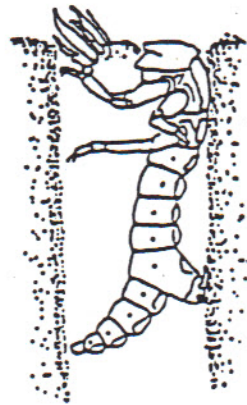
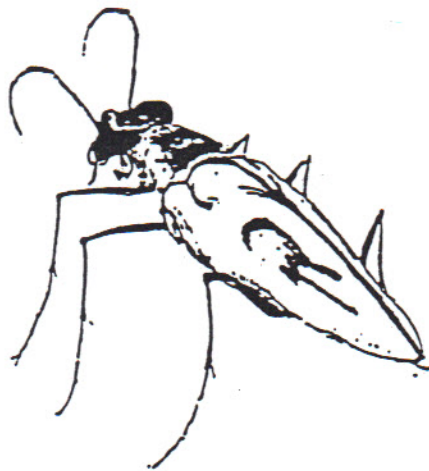


**POPULATION DECLINE OF THE  
NORTHEASTERN BEACH TIGER BEETLE  
IN CALVERT COUNTY, MD**

**FINAL REPORT**



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## ABSTRACT

This primary objective of this study, conducted during summer and fall of 1999, was to determine causes of the decline of the four Calvert County *C. dorsalis* populations in the past 3-5 years. Summer surveys of adults indicated that the peak numbers increased at three of the four sites: from 38 to 56 individuals at Cove Point (but still a very marginal population size); > three-fold at Flag Ponds to 210, and nearly four-fold at Western Shores to 1629. Numbers continued to decline rapidly (to 23 individuals in 1999) at Scientists Cliffs. The numbers of larvae were very low at all sites on both September and October, 1999 survey dates. This may indicate low recruitment and/or reduced activity during the survey dates.

The results of this study provide evidence that the decline in numbers of these four populations has been caused by various shoreline-habitat changes which reduced larval recruitment. An examination of aerial photographs from 1982, 1985, 1989 and 1998 did indicate an apparent decrease in the sandbar offshore from Flag Ponds from 1985 to 1998 and this might have caused some of the shoreline changes at that site and at Cove Point to the south. This study also found no evidence that Calvert County adults or larvae of *C. dorsalis* had increased mortality from pathogens.

The 400 m long Scientists Cliffs shoreline was not mapped but observations and field notes suggested no significant shoreline changes occurred at this site. The fact that adults were absent here in the mid-1980s, then appeared in 1988 and increased rapidly before the decline, suggests this site may not be suitable for long term survival of a *C. dorsalis* population. There were no obvious factors identified in this study to explain this pattern. At Cove Point, GIS-produced maps and field notes indicated that significant erosion and coincidental loss of larval habitat in the areas north and south of the pier accounted for most of the decline. Additional decline may have been caused by the very high percent of surface shell cover in the upper intertidal zone (oviposition area) where adults were most abundant in the past 3-4 years. Soil organic matter at this site was not significantly different from other sites and unlikely cause of decline.

The decline at Flag Ponds is clearly the result of shoreline changes in the northern half of the site. Erosion of the shoreline at the north end and a rapidly developing spit that replaced the old shoreline contributed to the loss of most of the former suitable adult and especially larval habitat. The newly developed shoreline is being recolonized much more slowly than expected, possibly in part because there is a high percent of shell cover along most of the upper intertidal zone where most of the larval recruitment would occur. It is not known if the decrease in the size of an offshore sand bar contributed to any of these shoreline changes. The decline of the population at Western Shores was in large part, but probably not completely, the result of significant narrowing and loss of habitat in a several hundred meter section of shoreline in the southern part of the site (previously very good habitat for *C. dorsalis*). Most of the erosion in this section occurred in late 1997 to 1998. The GIS map indicated a widening (apparent accretion) of much of the shoreline at Western Shores, and even the recently narrowed section may have widened somewhat in the 1980's before the recent erosion. The significant increase in adults at this site in 1999 suggests that the population may be recovering, but numbers may remain lower than earlier peak abundance because of the loss of some shoreline habitat in the southern part of the site.

The results of this study provide strong evidence that the loss and/or modification of beach habitat from erosion and other changes (at Flag Ponds) is a major cause of decline of the four Calvert County *C. dorsalis* populations. The primary effect of these shoreline changes seems to have been a reduction in recruitment of new larvae. There is also some evidence that accumulation of heavy shell cover has impacted habitat quality by reducing oviposition and/or larval survival. However, this study did not clearly identify any primary single cause for the shoreline changes at these four sites. Further study to accurately determine shoreline changes at these sites in the past twenty years by analyzing aerial photographs and other information would be very useful.



## INTRODUCTION

Six large populations of the Federally Threatened Northeastern Beach Tiger Beetle, *Cicindela dorsalis dorsalis*, occur in Maryland. All four of the large Calvert County populations have declined significantly in the past 3-5 years. The Flag Ponds population was near or over 4000 individuals in 1991 and 1992 but declined to a low of 62 individuals in 1998. The Western Shores population was similarly large until the early 1990s but numbers have declined each year since 1994 to a low of 418 in 1998. The Scientists Cliffs and Cove Point populations have had fewer adult numbers, but have also experienced similar proportional decline in the past few years. The cause or causes of these declines are unknown, but regular monitoring at Flag Ponds since 1988 provides evidence that the decline there has been largely the result of shoreline changes. At Flag Ponds erosion has eliminated several hundred meters of the best habitat and just south of this a point bar began developing in 1992 and by 1994-95 it developed into a spit beach which moved south >400 m and reattached to the shoreline. The original shoreline and the area just south of the point of connection were stabilized by the spit development and converted to non-habitat for the larvae of *C. d. dorsalis*. Consequently, nearly all of the best recruitment and larval development habitat (the northern half of the site) has disappeared. The newly developed shoreline has thus far not supported a build-up of the population as expected. Human activity at Flag Ponds may also be having a greater effect on the low numbers than previously. There are no obvious indications of what might be causing the decline at the other three sites. The objectives of this study were to investigate several factors that may be involved in the decline of the Calvert County populations. These factors include primarily shoreline habitat changes such as a decrease in beach width, unsuitable sand particle size distribution or high organic matter, or increase in shell surface cover, and possible effects of pathogens on adults or larvae.

## METHODS

**ADULT AND LARVAL SURVEYS.** This research on the Calvert County *C. d. dorsalis* populations was done during the summer and fall of 1999 at Cove Point, Flag Ponds, Western Shores, and Scientist Cliffs. To determine the current population size and peak seasonal abundance of adults at the four sites I conducted surveys on four dates, June 22-23, July 5-6, July 20-21, and August 10-11, 1999. The survey method was the visual index count method that has been typically used for *C. d. dorsalis*. This involved walking along the whole sandy beach shoreline at each site and counting all of the adults that were seen within separate



sections of a site. On survey days these counts could be accurately made by walking slowly right at the water edge which usually causes the beetles to run to the back beach as you progress. Thus, double counting is usually avoided.

Larval surveys were conducted on September 22 and October 22, 1999. To determine the distribution and abundance of larvae I counted all of the tiger beetle larval burrows within two meter wide belt transects across the whole width of the beach at regular intervals (usually 50 or 100 meters) along the length of the site.

**HABITAT AND SITE CHARACTERISTICS.** I examined several characteristics of each of the sites and where possible, made comparisons with previous years, in an attempt to determine if habitat changes may be accounting for the decline of *C. d. dorsalis*. One part of this was mapping of the shoreline to determine changes (since 1982-3) using a Trimble Geoexplorer II GPS unit. The field-collected GPS data obtained by walking the high tide line and the back edge of the beach were differentially corrected and exported along with the topographic maps from computer software (Terrain Navigator Professional series) to an ArcView GIS data base to produce the shoreline maps included in this report. The maps for three sites (Scientist Cliffs not mapped) show the present high tide line and back beach edge (based on our mapping) relative to the shoreline given on the (1981-83) topographic maps. While there are some sources of error in this comparison, the relative changes of the shoreline at the sites, as indicated on our GIS maps, should be accurate.

I also determined the beach width at each site, by measuring the distance between the most recent high tide and the back edge of the beach and compared this with data from determinations in previous years. Another method for examining shoreline changes that might explain the cause of the decline of *C. d. dorsalis* was to compare aerial photographs of the Calvert County sites from a date prior to the decline with recent photos. One of the hypotheses for a cause of the decline of beetles was possible effects of an offshore sand bar on shoreline habitat. This long sand bar just offshore from Flag Ponds south to near Cove Point was noticed about 1990. This bar may have formed earlier and changed in size in recent years and perhaps is modifying sand movement onshore and having an effect on the shoreline dynamics of the Calvert sites.

Surveys of the Calvert sites in recent years have revealed certain habitat features that may be decreasing habitat quality and affecting the beetle population. A large amount of coarse shell deposits has been seen along much of the intertidal zone at Cove Point and Flag Ponds, in areas where adult oviposition and larvae occur. To quantify surface shell deposits, I estimated the percent cover of these shell deposits within a 34"



diameter hoop ("Hula Hoop") placed at the upper edge of the intertidal zone at 50 or 100 meter intervals along the shoreline at each site.

Another habitat factor that could be a potential cause of decline is a change in sand particle size distribution. In another study I found that coarse sand was unfavorable for *C. dorsalis* larval development. Core samples were taken by pressing a plastic tube (3 cm diameter x 10 cm long) into the sand just above the high tide zone at approximately 100 m intervals along the shoreline at each site. These samples were placed in plastic ziplock bags, air dried in the laboratory, and then passed through a series of graded sieves (mesh sizes of 83, 100 and 300) which separated the sample into four fractions (coarse sand and gravel- medium grain sand- fine sand and very fine sand). The separate fractions were then weighed to determine the percent composition of each. Percent organic matter was also determined for representative subsamples of these soil samples by weighing them before and after heating in a muffle furnace at 500 C. for 1 hour.

**PATHOGENS OF ADULTS AND LARVAE.** There have been no reports in the literature of bacterial or fungal parasites of tiger beetles but this is probably because no investigations have been made. The method I used was to maintain Calvert County adults and larvae in the laboratory and compare their longevity with that of beetles from two viable Virginia populations. This approach is not the most conclusive for determining possible affects of microparasites or pathogens, but it should provide some indication of significant effects of such a factor. I collected 25 adults (15 from Western Shores and 10 from Flag Ponds) and 25 from Virginia (15 from Smith Point and 10 from Vir-mar beach) in July 1999. These were placed in one-gallon plastic containers (2 males and 3 females per chamber) with a 5-cm layer of sand and kept in a constant temperature chamber at 25 C. They were fed daily with *Tribolium* adults and larvae, provided with water and checked daily for survival. The same number of larvae were collected in late September from the same sites and placed in individual plastic rearing tubes (12 cm diameter x 25 cm long) with habitat sand, and maintained at the same conditions as adults. These were fed daily with *Tribolium* and checked for survival.

## RESULTS

**ADULT AND LARVAL SURVEYS.** The peak numbers of adult *C. d. dorsalis* were lower in 1999 than in 1998 at Scientists Cliffs but higher at Cove Point, Flag Ponds and Western Shores Estates (Fig. 1). The increases at these three sites could indicate a possible recovery from the



declines in previous years but continued increases in the next year or two are necessary to confirm this.

The peak number of adults at **Scientists Cliffs** was on July 20 when 23 beetles were counted (Fig. 2). The decline of adults at this site has been progressive and very great since the peak numbers of 2465 in 1991. The drop from 283 in 1998 to the 23 in 1999 is by far the greatest one year decline. Interestingly, there were no adults found at Scientists Cliffs in 1985 and 1986, but numbers increased rapidly from 1988 (464) to the peak in 1991 (2465). I previously speculated that the sudden appearance and build-up of beetles at this site represented a colonization event, but I have no explanation for this pattern, except that this is a characteristic of some tiger beetles and other colonizing species. The absence of adults at the site in 1985 and 1986 may indicate that this site does not provide a long-term viable breeding habitat for this species. The size of the site is relatively small (approximately 400 m of suitable wide beach habitat), especially for supporting the large numbers previously seen. Population counts at other sites, particularly different Maryland sites, indicate that smaller size sites exhibit great fluctuations in numbers, and frequently may become extinct. However, most of these sites were smaller in size and with much small numbers of adults.

The numbers of adults at **Cove Point** increased only slightly in 1999 (56) from 1998 (38). Interestingly, no adults were found on the June 22 and July 5 surveys, prior to the peak count of 56 on July 20 (Fig. 2). There was a rapid decline to 8 individuals on August 11. These 1999 peak numbers are relatively small and probably do not indicate any significant recovery of the habitat or the population at this site. Most of the adults (54 of 56) were in the area 500-800 m south of the pier, the same area where most adults were concentrated in the past few years (Table 1). An examination of the adult numbers within the specific shoreline sections at this site over the years provides an insight to the decline (Fig. 3). Specifically, the decline can be accounted for almost completely by the decline and then total disappearance of beetles from the two northernmost sections of the Cove Point shoreline (the sections just north of and immediately south of the pier) (Fig. 3). Observations and notes during this period indicate that the cause of the decline in these two sections is significant narrowing of the beach from erosion. Erosion has progressed rapidly in the section north of to immediately south of the pier, so that in the past few years, there has been no suitable habitat (little or no beach above high tide) to support larval development.

The peak number of adults at **Flag Ponds** in 1999 was 210 on July 20 (Fig. 4). Numbers declined to 88 on August 11. This increase in 1999 was more than three times the peak 1998 count of 68, and suggests the population may be recovering. All of the adults counted in July 1999 were



on the newly formed spit, most at the south end (Table 2). The remainder of the shoreline to the south, some formerly very good habitat, had no adults. The dramatic decline of adult *C. d. dorsalis* at this site is clearly the result of the loss of suitable habitat for recruitment and larval development. Prior to 1995, especially before 1993, a large percent of adults (and larvae) at this site were in the northern two sections (transects 15-31) (Fig. 5). However, the northern section (transects 25-31) rapidly disappeared because shoreline erosion eliminated the beach habitat. These shoreline changes could have been caused, at least in part, by construction of the pier at Long Beach and/or the decrease in size of a large sandbar just offshore of Flag Ponds. The decrease in the bar could have resulted in higher wave energy striking the shoreline and this somehow causing beach changes (more shell deposits?).

The new spit and shoreline that developed in this area created potential new habitat but eliminated most of the suitable habitat from transects 11-14. The southern, public beach section of the site had supported large numbers of adults in some years (1991, 1992), but never many larvae. Apparently, the high densities of adults at the northern half of the site triggered dispersal to the southern shoreline. The significant increase in adult numbers in 1999 may indicate that the population is building back up by increased recruitment in the newly developed shoreline. However, I found few larvae along this section of shoreline in fall of 1998 and 1999 (see below). Adult numbers in 2000 will give a better indication of how well the recovery of the Flag Pond population is progressing.

The number of adults at **Western Shores** in 1999 peaked at 1639 on July 20, then declined to 822 on August 11 (Fig. 4). The peak count was nearly a four-fold increase from 1998. The great majority of these adults were in the middle section of the site, specifically about 500-1000 m south of the public beach (Fig. 6). As with Cove Point and Flag Ponds, an examination of the changes in beetle numbers within sections of the shoreline at Western Shores provides valuable insight to the decline. The numbers of adults counted in the northern public beach sections varied greatly from 0 to nearly 700, but none have been found in this section since 1996. It is not certain if this area was ever a suitable larval habitat. Most of the decline, however, was within the middle and south sections which exhibited a generally similar reduction in numbers since 1994. The increase in numbers in 1999 was the result of higher numbers in the middle section. The southern portion (1000-1800 m south) has had declining numbers since 1992. A probable cause of this decline is the significant erosion and narrowing of the northern part of this section (first noted in late 1997) to the extent that there is now no beach habitat above high tide for about 400 m of this section (see map and below).



**LARVAL SURVEYS.** Surveys for larvae produced relatively low counts at all of the four Calvert sites on both of the larval survey dates. Total numbers of larvae were generally proportional to summer adult numbers at the sites. At the Scientists Cliffs site, a total of only two second instars were counted in 10 transects in the late September survey and three larvae (two second instars and one third instar) in late October.

At Cove Point, only three of 18 transects had larvae of *C. d. dorsalis* (Table 1). On October 22, two transects about 50 m apart in the area 500-600 m south of the pier had three and two second instars, respectively, and another transect about 800 m south had one third instar. No larvae were found in the late September survey. At Flag Ponds, a total of only 9 larvae were found in five transects on October 22 (Table 2). One transect at the south end of the new spit had one third instar and another had two seconds and one third. In the northern part of the spit one transect had two third instars and another had three second instars. No larvae were found in the late September survey. More larvae were found at Western Shores than the other sites, but numbers were still low relative to the adult numbers. A total of 75 larvae (44 second instars and 31 third instars) were found in 11 of 19 transects in the October survey (Table 3). These were found where adults were most abundant, 600-1100 m south of the public beach area. In the September survey 44 larvae were found, similarly distributed to those in October.

**HABITAT CHANGES AT CALVERT SITES.** The results of the GPS-GIS mapping, the comparison of aerial photographs, and the analysis of sand samples and shell fragments at the four Calvert sites provide useful information on the causes of the population decline of *C. d. dorsalis*. The GIS maps show the current beach width (lines for current high tide and back edge of beach) at a site and the approximate location of the present shoreline compared to 1982-83 when the topos were produced. Some caution must be exercised in interpreting these maps because the original topos have a possible error of up to 40' and the GPS data may be in error by several meters. However, the overall pattern of shoreline change at a site should be valid even though the actual amount of change may not be.

The comparison of 1982, 1985, 1989 and 1998 aerial photographs of the sites involved only visual examination to determine changes in offshore sandbars in Calvert County. The sandbar offshore from Flag Ponds was the only one seen. It appeared most highly developed in the 1985 photograph, then became increasingly reduced in size in 1988 and no visible in 1998. It is possible that this has contributed to some of the shoreline changes at Flag Ponds (and perhaps Cove Point to the south). The decrease in the sandbar may have increased wave energy and erosion of the onshore beaches. A more complete study (beyond the scope of this project) to accurately determine shoreline changes is needed. Such a



study would involve digitizing and quantifying the aerial photographs to determine actual shoreline changes, including offshore sand supply over the past 15-20 years. Habitat changes or characteristics indicated by the mapping and from sand samples and shell cover measurements are summarized below for each site.

The **Scientists Cliffs** site was very small (400 m) and not mapped. Observations and a comparison of notes from earlier surveys did not indicate any significant change in the portion of this site where *C. d. dorsalis* occurs. Sand particle size samples taken at 50-100 meter intervals along the 400 meters, from south to north, at this site were as follows (coarse sand- medium- fine - very fine): 3-66-20-11; 1-66-24-9; 1-92-5-2; 1-49-13-37; and 1-59-38-2). These samples were significantly different from the other three sites in having a much higher proportion of medium sand and a lower proportion of fine and very fine sand (see Tables 1-3). Percent shell cover for these same transects were: 18%, 15%, 6%, 15%, and 19%. This level of shell cover should not have been a negative factor for adult oviposition or larval development. The high proportion of medium sand is comparable to that at some good *C. dorsalis* sites in Virginia and probably not a negative factor. The maps of the other three sites are included at the end of this report.

The **Cove Point** GIS map (as well as the aerial photographs) indicates a significant amount of shoreline recession along most of the length of the site (except the southern end) since 1982-83 when the topo map was prepared. The significant erosion in the section immediately south of the pier and the section north of the pier (though not shown on the map) as indicated above accounts for most of the reduction in beetle numbers (Fig. 3). In the past few years adults and larvae occurred only along the 500-800 m south section near the middle of the site, and this section along with most of the Cove Point shoreline was narrower in 1999 than in 1996 (Table 1).

The sand particle size composition for both 1996 and 1999 is given in Table 1. The particle size distribution for most transects in 1999 included a significantly higher proportion of medium sand (and correspondingly less very fine sand) and slightly more coarse sand than in 1996. There was little difference among the samples taken at 100-m intervals along the shoreline. Shell cover was included with the overall particle analysis in 1996, but in 1999, when it was measured separately, there was a high percent of shell cover (on the upper intertidal zone) in most of the transects from 400 m to 800 m south. This is where adults have been concentrated since 1996. This high amount of shell cover could reduce recruitment by inhibiting adult oviposition or early instar larval survival.



Table 1. Beach parameters and adult and larval numbers at 100 meter intervals along the Cove Point shoreline. Adult numbers based on visual index counts at peak time.

Location (meters from pier)	BchWdt in(m)*		% Particle Size Distribution				Total N Adults		N of Larv. 1999
	99	96	Shel- Grav	Coarse Sand	Medium Sand	Fine Sand	'99	'96	
	Top line is 1996, second is 1999								
200N	1	2					0	0	0
100N	1.5	2	(22)**	8	64	28	0	0	0
50S	2	3	15**				0	0	0
100	2	3.5	13 (23)	1 70	70 18	24 12	0	6	0
200	2.5	4	14 (33)	8 24	48 44	46 32	0	2	0
300	0.5	2.5	(38)	2	79	19	0	2	0
400	3.5	3.5	3 (61)	1 13	41 56	55 31	0	22	0
500	3	7.5	19 (78)	7 3	25 76	49 31	23	102	3
600	5	7.5	16 (58)	5 6	48 74	31 20	25	60	3
700	7	8.5	5 (41)	1 2	57 94	39 4	6	14	0
800	4	5.2	5 (36)	1 21	64 73	31 6	2	2	1
900	7	5	20 (18)	6 16	20 74	54 10	0	0	0
1000	8	5	5 (28)	9 6	49 81	38 13	0	3	0
1100	5	5	2 (47)	1	64	35	0	0	0
1200	7.5	5	5 (22)	1	59	35	0	0	0
1300	7	10	7 (15)	3 8	58 63	33 29	0	0	0
1400	7	9	4	1	30	66	0	0	0
1500	11	14					0	0	0

- \*Beach width is measured as the distance between the most recent high tide mark and the vegetation line on the back beach. Measured in October of 1998 and 1999 August.
- \*\* Shell amounts were measured separately as % cover in 1999.



The shoreline changes at **Flag Ponds** are quite well indicated in the GIS map. The map does not clearly show the loss of shoreline habitat at the far north end, but it does show the development of the new shoreline that significantly modified the former area of good habitat. The effects of these changes on the decline of the *C. dorsalis* population are discussed above. Since the southern half of this site has never been a good habitat, recovery of the population will probably depend on the successful recruitment of larvae on the newly developed shoreline, something that has been progressing much more slowly than expected. A possible factor in the slow colonization and recruitment on the new shoreline was discovered in this study. All of the transects of the new shoreline had a very high percent (61-91%) of shell cover (Table 2). This might make oviposition and/or survival and early development of larvae difficult. Sand particle size distribution is probably not an inhibiting factor since it was not noticeably different from Western Shores transects where adults and larvae were fairly abundant. Beach width also was not likely a factor since most of the new shoreline had a wide beach (over 10 m) with some overwash areas.

Table 2. Shoreline parameters and adult and larval numbers at 100-m intervals at Flag Ponds, 1999.

Location, m S to N	Sand Particle Size Coar-Med-Fin-Vfin	% Shell Cover	Beach Width	N of Larvae	N of Adults	Shoreline Characteristics
0 (T-1)		12	5	0	0	South end, at pier
100		14	8	0	0	
200	6-15-61-18	8	6	0	0	
300	11-11-67-11	2	13	0	0	Just S boardwalk
400 (T-9)	10-1-81-8	1	17	0	0	
600 (T-13)		15	8	0	2	Fence, Start protected area
650		68		1	18	Base of spit, Start new shoreline
700	4-12-73-11	90		3	74	
750	8-8-75-9	91		0	28	
800	14-34-45-7	86		1	30	
850	17-10-66-7	84		0	16	
900		70		0	11	Middle spit
1000	1-1-88-10	61		0	9	
1050		63		2	22	
1100	6-21-65-8	21		3		Washover area
1200(T25)						Beach ends



The GIS map of **Western Shores** indicates an accretion of most of the shoreline since 1982-83, particularly in the northern and southern third of the site. This is puzzling since my notes indicate a very significant erosion along the section in the southern half of the site (where there is currently no beach at high tide) in 1997-1998. This is indicated on the map by the high tide and beach edge line being contiguous. A possible explanation is that the shoreline accreted between 1982-83 and the early 1990's, then eroded in this southern section in the past few years. Regardless, this section was formerly good adult and larval habitat, but has had very few adults and larvae in the past two years. Shell cover was relatively low (<20%) in all but two of the transects and particle size distribution was quite consistent along the whole site and similar to the other Calvert sites (Table 3).

Table 3. Shoreline parameters and larval numbers along 100-m intervals at Western Shores, 1999.

Location, m south	Sand Part. Size Coar-Med-Fin-V.Fin	%Shell Cover	Beach Width	No. of Larvae	Shoreline Characteristics
100	1-8-63-18	5	3	0	North end, S end Pub.Beach
200	2-2-85-11	8	2	0	
300	1-1-80-18	8	4	0	
400	2-2-78-18	3	6	0	Wide, straight shoreline
500	31-29-27-13				
600	0-1-84-15	18	6	9	Washover area
700	1-3-82-15	80	5	7	1 <sup>st</sup> stream enters, adults and larvae numerous
	1-1-91-7	2	7	5	
800	3-4-76-17	7	5	5	2 <sup>nd</sup> , 3 <sup>rd</sup> stream cuts
900	8-9-74-9	6	15	11	Adults and larvae abundant
	1-14-71-14	0	10	8	
1000	0-1-88-11	7	8	7	Bluffs start, low, far back
1100	0-0-84-16	3	4	7	Bluffs high, only 5 m from high tide line
1200	3-1-68-28	18	0	0	Start very narrow beach
1300	1-1-83-15	50	0	0	Bluffs close to water edge
1400	1-1-84-14	11	0	0	
1500	0-1-71-28	18	6	6	Beach widens,
1600	1-16-70-13	17	7	7	Wide, open beach
1800	1-2-82-15	7	12	3	Wide, flat, washover beach



The amount of organic matter was low and similar (range of 0.3 to 1.2%) for all of the six transect samples taken from each of the four sites. It is unlikely that these levels of organic matter accounts for any of the decline in beetle populations.

**POSSIBLE PATHOGENS AFFECTING ADULTS AND LARVAE.** This study did not indicate any reduced longevity of adults and larvae of *C. d. dorsalis* from Calvert County. The 25 adults from Calvert sites (10 from Flag Ponds, 15 from Western Shores) seemed to be similar in behavior and activity to 25 adults from two Virginia sites. Twenty two of 25 remained alive for the 5 weeks that they were maintained and observed in the laboratory. Twenty-four of the 25 Virginia adults remained alive for the same period. All of the 25 second instar Calvert larvae (10 from Flag and 15 from Western Shores) and all 25 of the Virginia larvae remained alive for six weeks in the laboratory, after which this study was terminated.

### **SUMMARY AND CONCLUSIONS**

The results of this study indicate the following about the four Calvert County *C. dorsalis* populations:

1. Peak numbers of adults in 1999 increased at three of the four sites: from 38 to 56 individuals at Cove Point; more than three-fold at Flag Ponds to 210, and nearly four-fold at Western Shores to 1629. Numbers continued a dramatic decline at Scientists Cliffs to 23.
2. Numbers of larvae were very low at all sites on both survey dates. This may indicate very low recruitment and/or reduced activity during the survey dates.
3. There is evidence from this study that the decline in numbers of the Calvert County *C. dorsalis* populations was caused by various shoreline-habitat changes that reduced larval recruitment. The decrease in size of the offshore sandbar at Flag Ponds from 1985 to 1998 may have caused some of the changes there and possibly at Cove Point, but this was not determined in this study. There was no indication that pathogens of adults or larvae were responsible for the decline.
4. The 400-m long Scientists Cliffs shoreline was not mapped but observations and previous notes indicated no significant shoreline change at this site. Because this site had no adults in the mid-1980s, then apparent colonization and a rapid build-up and decline,



- it may not be suitable for long term survival of a *C. dorsalis* population. Some tiger beetles are colonizing species that exhibit this type of life history pattern. There were no obvious factors identified in this study to explain the decline at this site. Sand particle size was somewhat different than at the other three Calvert sites but probably not a factor.
5. At Cove Point, GIS-produced maps and field notes indicated significant erosion and coincidental loss of larval habitat in the areas north and south of the pier accounted for most of the decline. Additional decline may be the result of beach narrowing and especially a very high percent of surface shell cover in the upper intertidal zone (oviposition area) of the shoreline area where adults have been most abundant in the past 3-4 years.
  6. The decline at Flag Ponds is clearly the result of the significant change in the shoreline which has occurred there. Erosion of the shoreline at the north end and a rapidly developing spit that replaced the old shoreline contributed to the loss of nearly all of the former adult and especially larval habitat. The newly developed shoreline is being recolonized much more slowly than expected, possibly in part because there is a high percent of shell cover along most of the upper intertidal zone where most of the larval recruitment would occur.
  7. The decline of the population at Western Shores was in large part, but probably not completely, the result of significant narrowing and loss of habitat in a several hundred meter section of shoreline in the southern part of the site which formerly was very good habitat for *C. dorsalis*. Most of the erosion in this section occurred in late 1997 to 1998. The GIS map indicated a widening (apparent accretion) of much of the shoreline at Western Shores, and even the current narrow section may have widened somewhat in the late 1980's before the recent erosion. Heavy shell cover or particle size distribution did not seem to be a cause for decline at this site. The significant increase in adults suggests that the population may be recovering, but numbers may remain somewhat low because of the loss of some shoreline habitat at the southern part. Organic matter in the sand samples was low and similar at all four sites and unlikely to be a factor in beetle populations.
  8. The results of this study provide strong evidence that the loss and/or modification of beach habitat from erosion and other changes (at Flag Ponds) is a major cause of decline of the four Calvert County *C. dorsalis* populations. The primary effect of this seems to have been a reduction in recruitment of new larvae in the



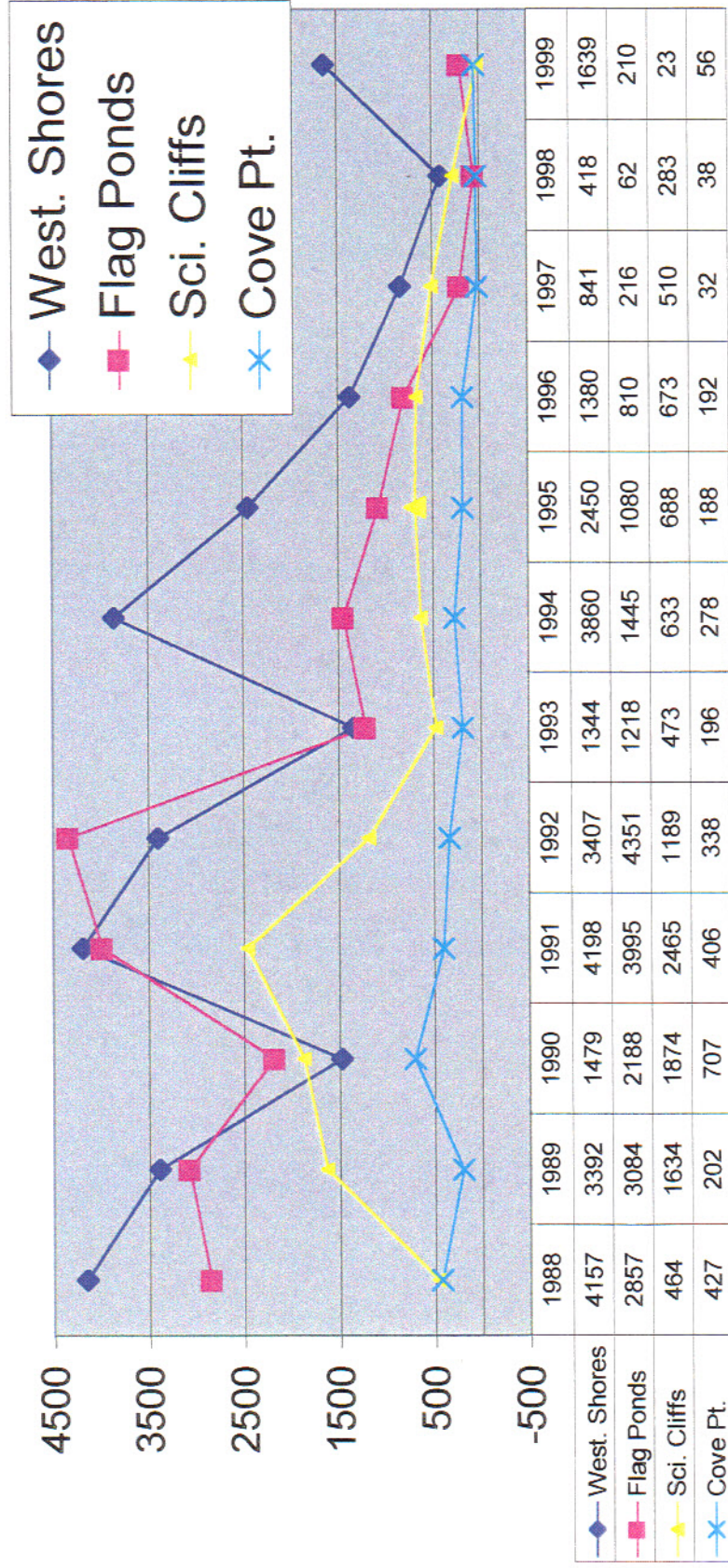
modified shorelines. There is also some evidence that accumulation of heavy shell cover has reduced beach habitat quality and retarded oviposition and larval survival at several sites. This study does not given an explanation for the primary cause of these shoreline modifications.

#### ACKNOWLEDGMENTS

Thanks to Dr. Chas Gowan for producing the GIS maps of the sites, to Chris Myers for assistance in the field, and to Michelle Canick of the Maryland-DC Chapter of TNC for providing aerial photographs. This study was made possible by the funding provided by the Cove Point Natural Heritage Trust.

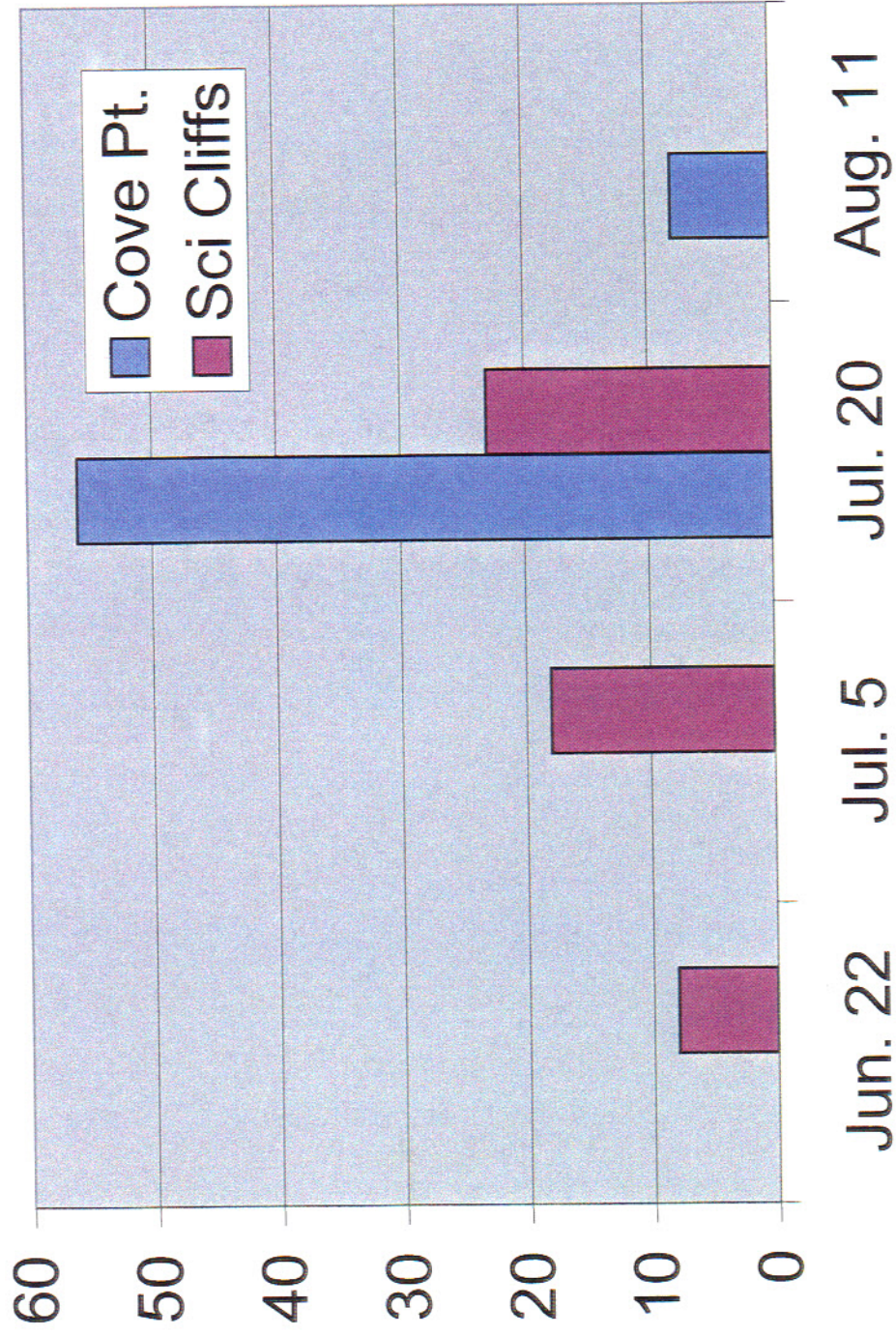


**Fig. 1. Population Sizes of Maryland *C. dorsalis*  
Populations, 1988-1999**



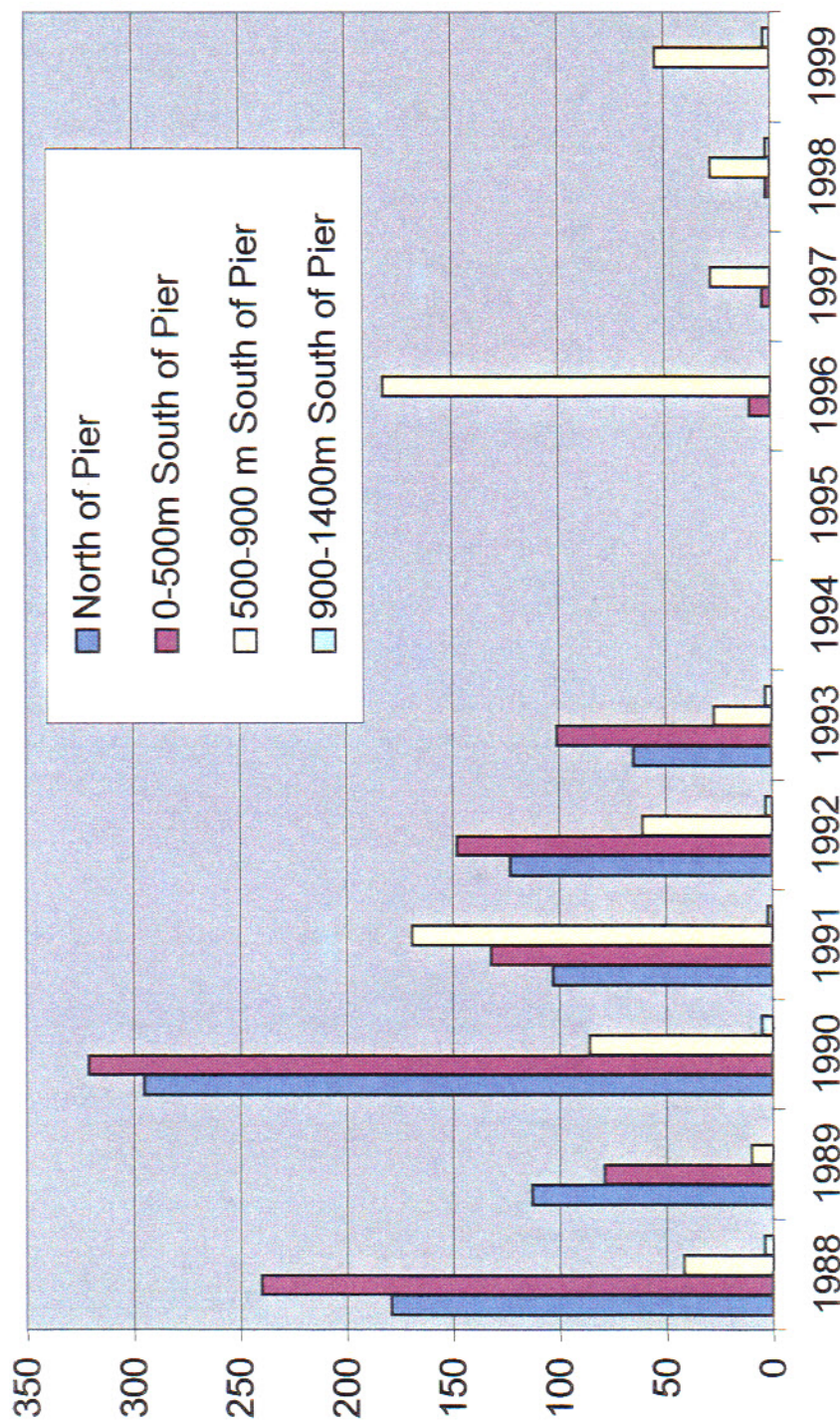


**Fig. 2. Numbers of Adult *C. dorsalis* at Cove Point  
and Scientists Cliffs in 1999**



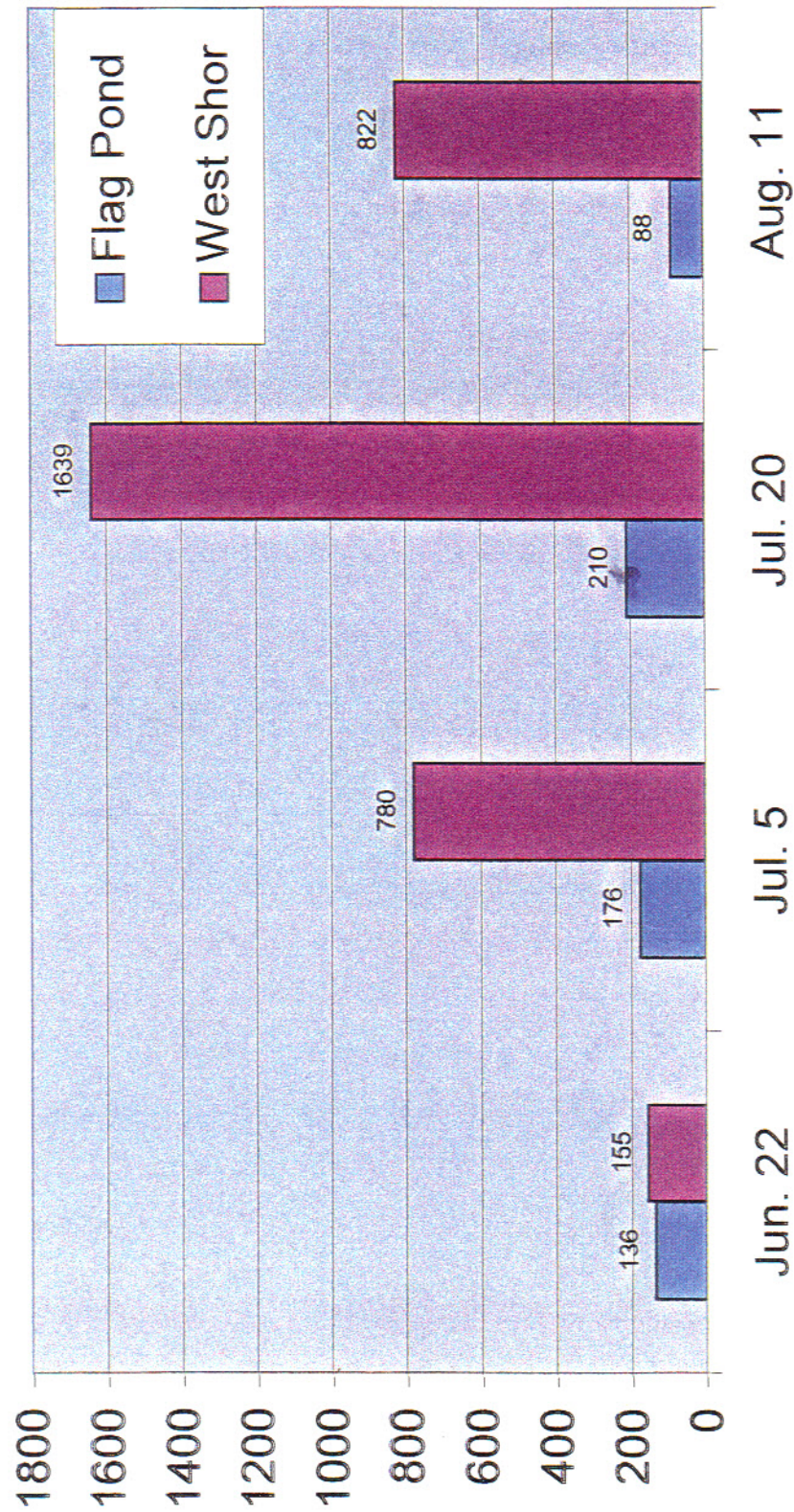


**Fig. 3. Numbers of Adult *C. dorsalis* Within Beach Sections at Cove Point, 1988-1999**



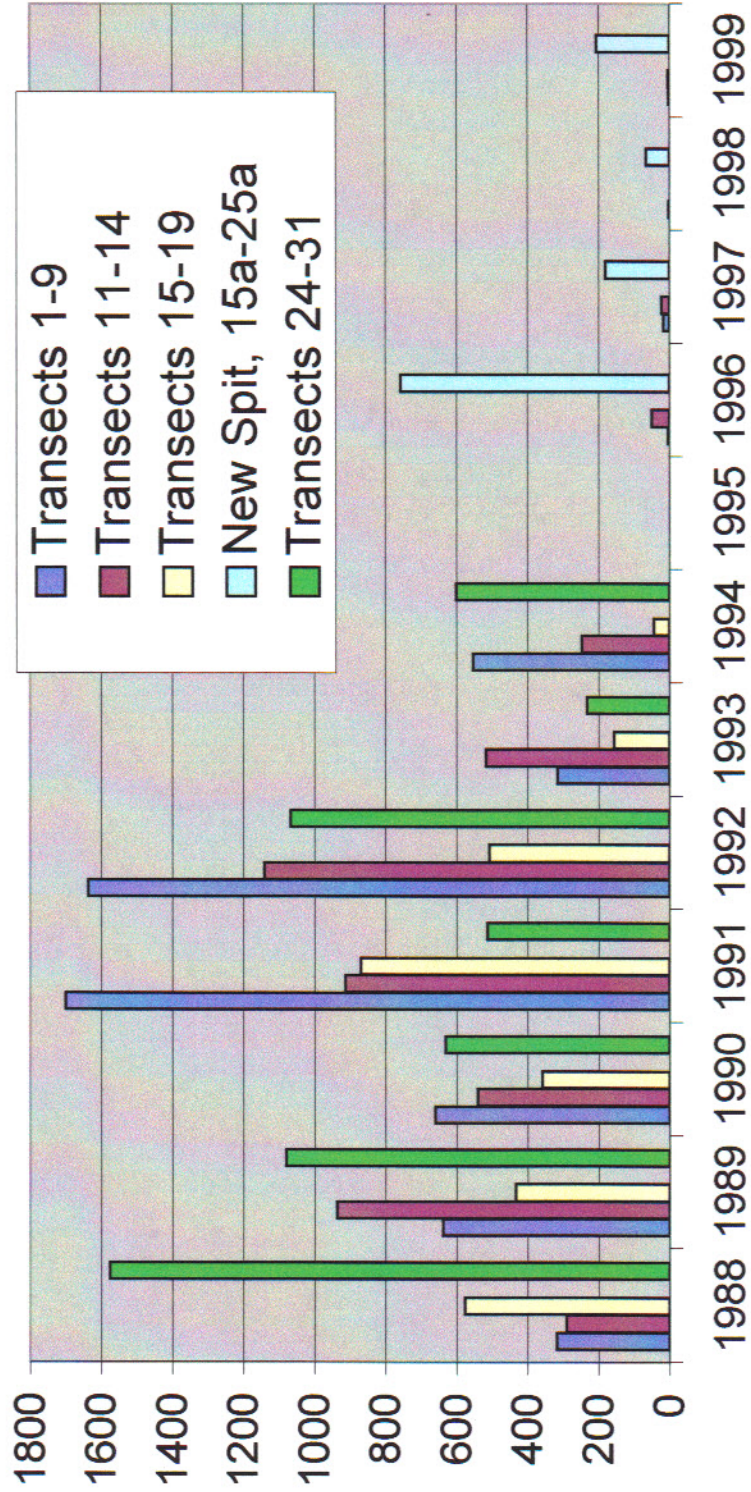


**Fig. 4. Numbers of Adult *C. dorsalis* at Flag Ponds and Western Shores in 1999**



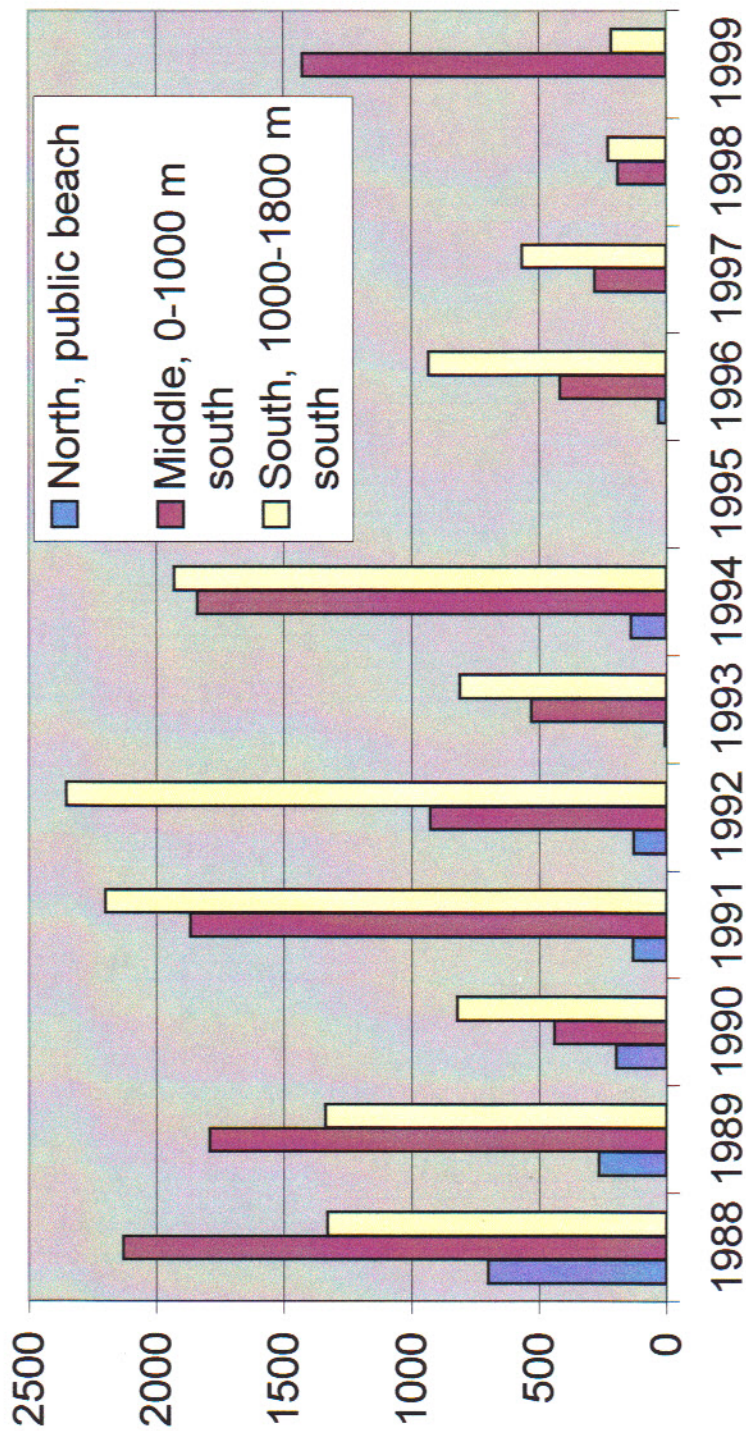


**Fig. 5. Numbers of Adult *C. dorsalis* Within Beach Sections at Flag Ponds, 1988-1999**





**Fig. 6. Numbers of Adult *C. dorsalis* Within Beach Sections at Western Shores, 1988-1999**





## TOPOGRAPHIC MAPS

The following three topographic maps show the current high tide line and back edge of beach (obtained from GPS field data) in relation to the shoreline in 1982-83 when the topos were produced. Relative beach width is indicated by the distance between the blue line (high tide line) and green line (back edge of beach). The transects indicated on the map do not correspond to those in Tables 1-3. There were only field reference points.





- Landmarks
- High Tide Line
- Beach Edge
- Transect

1 Kilometers

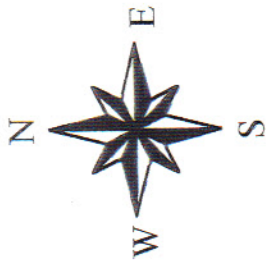
0.5

0



Pier

# Cove Point



Lighthouse

0 0.5 1 Kilometers

- Landmarks
- Hightide Line
- Beach Edge
- + Transect



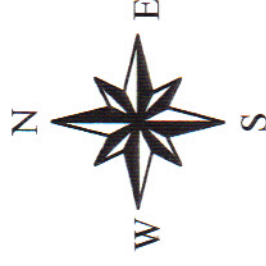
# Flag Ponds

Site Boundary

New Spit

Pier/Fenceline

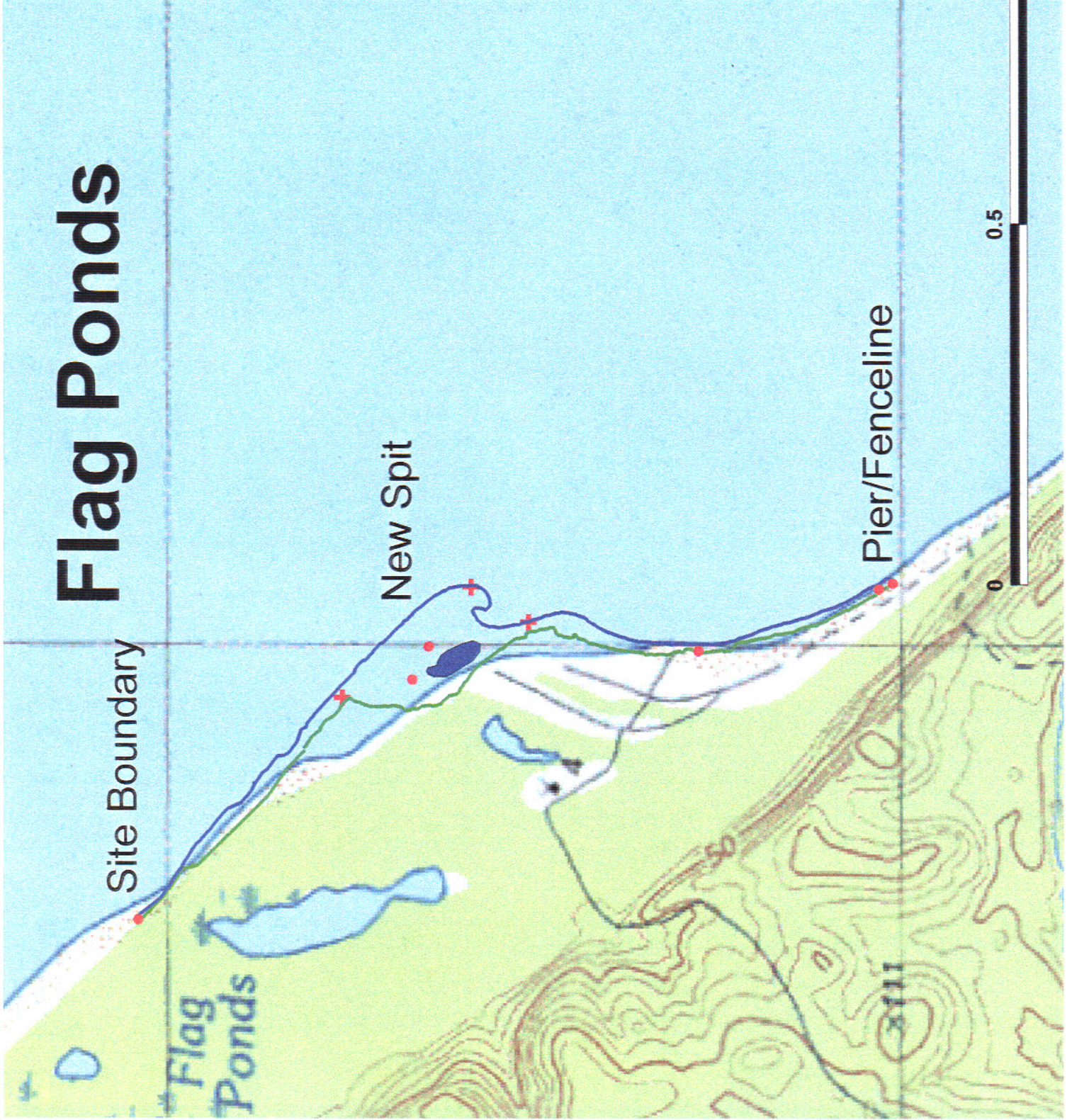
- Landmarks
- Hightide Line
- Beach Edge
- Transect
- Pond



1 Kilometers

0.5

0





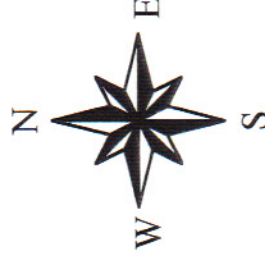
# Flag Ponds

Site Boundary

New Spit

Pier/Fenceline

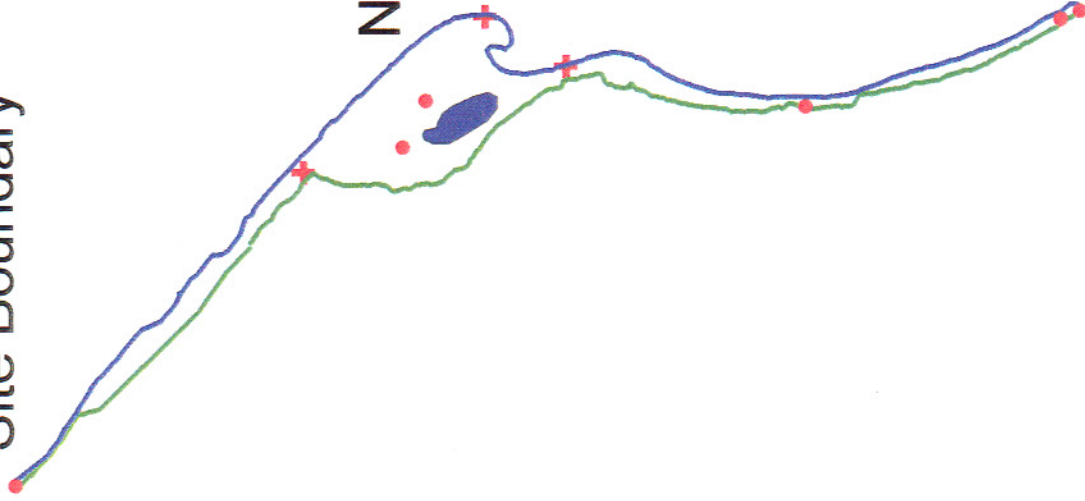
- Landmarks
- Hightide Li
- Beach Edg
- Transect
- Pond



0.5

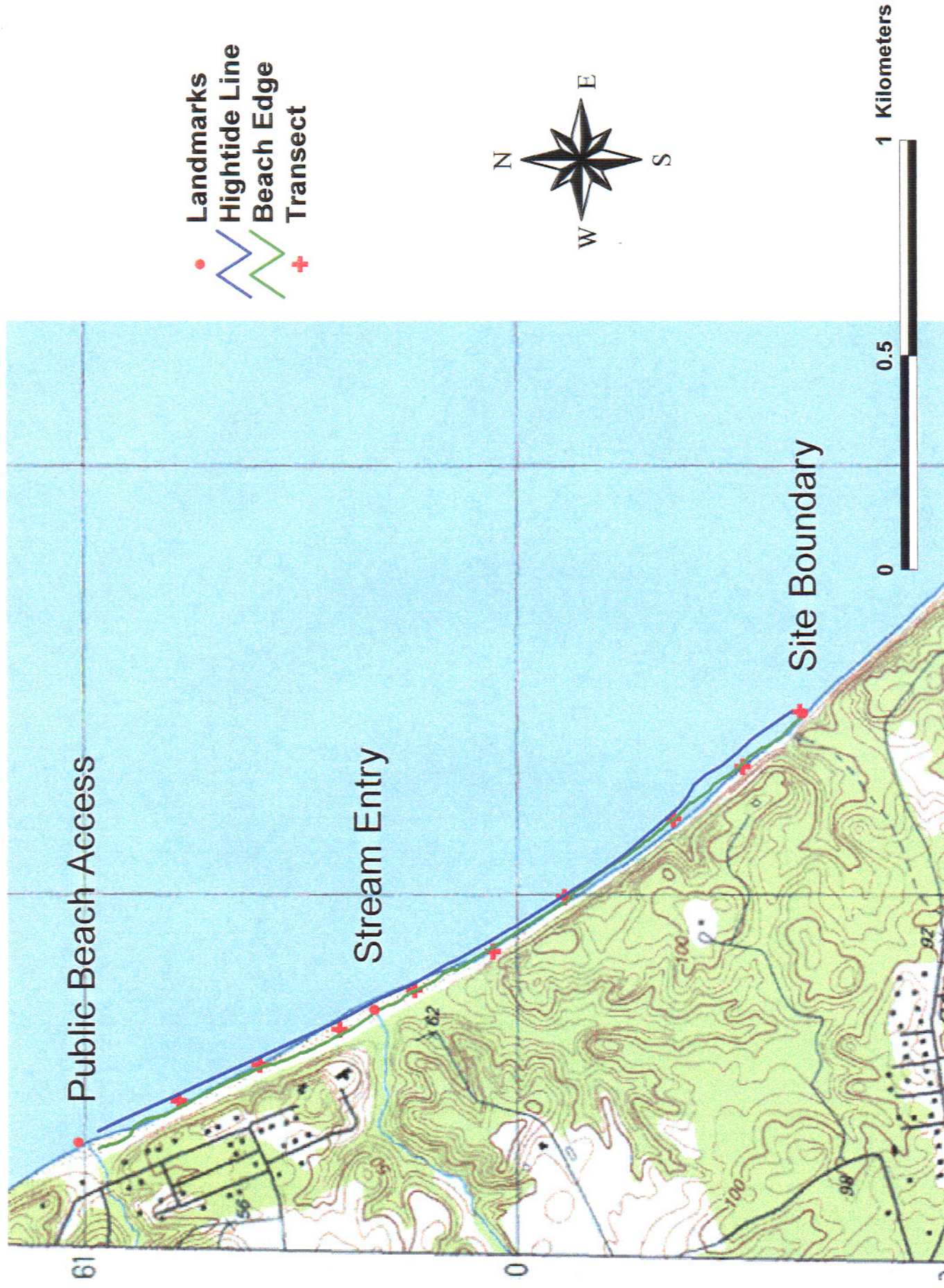
0

1 Kilometers





# Western Shores





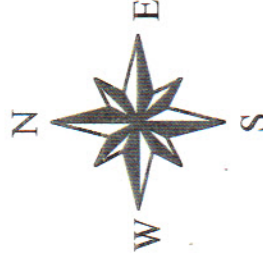
# Western Shores

Public Beach Access

Stream Entry

Site Boundary

Landmarks  
Hightide Line  
Beach Edge  
Transect



0 0.5 1 Kilometers