

**DISTRIBUTION AND ABUNDANCE OF *CICINDELA*
DORSALIS MEDIA AT ASSATEAGUE ISLAND
NATIONAL SEASHORE IN 2009**

FINAL REPORT



Submitted to:

**Assateague Island National Seashore
7206 National Seashore Lane
Berlin, MD 21811**

August 2, 2009

From

**C. Barry Knisley
1510 Beaverdam Creek Rd.
Crozier, VA 23039**

ABSTRACT

The objective of this study was to continue monitoring of the distribution and abundance of *Cicindela dorsalis media* at AINS, to compare the results with previous surveys and to use this information to inform management strategies. This species has exhibited dramatic fluctuations in abundance since the first survey in 1985, but numbers have been more consistently low, under 200 individuals in all but one year since 2002. Surveys for *Cicindela dorsalis media* in 2009 (on July 22-23) used methods identical to those used in the previous surveys for this species in 2001-2008. With this method adult numbers were based on a visual search method where the surveyors moved slowly throughout the areas of habitat and counted all adults seen. The survey area for *C. d. media* included the whole length of AINS shoreline from the north inlet to the Virginia line. The ocean shoreline of the North End, the State Park, the NPS Developed Zone and much of the southern part of the ORV zone from the state line to km 23 were surveyed by walking slowly along the shoreline. The northern part of the ORV zone, north of km 23 where few beetles have occurred in past years, was surveyed by two workers counting from a vehicle. A summary of the results is, as follows:

1. The **total count of *C. d. media* for 2009 was 84 adults**, including 21 along the North End shoreline and 63 others within the south end ORV zone, including 32 within the southern most 1 ½ km plover exclosure section and 31 others scattered along the shoreline from km 23 to 33. The 2009 total count compares with 60 in 2004, 429 in 2005, 57 in 2006, 66 in 2007, and 169 in 2008. The general pattern of alternating abundance with higher counts in odd year cohorts compared to adjacent even year cohorts was not continued because of low numbers in 2009.
2. Results of the *C. d. media* surveys further document the high year-to-year variation in population size. The low even year counts may have been triggered by hurricane Isabel or perhaps north end restoration work, but exact causes are unknown. Favorable habitat and other conditions in the north end should promote a build-up of both cohorts over time, but it seems that certain habitat conditions are not suitable to allow for successful buildup in the north end of the island.
3. The results of this 2009 survey and other recent years do not significantly change our conclusions and management recommendations from earlier reports. It is apparent from this year's survey that the population of *C. d. media* continues to occupy the North End restoration project area, although the numbers are so low that the population is not secure but subject to extinction. The subpopulation at the far south end has been consistently present at moderate to high numbers since 2001, suggesting this site is continuously producing new adults because of successful adult oviposition, larval recruitment and survivorship.

OBJECTIVES

The study objectives in these recent surveys remain the same: to determine the population size of *C. d. media* at AINS in 2009 and evaluate its population trends, distribution patterns and effects of the North end restoration project.

BACKGROUND

***C. d. media*.** This tiger beetle is restricted to extensive, dynamic sandy coastal beaches without significant human disturbance (e.g. shoreline erosion control structures, resort development, ORV's, high pedestrian use) (Boyd 1978, Glaser 1984, Knisley and Schultz 1997). It occurs in the beach zone at the water edge, not island interiors, because adults and larvae are dependent on regular tidal wave action to create suitable microhabitat conditions. Like the federally listed nominate subspecies (*C. d. dorsalis*), its presence is generally considered an indicator of relatively pristine or "natural" beach habitat (Knisley 1986).

Historically, *C. d. media* occurred at scattered localities along the Atlantic coast, from southern New Jersey to south Florida (Knisley and Schultz 1997, Pearson et al. 1997). Most records are from barrier islands but it also has been found along mainland coastal beaches directly exposed to ocean waves. It has been extirpated from many of these areas, probably as a result of intense human recreational use, beach erosion control and shoreline development. Today, it is considered rare to uncommon in much of its remaining range. The only extant populations north of Maryland are located at Cape Henlopen, DE and on a small island north of Atlantic City, NJ. To the south, it occurs in a few areas on the Virginia portion of Assateague Island and is locally common at several other Virginia barrier islands (Knisley and Hill 1992). Scattered, highly localized populations are also present in the Carolinas, Georgia, and Florida (Yarborough and Knisley 1994, Ciegler 1997, Knisley and Schultz 1997).

In Maryland, *C. d. media* probably occurred historically along most of the ocean shoreline of Fenwick and Assateague Islands (Glaser 1984; Knisley and Hill 1990). It was last collected from Fenwick Island during 1926 and has since been extirpated from there (Knisley and Hill 1990). On Assateague Island, surveys since 1985 indicate that it is largely confined to the northern 6 km of the island where a small population persists (Hill and McCann, unpublished data; Jack Kumer, pers. comm.). High intensity beach use by pedestrians and ORV's eliminated it from all areas between the State Park and Maryland-Virginia state line. During 1986-1991, annual counts of adults were relatively high ranging from approximately 120 to 400 individuals (Knisley 1986; Knisley and Hill 1990; Knisley and Hill 1992). Adult numbers dropped consistently thereafter to a low of 14 adults in 1998 (Knisley 1996; Hill and McCann unpublished data). The population rebounded dramatically to 698 adults in 2001 (Knisley et al. 2002) and then declined (220 in 2002 and 190 in 2003, 60 in 2004) before an increase to 455 in 2005 and declines to 57 in 2006, 88 in 2007, and 169 in 2008.

Cicindela dorsalis media, like the closely-related Federally Threatened taxon, *C. d. dorsalis*, is known to be impacted by a variety of natural and human-induced factors. The cause of the apparent severe decline at Assateague in the late 1990's is uncertain. However, several major coastal storms struck this region in the mid-late 1990's resulting in severe shoreline erosion at Assateague Island and dramatic changes in the shoreline configuration, elevation and overall habitat conditions on much of the island, especially on the North End. A 1998 storm event was particularly severe. The long-term sand starvation effects resulting from stabilization of the

Ocean City Inlet on natural barrier island beach processes also may have contributed to the apparent decline. Use of ORV's on the North End during routine patrols and piping plover research activities also may have contributed to the decline.

The potential effects (either positive or negative) of the shoreline modification projects at AINS are not well known. One of these projects, the Assateague Island Emergency Storm Berm project was constructed in August through September of 1998 to compensate for the impacts of Nor'easters in January and February of 1998. Approximately 134,000 cubic yards of sand were placed on northern Assateague along an 8,400 ft. long reach of the island located from 3.2 to 4.8 miles south of the inlet and shaped to construct a trapezoidal berm 100 ft in base width, and with 1:10 side slopes in this section of the island. It is important to note that this is the area where most of the beetles were found in the 2001 survey suggesting a possible beneficial effect on the species by providing additional or improved habitat. During 1999-2000, some beetles were incidentally collected at the North End during piping plover food and habitat studies (Jack Kumer, pers. comm.), confirming the beetle's continued presence at AINS.

Our detailed surveys of *C. d. media* before and after the North End Beach Restoration Project (in 2002) will hopefully provide new information on the effects of such shoreline modifications to this species. Surveys for this species along the whole AINS shoreline where there are varying levels of ORV and pedestrian activity are also providing us with information on these impacts. For example, our results from previous surveys have indicated *C. d. media* is nearly exclusively restricted to the two areas where ORV activity is most limited. The distribution of *C. d. media* and that of *C. lepida* (see below) will identify the critical habitat areas for these species and thus allow for the delineation of "no-spray" areas in the event that mosquito control occurs at AINS.

Tiger beetles and the North End Beach Restoration Project. A major beach restoration project was initiated in late summer 2002 (just after the 2002 data collection was completed) on the northern end ("North End") of Assateague Island. The project involved significant disturbance of nearshore beach habitats within critical habitat for *C. d. media*. Population data collected since that time and including this year's survey may provide us with an indication of potential effects of this 2002 project on *C. d. media*.

METHODS

We conducted surveys for adult tiger beetles during July 22-23, 2009. Two observers participated, both with extensive experience in conducting surveys for tiger beetles. The method we used was a direct visual index count which involved recording the numbers of all adults seen while observers walked slowly through potential habitat. We used hand-held GPS units to record adult beetle locations and also to regularly record reference waypoints to indicate the area covered in our survey. Using the GIS program ArcMap, these point locations were overlaid onto U.S.G.S. 7.5' topographic maps and aerial photos to depict beetle distribution along the shoreline of the island. The surveys for *C. d. media* involved walking along the wet intertidal zone of the beach during mid-morning to late afternoon when adult beetles are concentrated in this habitat. Shoreline areas covered by walking surveys included the ocean sides of the whole North End, the State Park and Developed Zone, and most of the OHV section (from the VA state line north to

km 22. The northern most section of the ORV zone, from km 23 north to the Developed Zone, which has supported few or no adults in recent years, was surveyed using a vehicle as had been done in several past surveys. The method involved two workers counting beetles along a 20 m width of intertidal zone from a very slow moving (5 mph) truck.

RESULTS AND DISCUSSION

We observed a total of **84 adults** of *C. d. media* during 2009, the fourth count of less than 100 individuals since 2001 (Table 1 and Figures). The north count of 21 adults compares with 5 last year, 57 in 2007 and 25 in 2006. North end adults in 2009 were more widely scattered than in most years and typically solitary with no mating pairs observed). As in other low count years, adults seem to be concentrated in a few areas and absent from long stretches of shoreline which is apparently unsuitable or marginal habitat. The highest north end count was 611 in 2001. In 2009 as in most other recent years, a relatively high concentration of adults was found in the far south end enclosure area adjacent to the VA state line (km 34-35). A total of 32 adults were counted in this section in 2009, including 5 observed mating pairs. The consistent presence of adults in this area suggests it is supporting a breeding subpopulation of the species. Interestingly in 2009 we also found a relatively high number (31 individuals) quite widely scattered from km 23 to 33. A highest ever count of 57 were found within this same section in 2008, most concentrated in a section of limited vehicle traffic. These results clearly indicate much of the southern ORV zone may have suitable potential habitat which could support a larger population if the negative effects of ORV traffic was limited. What these numbers (especially the north end) suggest is a pattern of abundance related to the two year life cycle, with abundance usually lower in even year cohorts and much higher in odd year cohorts. Thus, the low numbers in 1996 and 1998 may have led to the low counts in 2002, 2004 and 2006 (Table 1).

TABLE 1. Numbers of *Cicindela dorsalis media* observed at Assateague Island National Seashore from 1985-2009. Empty cells indicate no data collected.

North End (kms from Jetty)	1985	1986	1987	1988	1990	1991	1992	1996	1998	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	10	19	11		23	52	7	6	0	0	11	0	0	0	0	0	1	0
0.5	20	8	28		64	140	57	2	0	0	3	0	0	1	0	0	2	1
1	41	5	36		108	109	10	7	0	1	0	0	0	5	0	2	0	1
1.5	25	12	3		26	40	4	5	0	5	3	0	1	3	4	2	0	1
2	1	38	0		14	23	2	3	5	6	0	4	0	21	1	11	0	2
2.5	4	49	0		0	4	0	3	5	2	2	0	0	8	0	11	0	0
3	27	59	0		17	3	1	2	4	2	4	1	0	5	10	9	0	4
3.5	42	42	11		67	12	5	18	0	66	15	8	3	37	3	6	1	0
4	7	12	24		27	0	1	13	0	112	18	14	1	25	2	0	1	0
4.5	8	9	4		2	0	0	10	0	106	0	18	0	75	4	4	0	6
5	2	3	5		0	0	1	2	0	34	1	11	1	34	1	9	0	0
5.5	2	1	0		0	0	0	0	0	10	2	13	0	5	0	0	0	0
6	1	0	0		0	0	0	3	0	54	11	10	0	12	0	0	0	0
6.5	2	0	0		0	0	0	0	0	62	3	38	0	4	0	1	0	0
7	3	2	0		0	0	0	0	0	83	2	14	0	11	0	2	0	0
7.5	0	0	0		0	0	0	0	0	17	0	9	0	12	0	0	0	1
8	0	0	0		0	0	0	0	0	22	0	0	0	15	0	0	0	1
8.5	0	0	0		0	0	0	0	0	27	0	3	0	7	0	0	0	3
9	0	0	0		0	0	0	0	0	1	0	3	0	7	0	0	0	1
9.5	0	0	0		0	0	0	0	0	1	0	2	0	1	0	0	0	0
Total North end																		
Shoreline	195	259	122	200	346	383	88	74	14	611	75	148	6	265	25	57	5	21
North end Bayside										15	15		8		0	0	8	0
State Park and Dev. Zone	0	0	0	0		0	0	0	0	0	0	21	8	12		0	0	0
ORV Zone, N of closure										0	18	12	18	7	11	5	57	31*
ORV Closure Zone					13					72	97	9	20	145	21	16	99	32
Grand AINS total	195	259	122	220	359	383	88	74	14	698	220	190	60	429	57	88	169	84
* 10 in kms 23 through 25; 7 from km 27 through 29; 14 from km 30 through 33																		

The factors producing the considerable year-to-year fluctuations in population size of *Cicindela dorsalis media* cannot be determined without the simultaneous detailed monitoring of a wide array of factors (beetle development patterns, weather, erosion, shoreline changes, human impacts) which may directly or indirectly distribution and abundance. The range of annual fluctuations that we have found at AINS during the survey years between 1985 and 2009 is somewhat greater than what we have seen for the related taxon, *C. d. dorsalis*. Our experience with tiger beetles, including *C. dorsalis*, suggest that the population trends are largely driven by climatic factors, especially coastal storm events, or by severe perturbations to their habitat. Storm events cause direct larval mortality and habitat loss through beach erosion where active or overwintering larvae occur. Over the long term, however, storms are an essential element in maintaining and redistributing suitable habitat. Relevant and recent evidence of storm impact (Hurricane Isabel, in this case) were the results of my survey of adults of *C. d. dorsalis* at over 60 sites along the western shoreline in Virginia during the summer of 2004. Total numbers at these sites declined about 70% from the numbers in 2001 and 1998. Many individual sites declined by 80-90% and some sites with several hundred adults in previous surveys had none in 2004.

Interestingly, however is that a smaller number of survey sites along the southern part of the eastern shore of the Bay in Virginia did not decline. The observed condition of the beach sites on the western and eastern shorelines and available information indicated that the hurricane which struck in September 2003 had, in Virginia, a much greater impact on the western shore. The severe beach erosion apparently washed out large sections of shoreline with larvae, thus reducing the numbers of maturing and emerging adults in summer 2004. Surveys at Janes and Cedar Islands on Maryland's upper Eastern Shore also declined dramatically in 2004 compared to the several previous several years. Effects from Hurricane Isabel may also explain this decline.

Our past surveys at Assateague also provide some evidence of storm effects on tiger beetle numbers, and here we provide a brief chronology of these events. During 1985-1991, a period characterized by a general lack of major storms (Army Corps of Engineers 1998), adult numbers gradually increased, from 195 to 383 individuals. However, during October 1991 through January 1992, three severe storms struck the island. These three storms included the familiar "perfect storm" (October 31, 1991) and an even more severe storm (the third most severe on record for coastal Maryland) on January 4, 1992 (Army Corps of Engineers 1998). During the following summer of 1992, beetle numbers dropped to a then low of 88. No surveys were conducted the following three years (1993-95) but major storms occurred on March 2, 1994 and January 7, 1996 and numbers again appeared to remain low during surveys in 1996 with a count of just 74 individuals. Also, the lowest count ever in 1998 was preceded by two major nor'easters in January-February 1998.

In addition to annual fluctuations in population size, substantial shifts in distribution occurred, especially from 1985-2005 (Table 1). During 1985-86, the population was centered near km 1 to 5 then shifted northward to km 0 to 2 during 1990-1991. In 1998, it was confined to km 2 to 3. During 2001-2004, the population shifted again and was centered at km 3.5 to 7.0. Supporting data are lacking but these distributional changes were probably related to shifts in the extent and suitability of larval habitat resulting from storm events, other beach sand transport processes (e.g., long shore sand transport, normal tidal action) and perhaps human effects (e.g., Emergency Storm Berm). Also, during 2001-2005, the population was centered around the Emergency Storm Berm area which probably led to increases in larval habitat. The presence of a large number of adults within the area of the North End Restoration Project in 2003 is in part a result of the very high adult numbers in 2001 which should have produced a large cohort of offspring which became adults in 2003. Apparently significant numbers of these larvae survived and successfully emerged to produce the larger 2003, 2005 adult populations there. Correspondingly, the low numbers in 2004 and 2006, were in part a result of the low numbers of adults in 2002 and 2004, respectively. Fewer adults would have produced fewer larvae and thus fewer emerging new adults in these two years. It is likely that larval survival may also have been low in one or both of these years as a result of storm events or the activities or shoreline changes related to the North end Restoration Project in 2003.

The potential impacts of human activity, including heavy pedestrian foot traffic and OHV activity, has been previously documented as a cause of extirpation of *C. d. media* from portions of AINS (Glaser 1977, 1984; Knisley and Hill 1992). Our surveys over the past few years provide further evidence of these effects. However, we do not know what effects, if any, may be

caused by the more reduced beach vehicle use from park patrols and plover survey work on the North End. The continued low numbers along the North end shoreline suggest certain unknown conditions there are preventing the buildup of the population.

MANAGEMENT RECOMMENDATIONS AND RESEARCH NEEDS

Additional research and monitoring needs. Long-term monitoring data for *C. d. media* and *C. lepida* are an essential tool for evaluating potential impacts and providing adequate protection of these species and their requisite habitats. Monitoring also provides both intended and unexpected insights into their biology and ecological requirements. Continued monitoring in the immediate future will provide much needed information on the short-term effects of the North End Beach Restoration Project and, if implemented, the northward extension of the state line Piping Plover restricted area. Our survey work strongly suggests that numbers of adults within the ORV zone are inversely correlated with ORV use. Areas of lowest use such as the regularly restricted section (to protect plover nesting) near the VA line and to a lesser extent other sections further north have been the only areas with beetles present. The consistent presence of beetles in these localized areas suggest the beetles there represent a probable breeding population which would likely increase in ORV use was permanently prevented. The very low total numbers of *C. d. media* in 2004, 2006 and 2007 provide additional justification for the expansion of the Piping Plover restricted area. Maintaining a viable population of beetles at Assateague will be more likely if there are at least two sections of protected or partially protected habitat areas.

ACKNOWLEDGMENTS

The assistance and cooperation of the AINS staff, especially Carl Zimmerman and Jack Kumer, in providing logistic support and accommodations, are greatly appreciated. Outstanding field assistance was provided by Tim Koenig. We also thank Ryan Knisley help with the surveys and for the GIS work producing the maps used in this report. We thank Carl Zimmerman for arranging funding of these surveys and Jack Kumer for providing a vehicle and information on plover distribution.

LITERATURE CITED

- Boyd, H. P. 1978. The tiger beetles (Coleoptera: Cicindelidae) of New Jersey with special reference to their ecological significance. Transactions of the American Entomological Society. 104: 191-242.
- Ciegler, J. C. 1984. Tiger beetles of South Carolina. The Coleopterists Bulletin 51: 177-192.
- Glaser, J. D. 1977. Letters from our readers. Cicindela 9: 12.
- Glaser, J. D. 1984. The Cicindelidae (Coleoptera) of Maryland. Maryland Entomologist 2: 65-76.

- Knisley, C. B. 1979. Distribution, abundance, and seasonality of tiger beetles (Cicindelidae) in Indiana Dunes region. *Proceedings of the Indiana Academy of Sciences* 88: 209-217.
- Knisley, C. B. 1986. Status survey of two candidate species of tiger beetles, *Cicindela puritana* G. Horn and *C. dorsalis* Say. Final report to U. S. Fish and Wildlife Service.
- Knisley, 2001. Monitoring the Northeastern beach tiger beetle in relation to dredge deposition at Smith Point, Northumberland Co., VA, 2001 study. Report to OPS IDV OTS BR SPT SEC, Baltimore, MD.
- Knisley, C. B. 2002. A study of the effects of dredge spoil deposition on the Northeastern beach tiger beetle (*Cicindela d. dorsalis*) at Winter Harbor, Mathews Co., VA –First year post deposition , 2002. Final report to U. S. Army Engineering District, Norfolk, VA.
- Knisley, C. B. and J. M. Hill. 1990. Distribution and abundance of two tiger beetles *Cicindela dorsalis media* and *C. lepida* at Assateague Island, Maryland, 1990. Final report to Maryland Department of Natural Resources, Natural Heritage Program. 27 p.
- Knisley, C. B. and J. M. Hill. 1992. Effects of habitat change from ecological succession and human impact on tiger beetles. *Virginia Journal of Science* 43: 335-340.
- Knisley, C. B. and J. M. Hill. 1996. Studies of rare tiger beetles (*Cicindela dorsalis dorsalis*, *C. d. media* and *C. puritana*) in the Chesapeake Bay region of Maryland, 1996. Final report to Maryland Department of Natural Resources, Natural Heritage Program. 52 p.
- Knisley, C. B. and T. D. Schultz. 1997. The biology of tiger beetles and a guide to the species of the south Atlantic states. Virginia Museum of Natural History Special Publication Number 5. Virginia Museum of Natural History, Martinsville, Virginia 210 p.
- Knisley, C. B., J. M. McCann, D. Brinker and J. M. Hill. 2003. A study of rare tiger beetles at Assateague Island National Seashore: surveys for *Cicindela dorsalis media* and *Cicindela lepida* in 2001. Final report. Submitted to National Park Service, Assateague Island National Seashore and U.S. Army Corps of Engineers, Baltimore District. 24 p.
- Larochelle, A. 1974. Notes on *Cicindela lepida* Dejean. *Cicindela* 6: 66-68.
- Leonard, J. G., and R. T. Bell. 1999. Northeastern tiger beetles: a guide to tiger beetles of New England and eastern Canada. CRC Press, Washington, D.C. 176 p.
- Pearson, D. L., T. G. Barraclough, and A. P. Vogler. 1997. Distributional maps for North American species of tiger beetles (Coleoptera: Cicindelidae). *Cicindela* 29: 33-84.
- Schultz, T. D. 1988. Destructive effects of off-road vehicles on tiger beetle habitat in central Arizona. *Cicindela* 20: 25-29.

The Nature Conservancy. 1995. Vegetation classification of Assateague Island National Seashore. The Nature Conservancy, Boston, MA.

U.S. Army Corps of Engineers. 1998. Ocean City and vicinity water resources study: final integrated feasibility and Environmental Impact Statement. U.S. Army Corps of Engineers, Baltimore District. 957 p.

Yarbrough, W. W., and C. B. Knisley. 1994. Distribution and abundance of the coastal tiger beetle *Cicindela dorsalis media* (Coleoptera: Cicindelidae) in South Carolina. Entomological News 105: 189-194.

Figure 1. AINS Tiger Beetle Survey 2009
Blue numbers indicate waypoint number
Red numbers indicate tally of C. media adults



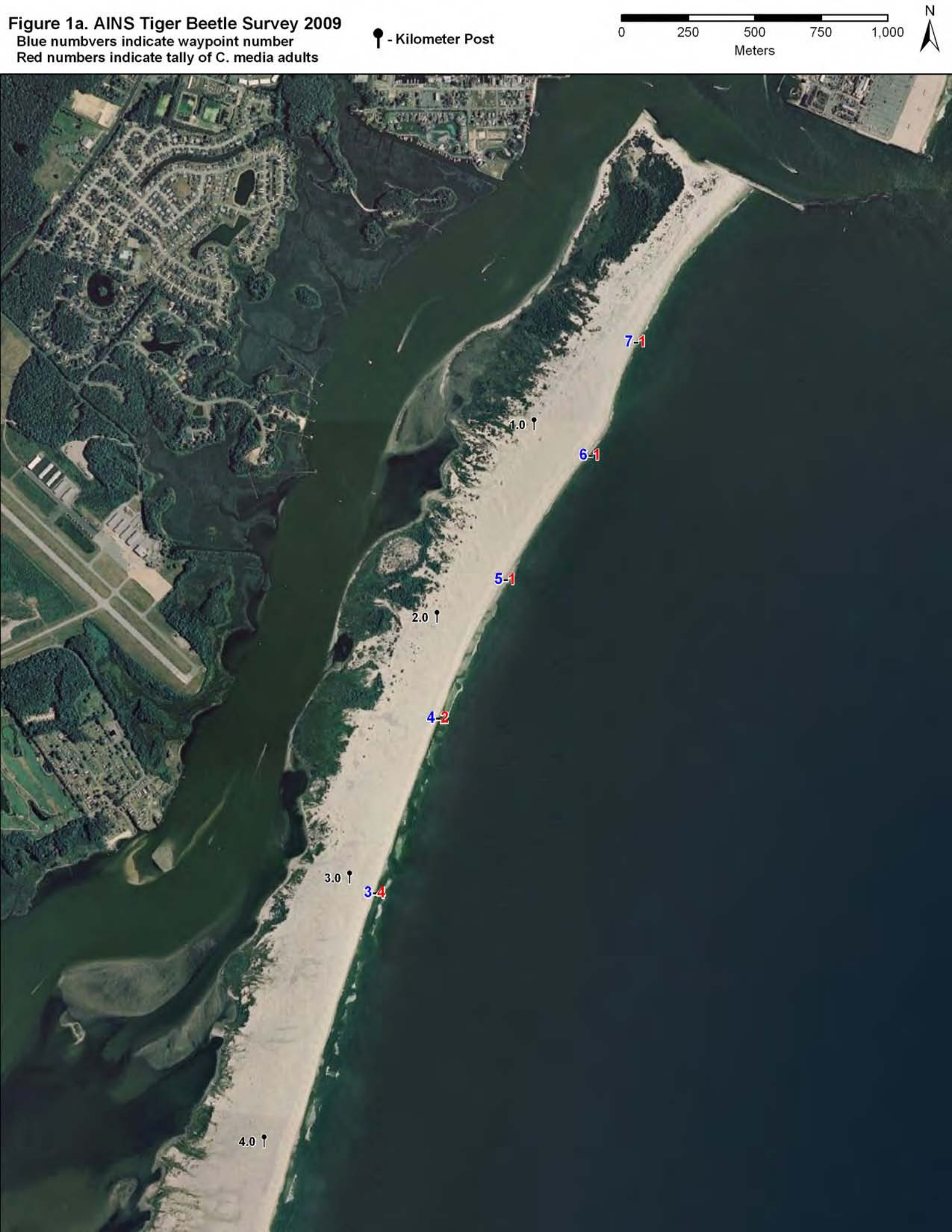
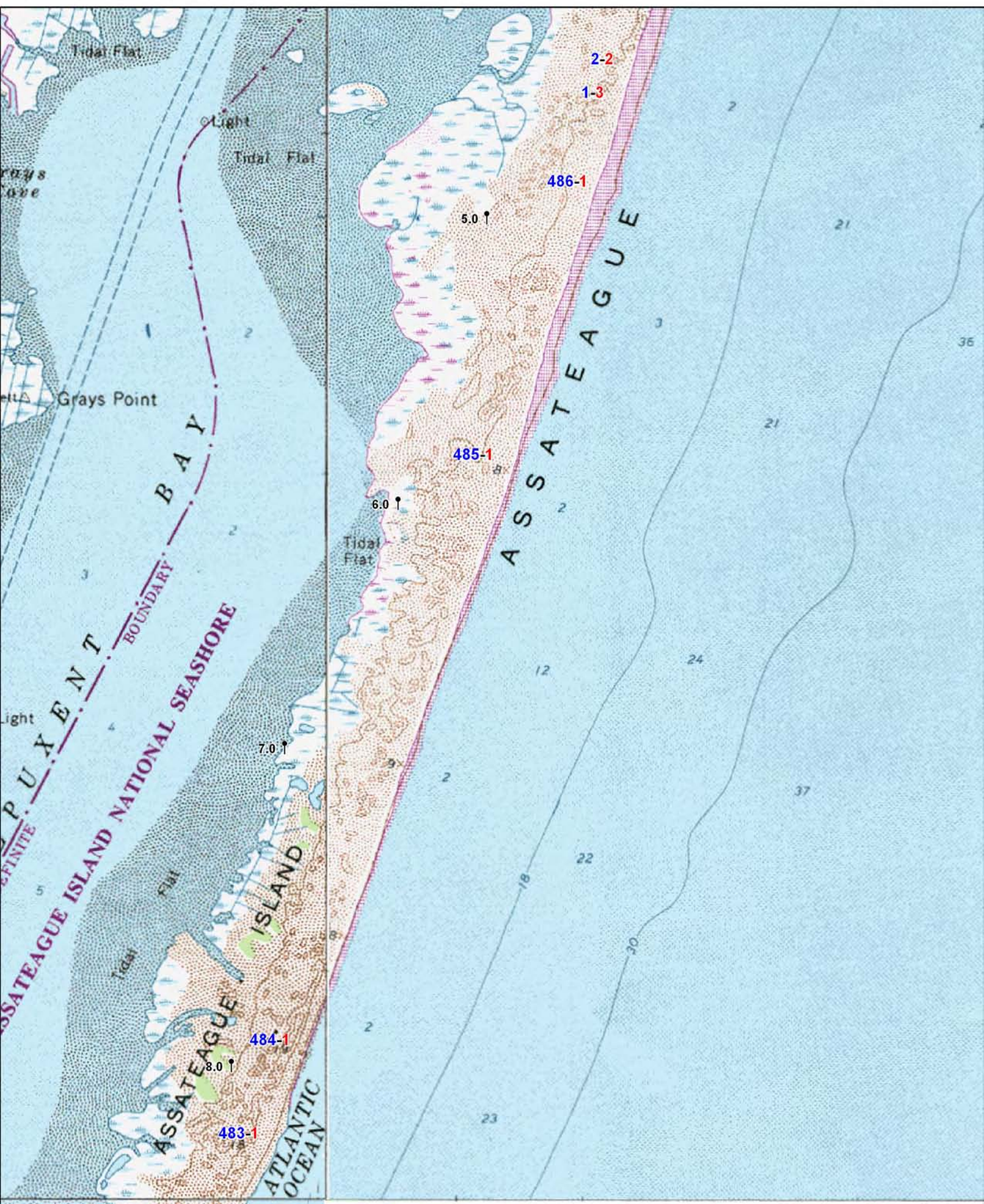
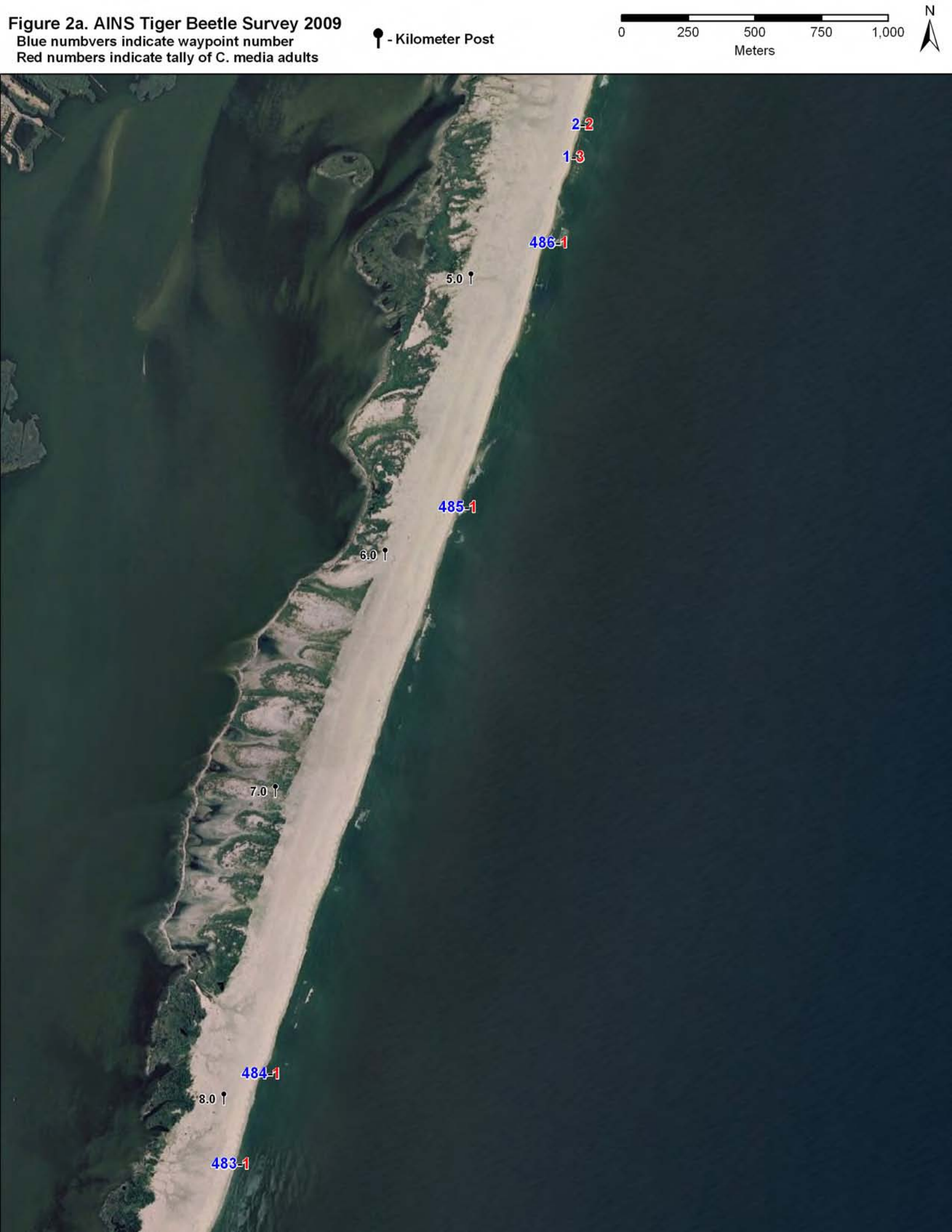


Figure 2. AINS Tiger Beetle Survey 2009
Blue numbers indicate waypoint number
Red numbers indicate tally of C. media adults





● - Kilometer Post



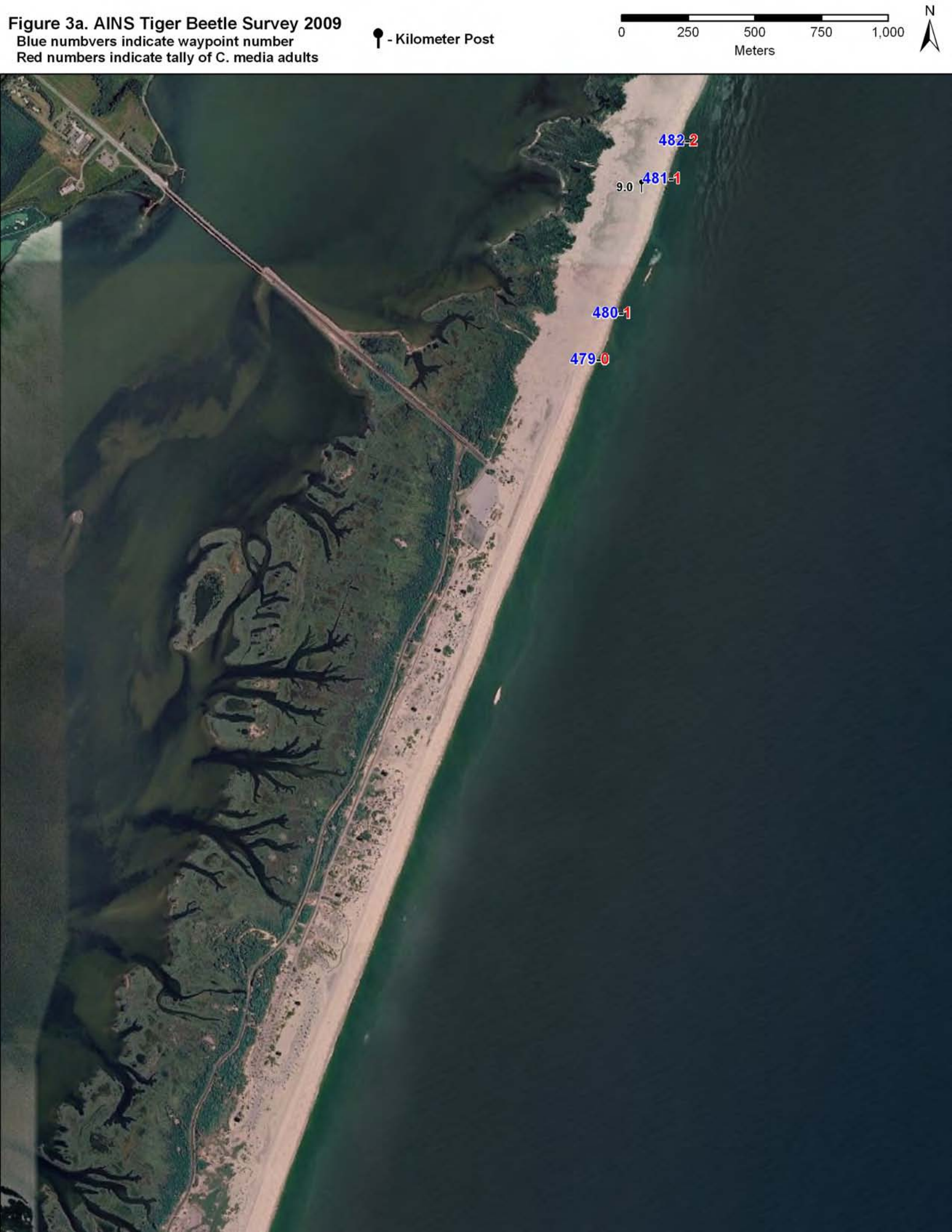
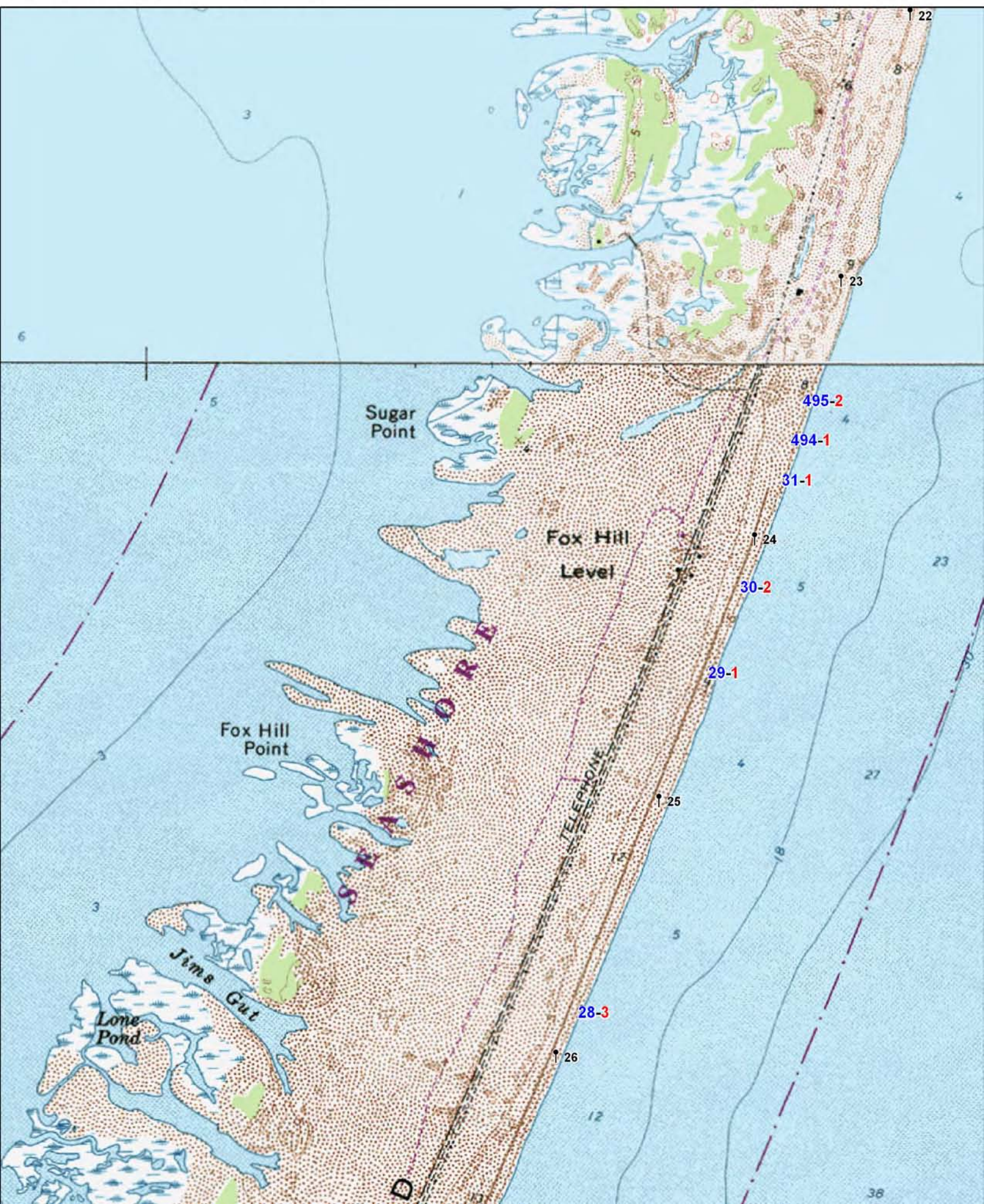


Figure 6. AINS Tiger Beetle Survey 2009
Blue numbers indicate waypoint number
Red numbers indicate tally of C. media adults



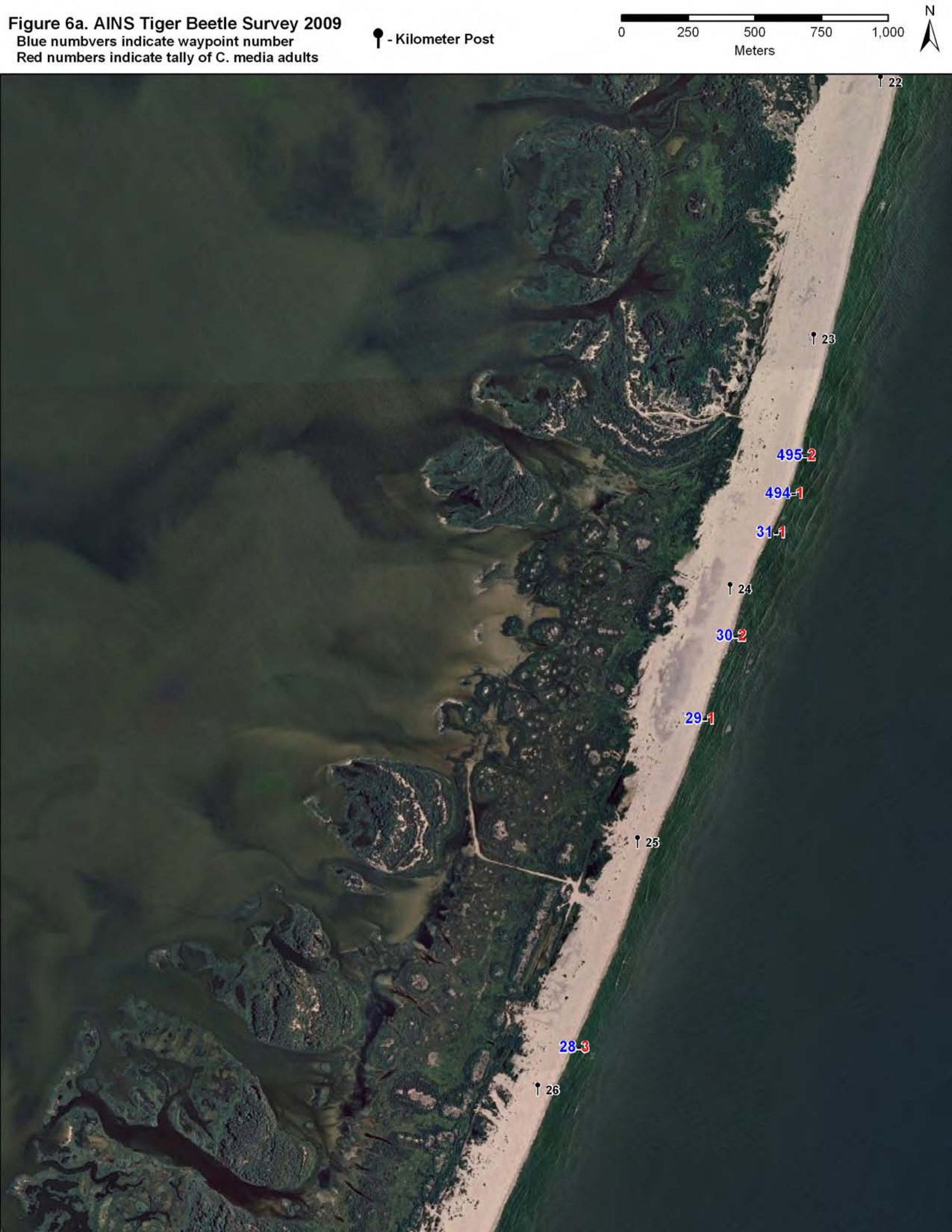


Figure 7. AINS Tiger Beetle Survey 2009
Blue numbers indicate waypoint number
Red numbers indicate tally of *C. media* adults

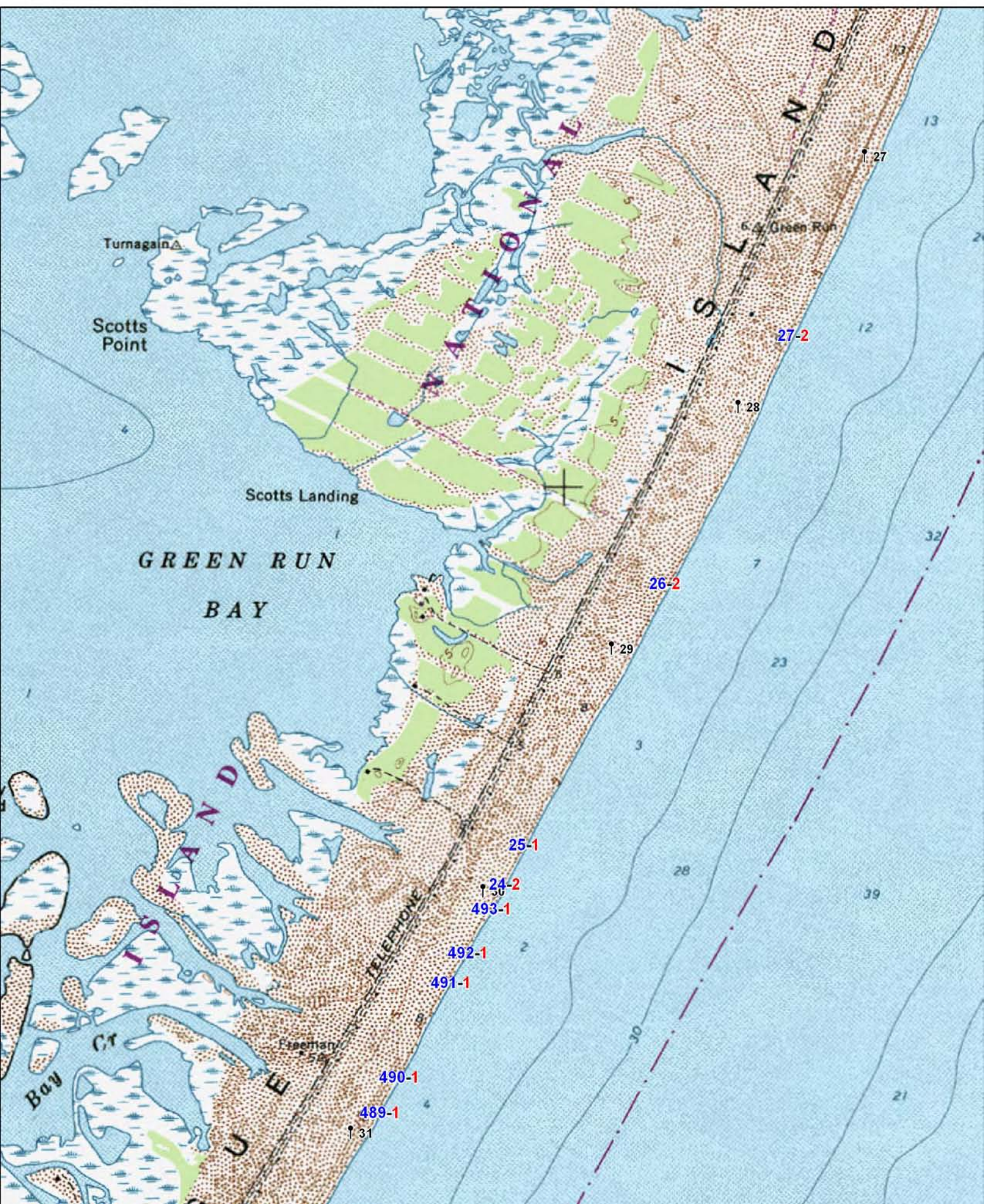


Figure 7a. AINS Tiger Beetle Survey 2009
Blue numbvers indicate waypoint number
Red numbers indicate tally of *C. media* adults

↑ - Kilometer Post

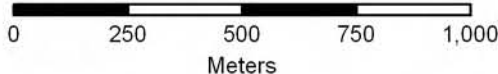


Figure 8. AINS Tiger Beetle Survey 2009
Blue numbers indicate waypoint number
Red numbers indicate tally of C. media adults

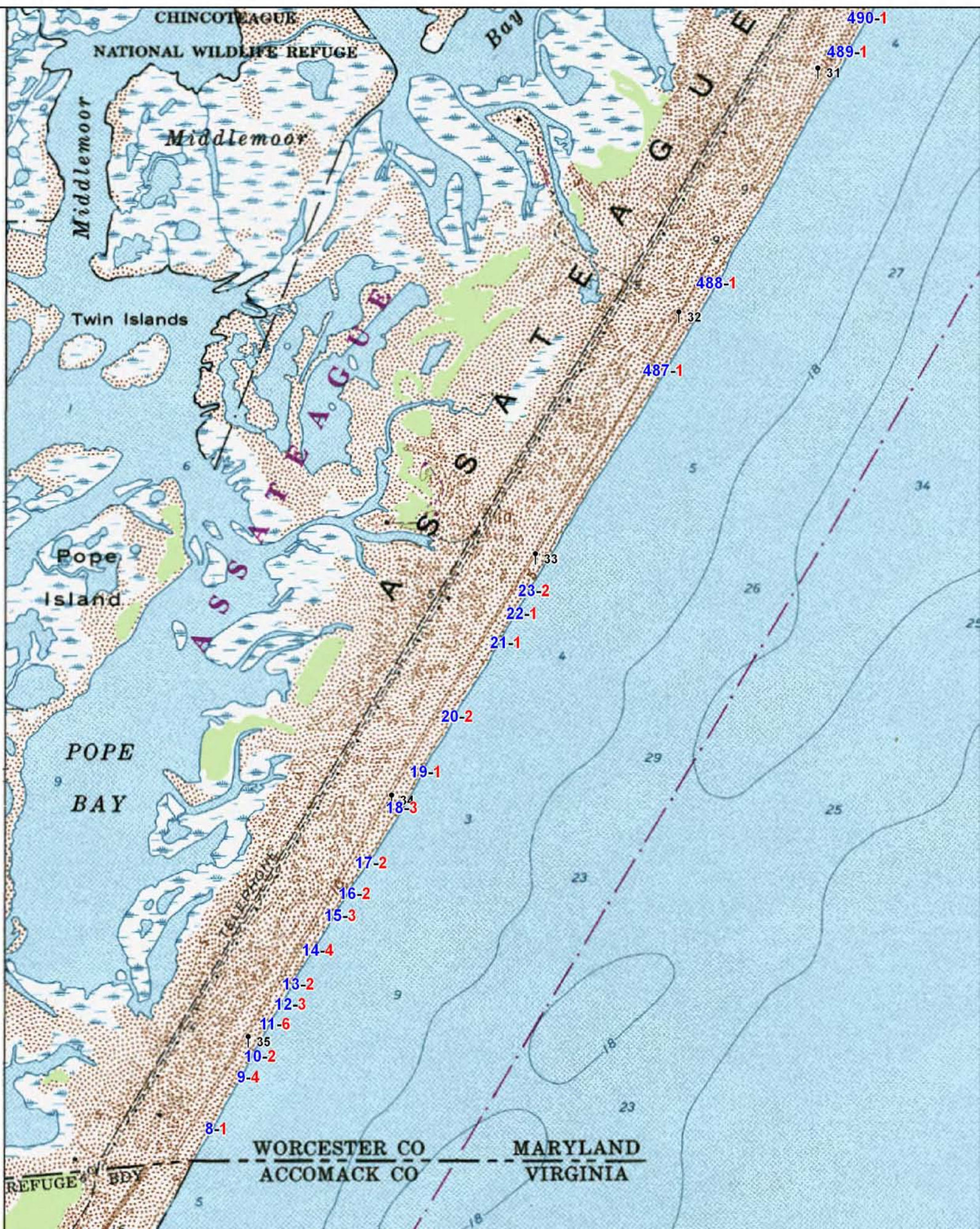
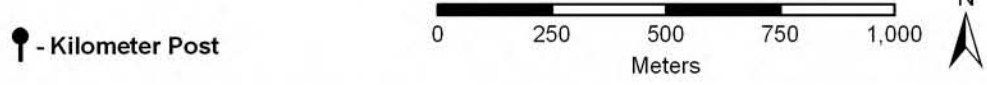


Figure 8a. AINS Tiger Beetle Survey 2009
Blue numbers indicate waypoint number
Red numbers indicate tally of *C. media* adults

