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VEGETATION TRANSECTS AND PROFILES ACROSS AN OVERWASH SITE AND STABLE DUNES ON SAND CAY (21° 12′ N, 71° 15′ W) IN THE SOUTHERN BAHAMAS

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Introduction

On the thousands of islands and cays which make up the Bahamas archipelago, only a few have been studied ecologically despite the long period they have been known to botanists. Most of the available information consists of floristic studies, in detail for readily accessible islands such as San Salvador (Smith, 1982), or on a broad scale (Correll and Correll, 1982). The many less accessible islands have been neglected, sometimes totally, by botanists.

One such island is Sand Cay, in the Turks and Caicos chain (Figure 1). Sand cay is one of the most southeasterly islands in the Bahama system. On January 15 and 16, 1985, we visited this island while on a Five College Oceanographic Cruise aboard the R/V Rambler. We were able to spend only two days on the island, one of which was used for actual sampling. This paper describes data collected along two transects representing two different physiographic zones on the island. A more complete survey of the species and vegetation of Sand Cay, by McCartney, et.al., is published in these proceedings.

Methods

The easily accessible portion of Sand Cay contained two distinct physiographic regions that were sampled by transects. The cay consists of two uplands made of consolidated coralline

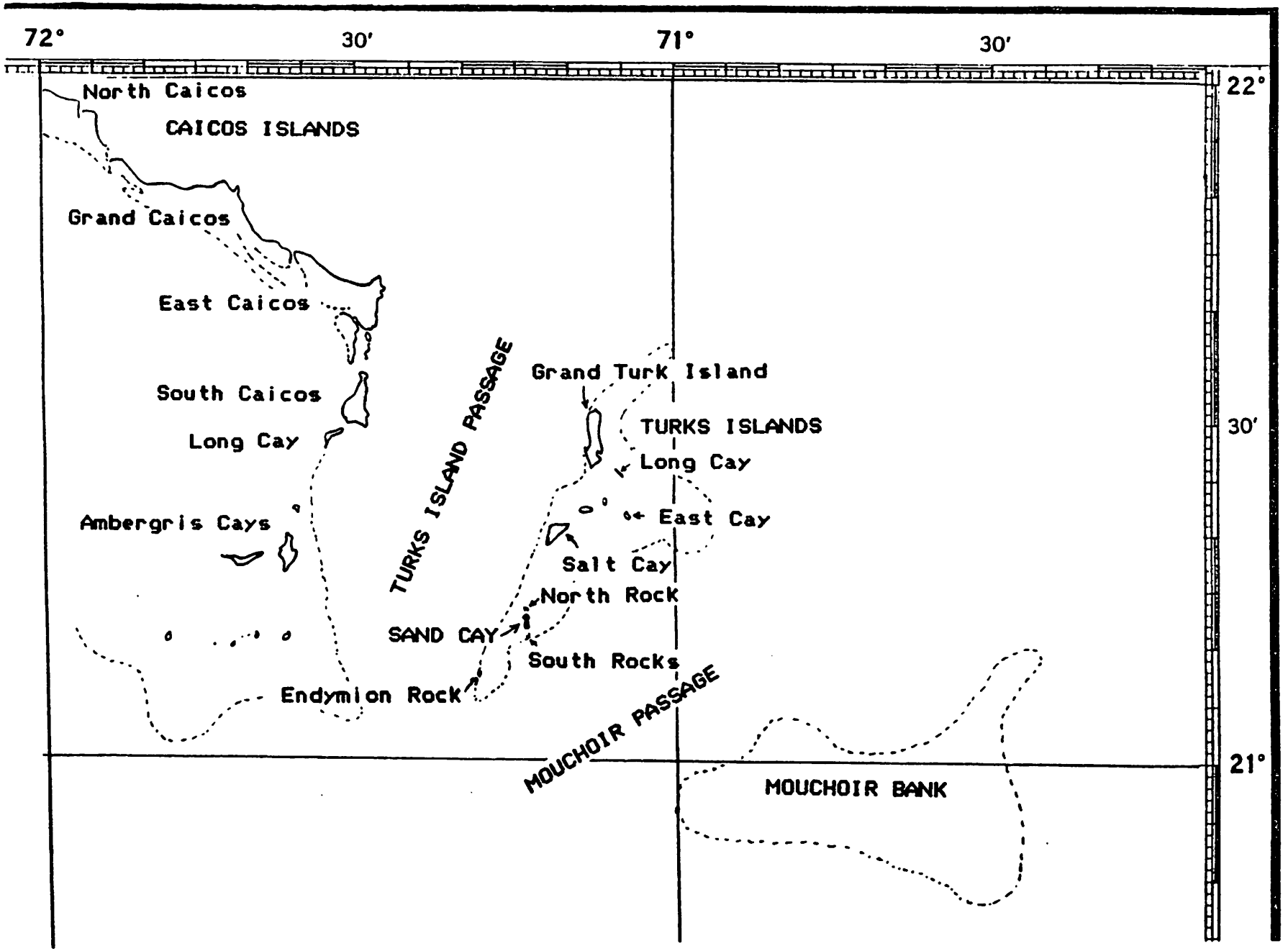

Figure 1: Map of the Southern Bahamas showing the location of Sandy Cay (21°

sands thought to be of Pleistocene Age (H.A.Curran, pers.comm.), connected by a narrow neck of unconsolidated sand with dunes and overwash features. In other words, the whole cay is a tombolo with a modern beach connecting two older uplands (Figure 2).

Transect #1 was chosen at random across the low beach and dune system. This area showed definite signs of overwash, and was therefore similar physiographically to areas we have sampled in North Carolina and Massachusetts. This "overwash profile" was laid out a distance of 98 meters from the swash line on the west facing beach to tide pools on the east side.

Transect #2, called "dune profile", was located to the south of #1 on stable dune system fronting limestone uplands. This transect also started on the beach passing into the dunes and over the top of the stable uplands, a distance of 86 meters. The upland was wider than the beach area of Transect #1, but could not be sampled in its entirety because of time restrictions.

Relative elevations on both transects were measured with a hand-held level and a meter tape attached to a pole serving as the survey rod (Figure 3). The lowest point on the transect, at the tide pool, was used as the zero reference. Accuracy was to 1 cm. Vegetation was sampled in alternate 1 meter quadrats located along the south side of Transect #1, and in every third meter on Transect #2 beyond 56 meters, because of the similarity of vegetation and lack of time. The average heights of each species in a quadrat were determined with a meter stick, and cover by estimation.

Results

Transect #1 (overwash profile) shows very low topographic relief (Figure 4) and evidence of recent overwash. The highest portion of the beach was on the west side, and storm surges evidently crossed the beach from that direction. That surface flow crossed the beach from west to east was shown by stream channels that went around slightly higher dune "islands" on which most of the vegetation was located (Figure 5). A great deal of debris on the land surface indicated the high water had covered the whole area, and thick lines of debris were present on the east side of the barrier.

The topography sloped upward toward the east from the berm crest, with a high point at 53 meters in low dunes, which was 2.3 meters above the relative base elevation. From there, the land sloped downward to the east, where the transect ended at protected tide pools.

Vegetation along Transect 1 can be divided into four categories: open beach, dune thicket, back-barrier shrubland, and back-barrier strand and storm drift.

On the open beach, the most seaward species, found at 40 meters on the line, was Euphorbia mesembrianthemifolia. Euphorbia was scattered around the berm with an average cover of about 10% and a height of 21.4 cm. It extended into the dune thicket and back-barrier zones to about 80 meters on the transect.

The dune thicket (Figure 6), consisted primarily of Suriana maritima, and was located between 45 and 65 meters on the line. The zone of Suriana shrubs was quite distinct, and in some

Figure 2a: Sand Cay study area showing the barrier beach and southern upland; view is south.

Figure 2b: Overview of the overwashed barrier barrier beach and transect site.

Figure 2c: View south showing the eastern side of the barrier beach and tide pools.

Figure 3: Topographic surveying method: Kat Herchenreder on the left holding a meter tape "survey rod", and Meera Sundaram on the right using a hand-held level.

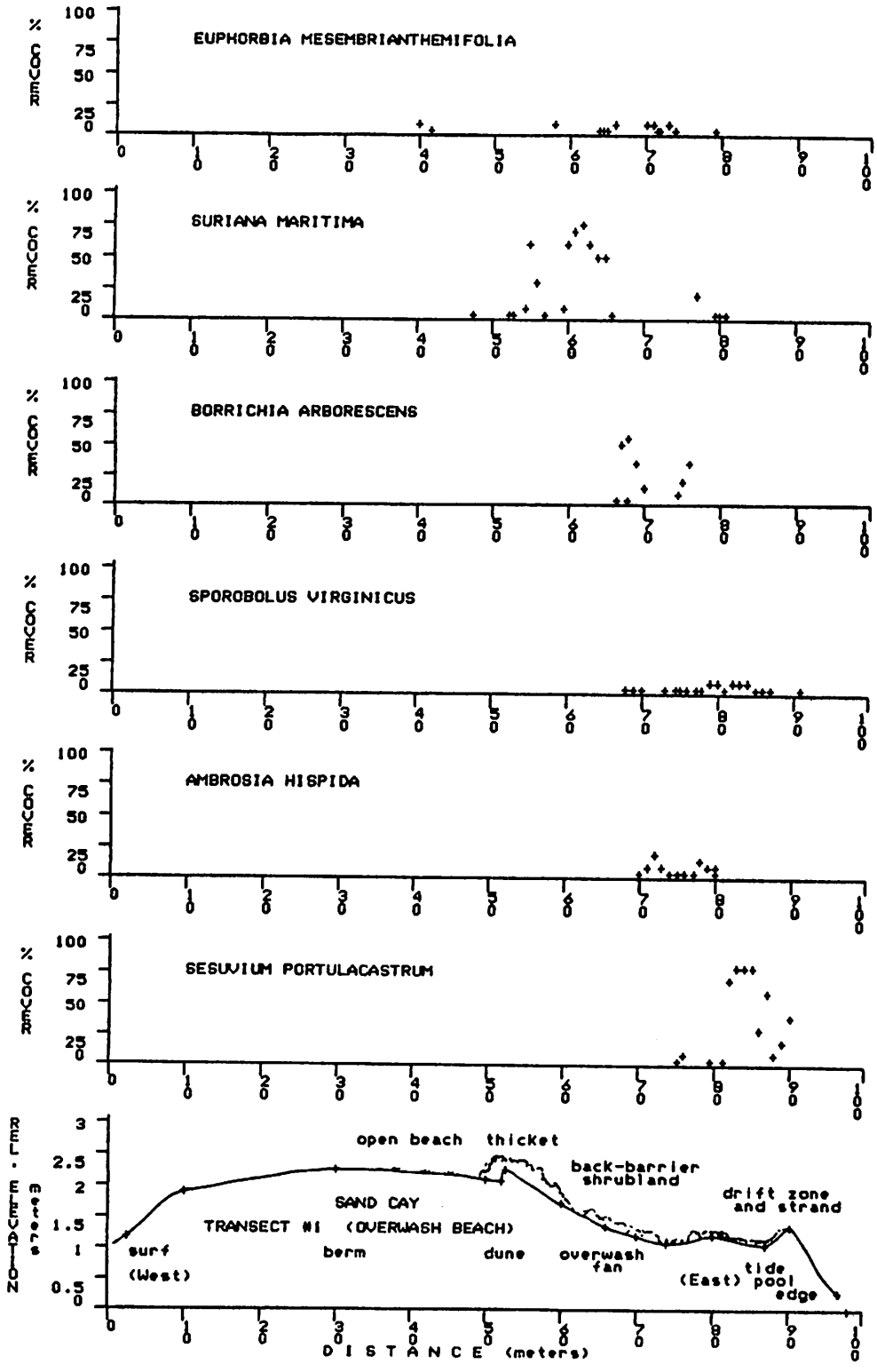

Figure 4: Plot of profile data and species cover along Transect #1. Plant cover was sampled at every other meter.

places very thick, covering about 60% of the ground on the seaward dunes and averaging 39.3 cm high. It was found further east on the transect to 80 meters, but had a cover of only 10%.

The back-barrier shrubland (Figure 7) occupied the region behind the Suriana dune thicket. It contained several species but was dominated by Borrichia arborescens. Borrichia was found between 65 and 77 meters on the line and ranged between 20 to 30% cover, with an average height of 44.7 cm. The sparse ground cover consisted mainly of Sporobolus virginicus, Ambrosia hispida, and Euphorbia mesembrianthemifolia. Sporobolus virginicus occurred between 67 and 90 m, with a cover of 10% or less and average height of 18.4 cm. Ambrosia hispida was in the same region, but stopped at 81 meters. Its cover values ranged between 10% and 20%, with an average height of 12.3 cm.

The back-barrier drift region (Figure 8) occupied the eastern end of the transect from 74 to 90 meters and was dominated by Sesuvium portulacastrum and Sporobolus virginicus. The distinctive feature here was the large amount of debris which accumulated from storm tides and flooding. Sesuvium was the only plant able to grow well in this material, with an average cover of 70% and height of 24.2 cm. Sporobolus was scattered thinly in this zone.

Transect #2 (dune profile) provided a major physiographic contrast to #1 by going from the surf zone into the stable uplands. All signs of storm flooding were restricted to the beach berm and foredunes. The relative elevation of the berm crest was 1.9 meters. From there the transect went through dunes to a high point of 5 meters at 63 meters distance (Figure 9).

Figure 5: Beginning of Transect #1 taken from the beach looking east. The open beach community is in the foreground with the Suriana dune thicket in the background. A washover channel is visible to the east of Kat and Meera.

Figure 6: Overview of the Suriana dune thicket at approximately 65 meters on the transect; view is south.

Figure 7: Back-barrier shrubland dominated by Borrichia and Suriana. Ground cover along the transect is Sporobolus and Euphorbia, with some Ambrosia. A washover channel is visible on the right side of the transect line. View is to the west.

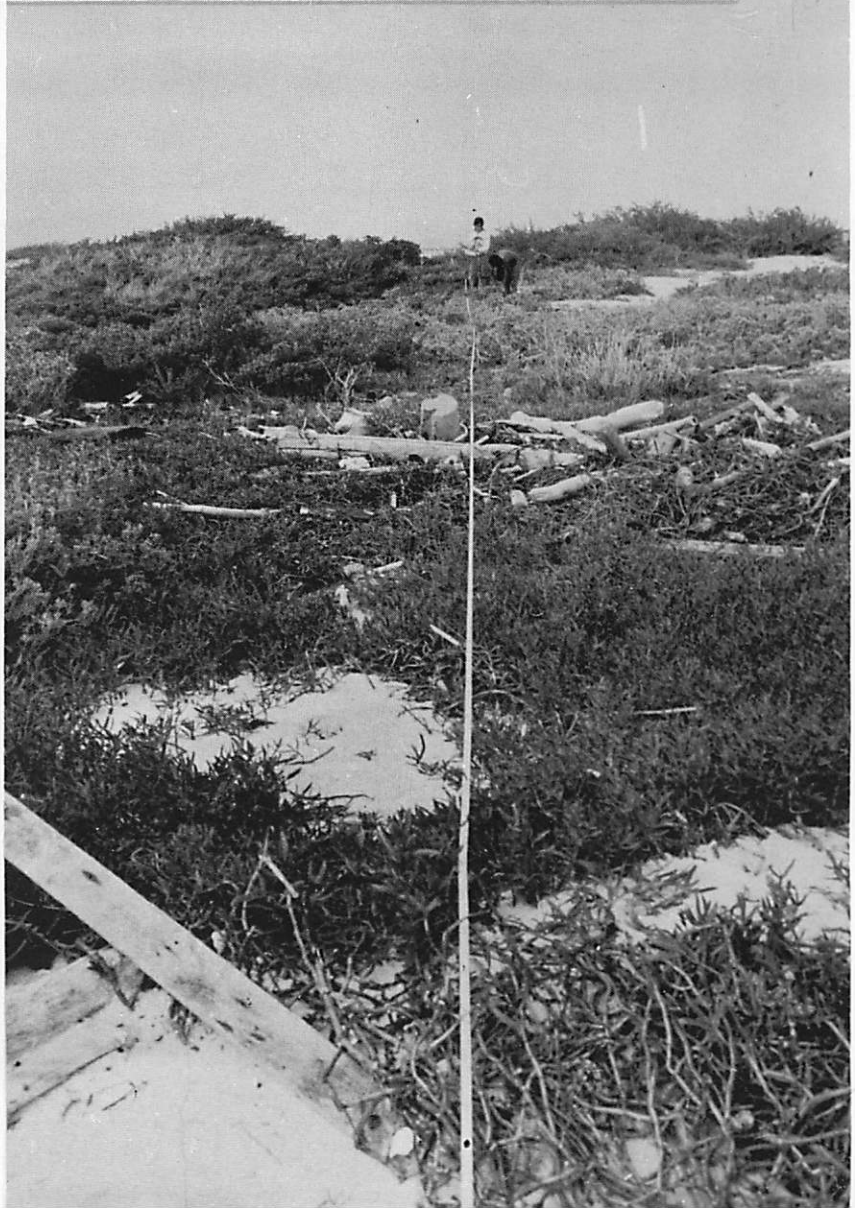

Figure 8: Back-barrier drift and strand zone where the transect drops down to a tide pool. In the foreground is an eroding sand beach covered with Sesuvium. The extensive line of storm drift shows in the middle of the photograph. The zone between is dominated by Sesuvium portulacastrum with some Sporobolus virginicus.

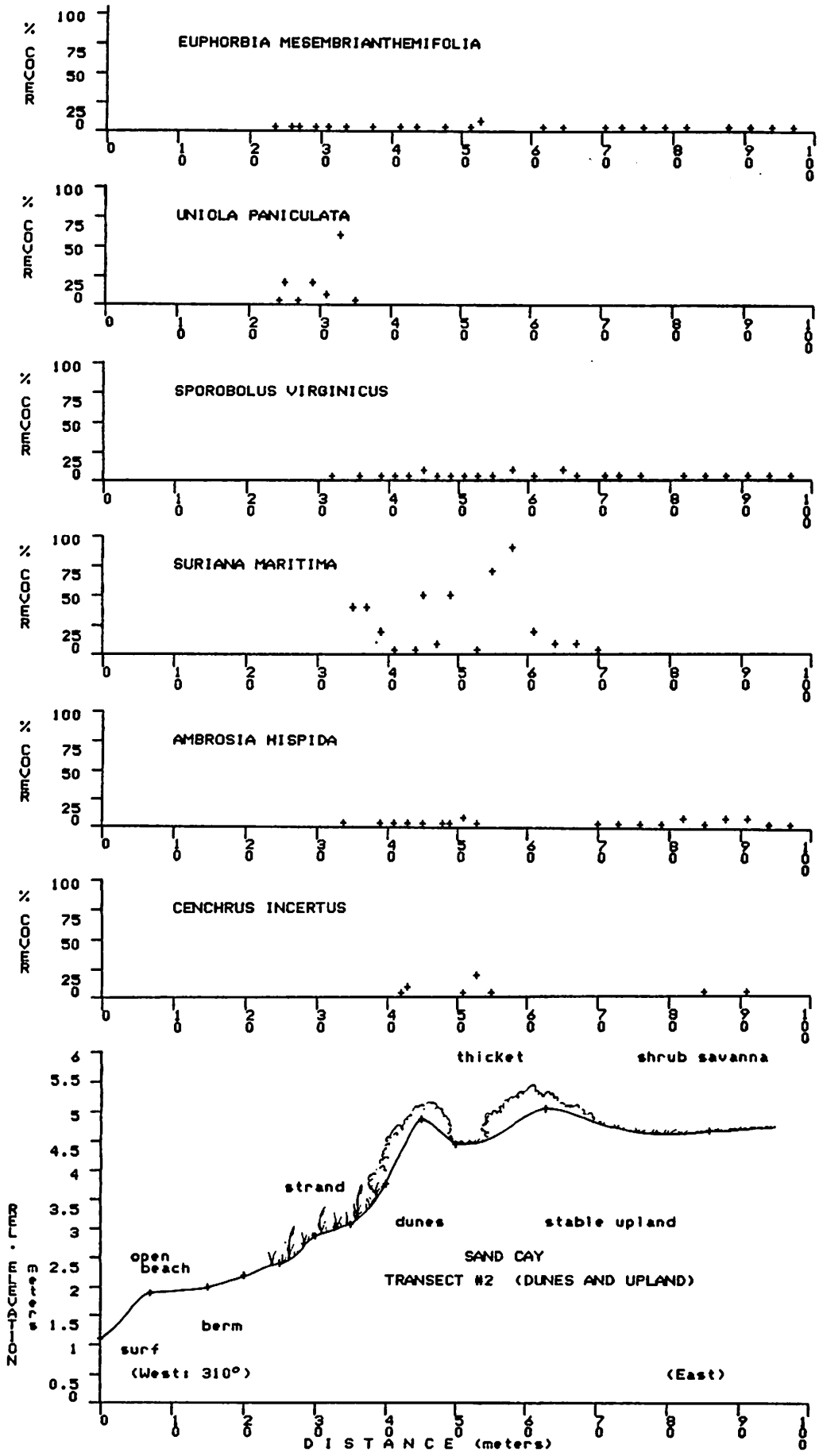

Figure 9: Plot of topographic readings and plant cover along Transect #2. Plant cover was sampled at 3 meter intervals beyond 56 meters distance.

Figure 10: View east along Transect #2, with the open beach community in the foreground and Uniola dune strand in the background.

From the crest, the land sloped down somewhat and then leveled off to the east.

Vegetation along transect #2 can be divided into open beach, dune strand, dune thicket, and shrub savanna. The open beach (Figure 10) featured Euphorbia mesembrianthemifolia, just as on Transect #1, but this plant was also found all the way across the dunes and uplands, thus making it the most widespread species on the line. Euphorbia was found between 21 and 86 meters from the beach, but had an average cover of 10% or less with a mean height of 23.3 cm. On the beach Euphorbia tended to grow prostrate, while in the dunes and uplands it grew upright.

The dune strand (Figure 10) was dominated by Uniola paniculata, which started at 23 meters distance and ended at 35

meters in the seaward face of the upland. There was evidence of storm tides having washed up into this zone. Uniola paniculata had an average cover of 40% and height of 93.6 cm. Growing with the Uniola was Euphorbia mesembrianthemifolia.

With increasing elevation, other species began appearing, such as Sporobolus virginicus, Ambrosia hispida, and a small amount of Cenchrus incertus. Sporobolus virginicus started at 32 meters distance and was then found along the entire transect, although sparsely on the limestone uplands. The average cover was less than 10% and its height was 22,5 cm. Ambrosia hispida occurred as well but did not gain dominance until east of the dune thicket. Cenchrus incertus was so infrequent that average cover was not calculated. The average height of the few plants found was 11.4 cm.

The dune thicket (Figure 11) was dominated by Suriana maritima, which occurred between 35 and 70 meters along the transect. Its peak density and cover were along the dune crest at 54 meters distance. In some places the Suriana thicket was nearly impenetrable. Its average cover was 70% and the heights of the plants around 60 cm. The only other members of this thicket community were scattered Euphorbia and Cenchrus.

The final zone on Transect #2 was a relatively flat open savanna (Figures 12 and 13), which contained mainly Sporobolus virginicus, Ambrosia hispida, Euphorbia mesembrianthemifolia and scattered shrubs. This was located to the east of the Suriana thicket and continued beyond our transect to the edge of the limestone uplands. Ambrosia hispida was the most common species in this community. It first appeared at 33 meters along the

transect, mixed with the dune strand plants, but was not present in the dune thicket. Eastward of the 63 meter point it was very common. The cover of Ambrosia was around 15% with plants averaging 10.6 cm tall. Included with the Ambrosia was Sporobolus viginicus, covering about 10% of the surface. Borrichia arborescens was scattered throughout the stable upland but only one representative was found on the transect. It was 63 cm high. Much of this region was bare limestone rock and sand.

Discussion

While they do not constitute an exhaustive survey of dune vegetation on Sand Cay, these two transects provide some indication of the relationship between geological processes, storm exposure, and elevation.

It is clear from the beach and dune structure that major flooding and wind deposition come primarily from the west. The nature of the beach shows that high energy waves forming in the deep water on the western side have formed the barrier by eroding the limestone uplands. The only dunes are also on the west side and result from westerly winds blowing across the wide beach berm. Storm-driven overwash that moves sand across the barrier also arrives from the west. The eastern side of Sand Cay is protected by reefs and relatively shallow water in the vicinity of the cay. Even so, drift line evidence suggests that exceptionally high tides submerge the eastern portion of the barrier beach.

The flora of Sand Cay is depauperate compared to larger Bahamian Islands, and certainly compared to dunes and beaches of southeastern North America. Nevertheless, the Bahamian and

Figure 11a: Suriana thicket on the crest of the dune zone at the edge of the upland, showing the dense nature of this community. View is north.

Figure 11b: View east along the dune upland showing the height of the Suriana thicket in relation to Meera and Kat.

Figure 12: Transition from the relatively closed Suriana thicket to the shrub savanna, showing scattered shrubs on the upland along the eastern side of the island. Shrubs are mainly Suriana and Borrichia. The transect ends near the shrub line in the background. View is east.

Figure 13: Open, sparsely vegetated zone of Sporobolus, Ambrosia, and Euphorbia along the east side of the stable upland at the transect end. The low vegetation cover is clearly evident in the foreground. View is south.

continental strands share such species as Uniola paniculata, Sesuvium portulacastrum, and Sporobolus virginicus.

On Sand Cay, only a very small number of species could be found in both the overwashed beach community and the uplands nearby. The most widespread species in all zones was the easily dispersed, opportunistic annual Euphorbia mesembrianthemifolia. The shrub Suriana maritima was very common on both transects, illustrating its ability to survive sea water flooding, salt spray and sand burial. It was by far the dominant shrub on Sand Cay. Other Bahamian dune strands, for example San Salvador (Smith, 1982), contain a much greater diversity of plants.

Two other species widespread on Sand Cay, and the Bahamas in general, are Ambrosia hispida and Sporobolus virginicus. Of tthe two, Ambrosia hispida is probably the most ubiquitous, occurring in nearly all habitats on Sand Cay, but more commonly in the uplands than on the overwashed beach. Sporobolus virginicus was found throughout the island, but was about equally important in the overwash and dune transects, although it made up a fairly dense grassland nearby Transect #2. Together, these species made up most of the beach and dune vegetation.

A major difference between the overwash site and the stable dunes was the presence of Uniola paniculata on the dunes. Uniola is a common strand species throughout southeastern North America and the Bahamas, but on Sand Cay it was present only in one area of the dunes on the west side.

Another major differnce between the two sites was the presence of Borrichia arborescens and Sesuvium portulacastrum, which dominated the lower sections of the overwashed beach. They

are salt and flood resistant and therefore survive well close to the sea. Both species, but particularly Borrichia arborescens, can also be found on higher areas of Sand Cay and other islands. However, these two species, along with Suriana maritima, seem to be the best adapted to overwash and flooding.

In general, the species composition along these two transects were not greatly different despite the major topographic variations and recent storm activities. In contrast, such topographic differences have been accompanied by substantial changes in dune strand communities of the U.S. East Coast (Godfrey and Godfrey, 1976; Godfrey and Disraeli 1982). On the continental coast, the overwash communities are usually quite different from those of stable dune systems. It would appear then, that most, if not all, of the species on Sand Cay are highly tolerant of severe environmental conditions, including salt spray, storm overwash, and sand burial. The low diversity of these communities would suggest an overall severe environment and a lack of diverse topographic conditions in which more non-tolerant species might survive.

Based on species present, the communities found on both transects would fall into the "sand strand" vegetation of Correll and Correll (1982) and Smith (1982) but with a much simplified species composition. However, the overwash area did not contain Uniola, a usually characteristic strand species. Also, the eastern third of Transect #2 was on the cemented dune uplands and crossed a very sparse Ambrosia, Euphorbia, Sporobolus zone. This vegetation was quite unlike the typical dune strand and more akin to a xeric shrub savanna with sparse herbaceous ground cover and

widely scattered shrubs.

Conclusion

Two elevation/vegetation transects across differing topographic features (overwashed beach and stable dunes) on Sand Cay produced similar results in terms of vegetation and species presence. The species most widely present, under all conditions including proximity to the sea, was Euphorbia mesembrianthemifoliah. Both sites supported a shrub thicket on dunes and uplands, dominated by Suriana maritima. Ambrosia hispida and Sporobolus virginicus were also found on beaches, dunes, and uplands. These two species made up the major vegetation zone on the upland to the east of a fringing dune thicket community. Borrichia arborescens and Sesuvium portulacastrum were most common in the lower two sites, where storm flooding was frequent. Borrichia, Sesuvium, and Suriana seem to be the best adapted to overwash conditions. The one species unique to the stable dunes was Uniola paniculata. The similar plant communities of both overwashed beach and dune/uplands are depauperate in species number and adapted to severe coastal conditions. The vegetation on both transects can be classified as a very simplified "sand strand community", but with a much less diverse flora compared to larger Bahamian islands or the southeastern U.S. coast. On the high ground of cemented dune sand, the vegetation differs significantly from the typical dune strand and can be best described as a "coastal xeric shrub savanna".

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