

# AFFORESTATION OF COASTAL SWAMPS AND DUNES AT RIO VERMELHO

Henrique Berenhauser \*

## RESUMO

*Na ilha de Santa Catarina, sul do Brasil, uma extensão de nove quilômetros de pântanos e dunas ao longo da costa estão sendo reflorestados.*

*As metas do projeto são pesquisas e educação florestal, associadas à implantação de áreas de recreação e mostrando a viabilidade econômica do reflorestamento em áreas aparentemente improdutivas.*

## ABSTRACT

On Santa Catarina Island, South Brazil, an extension of 9 kilometers of swamps and dunes along the coast have been reforested. The eventual goals of the project are research and education in forestry to provide some recreation areas and to show the economic validity in re-planting seemingly improdutive land.

## Introduction

Realizing that current cutting practices and rapid economic development may bring about the ultimate exhaustion of its natural forests, the Federal Government of Brazil, through its unique Fiscal Incentive laws, has launched a far-reaching program of reforestation. The State of Santa Catarina, even before the federal laws were enacted, recognized the need to encourage good forestry practices. In 1963, the state declared the Estacao Florestal do Rio Vermelho to be a demonstration forest. The choice was a good one for if forestry and reforestation could be made to work here, it would likely work well in most other areas.

## Rio Vermelho

The forest station is situated in the northeastern section of the Island of Santa Catarina. Florianopolis, the capitol city of the state, with a population of 120.000, is also located on the island, some 25 kilometers distant. The mountainous island is 60 kilometers long and 4 to 15 kilometers wide. At latitude 28° south, it enjoys a mild sub-tropical cli-

mate with a mean annual temperature of 20.5 degrees Centigrade. The sea-level location provides a nearly frost-free environment. Rainfall is 1400 millimeters and is well distributed throughout the year, with 20% of the annual precipitation falling in the three driest months of May, June and July. The three wettest months, January, February and March, account for only 35% of the total annual precipitation. The potential evapo-transpiration value for this location approximates 1000 millimeters per year, leaving a surplus of 400 mm, indicating a decidedly humid climate.

Colonization of the island started in the late 17th century. The countryside has since been divided, over the generations, into very small farms, of generally low production. The original soil mantle, never very rich, has been further deteriorated by erosion and exhaustive farming practices.

The Rio Vermelho Forest Station covers 1000 hectares and lies between the ocean and a lagoon. Much of the area has never been inhabited because of the swamps and sand dunes. At one time in its geological history, large areas of the station were covered by natural forests, possibly mangrove type swamps, established on ocean-deposited sands. Continuous cutting of the forest in centuries past together with wildfires and overgrazing prevented natural regeneration of the original forests. Shifting sand dunes then covered much of the area once in forest cover, sandwiching a layer of peat between two layers of sand in many places on the forest.

\*) Chefe da Estação Experimental de Rio Vermelho, SC.

## Afforestation Sites

Four distinct sites were found within the demonstration forest:

a) Swampy areas with high organic content, highly acid soils and high water table. These swampy areas were formerly the bed of a shallow lake. Only hardwoods of poor form and growth inhabited parts of these sites.

b) A large central dune of 110 hectares, covered with poverty vegetation of shrubs and low grasses.

c) A nine kilometer strip along the beach with a sparse cover of vines and grasses.

d) A strip of shifting sand dunes nearly eight kilometers in length, situated between the larger dune (b) and the ocean-side strip (c).

## Choice of Species

**Eucalyptus** species might have been ideal trees for this afforestation work. However, since the native **Araucaria** forests are facing depletion, there was a need to consider the future supplies of softwood. This circumstance indicated that the project should work preferably with **Pinus** species which are also excellent pioneering vegetation.

Twenty-five tropical and sub-tropical pine species have been planted in various trials at the station. As might be expected, **Pinus elliottii**, **P. taeda** and **P. palustris** have shown the best growth and adaptation to the difficult sites at Rio Vermelho. However, **P. pinaster** competes favorably with **P. elliottii** on the drier sites. It is interesting to note that in Brazil, **P. palustris** has a surprisingly short grass stage of only one to two years. All the other pine species have proven unsuitable. Perhaps the strong sea-breezes, laden with salt mist, have not provided a favorable environment.

**Eucalyptus robusta** and **E. saligna** are two species that appear to be well adapted for growth on the harsh, exposed, windy ocean-side sites at Rio Vermelho.

In addition to the pines and eucalypts, various **Acacia** species, such as

**longifolia** and **mimosa**, have been used, both for site improvement and visual effect. The native vines and grasses have also been used to good effect and where protected from grazing and fire, have thrived and multiplied.

## Nursery

A small nursery was developed on the station to provide planting stock. For the first three years, the growth of the various pines was disappointing. The root systems did not develop mychorizae in the newly established nursery. Potted seedlings were obtained from an older pine nursery and planted every two meters along the beds. The new seedlings were then satisfactorily inoculated with mychorizae.

## Swamp Sites

The first plantings were made in the swamp areas where the best growth could be expected because of the high organic content of the soil. More than 35 kilometers of drainage ditches were required to lower the water table to tolerable levels within the 550 hectares of swamp sites. These ditches were opened by hand over a period of 8 years because one of the purposes of the project was to provide jobs for the local people.

In the swamp sites, **P. elliottii** mean growth now exceeds 1,20 meters per year. **P. taeda** growth is slower, due perhaps to an unsuitable seed source since in other areas in Brazil, this species does as well as **P. elliottii**, and, in some instances, exceeds it in growth.

Extremely acid soil in the swamps, as low as pH 3,5, proved to be an obstacle to good initial growth of the pines. By draining the swamps, favorable oxygen relationships were apparently restored and the pH raised to more tolerable levels for pine growth.

There were some areas of the swamps with a thick layer of sphagnum moss. Seedlings planted directly in this substrate did not survive. But by first filling the planting hole with a bucket of sand from a nearby drainage ditch, the survival was greatly improved.

One area of the swamps had a 90 centimeter layer of peat. Initial growth on this extremely acid site was very poor, but after two years the seedlings recovered and began to grow normally. This may have been due to a change in the acidity of the peat layer following drainage and aeration or to the penetration of the roots to the underlying sand layers, or to the development of mychorizae, or a combination of these factors.

### Central Dune

There were no particular problems in planting the central dune area which was only sparsely covered with vegetation. However, seedlings planted on this site have a noticeably slower growth rate to date.

### Ocean Boundary

Experimental plantings were started during the second year of the project on the area close to the beach. **Acacia longifolia** was used here as the species to provide a nurse crop for the site. When the **Acacia** reached a height of 50 centimeters, pines and eucalypts were interplanted. Six years later, **Pinus elliottii** and **Eucalyptus robusta** were more than four meters tall, and the **Acacia** are rapidly dying out, except along the border where they now provide an interesting contrast to the taller trees, especially when they are in bloom.

In order to hold the shoulder of the beach, three species of native vines (**Impomoea pes-caprae**, **Scaevola plumieri** and **Canavalia obtusifolia**) have been planted there. These hardy vines resist covering by the sand, growing up and over the sand as fast as it covers them. Thus they serve an excellent function in increasing the height of the fore-dune, providing needed protection on the lee side of the sand dune allowing the taller vegetation to become established.

**Sophora tomentosa**, a native shrub of the dunes, has also been planted near the beach area in closely spaced, fence-like rows. It is expected that these living fences will provide protection to the tree seedlings planted there.

As one of the ultimate objectives of the project is to establish a recreation area along the beach, there is a special interest here to bring the forest right down to the beach, for shelter and shade. However, trees growing just behind the shoulder of the beach are constantly subjected to strong winds and salty air, both factors detrimental to their best development. Tree species are still being sought for this difficult site.

### Shifting Dunes

The very aggressive vines and grasses along the beach have built a protecting fore-dune, and held the coastal strip in place, preventing its becoming an area of shifting dunes. However, in two places the fore-dune did not hold the sand mass which drifted along the beach. Through these openings the sand mass moved inland and established a range of shifting dunes, parallel to the coast.

It is impossible to plant trees directly on shifting dunes. The wind carries away the sand about the base of these trees, wearing away the tender bark and exposing the roots to the drying sun. Several methods for controlling the sand were tried in order to avoid the construction of expensive fences. The stabilization of the dunes was finally accomplished in a simple and inexpensive manner by covering them with a thin layer of reed grass. The peculiar fact about the use of this grass is that it does not need to be secured or pinned down. Cut fresh, where it grows in the lower and wetter sections of the beach area, it is simply spread in a thin layer over the dunes and there it stays, undisturbed by the ocean winds.

Once the dunes are covered with the reed grass, they can be planted. Each planting hole was filled with one to two buckets of peat, readily available from a large deposit of muck just behind the dunes. Both **Eucalyptus robusta** and **Pinus elliottii** have been successfully planted on these stabilized dunes. The reed grass, acting as a mulch, also reduces the temperature of the sand around the seedlings.

## Results

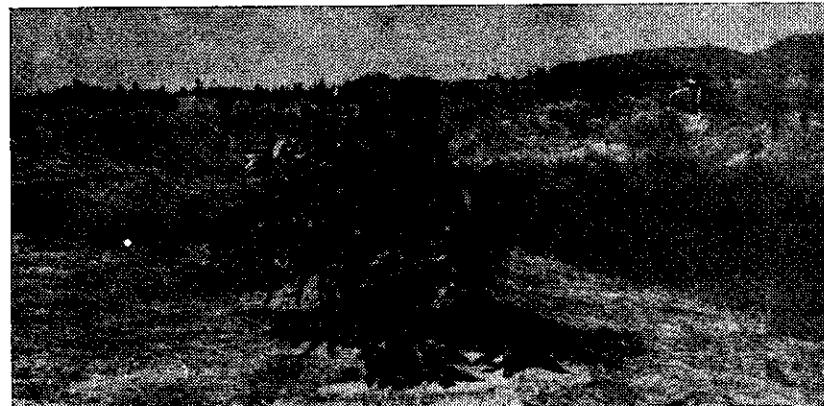
In the nine years since the Rio Vermelho project was started the annual budget ranged from \$ 10.000 to \$ 20.000. More than 750 hectares of once useless land has been made productive again. New roads have been opened into the area, benefiting the local population, providing access to the metropolitan area of Florianopolis. During this period, local labor was effectively employed on a regular basis, providing a stable income for many families. The recreation and week-end use of the demonstration forest has increased tremendously in the past few years, providing enjoyment to

thousands, where once only scrawny cattle ranged.

With the return of the forest cover, wildlife is also returning and birds, once rare only a few years ago, are becoming increasingly common.

The successes at Rio Vermelho have not been easy to achieve, but the results indicate that afforestation of the coastal swamps and sand dunes can be successful. More than that alone, are the amazing side benefits to afforestation in the form of work for local people, recreation for all, and a sense of providing something useful in restoring ravaged land.

**Eucalyptus robusta**  
on dune covered with  
reed grass mulch.



**Six year old planting**  
on dunes consorciation  
of *Acacia longifolia*,  
*Pinus elliottii*, *P. pinaster* and *Eucalyptus robusta*



8 years old *P. elliottii*  
on drained swamp



*Ipomoea pes-caprae*  
vine protecting the  
shoulder of the beach