DISTRIBUTION AND ABUNDANCE OF TWO RARE TIGER BEETLES, *CICINDELA DORSALIS MEDIA* AND *C. LEPIDA*, AT ASSATEAGUE ISLAND NATIONAL SEASHORE DURING 2004

FINAL REPORT

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ABSTRACT

The objective of this study was to determine the distribution and abundance of two rare tiger beetles (*Cicindela dorsalis media, Cicindela lepida*) at AINS, to compare the results to previous surveys and to use this information to inform management strategies. The survey was conducted on July 13-15 and July 22, 2004. Methods were identical to those used in the 2001, 2002 and 2003 surveys. Determinations of adult numbers of each species were based on a visual search method where the surveyors moved slowly throughout the areas of probable habitat and counted all adults seen. The survey area for *C. d. media* included the whole length of shoreline from the north inlet to the Virginia line. Both shorelines of the North End, the State Park, the NPS Developed Zone and the plover closure at the far south end were surveyed on foot as in previous years. The rest of the ORV zone, where few beetles have occurred in past years, was surveyed by two workers counting from a vehicle. Surveys for *C. lepida* were conducted along the whole length of the ORV zone and concentrated at and behind the primary dune line where this species has been most common. A summary of the results of these studies were:

1. The **total count of *C. d. media* for 2004 was 60 adults**, of which only 6 occurred along the ocean shoreline of the North End (the lowest ever count in this section) and 20 within the south end plover closure. This was the second lowest count we have ever reported; the lowest count of 14 adults was in 1998. Other recent counts were 190 in 2003, 220 in 2002, and 698 in 2001.
2. Results of the *C. d. media* surveys further document the high year-to-year variation in population size. The low count in 2004 may have been due, in part, to relatively low adult numbers during 2002-3 and the coincident reduction in recruitment. Additional limiting effects on the beetles or the habitat may have resulted from the North End restoration activity and/or erosional effects from Hurricane Isabel. The hurricane was found to significantly reduce many populations of *C. d. dorsalis* in Virginia and Maryland, and the *C. d. media* population at AINS likely experienced similar effects.
3. The **total number of *C. lepida* counted in 2004 was 582**. This compares with the highest ever count of 892 in 2003 and 214 in 2002. Lower numbers were found in two surveys in the 1990's. The distribution of beetles was similar to that found in 2002 and 2003, and included most of the ORV zone (km 16 to the Virginia line). Highest numbers in 2004 and in the previous two years were between km 25 and 30. Over 70% of the individuals counted in 204 were along the edges, flats and slopes of breaks, washovers, and pans that were cut through the primary dunes.
4. The high numbers of *C. lepida* in the past two years indicated favorable recruitment and survival, perhaps the result of increasing colonization of these areas of primary dune habitat that were created several years ago by intense storm and erosion activity.
5. The results of this study do not significantly change our conclusions and management recommendations from the 2001-2003 surveys. 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 at a marginally viable population size. A significant increase in numbers in 2005 may be necessary to sustain the viability of this population.

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OBJECTIVES

The study objectives were as follows:

1. Determine the current distribution and abundance of *C. d. media* and *C. lepida* at AINS during 2004.
2. Evaluate recent population trends and distribution patterns for *C. d. media* and *C. lepida* at AINS during the last 13-18 years.
3. Determine potential effects that the recent (2002) North End Beach Restoration Project might have had on *Cicindela dorsalis media.*
4. Examine the degree to which *C. lepida* has become established along recently closed sections of the Off-road Vehicle Route or in other areas impacted by coastal storms.

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).

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.

C. lepida. This species is typically found in sparsely vegetated dunes with dry, loose sand (Larochelle 1974; Boyd 1978; Knisley 1979; Glaser 1984; Knisley and Schultz 1997; Leonard and Bell 1999). It occurs in widespread, scattered localities throughout central and eastern North America (Knisley and Schultz 1997; Pearson et al. 1997; Leonard and Bell 1999). In most parts of the eastern U.S. it is uncommon to rare especially along the Atlantic coast where it is nearly restricted to coastal dunes (Boyd 1978; Knisley and Schultz 1997). North of Maryland, the closest extant population is located at Cape Henlopen, Delaware. A few populations may still occur in New Jersey but the species apparently has been extirpated from much of the remaining northeastern U. S. including Massachusetts, Long Island and Pennsylvania. South of Maryland, the species is known from only two areas, the Virginia portion of Assateague Island and Nags Head, North Carolina. In Maryland, it has been extirpated from Fenwick Island (Glaser 1984),

and the state's only remaining population appears to be restricted to the southern part of AINS (Hill and McCann, unpublished data). Beach stabilization, coastal development, ORV's and other sources of dune disturbance (e.g. high levels of pedestrian use) have probably contributed to the decline and extirpation of this species from many coastal areas in the eastern U.S. (Knisley and Schultz 1997; Leonard and Bell 1999).

C. lepida was first reported in Maryland by Glaser (1984) and Knisley (1986). Before our recent studies (2001-present) the only attempts to systematically survey for *C. lepida* at AINS occurred in 1990 (Knisley and Hill 1990) and 1998 (Hill and McCann, unpublished data). In 1990, a total of 127 adults were found at 5 sites on the southern end of the Maryland portion of the island. Approximately half of the individuals occurred at a single site. In 1998, a similar number (84 adults) was detected in three areas although there appeared to be some changes in distribution. Storm-related changes in habitat availability apparently resulted in lower numbers of beetles in some interdunal areas that were occupied in 1990. However, more beetles were found in newly formed habitat in nearby, primary dune blowouts. In addition, *C. lepida* was found for the first time in and along recently closed sections of the Off-road Vehicle Route.

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 during 2003 and 2004 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 13-15 and 22, 2004. Four observers participated, each with extensive experience in conducting surveys for tiger beetles. Our surveys focused on those areas known to support *C. d. media* and *C. lepida* based on previous survey results, particularly during the past three years (2001-2003). Surveys were conducted using direct visual index counts which involved recording the numbers of all adults seen while 1-4 observers walked slowly through potential habitat. We used hand-held GPS units to record adult beetle and survey locations. Using the GIS program ArcMap, these point locations were overlaid onto U.S.G.S. 7.5' topographic maps and AINS vegetation data layers to depict beetle distribution relative to vegetation type and other surface features.

We conducted surveys for ***C. d. media*** by walking along the wet intertidal zone of the beach during mid-day when adult beetles are concentrated in this habitat. Shoreline areas covered by walking surveys included both the bay and ocean sides of the whole North End, the State Park and Developed Zone, and the southern most two kilometers which included the plover closure section. The rest of the ORV zone 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.

Annual monitoring of ***C lepida*** has been less frequent than for *C. d. media.* However, each year during 2002-4, we completed comprehensive, standardized surveys at AINS during which the entire length of the ORV zone was surveyed from km 16 to the Virginia state line. These surveys involved thorough searches of primary dune and interdunal habitats, including the back beach, the front of the fore dune, open areas behind the foredune, and associated washovers and cut throughs. These areas were searched by two observers positioned about 10 m apart walking slowly in a zig-zag pattern through potential habitat. We also spot checked potential areas further inland (e.g., Fox Hills area, along the old ORV road). Areas with clearly unsuitable habitat (e.g., wet swales, vegetated patches and dense scrub) were bypassed.

RESULTS AND DISCUSSION

***C. d. media*.** We observed a total of only 60 adults during 2004, the second lowest count since monitoring began in 1985 (Table 1). These findings indicate a continuation of a recent decline since 2001 when we recorded 698 adults, the highest number ever documented at AINS. Only 6 adults in 2004 were found along the ocean shoreline of the North End, the lowest count ever in this section. A small number of adults were found on the bay side of the North End (8) and along the beach of the State Park and Developed Zone (8). An additional 20 adults were found within the plover closure zone near the Virginia state line and another 18 along the rest of the ORV zone, north of the plover closure. As was the case in 2003, the numbers in the plover zone were much lower than in 2001 (72 counted) and in 2002 (97 counted). We found small numbers of adults in the State Park and Developed Zone only in 2003 and 2004, but not in any previous surveys.

Our surveys for *C. d. media* have resulted in highly variable counts. Prior to 2001, there were three years of very low counts: 88 in 1992, 74 in 1996 and 14 in 1998. These counts were followed by the highest ever count of 698 in 2001 and then progressive, significant decline to the 60 in 2004. 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 2003 is somewhat greater than what we have seen for the related taxon, *C. d. dorsalis*. However, this taxon also has shown comparable fluctuations at a few sites.

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 results of 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 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), adults 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 during 1985-2004 (Table 1). During 1985-86, the population was centered around 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 2001-2003, 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). Interestingly, during 2001-2003, the population seems to be 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 2003 adult population there. Correspondingly, the low numbers in 2003 and especially 2004, were in part a result of the low numbers of adults in 2002 and 2003, 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.

Table 1. Numbers of adult *Cicindela dorsalis media* observed at Assateague Island National Seashore during 1985-2004. Note that empty cells indicate no data were collected

North End(kms. from jetty)	1985	1986	1987	1988	1990	1991	1992	1996	1998*	2001	2002	2003	2004
0	10	19	11		23	52	7	6	0	0	11	0	0
0.5	20	8	28		64	140	57	2	0	0	3	0	0
1	41	5	36		106	109	10	7	0	1	0	0	0
1.5	25	12	3		26	40	4	5	0	5	3	0	1
2	1	38	0		14	23	2	3	5	6	0	4	0
2.5	4	49	0		0	4	0	3	5	2	2	0	0
3	27	59	0		17	3	1	2	4	2	4	1	0
3.5	42	42	11		67	12	5	18	0	66	15	8	3
4	7	12	24		27	0	1	13	0	112	18	14	1
4.5	8	9	4		2	0	0	10	0	106	0	18	0
5	2	3	5		0	0	1	2	0	34	1	11	1
5.5	2	1	0		0	0	0	0	0	10	2	13	0
6	1	0	0		0	0	0	3	0	54	11	10	0
6.5	2	0	0		0	0	0	0	0	62	3	38	0
7	3	2	0		0	0	0	0	0	83	2	14	0
7.5	0	0	0		0	0	0	0	0	17	0	9	0
8	0	0	0		0	0	0	0	0	22	0	0	0
8.5	0	0	0		0	0	0	0	0	27	0	3	0
9	0	0	0		0	0	0	0	0	1	0	3	0
9.5	0	0	0		0	0	0	0	0	1	0	2	0
Total: North End ocean shoreline	**195**	**259**	**122**	**200**	**346**	**383**	**88**	**74**	**14**	**611**	**75**	**148**	**6**
North Bayside and interior										15	15		8
State Park and Dev. Zone	0	0	0	0	0	0	0	0	0	0	0	21	8
ORV Zone, N of closure										0	18	12	18
ORV Closure					13					72	97	9	20
Total For AINS	**195**	**259**	**122**	**220**	**359**	**383**	**88**	**74**	**14**	**698**	**220**	**190**	**60**

* for 1998 counts are approximate and not recorded for individual sections

***C. lepida*.** During 2004, we observed a total **of 582 adults**. This number is considerably lower than the 2003 count of 892 beetles, the highest ever recorded at AINS. Several surveys that we did in the 1990's were not as comprehensive and produced much small adult counts: 84 adults in 1998 and 127 in 1990. Survey results from 2002-4 show no significant change in distribution. In all three years some adults were present in most 1 km sections from 16 to 34, but in 2002 few adults were found north of km 22 (km 16 to 21). The highest numbers of adults during all three years occurred between km 23 and 32 and especially between 25 and 30. The highest counts per transect in 2004 were 93 in km 25, 79 in km 29 and 72 in km 30. This compares with highest transect counts in 2003 of 82 in km 29, 76 in km 27 and 75 in km 30. The most notable shift in

distribution involved the much lower numbers of beetles (compared to 1990's surveys) in the inland dune area, west of the abandoned ORV road, near Fox Hills where they were most abundant in these earlier surveys. Few or none were found here in the past three years.

In 2003 and 2004, and to a lesser extent in 2002, we found a very high proportion of the adults (over 70%) and most patches of larvae in overwash and cut through areas where the primary dune had been breached. Active adults, patches of larvae, and adult burrows were especially common along the sides and adjacent flats of these cuts.

Table 2. Numbers of adult *Cicindela lepida* observed at Assateague Island National Seashore during 1990-2004

Location (km)		**Numbers of Adults**			
	1990*	1998*	2002	2003	2004
0 -10			0	0	0
16-Nov			0	0	0
16-17			0	24	9
17-18			2	40	1
18-19			0	65	5
19-20			0	67	13
20-21			3	46	8
21-22			3	11	4
22-23			8	12	6
23-24			19	73	2
24-25			22	34	34
25-26			22	66	93
26-27			9	68	52
27-28			27	76	64
28-29			19	52	42
29-30			19	82	79
30-31			25	75	72
31-32			15	22	27
32-33			8	51	20
33-34			7	20	35
34-35			5	6	14
35-VA line			1	2	2
Totals	**127**	**84**	**214**	**892**	**582**

* No data collected for individual segments in 1990 and 1998

We believe that our surveys for *C. lepida* in the past three years provide a reasonably accurate representation of their relative abundance and distribution at AINS. The higher numbers and the change in distribution of this species since the 1990's may be a result of the effects of storm activity causing habitat changes along most of the length of the southern shoreline. In these recent surveys we have found increasing numbers of adults present in the primary dune area, and a more eastward movement from earlier surveys. A series of storms in the mid- and late 1990's caused significant breaks in the primary dunes and resulted in washovers with the deposition of many patches of new sand behind the foredunes. These dynamic events have also resulted in progressive wind-driven sand movement since that time, creating new habitat for *C. lepida* in the cuts, breaks, and overwashes in the primary dune. Our observations of many adults and large numbers of larvae in the past two years in these overwash pans indicate ideal habitat for adult foraging and oviposition and larval development. *Cicindela lepida*, like many tiger beetles, is a colonizer of newly opened bare ground, and unable to persist in habitats that are more stabilized or with reduced sand movement. No research has fully determined the cause of this preference for newly created habitats typical of many species, but it could be their need for more open habitat (where plant density is reduced) for feeding and other activities or elimination of natural enemies or pathogens that may build up in stabilized habitats.

Our surveys during the past three years suggest that the elimination of ORV's on the inland road has not yet increased beetle numbers or apparent habitat. This may be because this area has now become too stabilized and lacking in dynamic sand movement. Also many sections of the road are low in elevation and the water table is close to the surface, thus increasing vegetation growth and eliminating open areas needed by *C. lepida*. However, future storm events could increase sand movement or deposition and create favorable habitat on and adjacent to the road.

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. The very low numbers of *C. d. media* in 2004 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.

Remarkably, some basic features of the two species' biology remain poorly known. Of particular importance, it is still uncertain if *C. d. media* has a one or two-year life cycle. As mentioned earlier, this information is essential for understanding the species' population dynamics. Dispersal ability and the seasonal timing of dispersal are also poorly understood. Such information will play an obvious role in determining the degree to which there is exchange between different population segments on the island or even, in the case of *media*, if the North End and state line beetles represent discrete populations or a single metapopulation.

Finally, it would be very helpful if future inventory and monitoring efforts for these species occurred throughout the island (i.e., Chincoteague NWR) and that these activities be coordinated between refuge and park staff.

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APPENDIX

Maps of AINS showing Tiger Beetle Distributions and Survey Areas

Maps 1-8: USGS topographic maps with dots showing survey areas and beetle locations. See legend on each map for color coded numbers of *C. d. media* and *C. lepida*

Maps 1a-8a: Corresponding maps of vegetation associations, using same legends

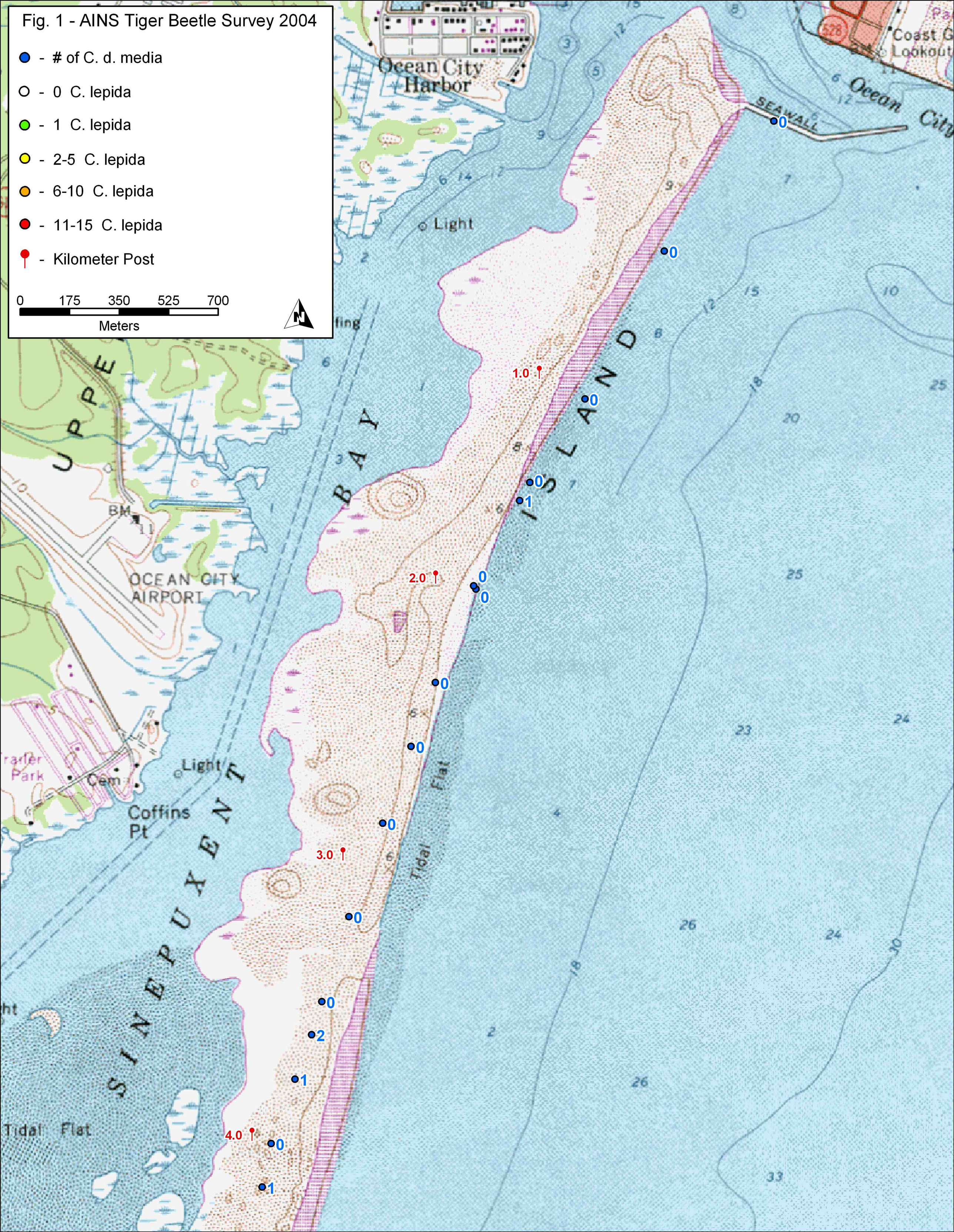
Fig. 1 - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Ocean City Harbor
Light
SEAWALL
Ocean City
UPPER
BAY
ISLAND
OCEAN CITY AIRPORT
Coffins Pt
Light
Cem
Trailer Park
SINEPUXENT
Tidal Flat
1.0
2.0
3.0
4.0

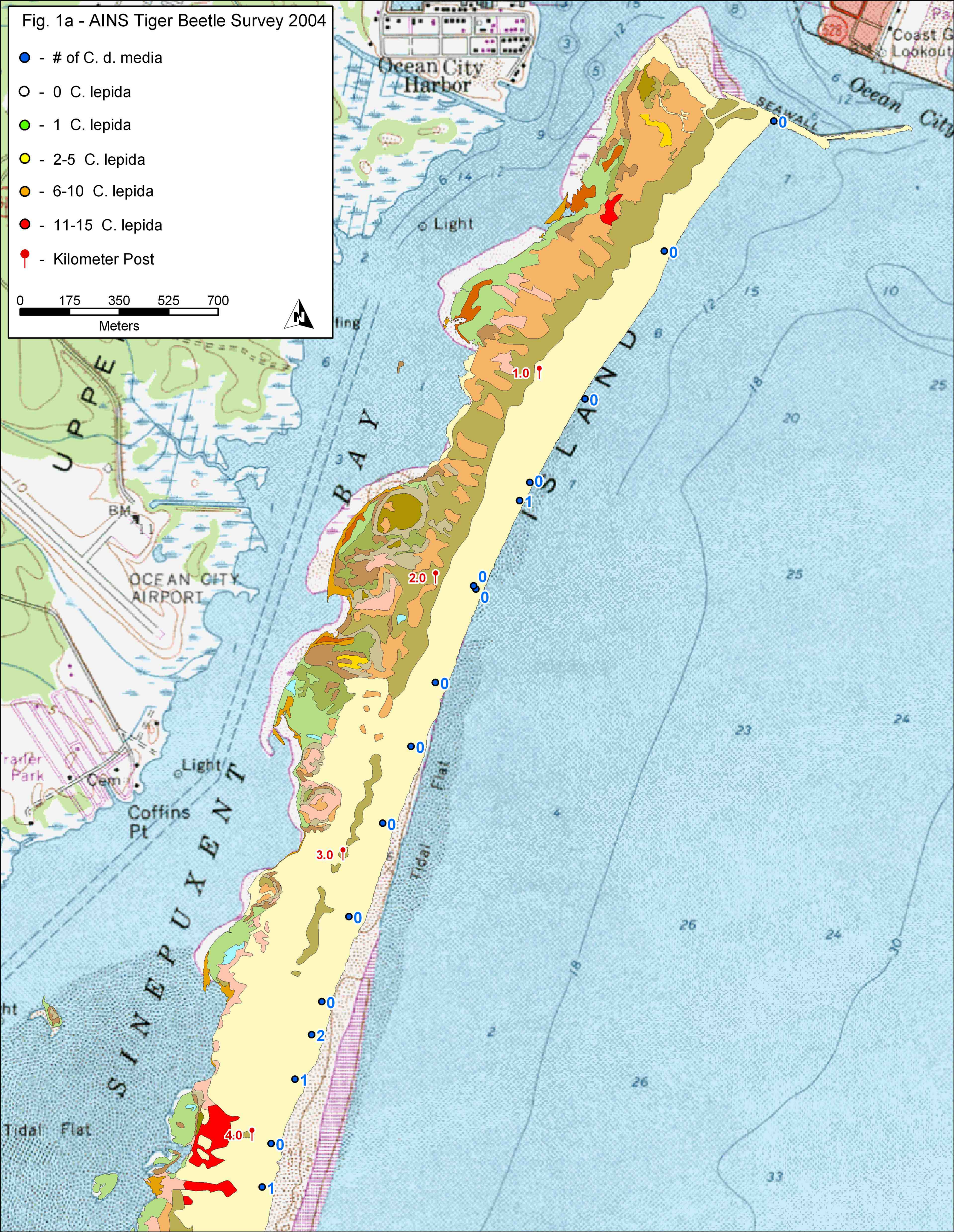
Fig. 1a - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Ocean City Harbor
Light
SEAWALL
Ocean City
Coast G
Lookout
UPPER BAY
ISLAND
OCEAN CITY AIRPORT
Light
Coffins Pt
SINEPUXENT
Tidal Flat
Tidal Flat
1.0
2.0
3.0
4.0

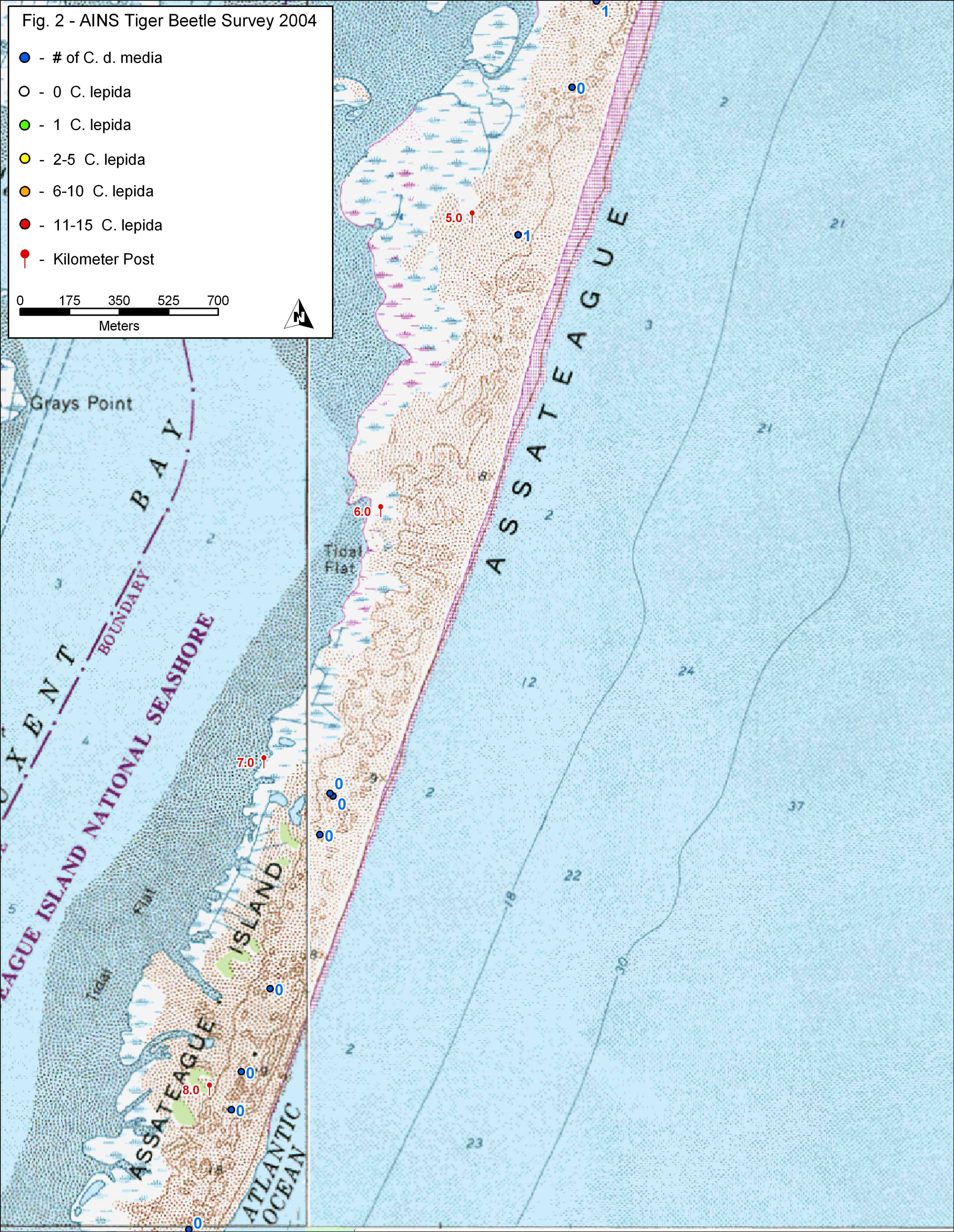
Fig. 2 - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Grays Point
BAY
EXTENT
BOUNDARY
ASSATEAGUE ISLAND NATIONAL SEASHORE
ASSATEAGUE
ISLAND
ASSATEAGUE
Tidal Flat
Tidal Flat
ATLANTIC OCEAN
5.0
6.0
7.0
8.0
1
0
1
0
0
0
0
0
0
0

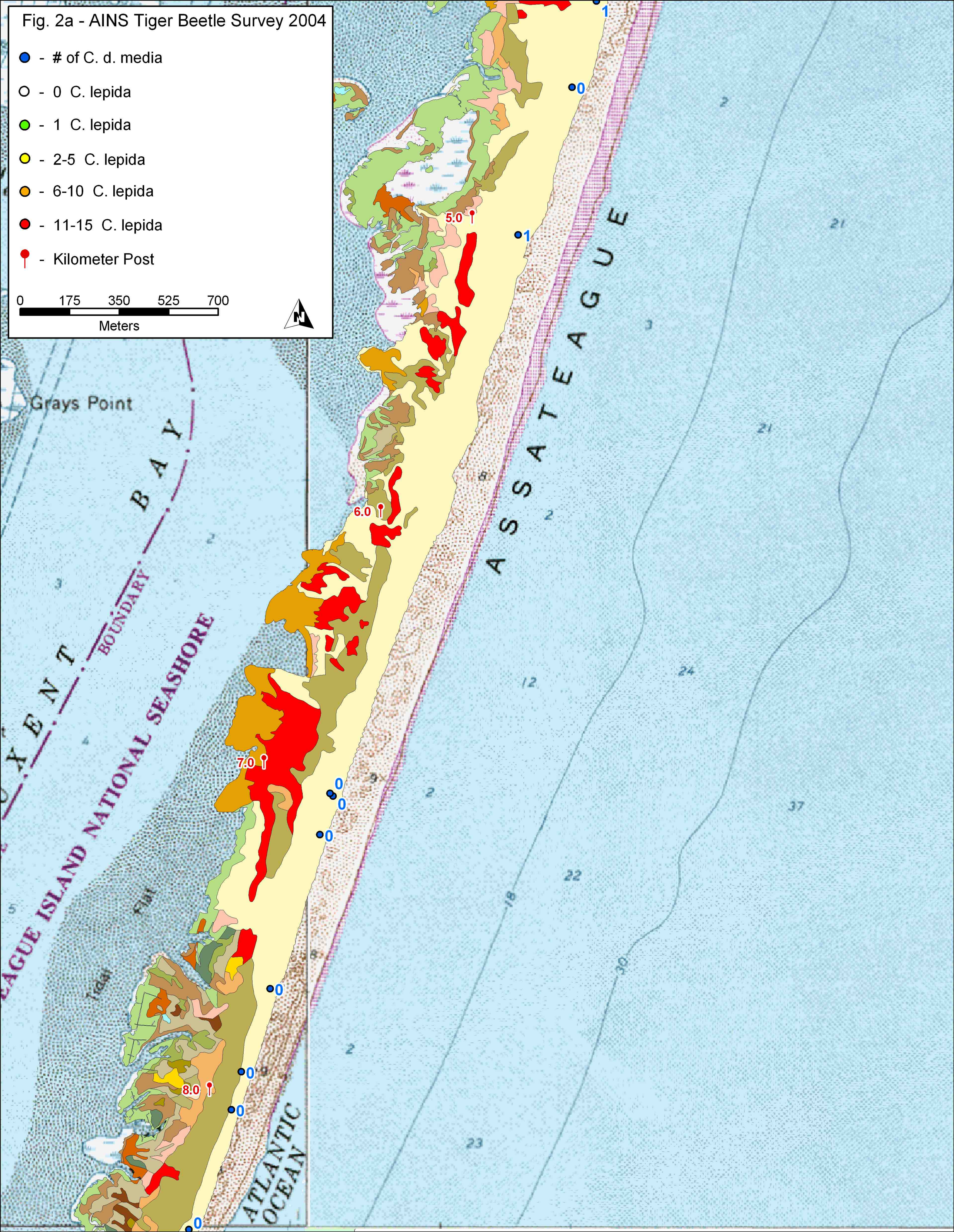
Fig. 2a - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Grays Point
BOUNDARY
NATIONAL SEASHORE
ISLAND
Tidal Flat
ASSATEAGUE
ATLANTIC OCEAN
5.0
6.0
7.0
8.0
1
0
1
0
0
0
0
0
0
0

Fig. 3 - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
9.0
Tidal Flat
TIDAL FLAT
Sandy Point Island
ASSATEAGUE ISLAND STATE PARK
Green 2
Mud
0
2

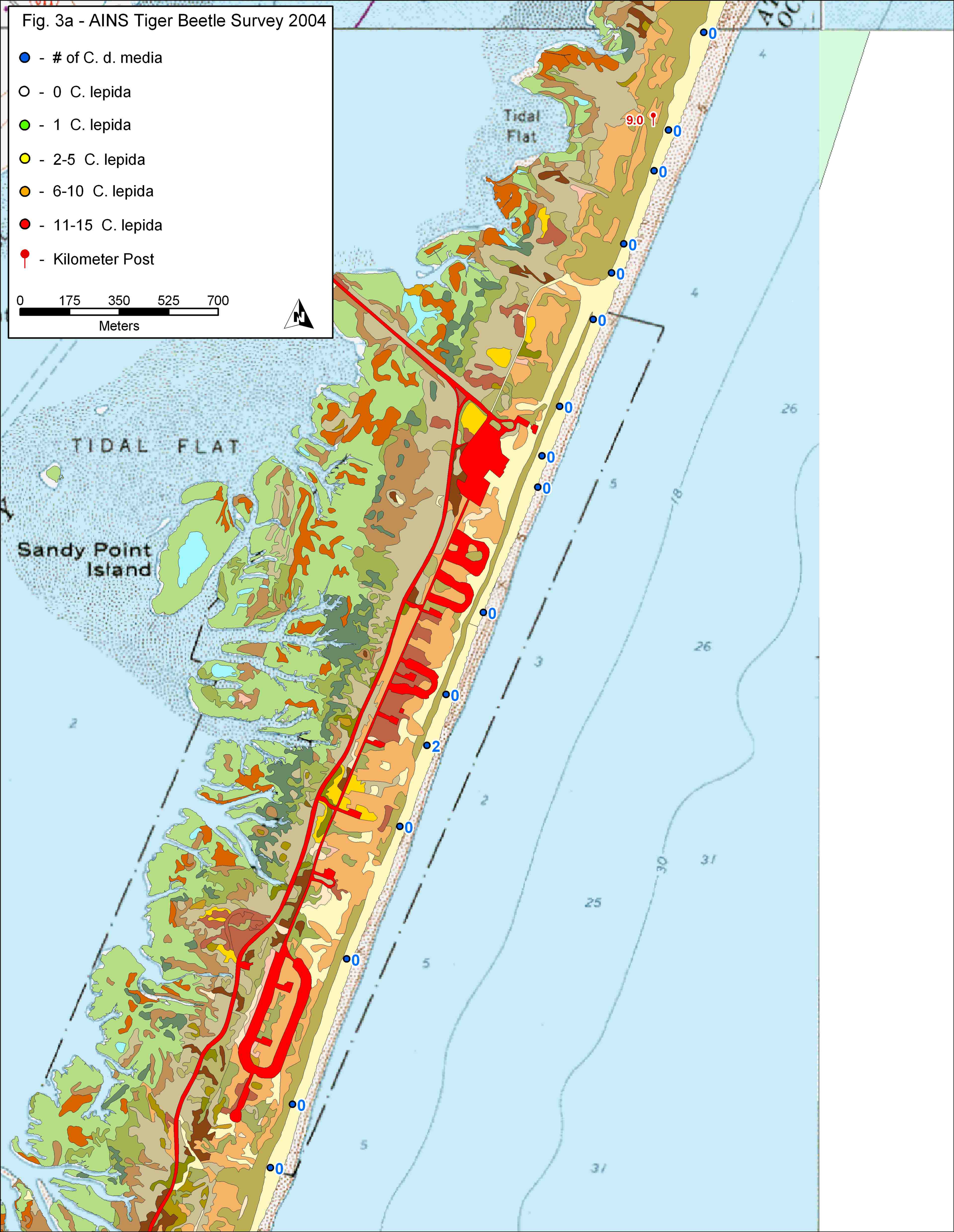
Fig. 3a - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Tidal Flat
9.0
TIDAL FLAT
Sandy Point Island
0
2

Fig. 4 - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Goose Point
Little Beach
Great Egging Beach
North Beach
Lumber Marsh
Parking
611
16b
17
1
1
0
3
3
1
0
10
25
30
33
24
8
27
27
2
2
18
1
3
3

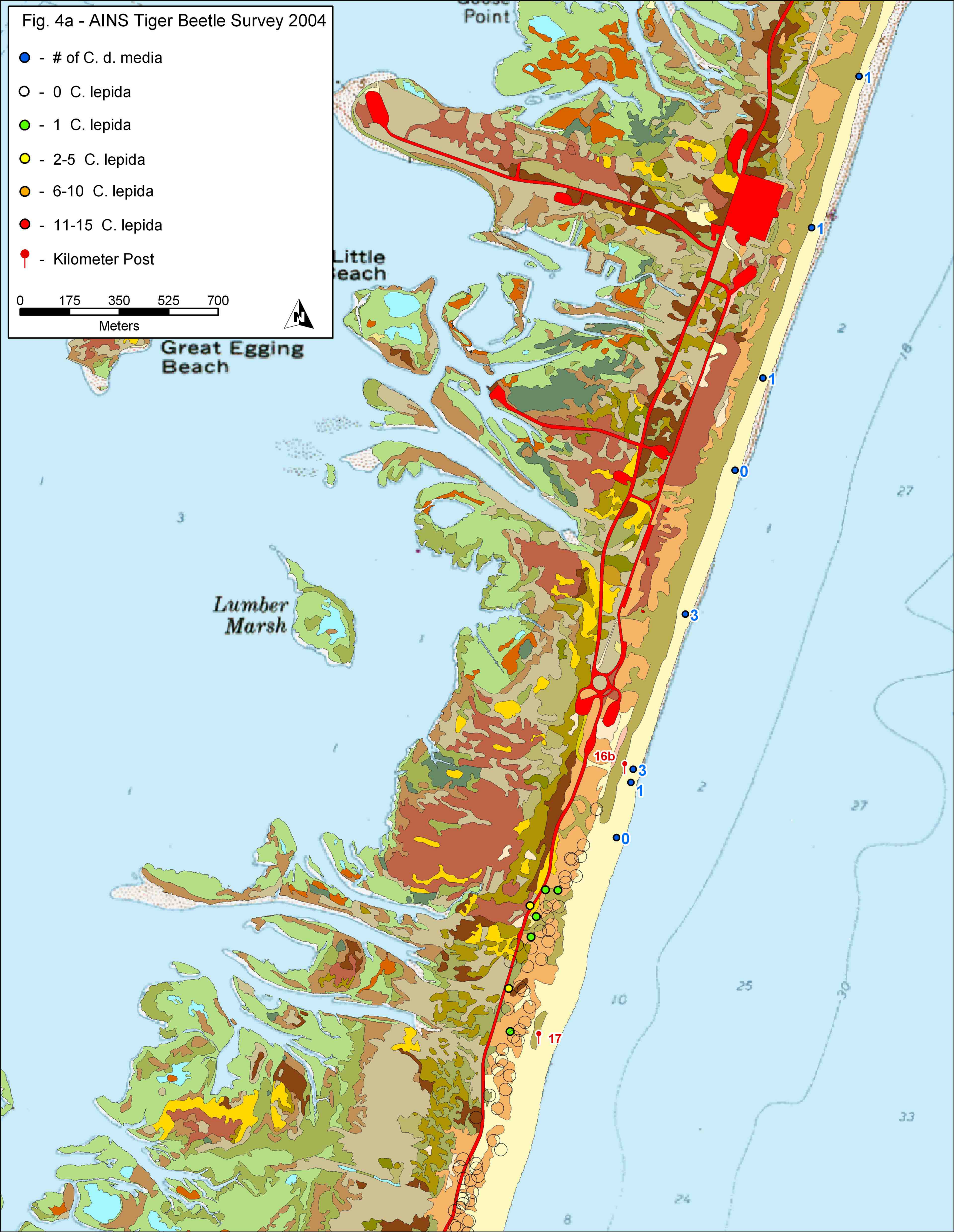
Fig. 4a - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Goose Point
Little Beach
Great Egging Beach
Lumber Marsh
16b
17
1
1
1
0
3
3
1
0

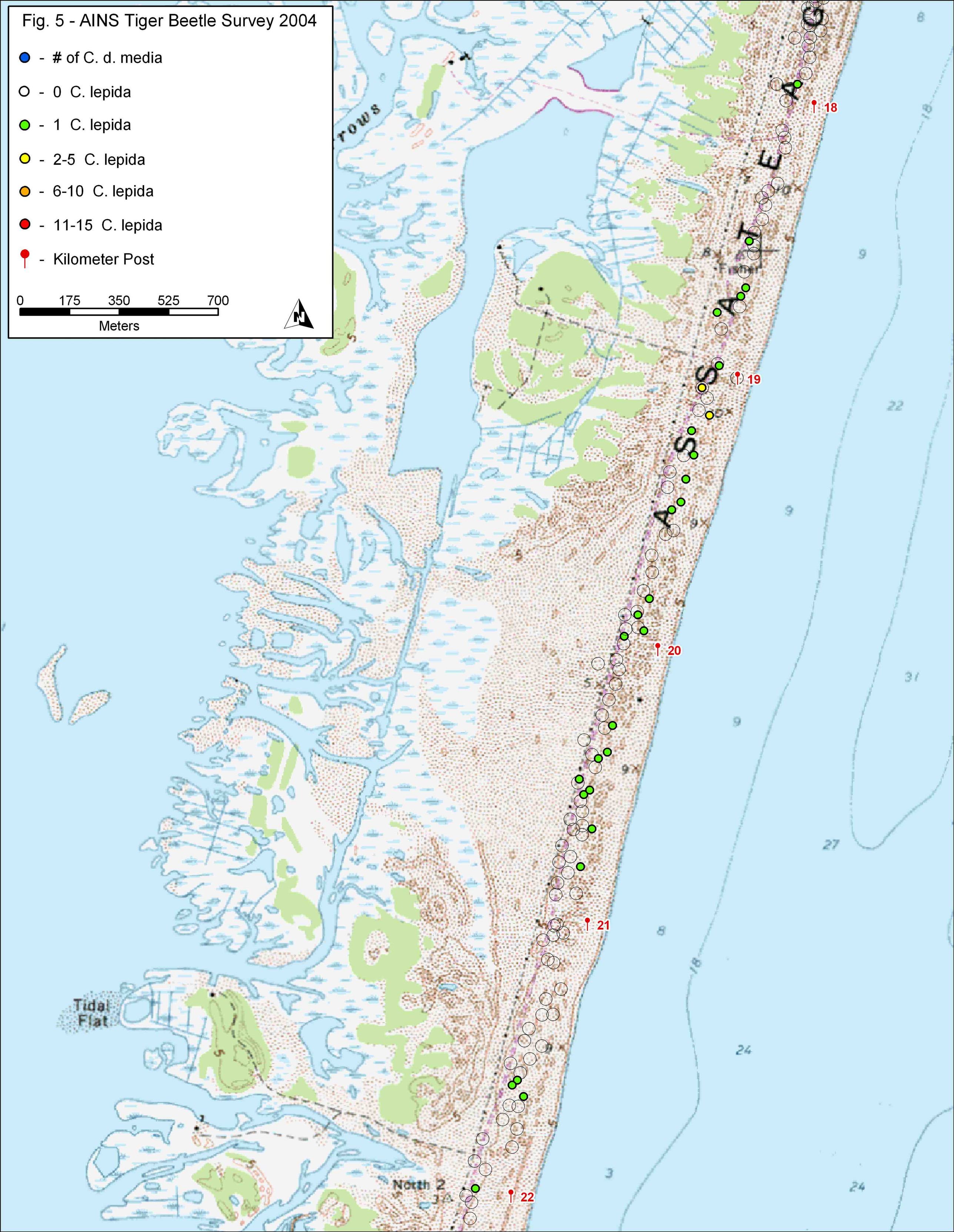
Fig. 5 - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
18
19
20
21
22
Tidal Flat
North 2

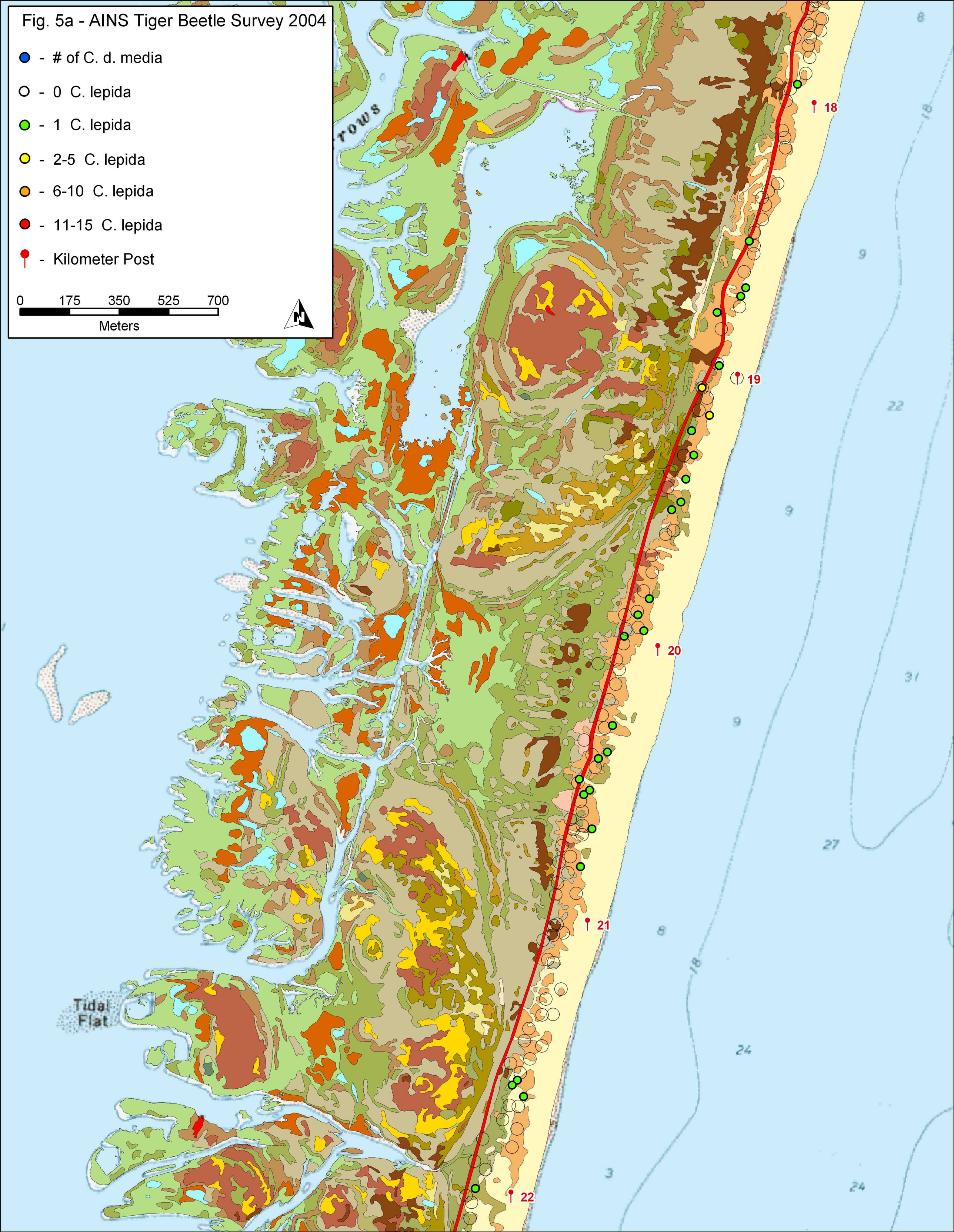
Fig. 5a - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
18
19
20
21
22
Tidal Flat

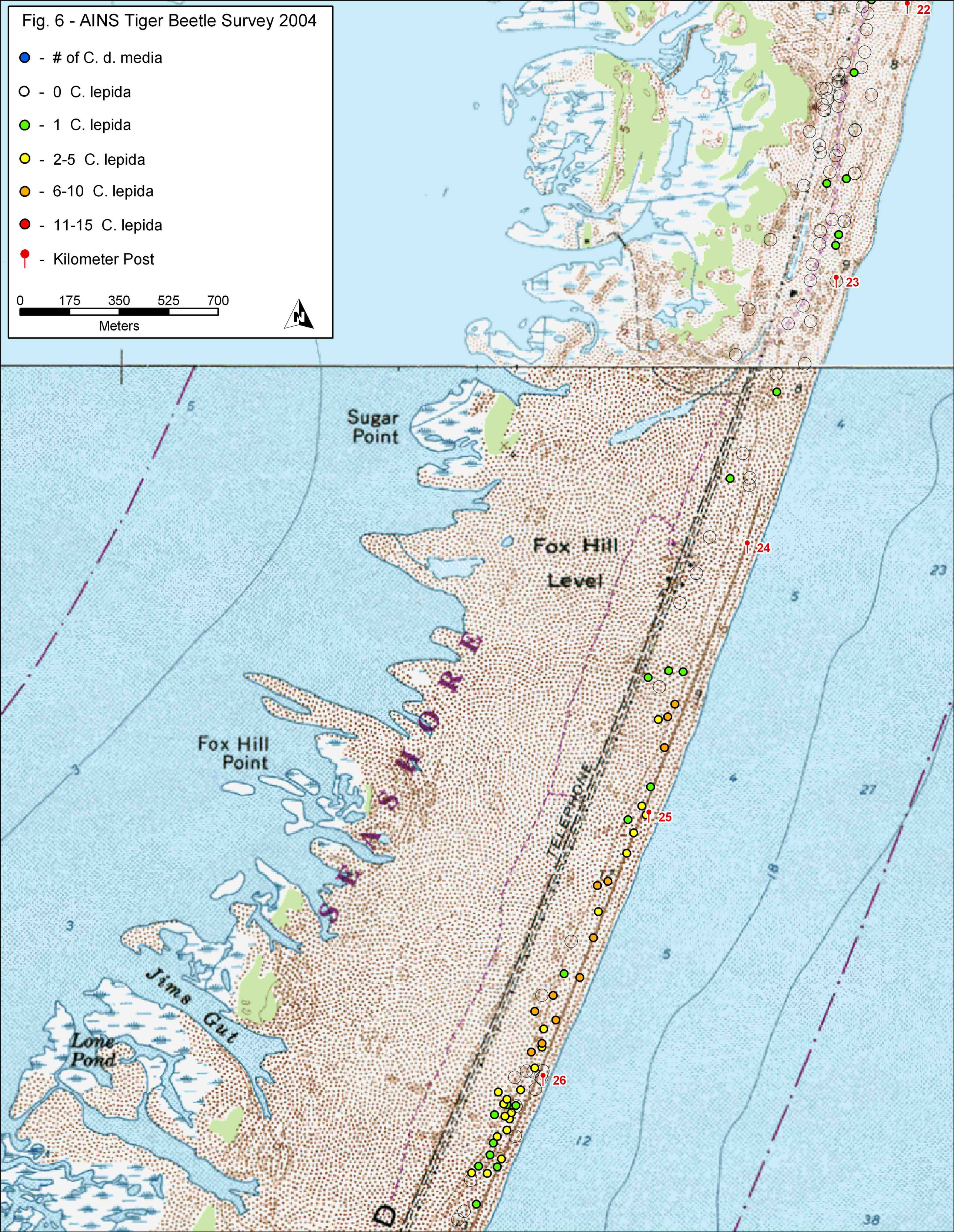
Fig. 6 - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
22
23
24
25
26
Sugar Point
Fox Hill Level
Fox Hill Point
ASHORE
TELEPHONE
Jim's Gut
Lone Pond

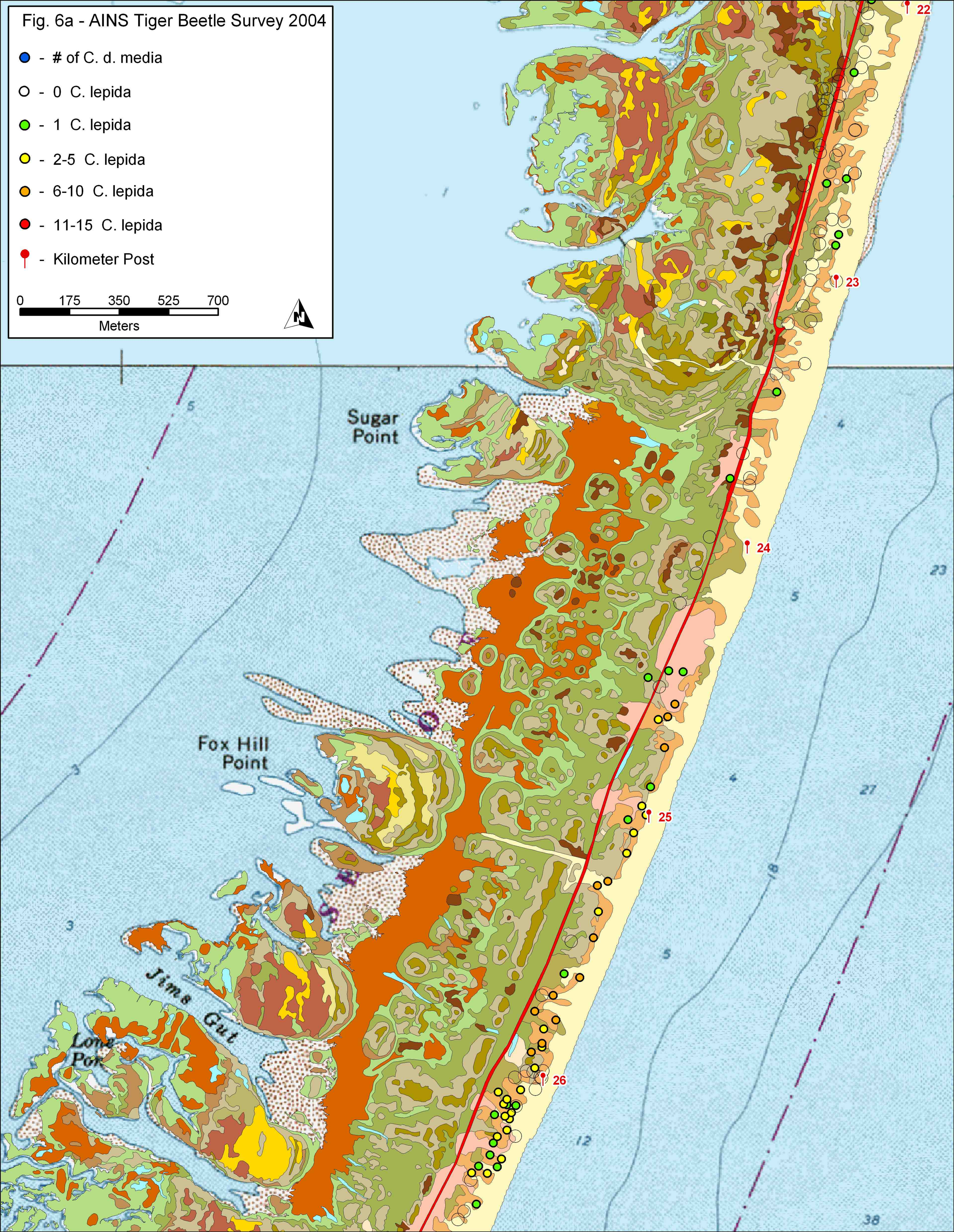
Fig. 6a - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
22
23
24
25
26
Sugar Point
Fox Hill Point
Jims Gut
Lone Pon

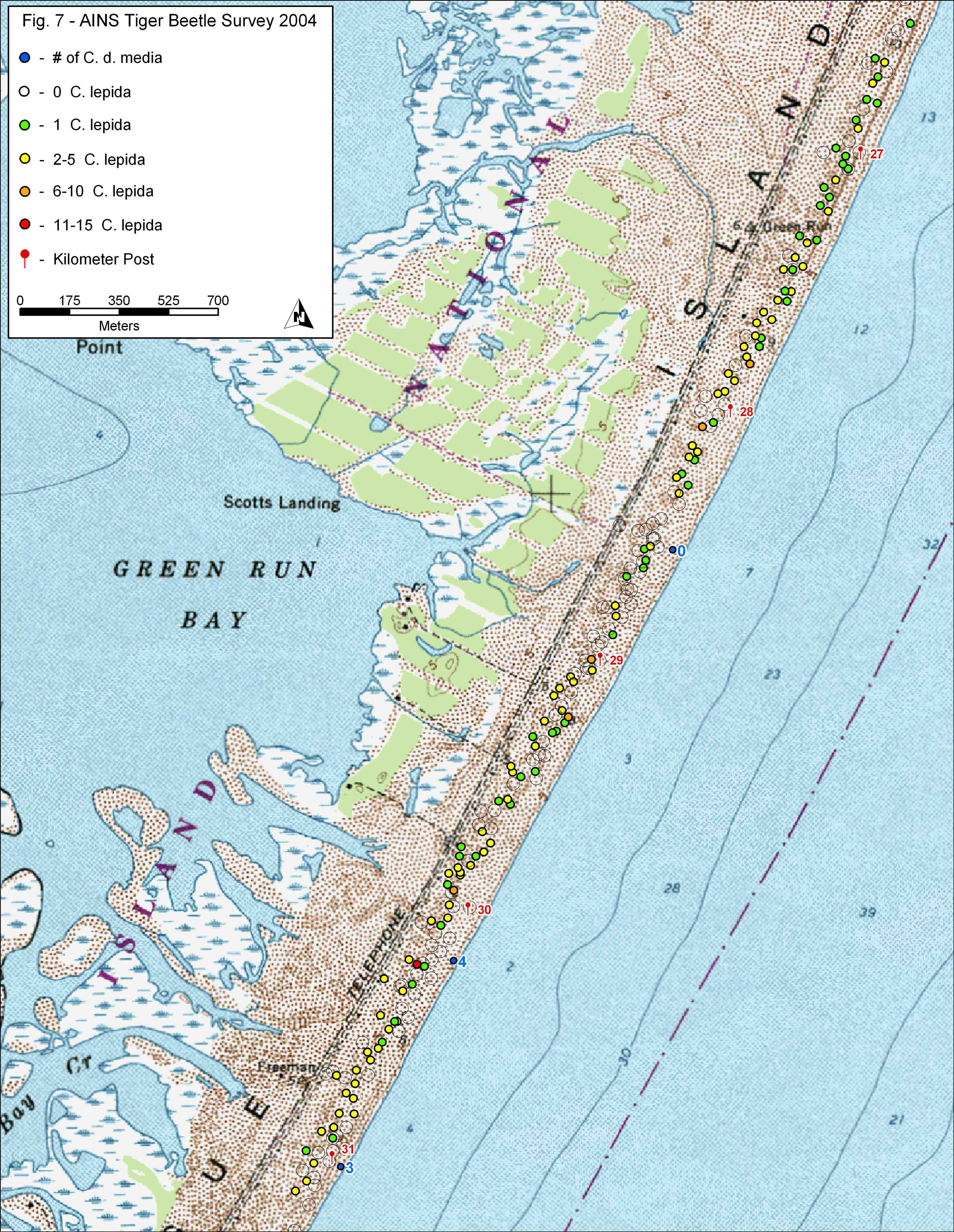
Fig. 7 - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Point
Scotts Landing
GREEN RUN
BAY
NATIONAL
ISLAND
ISLAND
TELEPHONE
Freeman
Bay
Cr
27
28
0
29
30
4
31
3

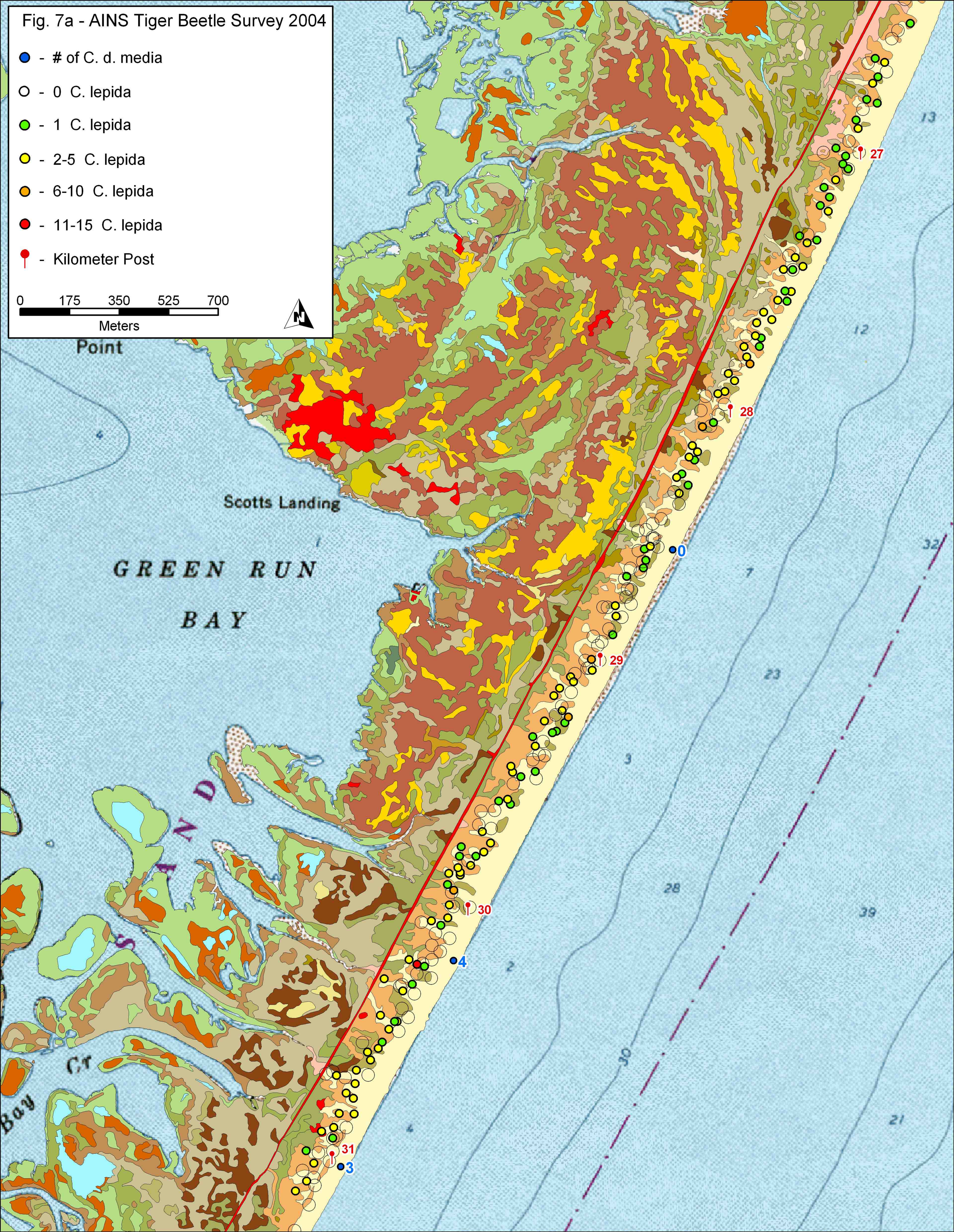
Fig. 7a - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Point
Scotts Landing
GREEN RUN
BAY
27
28
29
30
31
0
4
3

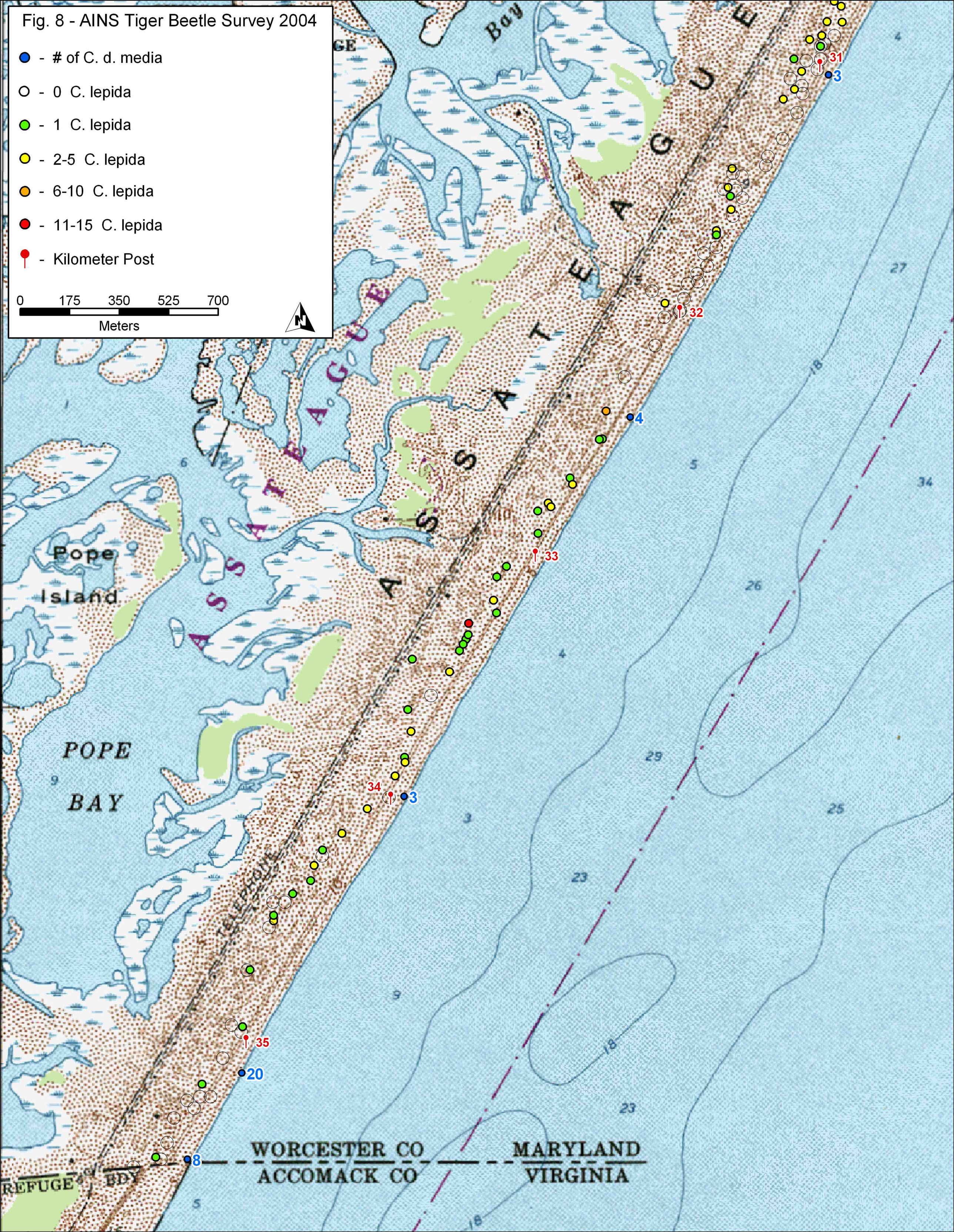
Fig. 8 - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Bay
ASSATEAGUE ISLAND
Pope Island
POPE BAY
WORCESTER CO
ACCOMACK CO
MARYLAND
VIRGINIA
REFUGE BDY
31
3
32
4
33
34
3
35
20
8

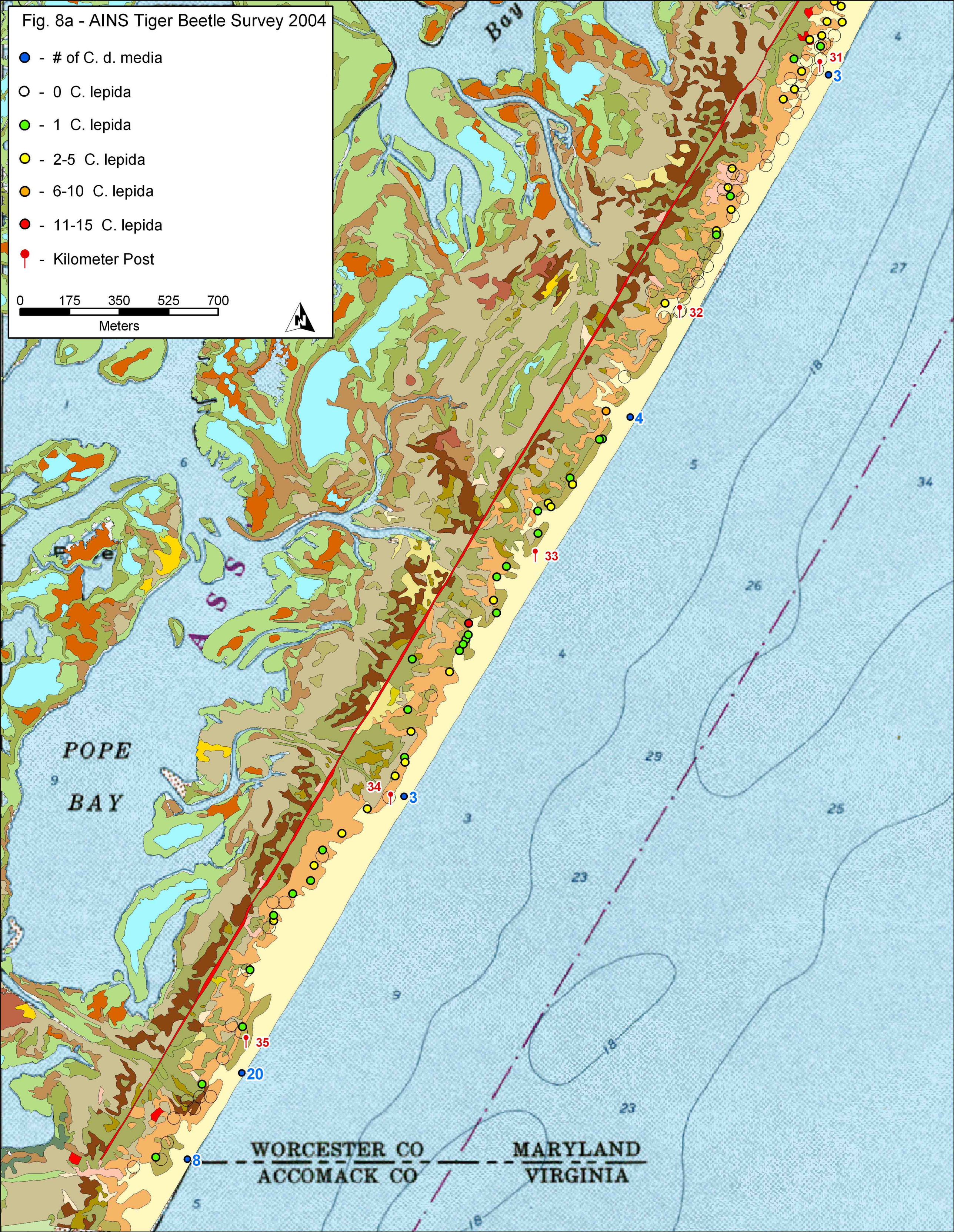
Fig. 8a - AINS Tiger Beetle Survey 2004
- # of C. d. media
- 0 C. lepida
- 1 C. lepida
- 2-5 C. lepida
- 6-10 C. lepida
- 11-15 C. lepida
- Kilometer Post
0 175 350 525 700
Meters
N
Bay
POPE
BAY
WORCESTER CO
ACCOMACK CO
MARYLAND
VIRGINIA
31
3
32
4
33
34
3
35
20
8