Human Impact on the Vegetation of Aruba

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Abstract

What was the impact of thousand years of human presence on the island? Palynology, the study of fossil pollen and spores in old deposits, can help us to reconstruct the vegetation history for Aruba. The first results of a palynological research carried out at Boca Prins and the Spaans Lagoen are presented here. They indicate that the vegetation of Aruba has changed over the years, due to climatic fluctuations and human impact. Fossil pollen and spores were identified of plant species that nowadays are hardly found on the island. Fern spores in older sediments may indicate that Aruba was much wetter in the past. Fossil pollen from **Pal'i sia cora** or gumbo limbo tree (*Bursera simaruba*) were abundant in older sediments of the Spaans Lagoen indicating that the tree was a common specie of the vegetation surrounding the Lagoon. At present only a few trees are left to be admirred. The results will help to formulate goals for the preservation of the terrestrial vegetation of Aruba.

Introduction

Within the Neotropics dry forests have always been the first choice for human settlements. Human impact often resulted in a large perturbation and transformation of the original vegetation. Increasing human pressure on the land and less conservation attention for dry forests makes it one of the most threathened terrestrial ecosystems (Fajardo et al., 2005). Fortunately on Aruba a relative large part of the island is nature conservation area. The 34 km^2 Parke Nacional Arikok (Figure 1) covers almost 19 % of the island. If the broad band along the north coast and the Spaans Lagoen will also be assigned nature conservation area the total area protected will be doubled to approximately 70 km^2 (Figure 1).

In the past most of the area was probably covered by a dry tropical forest. Thousand years of human presence had a large impact on the ecosystem and only fragments of different dry forest types are still present. Human impact during the last decades was probably as severe as the impact on the nearby islands of Curaçao and Bonaire. Landscape and vegetation surveys of Curaçao (Beers et al., 1997) and Bonaire (Freitas et al., 2005) shows that many of the described vegetation types are secondary communities and that only a few remnants of the original climax vegetation, as described by Stoffers (1956), ar left. The authors

conclude that a major impact is still the (over)grazing by free roaming goats and donkeys. Grazing results in a reduction of the vegetation cover, the dominance of weedy species and a hampering of the regeneration of woody species.

For conservation purpose it is important to know what the human impact was and if the 'original' vegetation could be restorated. As 'original' vegetation we refer to the situation just before the first humans arrived on Aruba.

Questions we would like to answer are:

- How did the vegetation looked like when the first humans set foot on Aruba some 5000 years ago? Was Aruba for a large part covered by forests?
- Which species did the Indians introduce?
- Did they use slash-and burn agriculture?
- Which trees were used for construction and did they altered the forest by selective logging?
- Was the vegetation on Aruba in 1500 already strongly alterred?
- Was the Brazil tree a major specie of the tropical forest when Spanish colonists named the island Brasilwood Island?
- What was the impact of the Spanish and Dutch colonisation?

In the period 2008-2009 the Fundacion Parke Nacional Arikok will conduct a palynological research to reconstruct the vegetation history of the park. This will be the first palynological research for Aruba. The research will help to formulate restoration goals for the dry forests within the Parke Nacional Arikok. Here we present the first results of some analysed samples from Boca Prins and the Spaans Lagoen.

Figure 1: Aruba with core locations. Indicated in green are the Parke National Arikok (blue dashed line) and planned nature conservation areas (map after DIP, 2008)

Materials and Methods

Cores were raised at the Spaans Lagoen and Boca Prins (Figure 1). The top 1.7 m of the 4.0 m Spaans Lagoen core was sampled every 10 cm. The 3.5 m Boca Prins core was sampled at two depths. Samples were prepared using standard palynological extraction procedures, but without a HF treatment (Faegri and Iversen, 1989). For each sampled depth a complete slide was counted for pollen and palynomorphs at 400x magnification.

Results

The Spaans Lagoen core consists almost exclusively of organic sediments. The organic sediments from 30-70 cm depth contain some clastic material. The upper 30 cm is almost exclusively mineralogical and consists of erosional material carried to the lagoon by rooi Francés, rooi Bonheur and rooi Taki.

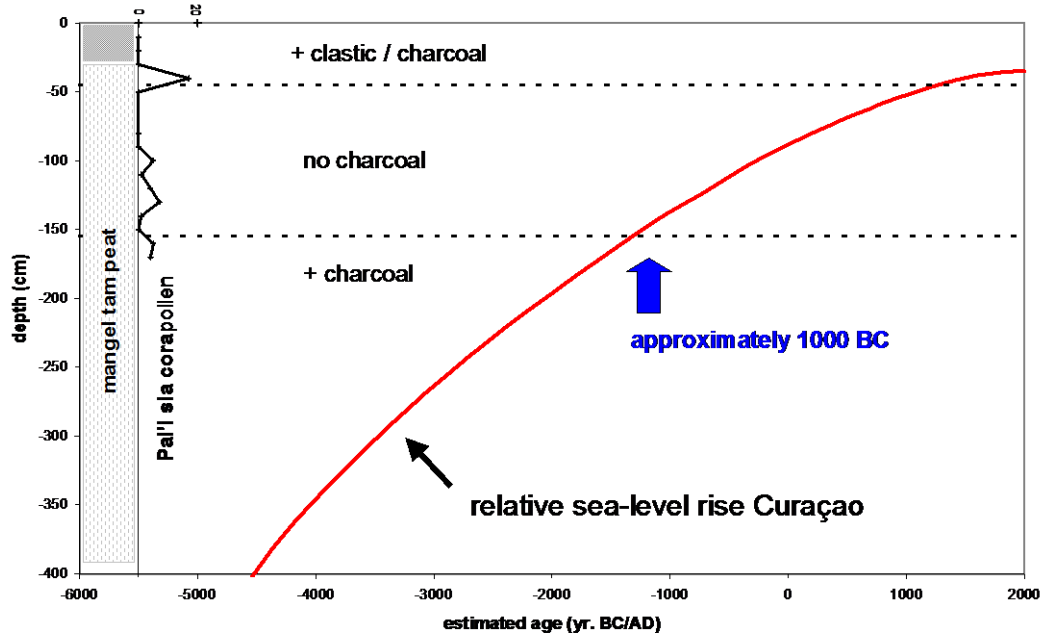

Figure 2: Spaans Lagoen core with lithology and number of **Pal'i sia cora** pollen/slide and the presence of charcoal within the samples. The transition at 155 cm depth has an estimated age of ~1000 BC. The estimated age was based on the relative sea-level rise curve from Curaçao (Klosowska, 2003) assuming mangrove peat accumulation around mean sea level. The radiocarbon dating could change the estimated age significantly.

The top 1.7 meter of the core spans approximately the last 3000 years. The age-depth relation is based on the relative sea-level rise curve from Curaçao (Klosowska, 2003), assuming that **Mangel tam** (*Rhizophora mangle*) peat accumulation occurred predominately around mean sea level. A few samples will be radiocarbon dated to verify this age-depth model.

All samples are dominated by mangrove pollen from **Mangel tam** (*Rhizophora mangle*) and **Zwartmangel** (*Avicennia nitida*). Only the upper 30 cm of the core contains relatively more pollen from species growing in the hinterland. These pollen were brought to the lagoon by the rooien, together with eroded soil material.

Striking is the presence of charcoal in the deepest analysed samples indicating human disturbance. **Pal' i sia cora** (*Bursera simaruba*) pollen were present upto 100 cm depth and show a small peak around 40 cm depth (Figure 2). This tree has a wide distrubution from Florida up to northern South America including most of the Caribbean islands (de Freitas, 1996). In Southern Mexico and Guatemala the tree is very common and occurs in many different vegetation types and successional stadia (Lundell, 1937; Miranda, 1958; Sánchez and Islebe, 2001). Islebe and Sanchéz (2002) related high abundancy of Bursera pollen in a

Mexican mangrove peat to disturbance and probably a more open landscape (Islebe and Sanchéz, 2002).

The presence of charcoal and **Pal' i sia cora** pollen in the deepest samples probably indicate disturbance by the first human settlements near the lagoon. The second increase in **Pal' i sia cora** pollen occurred together with an increase in charcoal and clastic material. This strong disturbance is probably related to large-scale deforestation during the Spanish and Dutch colonisation of the island. Deforestation resulted in large-scale soil erosion.

The Boca Prins core is almost exclusively mineralogical with only a thin organic layer at 3.3 m depth. A sample from this organic layer was analysed on pollen. The sample was dominated by *Rhizophora mangle* pollen indicating the presence of a **Mangel tam** (*Rhizophora mangle*) mangrove at the time of deposition. Nowadays **Mangel tam** mangroves are only found at the southside of the island.
The mangrove was rapidly replaced by a **Fofoti** (*Conocarpus erecta*) swamp when erosional products accumulated at the site. The sample at 2.4 m depth is already dominated by *Conocarpus erecta* pollen. The site is still a **Fofoti** (*Conocarpus erecta*) swamp but lacks many species encountered in the 2.4 m depth sample, like ferns and *Blutaparon vermiculare*.
The presence of fern spores could indicate wetter conditions in the past but could also indicate disturbance of the mangrove ecosystem, as suggested by Islebe and Sanchéz (2002).

Conclusions

The first results of a palynological research carried out at Boca Prins and the Spaans Lagoen indicate that the vegetation of Aruba has changed over the years, partly due to human impact. Human impact was particulary large during the Spanish and Dutch colonisation causing large scale deforestation and soil erosion. At Boca Prins eroded material has completely filled the boca and resulted in the disappearance of the **Mangel tan** (*Rhizophora mangle*) mangrove. Human disturbance was also significant during the first human settlements on the island as demonstrated by the presence of charcoal and **Pal' i sia cora** pollen in older sediments of the Spaans Lagoen. **Pal' i sia cora** (*Bursera simaruba*) seems a good indicator of human disturbance. However large human impact can also make this tree extinct. Nowadays only a handful **Pal' i sia cora** trees are left to be admirred.

Further palynological work in 2008-2009 will increase our knowledge about the human impact on the vegetation and will help to formulate goals for the restoration of the original dry forests of Aruba.

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