USE OF IMAGE PROCESSING TO MAP SEDIMENTARY ENVIRONMENTS AND VEGETATION ZONES OF SANDY BEACH MARSH, GASPE, CANADA

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INTRODUCTION

Sandy Beach marsh is a low energy, sediment trap located on the southern portion of Sandy Beach Spit in Gaspe Bay between 48 48' N and 48 50' N, and 64 24' W and 64 23' W. As a salt marsh community of "emergent vegetation rooted in soils that are alternatively inundated and drained by tidal action" (Nybakken, 1988, p 361), Sandy Beach marsh is inhabited only by certain species of vegetation that are adapted for this environment. Distinctive zones of sedimentary environments and flora may be recognized in the field and by air photos. The combination of field identification, remote sensing by air photos, and image processing were used to produce a map of the ecologic zones and sedimentary environments on Sandy Beach Spit.

FIELD METHODS

Species of marsh and dune vegetation and sedimentary environments were identified along a transect between A and A' in Figure 1. A laser Theodolite was used to measure differences in elevation and distances along a profile across Sandy Beach Spit. The transect crossed through marsh and dune environments and was bounded by foreshore on either side of the spit. Global positioning coordinates from a Magellan satellite navigation system also were used to determine the position of all measurements on Sandy Beach Spit. Buried marsh beds outcropping on the beach on the eastern side of Sandy Beach Spit were examined to estimate a rate of migration for the spit. A log imbedded in the exposed peat near our transect was excavated and dated at 195 +/- 60 years as referenced to the year A.D. 1950 by Kruger Enterprises using radiocarbon age determination.

OBSERVATIONS

Cross section evaluation of the transect indicated the location and differentiation among tide flats, low marsh, high marsh, salt panne, and dune floral assemblages. These tide controlled zones were identified by their characteristic species of vegetation. A characteristic low marsh and tide flat species, *Spartina alterniflora* was found in isolated channel cutoffs. In Sandy Beach marsh, *Spartina patens* was the dominant species of vegetation in both the low and high marsh. *Juncus gerardi* dominated the terrestrial high marsh border by competitively excluding S. patens to lower marsh levels (Bertness, 1991, p 125). *Distichlis spicata* , a more salt tolerant species (Bertness, 1991, p. 125), was found in the salt pannes. The exposed marsh beds outcropping on the eastern foreshore are mainly comprised of *Spartina patens* which indicated the development and subsequent coverage of a high marsh environment as Sandy Beach Spit migrated. *Ammophila breviligulata* (American Beach Grass) and *Lathyrus maritmus* (Beach Pea) were found in sandy dune environments. Both species were found in the dunes on both sides of the marsh.

COMPUTER ANALYSIS

A black and white air photograph of Sandy Beach marsh was scanned into a MAC II computer and analyzed with an image processing program (IMAGE 1.37) to generate an enhanced grayscale image of the marsh (Figure 1) (Lennard, 1990 and Morris, 1990). A profile of grayscale intensities along line A - A' was used to correlate the ecologic zones measured in the field with the grayscale intensities on the map (Figure 2). Areas of the marsh with greater grayscale intensities were the salt pannes and tidal flats which also appeared darker on the air photo and occured in the lowest elevations of the marsh. The lightest areas represent beach and dune environments, with the intermediate grayscale intensities indicating high and low marshes. The boundaries between the ecologic zones were drawn on a color enhanced image of the marsh. The symbols of the ecologic and sedimentary zones were transfered to the final map with the Adobe Illustrator 88 program (Figure 3).

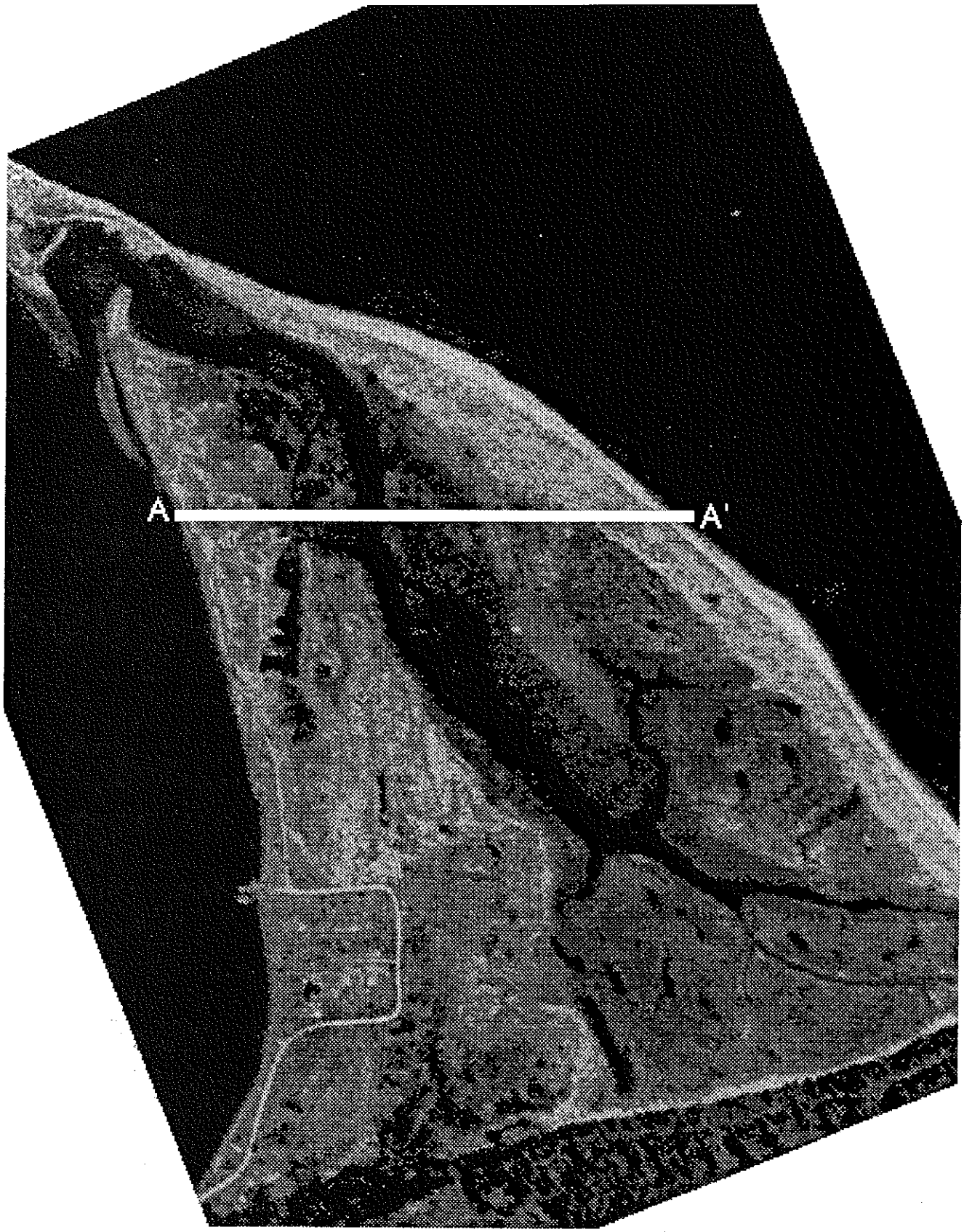

Figure 1. Enhanced image from aerial photograph of Sandy Beach Marsh. Profile of vegetation zones along line A - A'.

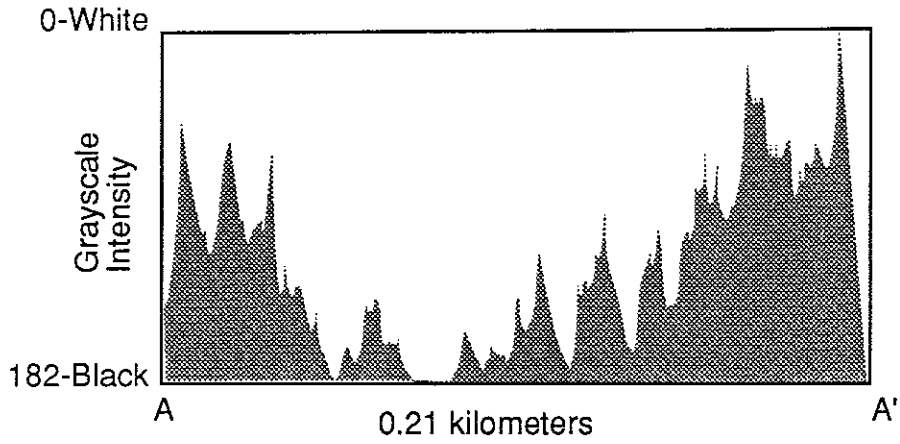

Figure 2. Grayscale intensity plot along line A-A'.

RESULTS

The map of the sedimentary environments and vegetation zones (Figure 3) indicates a well-developed beach and dune system along the eastern shore of the spit facing onto the Gulf of Saint Lawrence. The beach and dune system along the western shore is protected by the spit from direct attack by the waves from the Gulf. The dune system along the western shore has several ridges which parallel the shore and may indicate westward migration of Sandy Beach Spit. Salt marshes are developed behind the dunes with areas of high and low marsh clearly distinguished on the color images. Faunal assemblages within Sandy Beach marsh did not represent the break in high and low marsh species apparent on the color image. Therefore, the difference in grayscale may be a function of plant density of consequence of intertidal submergence. Tidal channels draining the marsh flow between barren tidal flats. Salt pannes within the marsh are preserved as remnants of channel cutoffs or the tidal flats. These areas of higher salinity which were once vegetated by low marsh species will eventually be colonized by high marsh species.

The rate of westward migration of the beach and dune system can be calculated by dividing the distance between the marsh outcrop and the nearest living marsh by the age of the tree preserved in the marsh outcrop. The distance across the foreshore and dune from the marsh outcrop to the living marsh is 36 meters. Using an age of 296 years before present, the migration rate was calculated as a minimum of 0.12 meters per year.

CONCLUSIONS

It is possible to combine a profile measured in the field with an enhanced color image to draw a map of the six vegetation zones and sedimentary environments on Sandy Beach Spit. The ecologic zones include beach, dune, high marsh, low marsh, salt panne and tidal flat. The marsh outcroping on the eastern shore has been dated using radiocarbon methods to compute a westward migration rate of at least 0.12 meters per year for the spit.

REFERENCES CITED

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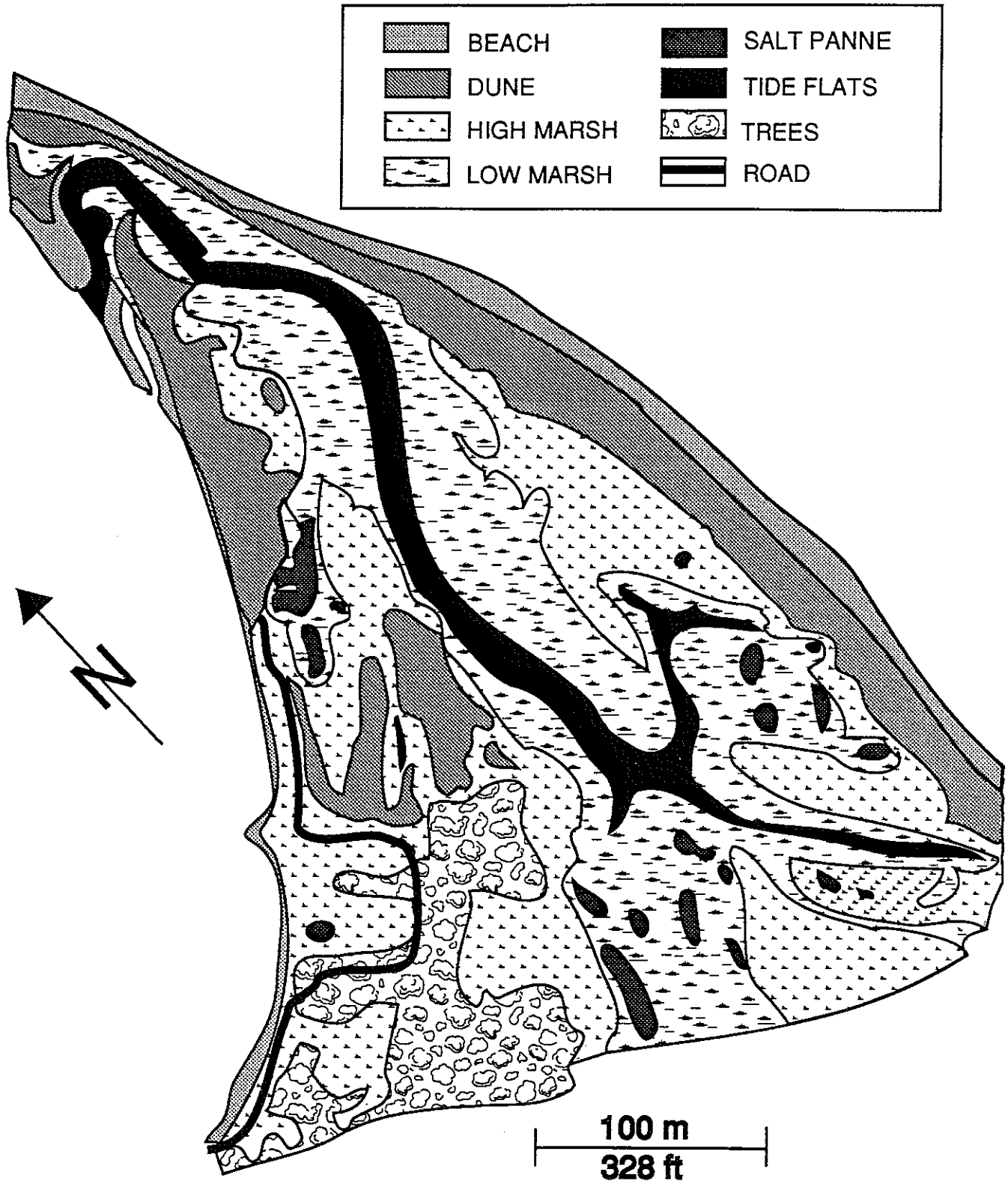

Figure 3. Map of sedimentary environments and vegetation zones on Sandy Beach Marsh, Gaspe, Canada.