The Relationship Between the Beach Morphology and the Pioneer Vegetation on Santinho Beach, Santa Catarina, Brazil

Janice Rezende Vieira Peixoto, Tânia Tarabini Castellani, Norberto Olmiro Horn Filho & Ulisses Rocha de Oliveira
Universidade Federal de Santa Catarina
Tartbr@yahoo.com.br

1. Introduction

According to Carter (1988), the dunes vegetation ecological dynamic is an important contribution to the frontal dunes growth. They represent an important role in the natural protection, once they deaden the undulations and the strong winds, they balance the sediment supply, they exchange sandy with the beach and they retain water.

The dune slope formation and the shore terrace morphology or of the beach ridge depend on the way the beach was colonized, on the plants density and distribution, on the sand volume, on the wind speed and on the species morphology.

On the other hand, the occurrence of beach species and frontal dunes can depend if there are available beach areas to still be colonized and dunes for supplying seeds (Obeso & Aedo, 1992); it can depend of the coastal energy level that determines the salinity, the sedimentology and the substract mobility (Moreno-Casasola & Epejel, 1986; Hesp, 1991; Barbour 1992); it also depends on the the stablished vegetation interferences (Moreno-Casasola & Epejel, 1986; Wisheu & Keddy,1994); on the geomorphological features and on the expansion trend or coastline regression (Moreno-Casasola & Epejel, 1986; Johnson, 1997).

According to Hesp (1989), the beach stability is intrinsically connected to the vegetation growth. Whenever the frontal dunes suffer the accretion, the vegetation tends to expand itself, increasing so the width of dunes. Therefore, when the dunes pass by an erosion process, the vegetation becomes limited and there are scarps on the frontal dunes.

The frontal dunes typical vegetation is known as pioneer vegetation that stands the salinity effects and also represents the first obstacle to the sand brought by the wind into the continent direction. The pioneer vegetation is seen as a sediments fixative and it works like a dynamic barrier against the storm surges (Bernardi *et al*., 1987).

The sediments characterization is based on the grain size and compositional parameters, and it is substantial to the faciological sets individualization and it also determines the sedimentary environment characteristics. It’s really important to mention the way the morphodynamic occurs on a beach, defining the expecting morphological variation. The evaluation above increases considerably the grade of success from several activities related to the coastal zone management (Carter).

Herein, it aims at verifying how the beach morphology presents itself to the pioneer vegetation, which is distinguished by (South, Central and North) on Santinho beach, on the East coast of Santa Catarina Island, Brazil.

2. MATERIALS AND METHODS

Santinho beach is located on the East coast of Santa Catarina Island, according to the geographical co-ordinates 27º 27'S and 48º 22W, between Ingleses and Calhau Miúdo Hills (figure 1).

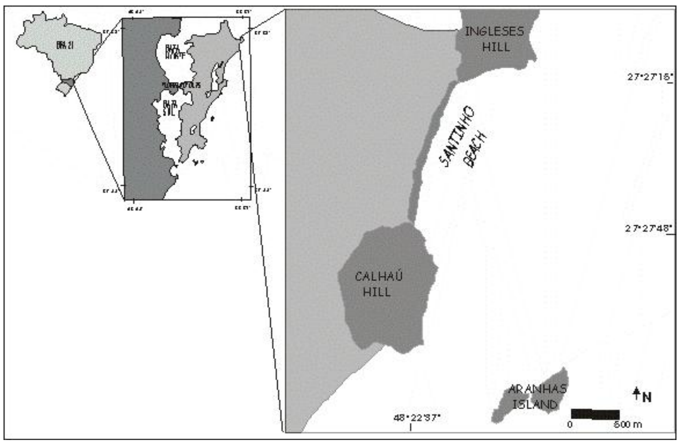

Figure 1: Map of study area, Santinho Beach, Santa Catarina Island, Brazil.

Three surveys of topographical profiles were done between the months of December 2003 and March 2004. They were disposed in three sectors: South, Central and North. Each one had the frontal dune reverse extension measured up to the foreshore. The technique used was the leveling method with leveling and stadia, described by Birkmeier (1985) The topographical profiles processing were done with *97 EXCEL program*.

The sediment collecting was done in the three sectors. They were submitted to a grain size analysis, through a washing, drying, weighing, quartering and bolting process, according to Wentworth's grade scale (1922), 1/2 Ø (phi).

The grain size analysis data processing was done through an analysis and textural classification program of grain size parameters – PANCOM (Toldo Jr. & Medeiros. 1986) that manipulates the statistical programs following Folk & Ward methods (1957).

The vegetation analysis was done in March, by the point method. This method consists on the vertical projection of a pine on a surface point and then on each point the intercepted species are registered. The points were distributed from the converse of the dune up to its frontal base along the geographical profile on the area taken by vegetation.

Every 2m, 40 points of sample were collected, 20 from the right and 20 from the left, until 1m far from the profile.

In each profile, the vegetal cover and every present species were calculated in percentage.

Cover percentage

$$\text{total} = \frac{\text{number of points occurring at least in one specie}}{\text{total of collected sample points}} \times 100$$

$$\text{present species percentage} = \frac{\text{number of points occurring by species}}{\text{total of collected sample points}} \times 100$$

An analysis of floristical similarity among each profile was done by Sorensen coefficient (Krebs, 1989):

$$Ss = 2a / (2a + b + c)$$

a = number of commons species in samples A and B
b = number of species in sample B only, not in A
c = number of species in sample A only, not in B

3. RESULTS AND DISCUSSION

Santinho beach presents an uniform grade scale in all sectors: fine sands on the reverse, on the base of the dune and on the backshore; and medium sand at the foreshore (figure 2).

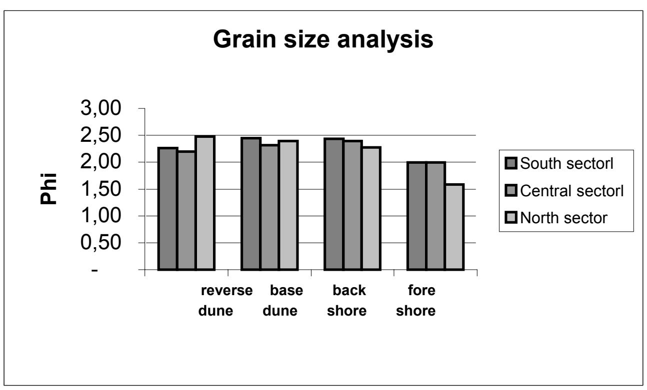

Figure 2: The grade variation along the beach profile in three sectors on Santinho beach.

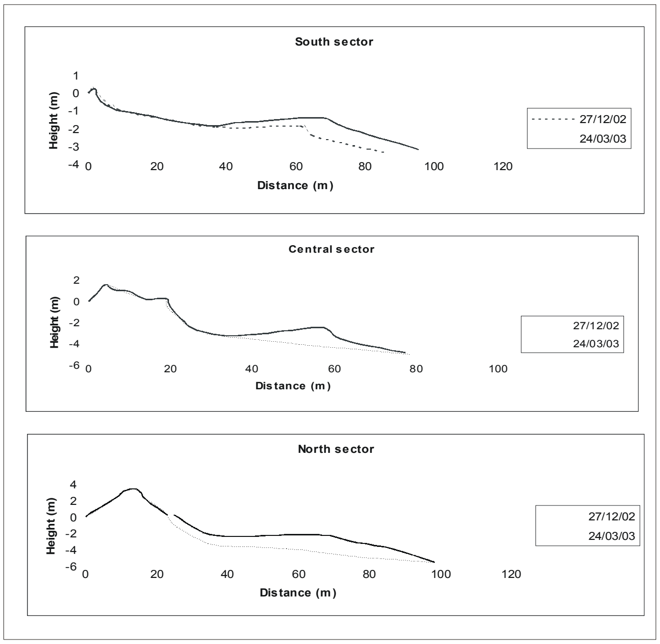

Figure 3: The beach profiles on Santinho beach show the South, Central and North sectors during December and March.

The south sector on Santinho beach has a declivity of 3.31º (figure 3 and table 1). It is the most sheltered sector due to Aranhas Island and Aranhas Coast, which protect the beach from the S-SE swells (figure 1).

This sector presents itself in the flattest shape, were it is possible to see only two incipient dune ridges, which means an average size of 0,75m. The Central and North sectors are more exposed to the incident swells presenting larger beach declivities and a larger frontal dune growing. On the North sector the dunes height got its higher growth at 6,5m. (figure 3 and table 1)

A total of 23 species was sampled (table 2), but the most floristical similarity happened between the Central and North sectors (0.84). The South and North sectors presented a similarity index of 0.18 and the South and Central sectors an index of 0.17.

The South sector was distinguished by a species abundance falling. In this sector, the most vegetal cover species was the shrubby *Leguminosae Dalbergia ecastophyllum*, which expanded itself from the more established interior areas on the incipient dune ridge. There was not any occurrence of this species at the energizer sector, where Gramineae *Panicum racemosum* was the most dominant species (table 2).

Table 2: Physical and biological parameters at the beach sectors: Declivity, Grade scale, Frontal dune height, dune base extension up to its reverse, species abundance, total cover found in the sectors on Santinho beach.

	Sector South	Sector Central	Sector North

Declivity	3.31º	4.26º	3.98º
Grade size analysis foreshore backshore dune base dune reverse	medium sand fine sand fine sand fine sand	medium sand fine sand fine sand fine sand	medium sand fine sand fine sand fine sand
Dune height frontal	0.75m	4.00m	6.5m
Base dune extension up to its reverse	3.6m	19m	26m
Species abundance	7	16	15
Cover Total	62,5%	85,9%	79,5%

All this evinces that on Santinho Beach the sectors, where there are higher energy waves, develop extensive frontal dunes supporting so a larger species abundance with more floristic similarity. This reinforces what HESP (1998) has suggested about arguing that there are seeming correlations among the frontal dune height, the beach morphology and the sediment transport by incidental swells.

Many studies about pioneer species beach and dunes suggest that in more sheltered areas it tends to grow widely the shrubby species, as it happened in the South sector, and these species inhibit the growth of herbal species (Moreno-Casasola 1993, Wisheu & Keddy 1994).

Table 2: The vegetable cover percentage for every species (PCi) shows South (profile 1), Central (profile 2) and North (profile 3) sectors on Santinho beach during summer (SUM).

	Profile1 SUM	Profile2 SUM	Profile3 SUM
Acicarpha spathulata	10.0		
Androtrichum trigynum		0.5	
Asclepias mellodora		0.2	
Baccharis radicans			0.1
Blutaparon portulacoides	9.5		
Cenchrus incertus		11.8	9.4
Chloris retusa		0.7	2.5
Conyza canadensis			0.4
Cyperus obtusatus		0.5	0.1
Dalbergia ecastophyllum	26.0		

Eragrostis cf. *lugens*		10.5	2.5
Hydrocotyle bonariensis	6.5	-	
Ipomoea imperati	2.0	11.6	1.6
Ipomoea pes-caprae		9.5	9.7
Noticastrum malmei		3.6	6.9
Oenothera molissima		0.5	
Oxypetalum cf. *banksii*		2.5	0.3
Panicum racemosum	9.5	38.4	52.5
Paspalum vaginatum	15.5		
Polygala cyparissias		2.3	2.6
Porophyllum ruderale		0.5	0.6
Remiria maritima		20.5	7.0
Senecio crassiflorus	-	2.3	1.5

4. BIBILIOGRAPHY REFERENCES

BARBOUR, M. G. Life at the leading edge: The beach plant syndrome. *In:* Coastal plant comunities of Latim America (U. Seeliger, ed). Academic Press, San Diego, p. 291-307. 1992.

BERNARDI, H. ; CORDAZZO, C.V. & COSTA C. B.S. Efeito das ressacas sobre *Blutaparon portulacoides* (St. Hill.) Mears, nas dunas costeiras do sul do Brasil. *Revista Ciência e Cultura* 39 (5/6): 545 – 547. 1987.

BIRKMEIER, W.A. *A user's guide to ISRPN: The interactive survey reduction program.* instructions Report Cere. U. S. Army Engeneer Waterwais Experiment Station. Vickburg, Mississipi, Coastal Engineering Researsh Center, 84p. 1985.

CARTER, R.W.G. Coastal enviroments: *An introduction to the physical, ecological and cultural system of coastlines.* London, Academic Press.617p. 1988.

FOLK, R.L & WARD,W.C. Brazos River Bar: a study in the significance of grain size parameters. In: *Journal of Sedimentary Petrology.* 27:.3-7. 1957.

HESP, P.A. Review of biological and geomorphologica1 process involved in the inititation and development of incipient foredune. *Royal Society of Edimburges.* 96: 181 – 200. 1989.

HESP, P.A. Ecological processes and plant adaptations on coastal dunes. Journal of Arid Environments. 21: 165-191. 1991.

JOHNSON, A. F. Rates of vegetation succession on coastal dune systems in Northwest Florida. *Journal of coastal research*. 13: 373-384. 1997.

KREBS, C. J. *Ecological Methodology*. Harper & Row, publishers, New YorK.1989.

LIMA, S.F.; SILVA FILHO, W.F.; PINHEIRO, R.D.; FREIRE, G.S.S.; MAIA, L.P. & MONTEIRO, L.H.U. ANASED – Programa de Análise, Classificação e Arquivamento de Parâmetros Sedimentológicos. *VIII Congresso da ABEQUA*, Imbé, RS, 2001.

MANTOVANI, W & MARTINS, F.R*. O método de pontos*. Acta Bot. Bras. 4 (2): 95-122. 1990.

MORENO-GASASOLA, P. & EPEJEL, I. Classification and ordination of coastal sand dune veegtation along the gulf and Caribbean sea of Mexico. Vegetatio. 66 : 147-182.1986.

OBESO, J. R & AEDO, C. Plant-species richness and extinction on isolated dunes along the rocky coast northwestern Spain. *Journal of vegetation science.* 3:129-132.

TOLDO JR E.E. & MEDEIROS R.K. Programa Interpola em linguagem basic para análise estatística e propriedades texturais de amostras sedimentares em computador. *Pesquisas*, 18: 91-100. 1986.

WENTWORTH, C.R. A scale of grade and class terms of clastic sediments*. Journal of geology*, 3: 377-392. 1922.

WISHEU, I.C. and KEDDY, P.A., 1994. The low competitive ability of Canada's atlantic coastal plain shoreline flora: implications for conservation. *Biological conservation*, 68:247-252.