; 0-1 m wide beach	4244312.00	377018.00
187			0	0	0	2	2	0	3	0		good cliffs with no beach	4244241.00	376974.00
188			0	0	0	0	0	0	0	0		end rip rap, start good cliff habitat, no beach	4244162.00	376920.00
189			0	0	0	0	0	0	0	0		S. end, start N of beach at large house with rip	4244057.00	376863.00
				0	**0**	**829**	**172**	**111**	**30**	**42**				

Totals	C. dorsalis						
	2007	2006	2005	2004	2006	2005	2004
Randle	0	0	0	0	18	31	27
C. Roosev.	0	0	0	ns	0	0	ns
Bayside	0	0	0	0	6	2	0
Warrior	0	0	0	0	1388	155	na
Sci.Cliffs	0	0	2	0	213	111	280
Wshore/Calv	716	699	623	627	886	232	1279
Flag	51	61	121	80	0	0	0
CCNPP	0	0	ns	4	109	ns	121
CCSP	0	0	0	0	338	242	ns
Cove	0	0	0	11	0	0	0
Little Cove	0	0	0	0	615	298	251
Cliffs of Cal	0	0	0	0	111	30	42
	767	760	746	722	3684	1101	2000

Figure 7. CCNPP

Numbered points indicate GPS waypoint



DISTRIBUTION AND ABUNDANCE OF *CICINDELA PURITANA* AND *C. DORSALIS DORSALIS* IN MARYLAND, 2005

Part 1: *Cicindela d. dorsalis* and *C. puritana* in Calvert County

Part 2: *Cicindela puritana* near the Mouth of the Sassafras River

Part 3: *Cicindela d. dorsalis* at Janes and Cedar Islands

FINAL REPORT

December 20, 2005

Submitted to: Heritage & Biodiversity Conservation Programs
Forest, Wildlife, and Heritage Service
Maryland Department of Natural Resources
580 Taylor Ave., E-1
Annapolis, MD 21401

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ABSTRACT

1. This report presents the results of annual surveys of two rare Maryland tiger beetle species, C. *puritana* and *C. dorsalis*, in 2005. All sites where both species occur in Maryland were surveyed.

2. The 2005 Calvert County surveys produced a total count at all sites of 1101 *C. puritana* and 750 *C. dorsalis*. The numbers of *C. puritana* are the lowest recorded for any year and compare with other low recent counts of 1909 in 2003 and 2027 in 2002, and the higher count of 2167 in 2004. The 2005 results confirm a declining metapopulation since the early to late 1990's. This low count was caused primarily by the decline of adults numbers at Warriors Rest (and Scientists Cliffs) with only 111 compared to 447 last year and at Western Shores plus Calvert Beach with only 232 compared to 1279 last year. Calvert Cliffs State Park was surveyed for the first time since 1998 and produced a count of 242 adults of *C. puritana.*

3. The 750 *C. dorsalis* in 2005 was comparable to the lowest ever count of 722 last year and the 781 in 1998. The decline in abundance in these past two years were primarily a result of a significant decline at Western Shores (which had 2459 in 2003, but only about 600 in 2003 and 2004) and at Flag Ponds (which had 748 in 2003 but <130 in both 2003 and 2004). The low numbers for both *C. puritana* and *C. dorsalis* is uncertain but may be due at least in part to continuing effects of hurricane Isabel in September 2003. Recovery from this effect may be realized if there is increased abundance of both species in 2006 and 2007.

4. The total count for Sassafras River *C. puritana* was 386, the lowest ever numbers and comparable to other recent low counts of 398 in 2004, 400 in 2002 and 411 in 1999. The only other recent count was 630 in 2003. These low counts are largely a result of the significant decline at Grove Point which has typically had well over 50% of the total Sassafras metapopulation numbers. Three populations did have increases in 2005: West Betterton with 52 compared to 34 in 2004, East Lloyd with 73 compared to 11 in 2004, and East Turner with 35 compared to 8 in 2004. Numbers at all sites continue to be well below the peak numbers in the early 1990's. The low numbers at these sites in recent years are believed due to increasing vegetation growth on the bases and faces of the cliffs and/or narrowing beach width.

5. The populations of *C. d. dorsalis* at Janes and Cedar Islands increased significantly from last year, Janes numbers to 2475, compared to 369 in 2004 and a record high of 6094 in 2003 and Cedar to 1298 compared with 528 in 2004 and 2229 in 2003.

Part 1. Surveys of *Cicindela d. dorsalis* and *C. puritana* in Calvert County

INTRODUCTION AND METHODS:

This part of the report presents the results of continuing monitoring studies for two rare tiger beetles in Maryland. The two Federally Threatened species are *Cicindela puritana* (Puritan Tiger Beetle) and *C. d. dorsalis* (Northeastern Beach Tiger Beetle), and both occur in Calvert County. Annual surveys, using similar methods, have been conducted for these two species at these same sites in Calvert County since 1988. The survey results with these two insects have provided us with two of the longest monitoring histories for any insect.

The objectives of our 2005 surveys were the same as in previous years: to obtain counts of adults of these two tiger beetle species using a standard survey method under ideal conditions so that population trends can be determined. The surveys are done during the season of peak abundance, usually from late June to mid-July. In 2005, the surveys for adults at the Calvert County sites were conducted between July 5 and 9. Conditions on all survey days were sunny to partly cloudy with temperatures in the low to upper 80's. All of the sites were surveyed at low to mid-tide. The survey method we used was the same as in all previous years. One person walked slowly along the shoreline at the water edge and counted all adults that were seen. In areas where there was a narrow beach or cliffs near the water, the base of the cliffs was examined and beetles there included in the count. In sections of wider beach the surveyor moved more slowly so the back portions of the beach could be surveyed. In 2005 we made counts within the same sections of shoreline as in 2004. A Garmin GPS unit was used to locate these coordinates. Consequently, we used the same waypoint numbers and these were indicated on the same GIS/topographic map sections as in 2004. Shoreline characteristics were also recorded for each of these sections and included in the report tables.

RESULTS AND DISCUSSION:

Summary of *C. puritana* Trends. The **total number of adult *C. puritana* at all sites in 2005 was 2167** (Table 1)**.** This count is the lowest ever recorded since the annual

counts were begun in 1988, and even included a count at Calvert Cliffs State Park for the first time since 1998. The 2005 total is similar to the previous lowest counts of 1909 in 2003, 2027 in 2002 and 2167 last year (2004). The low count of 1668 in 1994 was, in part, a result of one major site not being included. Although the counts have widely fluctuated over the years, often 2-3 fold from one year to the next, the Calvert metapopulation shows a distinct trend of declining numbers since the early to late 1990's. This is demonstrated by the progressive decline since 1998 to 2000 and by the recording of four of the five lowest counts in the last four years. Total counts in the late 1980's and most of the 1990's were over 3000 in most years and reached high counts of over 6000 in four years to a high count of 11,431 in 1988, the first year of the counts.

The low total count in 2005 was caused primarily by a significant decline of adults at Scientists Cliffs (including the Warrior Rest section in previous counts) and at Western Shores + Calvert Beach. In most previous years the totals for these sites combined had over 1000 adults and usually over 1500, but totaled only 498 in 2005. Even in 2004 when totals were only 2167, the count at these sites totaled 1747. Changes at other sites in recent years have had less of an effect on the total decline but numbers at Little Cove Point and Cliffs of Calvert were also among the lowest in recent years. The specific causes for this significant decline in recent years are uncertain, but our field observations suggest there is both increased vegetation growth on some of the cliff habitat and a narrowing of the sandy beaches at the cliff base. Each of these conditions reduce habitat quality for *C. puritana.* The negative effect of vegetation growth may be increasing because of the lack of significant beach and cliff erosion to keep the habitat open and suitable for *C. puritana.* However, there was a significant amount of new erosion of both beaches and cliffs seen in the 2004 surveys, apparently a result of Hurricane Isabel. This may explain some of the recent decline, especially in 2005 when reduced recruitment or high larval mortality in 2003 could have become realized. These erosional impacts could eventually benefit both *C. puritana* and *C.* dorsalis, possibly within the next year or two, by increasing habitat and thus recruitment of new larvae at these sites. The increased narrowing of beaches may be the result of increased water levels from sea level rise.

Summary of *C. dorsalis* Trends. The total count for **adult *C. dorsalis* at all sites in 2005 was 746, the second lowest ever count to the 722 in 2004.** The other lowest count was 781 in 1998 (Table 2)**.** As with *C. puritana* adult nmbers of this species have fluctuated widely from year-to-year but the two-year total for 2004 and 2005 is significantly lower than any other two-year period. In the early 1990's total numbers were over 6000 in most years and over 10,000 in both 1991 and 1992. The numbers in recent years have been largely driven by the numbers at Western Shores since all other populations have declined to very low levels during this period. After increasing declines in the 1990's numbers at Western Shores then increased to 2209 in 2003 before the significant declines in 2004 and again in 2005. It is likely that some of the decline in these past two years was a result of Hurricane Isabel. There was clear evidence of very significant erosion or the beach and cliff base at this site in summer 2004, some still evident in 2005. Hopefully, numbers will increase in 2006 and 2005 as a result of

additional habitat (beach width) and more adults from better recruitment in 2004 and 2005.

Summary Results for Individual Calvert Sites. Table 3 gives the results of the surveys at all Calvert sites in 2005. Included are the adult numbers for both *C. puritana* and *C. dorsalis,* shoreline characteristics for each section of shoreline, and the coordinates of each waypoint. The locations of these waypoints are shown on the topographic maps included with the report.

RANDALL CLIFFS. This is the northernmost *C. puritana* site in Calvert County and has had consistently low numbers of usually less than 100 since 1990, except for a count of 234 in 2001. The count of 31 in 2005 was comparable to the 27 in 2004 and the same number as in 2003. Numbers for this site have been less than the overall average of 72 per year for the past 4 years, but the cause of the decline is not known. It is apparent at least in recent years that this site has a relatively small amount of suitable habitat, primarily very narrow beach width throughout most of the length and only limited sections of suitable cliff. The beach here is restricted to very small patches and even those are covered at mid-tide levels. There seems to be evidence of progressive and significant erosion here in the past 10 or more years.

CAMP ROOSEVELT. There were no adults observed at this site again in 2005, as in each year since 2002. Since a count of 12 in 1995, this site has had counts of 0 to 2 adults, and only in three years from 1986 to 1991 were there more than 17 adults. This site has always been an apparent marginal site, although 73 adults were found here in 1988 and early workers seemed to regularly find adults at this site. It is a relatively long site but the beach is narrow and/or the cliffs are dry and with very little sandy substrate needed for oviposition by *C. puritana.* .

BAYSIDE FOREST. This site had no adults in 2004 and only 2 were seen in 2005. There were only 6 adults in 1989 but most years there were 40 or more adults, and a peak number of 149 was recorded in 2003. Observations during the 2004 survey indicated this site experienced very severe erosion, apparently due to Hurricane Isabel. Most of the shoreline and especially the southern portions where beetles were always most common lost several meters or more of cliff face with extensive cliff breakdown and trees littering the beach and cliff base. There were also tracks and compaction from heavy equipment on the beach, apparently being used to clear the beach of downed trees. In 2005 there was no evidence of the downed trees and rubble or of heavy equipment on the beach. However, the beach was wide and cliffs relatively unvegetated. Numbers were probably low again in 2005 due to the hurricane impacts on the 2003 larval cohort which would have been adults in 2005.

WARRIOR'S REST AND SCIENTISTS CLIFFS. This very long section of shoreline is now separated into two sites because of differences in ownership and management. In previous years the beetle counts were combined. The Warrior Rest count was 155 *C. puritana* in 2005, and 111 were counted at Scientists Cliffs. This is the second lowest combined total (266) ever recorded for this area. The previous low total

was 256 in 2003, but numbers were also low in 2004 (447). The low numbers at these sites at these sites compared to earlier years have contributed significantly to the overall decline of the Calvert metapopulation. In most earlier years, numbers ranged from 1000 to over 2000 adults, and were as high as 3792 in 1998. There has been a recent pattern of decline from 2317 in 2000, 1375 in 2001, and 691 in 2002, and the two even lower counts in the past two years. Our observations in recent years suggest a decline in the amount and suitability of habitat at this site. One change is increasing vegetation along the very extensive groin section in the northern part of Scientists Cliffs. Only 37 adults were found in this section in 2005. Even though this section has never supported very large numbers of adults, the decline in more recent years is significant. Much more important in contributing to the decline in numbers in this section of shoreline is the decline at Warrior Rest which over the years has consistently supported a high proportion of adults of the combined Scientists Cliffs/Warrior Rest shoreline. Another major effect seems to be "natural" erosion. The Warriors Rest section has always had a narrow beach, making it difficult to survey, but the width seems to be getting increasingly narrow. Such narrow beaches make it impossible for adults to effectively forage, and thus may reduce feeding and ultimately oviposition and recruitment. Large numbers of *C. puritana* have apparently existed here because of the very good cliff habitat characterized by abundant deposits of suitable upper sandy strata. The southern end of Scientists Cliffs, south of the public beach has a length of suitable beach and cliff habitat and has supported variable numbers of adults over the years. This south section had 74 of the 111 total for Scientists Cliffs in 2005.

The public beach portion of Scientists Cliffs had a very large population of *C. dorsalis* until the mid-1990's, but after that numbers began a dramatic decline and had disappeared by 2001. Small numbers of adults were found at the far south end of Scientists Cliffs in 2002 and 2003 and 2 were found in 2005, but no population has become established there.

WESTERN SHORES ESTATES/CALVERT BEACH. These two sites are now combined because of comparable management options. This is also logical because they are part of the same section of shoreline and the same populations of *C. puritana* and *C. dorsalis.* It is the only site in Maryland with large populations of both of these species. The total number of *C. puritana* in 2005 was a second lowest ever (combined) count of 232. The lowest count of 101 in 1994 was recorded during unfavorable survey conditions. The 2005 count is significantly less than the 1279 in 2004 and the 577 in 2003. The *C. puritana* at this site have always been at the southern end of the Western Shores part, adjacent to Calvert Beach where cliffs are very well developed and beaches relatively narrow. There is some evidence for a recent decline in the quality of *C. puritana* habitat at this site because of increased growth of vegetation on and along the base of the cliffs. This vegetation now includes larger trees and dense shrubs which probably block the movement of adults of *C. puritana* up and down the cliffs as they switch from foraging on the beach to oviposition on the cliff face. Observations in 2004 indicated that erosion, probably from Hurricane Isabel, pushed up new sand onto the beach and cleared out some of the vegetation along the cliff base. This could prove beneficial for both species'populations in the next few years.

The number of *C. dorsalis* at this site in 2005 was 623, a count nearly identical to the 627 in 2004. This species has been variable in distribution over the years, sometimes along all sections but most often in the middle and north sections. Some years adults have also been present in the northern public beach. In 2005 and 2004, most adults were in the middle section (near where most *C. puritana* were found) and a smaller concentration in the northern section. This increasing overlap in the distribution of the two species may result in increasing competition, and has been caused by an interesting transition of the shoreline in the middle portion of the site, the area which formerly separated Western Shores and Calvert Beach. The beach has been progressively moving southward with increasing beach width. The result has been an extension of the *C. dorsalis* habitat southward into Calvert Beach where *C. puritana* has been dominant. Before 1999 there were few or no *C. dorsalis* within the limits of Calvert Beach, but the numbers there have increased from 2000 to the present, as the beach has widened in the northern part of the former Calvert Beach.

FLAG PONDS. The number of adult *C. dorsalis* here was 121 in 2005, a count similar to the second lowest ever count of 80 in 2004. This site has experienced a very significant decline in abundance since the mid-1990s when there were consistently over 1000 adults. Numbers were even higher into the early 1990s when they reached peaks of over 3000 in several years. The only high count (over 225) in the past nine years was 748 in 2003. That count suggested the population was building back up as adults were recruiting significantly in the northern part of the shoreline at the site. The declines in 2004 and 2005 could be due to impacts from Hurricane Isabel eroding out many developing larvae in September 2003 and thus reducing numbers of adults emerging in 2004 and 2005. If the hurricane was a factor, numbers should begin increasing in 2006. Most adults in recent years have been largely concentrated in the spit beach near the north end of the site.

CALVERT CLIFFS NUCLEAR POWER PLANT. This shoreline has supported a moderate population of *C. puritana*, but numbers have been highly variable from year-to-year. No count was made in 2005 because of difficulty of access due to a high security alert. The adult count was 121 in 2004, about half the 2003 count of 226. The range of numbers at this site included a high of 616 in 1998 and a low of 49 in 1999. Most adults have been concentrated near the middle and at the south end of the site where there is good cliff and beach habitat. Much of the rest of the site has a narrow or rocky beach.

COVE POINT. No adults of *C. dorsalis* were found at this site in 2005, suggesting the low and declining numbers here since 1996 have finally culminated in the apparent loss of this population. The very low numbers of adults (<20 counted in 4 of the past 5 years) indicated this population was at risk of extinction. Counts of over 300-400 were found in the late 1980's to early 1990's, but after that there was a significant decline. There has been significant erosion in the northern part of this site where beetles once occurred, but other factors could be involved in decline (such as heavy shell cover on the beach or *Phragmites* encroachment). The adults at this site in recent years have consistently been concentrated in a small section near the middle of the site.

LITTLE COVE POINT. This long section of shoreline with extensive cliffs and mostly narrow beach has consistently (except for a very few years) supported a moderately large population of *C. puritana.* The count of 298 in 2005 is very similar to the 251 in 2004. These two counts are however among the lowest at this site which has a current average of 399 per year. There were 586 in 2003 and a highest ever count of 913 in 1996. Adults have typically been found along the whole length of this site, but usually in concentrated patches where there are tall, bare cliffs with moderate to narrow width beaches. These alternate with areas without cliffs. Most adults in 2005 and in 2004 were in the middle section of the site (points 160-164). There have been some shoreline modifications in this and the adjacent Cliffs of Calvert shoreline in recent years, and these could be having some negative effect on habitat quality.

CLIFFS OF CALVERT. This site borders the above site and thus supports a part of the same *C. puritana* population. The count in 2005 was only 30 adults and comparable to the 42 adults counted here in 2004. The highest count at this site was 913 adults in 1996, and the current average per year is 241. As in previous years, nearly all of the adults were in a short section in the middle portion of the site. The limiting factor at this site may be the narrow beaches over most of the site's length since there is a long section of tall cliffs with suitable substrate, seemingly capable of supporting larger numbers.

DRUM POINT. No survey was done at this site in 2005, but in 2004 and other recent years, no adults of *C. dorsalis* have been found. This site supported a small number of adults for several years from 1988 to 1994 when the population built up to a peak count of 90 in 1989, but after that no adults were seen.

Part 2. Surveys of *Cicindela puritana around* the Mouth of the Sassafras River, Maryland.

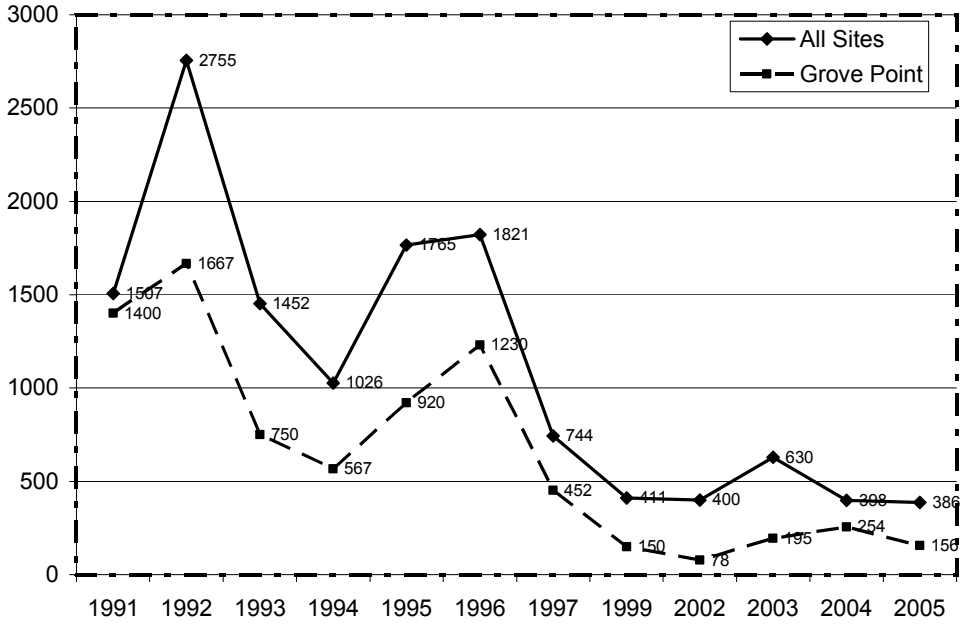
INTRODUCTION AND METHODS:

This part of the study involved a survey of the 9 sites in the area around the mouth of the Sassafras River in the upper Eastern Shore of Maryland. Surveys at these sites were conducted on July 12, 2005. Weather conditions were favorable for the surveys: clear skies with warm temperatures (in the 80's), light winds, and tides at mid- to low levels. Two workers conducted the surveys, each covering different sections of shoreline. The survey methods used were the same as in the Calvert surveys described previously. Adults were counted along separate sections of the shoreline at each site and shoreline characteristics noted. A GPS was used to match the waypoint locations from the 2004 surveys so that adult numbers within the same sections of shoreline could be compared.

RESULTS AND DISCUSSION:

The results of these surveys produced a **total count of 386 adult *C. puritana* for all Sassafras River sites in 2005.** This count is comparable to the 398 in 2004 and the counts of 400 in 2002 and 411 in 1999 (Tables 4, 5). The highest recent counts were 630 in 2003 and 744 in 1997. The 2005 results further confirm the significant decline of the Sassafras River metapopulation since 1996, and the decline of all individual populations. Counts from 1991 to 1996 were near or over 1500 in all years except 1994, but after 1996 there was a significant decline (Fig. 1). Even though numbers at all populations has declined, the largest portion of the decline in recent years has been accounted for by the decline at Grove Point, which has typically had more adults than all other sites combined.

Fig. 1. Counts of Adult *C. puritana* at Grove Point and all Sassafras River Sites, 1991-2005



Numbers at all sites in 2005, except West Betterton, East Lloyd and East Turner had similar or lower numbers than in 2004. The Grove Point count was 156 during our first survey, but a survey a week later produced a count of 182. Both of these counts are among the 4 lowest counts recorded at this site, and indicate a significant decline from the 254 adults counted in 2004. Other recent counts were 150 in 1999, 78 in 2002 and 195 in 2003. Adults at this site were scattered over a fairly large portion of the shoreline but most were concentrated in a short section near the middle of the site, points 63 to 65, and nearly all others from points 65 to 69. This is the section that has consistently supported the largest numbers of adults. Although this site includes a rather long section of shoreline, most is now less suitable habitat, either because the beach is too narrow or rocky and/or the cliffs are too vegetated or with too little sandy substrate. The new 2004 survey location site north of Grove Point which had 45 adults then had none in 2005.

This site had a narrow or rocky beach and mostly low or vegetated cliffs and did not seem to be high quality habitat.

Ordinary Point had 28 adults in 2004 compared to 40 in 2004, 9 in 2003 and 0 in 2002. Most adults were concentrated near the north end of the site as in 2004. This site includes a long section of shoreline with sections of suitable cliff habitat and other sections that are apparently too vegetated. There is very little wide beach at this site which reduces overall habitat suitability.

Adult numbers at other the sites with previous moderate to larger populations were again low: North Stillpond (26 in 2005, 42 in 2004) and West Betterton (52 in 2005, 34 in 2004). North Still Pond had adults along most of its length except at the south end and adults were in the same locations as in 2004. The beach at North Stillpond is relatively wide but only limited sections of the cliffs are suitable because they are too vegetated or rocky. West Betterton includes a relatively long section of shoreline, but adults were concentrated near the far eastern end of the site, nearest to the town of Betterton. Much of the length of the site is non-habitat because of rip-rap or heavily vegetated cliffs. Beaches are also very narrow along the whole length. East Lloyd has had highly variable numbers over the years, but some sections of suitable habitat. Observations in 2004 indicated that nearly all of the site had a very narrow beach and much cliff vegetation which might explain the small numbers of adults present.

East Betterton and West Turner both had counts of less than 15 adults in both 2004 and 2005. These numbers are low enough to seriously threaten the viability of these populations. East Betterton has had consistently low numbers and very little suitable habitat. The cliffs are very vegetated and the beach very narrow throughout. The West Turner Creek site includes small sections with limited habitat and has had counts of 20 or less since 1997. Probably the primary limiting factor at both of these sites were very narrow beaches and rather heavily vegetated cliffs and bases of the cliffs. Two sites did show a very significant increase in adult numbers. Numbers at East Lloyd increased to 73 in 2005, compared to 11 in 2004 but less than the 160 in 2003. Numbers at this site have been highly variable over the years, but some sections of the site have suitable habitat and sporadically produce moderate numbers. Observations in 2004 and 2005 indicated that nearly all of the site had a very narrow beach and much of the cliff was vegetated, possibly accounting for low numbers in most recent years. The East Turner Creek site showed a significant rebound in numbers in 2005 (35 adults counted) compared to the numbers of less than 10 since 1996.

The cause of the decline in the Sassafras metapopulation over the past 8 years is uncertain, but our observations during these surveys suggest it is probably a result of a decline in habitat suitability. We have noted a progressive increase in the growth of vegetation on the cliff faces and especially at the base of the cliffs at most sites. During the past few years' surveys we noticed that at several sites, there has been rapid growth of woody vegetation in areas of former habitat. This vegetation can have several negative impacts on the *C. puritana* population. The cliff vegetation and especially that along the back beach and base of the cliffs will prevent or reduce the movement of adults or

prevent them for utilizing the foraging areas on the beach. Their movement to suitable oviposition sites on the cliff faces may also be impeded. We are uncertain of the cause of this apparent increased vegetation growth. Shoreline erosion and coincidental cliff face erosion should be occurring and apparently has occurred regularly in the past, thus providing suitable habitat for *C. puritana*. An absence or reduction of storms and other erosional episodes in recent years could logically explain the increase in vegetation. It may also be the composition of the vegetation on the cliffs is changing to more invasive species or to plants more resistant to erosion and/ or more effective in stabilizing the cliff faces.

Part 3. Surveys for *Cicindela dorsalis dorsalis* on Janes and Cedar Islands, 2005.

INTRODUCTION AND METHODS

These two sites on Maryland's Eastern Shore have had the two largest populations of *C. d. dorsalis* in Maryland in recent years. They are at the northern end of the species range within the Chesapeake Bay, both isolated, large sites that are not affected by human impacts. The 2005 surveys were conducted by Jim McCann and Dave Brinker on July 11. Conditions were sunny and warm and suitable for producing a high level of *C. dorsalis* activity and thus abundance. The methods used were as described in part one of this report. Numbers of two other common tiger beetles, *Cicindela hirticollis* and *C. marginata*, were also recorded in Table 6.

RESULTS AND DISCUSSION

The results of the Janes and Cedar Islands surveys are given in Table 6 along with results from 2004. It includes the numbers of adults within shoreline sections at each site and relevant shoreline characteristics for each section. Locations of these sections and the waypoints recorded with GPS units are shown on the included topographic maps. The **total number of adult *C. d. dorsalis* counted at Janes Island in 2005 was 2475**. This number represents a significant increase from the lowest ever count of 369 in 2004. Previous counts at this site included an extremely high count of 6094 in 2002, and significantly lower numbers of 938 in 1997 and 1991 in 1998. In 2005 as in previous years, numbers varied significantly along the different sections of the island, but largest concentrations were in the area of Rock Pond (points 9-11), Back Creek (points 23-28), and just south of this previous section (points 31-33). A section near the middle (points 18 to 22) and at the south end (36-42) had no adults. Counts of co-occurring species were 201 for *C. hirticollis* (compared to 29 in 2004) and 1173 for *C. marginata*, a significant increase from the 400 in 2004.

The **2005 adult count at Cedar Island was 1298, compared to 1095** in 2004. This site exhibited generally less variation than Janes with previous counts of 2464 in 2002, 1495 in 1998, and 669 in 1997. In 2005 the adults were generally distributed along most of the length of the west-facing shoreline of the island, but highest concentrations were along the middle section of the shoreline (map points 7-10); this is the section of

shoreline fronting Cow Point Creek. Very few adults were found along the southern shoreline opposite Cedar Island Creek. These areas of concentration were comparable to those found in 2002 and 2004. Counts of other co-occurring species were 528 for *C. hirticollis* (compared to 483 in 2004) and 2229 for *C. marginata* (compared to 963 in 2004).

The cause of significant increase in adult abundance at Janes Island from 2004 along with the slight difference in adult numbers at Cedar Island from last year is puzzling. Most often these two sites have fluctuated in a relatively similar pattern of abundance, except in the last two years. The dramatic decline at Janes in 2004 may have been a result of impacts from Hurricane Isabel that struck the Chesapeake Bay area on September 18, 2003. Many western shoreline sites surveyed in Virginia has similar levels of decline in 2003, but most of a few eastern shoreline sites surveyed had little change. However, Cedar experienced a much lower decline in 2004. The 7-fold increase in numbers at Janes from 2004 suggests significant recovery if the 2004 decline was due to hurricane effects. In general, the causes of these increases and decreases of this species have not been easily determined, in part because more intensive studies of habitat and beetle ecology are necessary to monitor the many factors that might be involved in driving fluctuations.

Adult counts at Janes and Cedar Islands in all survey years:

	1997	1998	2002	2004	2005
Janes Island	938	1991	6094	369	2475
Cedar Island	669	1495	2464	1095	1298

ACKNOWLEDGMENTS:

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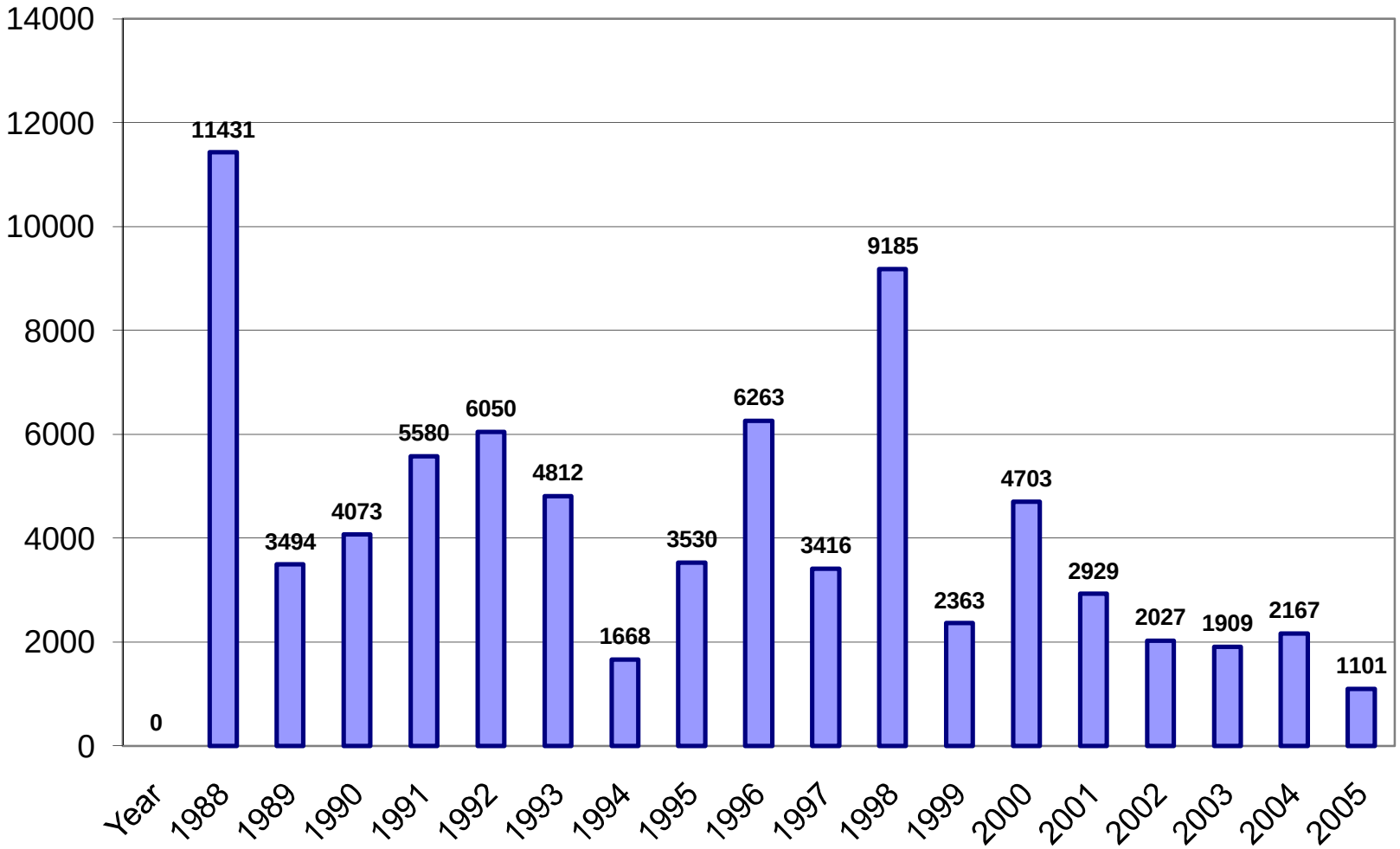
TOPOGRAPHIC MAPS OF SURVEY SITES SHOWING SITE BOUNDARIES AND SURVEY SECTIONS

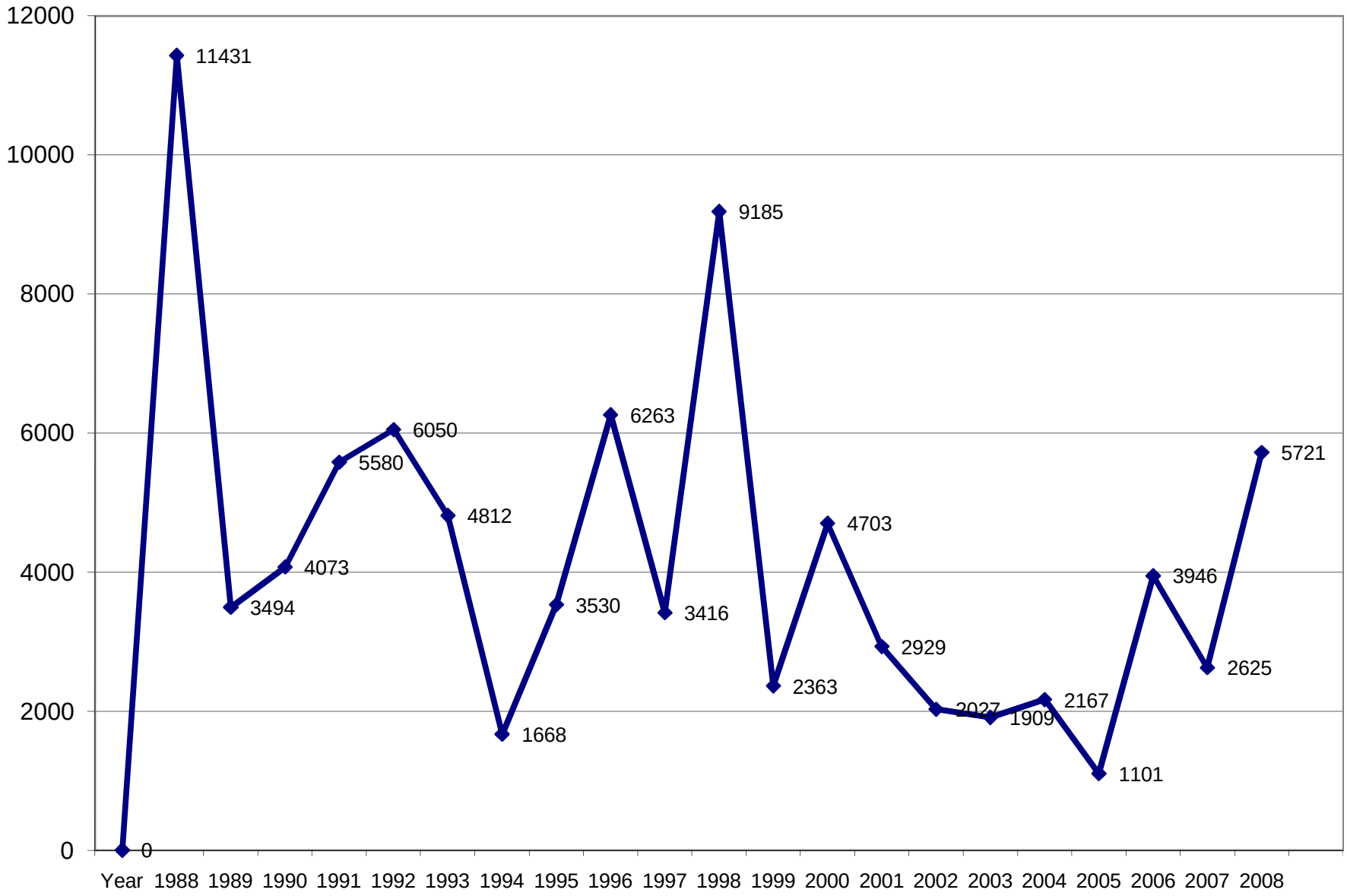
CALVERT COUNTY SITES

SASSAFRAS RIVER SITES

CEDAR AND JANES ISLANDS

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

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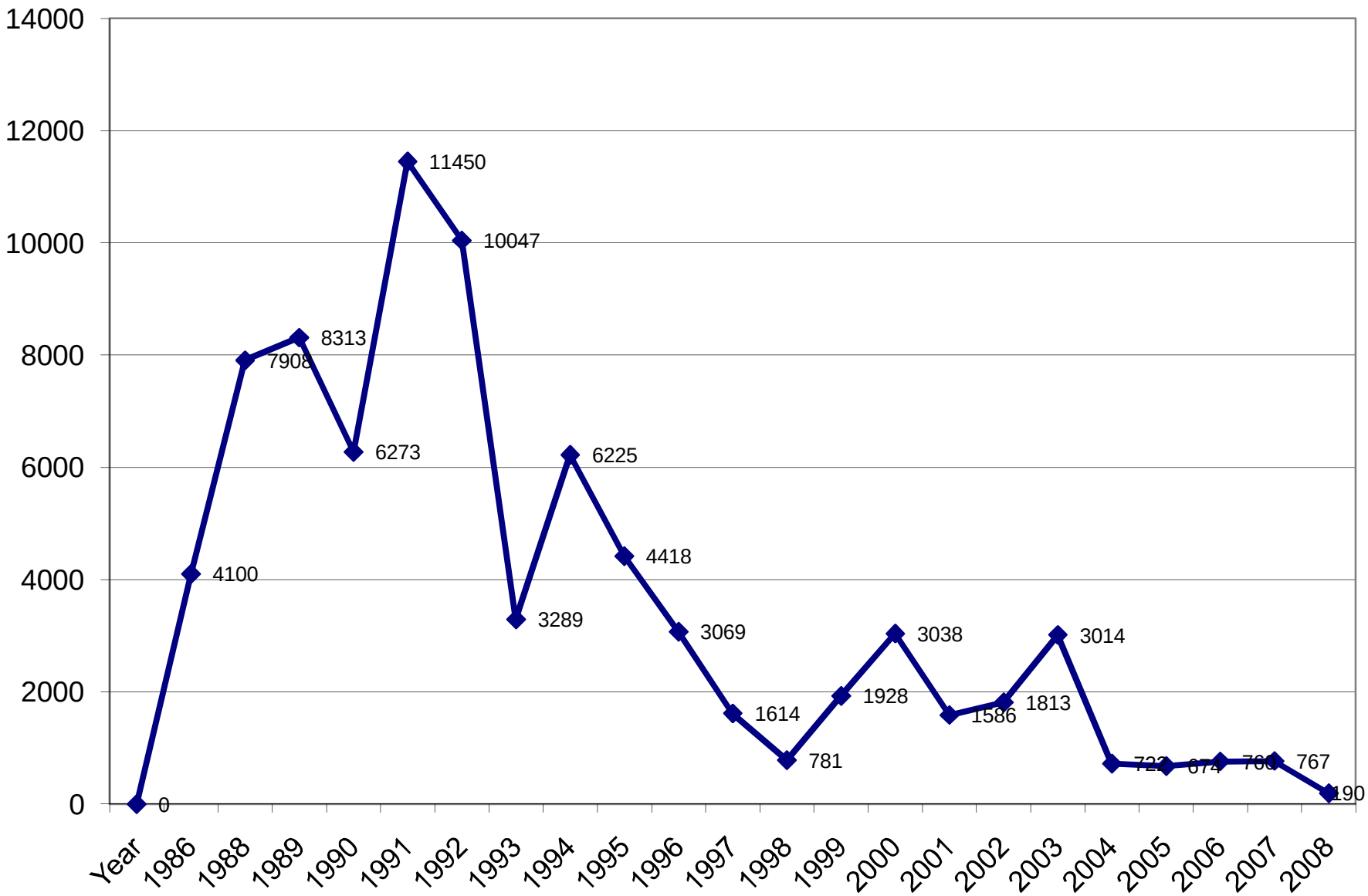
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Table 1. Numbers of Adult *C. puritana* at Calvert County Sites, 1986 to 2004

Year	Rand	CRsv	Bays	Wrest	ScCl	WS+CB	CCNP	CCSP	LCov	CofC	Total	Year
1986	200	20	72		1000				250		1542	
1988	93	73	22		3571	4891		2194	328	259	11431	1988
1989	119	4	6		1491	1052		702	85	35	3494	1989
1990	133		64		1342	1747		643	102	42	4073	1990
1991	57	17	38		2057	1653		835	738	155	5550	1991
1992	65	10	75		2029	767		2565	232	307	6050	1992
1993	68	2	68		2007	731		1177	538	221	4812	1993
1994	24		19		681	101		756	87		1668	1994
1995	82	12	119		1146	1150		541	340	140	3530	1995
1996	45	0	66		1904	1489		919	927	913	6263	1996
1997	75	2	51		1091	851	119	507	525	195	3416	1997
1998	83	1	44		3792	2597	616	984	566	502	9185	1998
1999	29	0	41		408	1169	49		373	294	2363	1999
2000	11	0	22		2317	1161	367		462	363	4703	2000
2001	234	2	109		1375	502			352	355	2929	2001
2002	52	0	28		691	621	80		397	158	2027	2002
2003	31	0	149		256	577	226		586	84	1909	2003
2004	27	0	0		447	1279	121		251	42	2167	2004
2005	31	0	2	155	111	232		242	298	30	1101	2005
2006	25	0	6	1366	218	1123	105	380	612	111	3946	2006
2007	21	0	14	631	206	273	276	292	740	172	2625	2007
2008	23	0	5	958	218	841	122	1609	1116	829	5721	2008
Total	1528	143	1020	3110	28358	24807	2081	14346	9905	5207		

1986 surveys were incomplete

Table 2. Numbers of Adults of *C. dorsalis* at all Calvert County Sites per year, 1986 to 2004

Year	**CRsv**	**Bays**	**PkM**	**ScCl**	**WS+CB**	**Flag**	**CCSP**	**Cove**	**LCov**	**CofC**	**Total**
1986	0	0	0	0	3500	500	0	100	0	0	4100
1988	3	0	0	464	4157	2857	0	427	0	0	7908
1989	0	0	0	1634	3392	3084	1	202	0	0	8313
1990		20	0	1874	1479	2188	0	707	0	5	6273
1991	16	37	328	2465	4198	3995	0	406	5	0	11450
1992	0	10	752	1189	3407	4351	1	335	1	1	10047
1993	0	2	49	473	1344	1218	0	196	7	0	3289
1994		9	0	633	3860	1445	0	278	0	0	6225
1995	8	4	0	688	2450	1080	0	188	0	0	4418
1996	1	5	5	673	1380	810	0	192	3	0	3069
1997	0	0	15	510	841	216	0	32	0	0	1614
1998	0	0	0	263	418	68		32	0	0	781
1999	0	0	0	23	1639	210		56	0	0	1928
2000	0	1	7	24	2813	171		22	0	0	3038
2001	0	0	1	0	1353	221		11	0	0	1586
2002	0	4	0	31	1635	130		13	0	0	1813
2003	0	0	1	13	2209	748		42	0	1	3014
2004	0	0	0	0	627	80	4	11	0	0	722
2005	0	0	0	0	623	121	0	0	0	0	744
2006	0	0	0	0	699	61	0	0	0	0	760
2007	0	0	0	0	716	51	0	0	0	0	767
2008	0	0	0	0	188	2	0	0	0	0	190

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