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Dynamic of the Vegetation in the Surrounding Zones of the Coastal Village of Playa Florida, Camagüey, Cuba

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Abstract A study about the dynamic of vegetation during the last 50 years was made in the surrounding areas of the coastal village Playa Florida, south coast of the province of Camagüey, Cuba. The information to analyze the changes of the coastal vegetation, considered those located below the lever curve of 5 m, was obtained from 1:50 000 cartographic maps of 1956 and 1977, and a satellite photo of 2010. The covered area for every type of vegetation was calculated using digital cartography tools. It was observed an increase of the mangrove area that includes mangrove, lagoons and herbaceous vegetation up to the tide line. It is explained by the fact of the displacement of the mangrove to the terrestrial zone has been higher that the backward of the coastal line, mainly due to the natural sinking of the marine platform and the erosion produced in the beach by human activity.
Keywords Dynamic of vegetation; Coastal vegetation; Mangrove; Camagüey; Cuba

1 Introduction

The mangrove is a primary element in coastal ecosystem considered as fragile ecosystems (Irman and Brush, 1973). It is also considered as one of the main sources of organic matter to the marine environment and it is nurseries to many larvae of crabs, crustaceans and fish. Its dynamics is determined by a set of factors that act in complex ways (World Bank Environmental Department, 1993).

However, it is identified that one of the factors that affects the coastal vegetation dynamics is the man and the management of this area by man, the management that he makes of this area. The damages caused by misuse of coastal vegetation belts can range from the disappearance or reduction of populations of a species (Dugan, 1990), until the destruction of the ecosystem as a whole (Scodari, 1990).

To the south coast of Camaguey Province has been reported a natural sinking as a result of geological processes, which in conjunction with sea level rise resulting from climate change, 2.9 mm / year (Perez et al. 1999), influences vegetation dynamics, both mangrove fringe and the adjacent vegetation.

To this natural problem, the mismanagement that man has made in the area is added, among which include the construction of a road to access to the community through mangrove without water passages, causing disruption of natural flow and reflow, as well as mangrove cutting in the beach area associated with this village (Plasencia et al. 2001).

Similarly, the vegetation adjacent to the mangrove fringe, dominated initially by sub-coastal evergreen forest, was affected by the clearing made in the late 60s of the last century and constant fires that occur in the area during the driest periods.

Notwithstanding these effects, the flora of the area still retains interest values of biodiversity. For the area, 64 species belonging to 58 genera and 32 botanical families have been reported, with 14.9% of endemic (Plasencia et al., 2005).

The objective of this paper is to analyze the dynamics of the vegetation of the areas surrounding the coastal village of Playa Florida in the last 50 years and evaluate the possible causes that have influenced this dynamic.

1.1 Description of the work area

Playa Florida is a coastal village located to southwest of the town of Florida, Camaguey Province, Cuba, in the lower part of the river basin Mala Fama, on a sandy bar, so that during the rainy season, some surrounding areas are flooded by the spilling of the river.

The study area bordered to the north by the Negrito estuary, to the south by the estuary The Jatía, to the east by antropic savanna ecosystem and to the west by the Gulf of Ana Maria (Figure 1), and consists of marsh deposits; carbonated from land origin and mangrove peat belonging to the Holocene (Iturralde-Vinent, 1989).

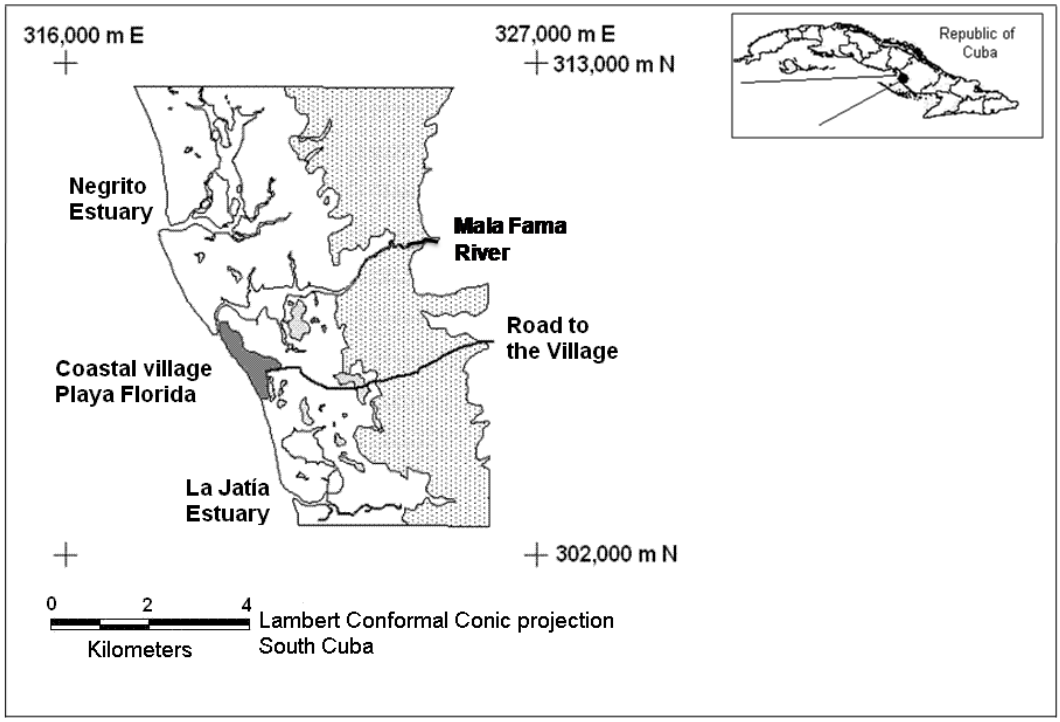

Figure 1 Geographic location of the work area

The average depth of water table level table water level is less than 5 m (Elias et al., 1989), a feature of importance to understand the balance of water in the wetland and in the distribution of vegetation. Depending on the season of year, groundwater can emerge spontaneously, even in brackish lagoons or into the sea (Hernández, 2004).

In the permanently flooded area, soils are hydromorphic type but, in the rest of the basin and therefore in the surrounding area of land, soils dominate are ferralitic quartzite (Blanco and Montero, 1989).

2 Materials and Methods

Vegetation information was obtained from the 1:50 000 map sheets 1956 and 1977, and a 2010 form Google Earth (satellite photo). In the latter case it was necessary to make field inspections to determine the type of vegetation corresponding with the photo.

Later, both map sheets and photo from Google were digitalized and the information of the cover area by each type of vegetation for each year was calculated using digital cartography tools. To name the vegetation was used the classification by Capote and Berazaín (1984).

As mangrove, it was considered the area between the shoreline, bounded on most of the area dominated by *Rhizophora mangle* L, and *Avicennia germinans* (L.) L. var. *germinans* and tide line, in which were considered small lagoons and herbaceous vegetation, whether grassland communities or marsh halophytes. The area occupied by the community was not considered within the mangrove area when making calculations extent of vegetation.

3 Results and Discussion

The main trend observed in the dynamics of the vegetation in the last 54 years is the increase in mangrove area, which also includes mangrove, lagoons and herbaceous vegetation below the tide line (Figures 2, 3 and 4). This increase is explained by the fact that the displacement of this type of vegetation to the land phase was greater than the decline recorded in the shoreline (Figure 5). Table 1 summarizes the values of each vegetation type in different years evaluated.

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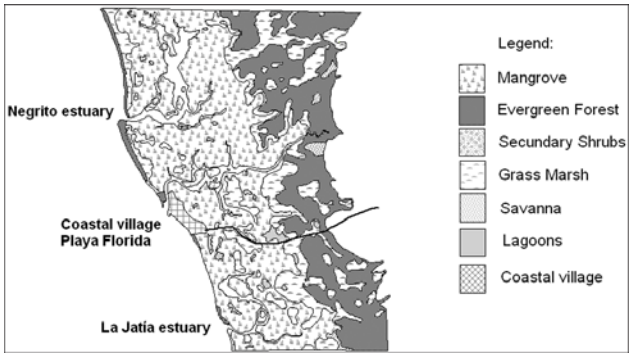

Figure 2 Distribution of vegetation in the work area in 1956

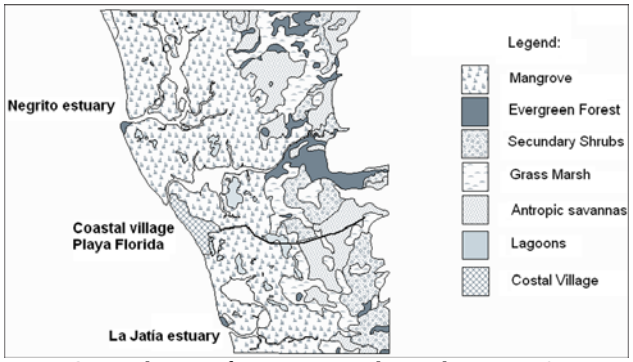

Figure 3 Distribution of vegetation in the work area in 1977

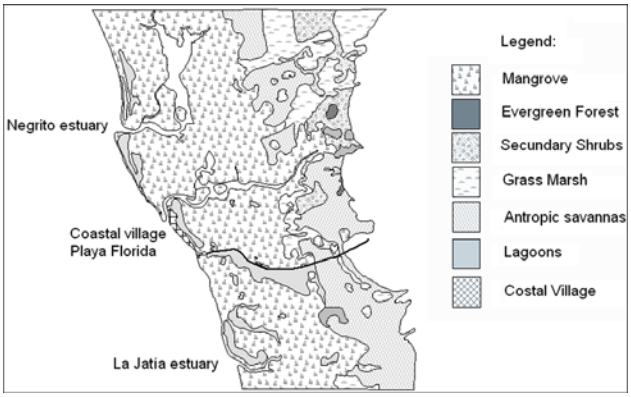

Figure 4 Distribution of vegetation in the work area in 2010

Table 1 Changes in vegetation cover in the surrounding area of the coastal village Playa Florida in the years 1956, 1977 and 2010. Vegetation cover is in square kilometers.

Vegetation	1956	1977	2010
Mangrove Forest	23.76	27.25	30.54
Mangrove	20.51	26.04	27.77
Lagoons	0.59	1.21	2.77
Herbaceous vegetation (Halophyte plant stands and Grass Marsh stands)	2.66	–	–
Evergreen forest	14.62	2.97	0.47
Secondary shrubs	–	5.43	2.90
Grass Marsh	10.74	7.05	5.82
Antropic savannas	0.77	7.19	10.16

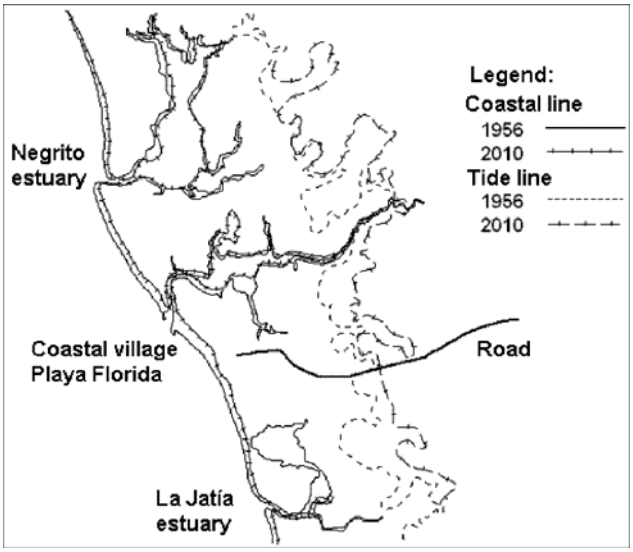

Figure 5 Changes in the coastal line and tide line in the period 1956 – 2010 in the work area

The best example of these changes in this area is in the marsh vegetation near the access road in 1956 (Figure 2), which was transformed into a lagoon (Figure 4). These changes reflect the increase in sea level due to the process of sinking of the platform and the increase in sea level itself, due to climate change as well as the actions of a man-made aspects that have influenced on the transformation of not only the coastline (Figure 5), but in the structure of the mangrove.

The salt marsh vegetation, usually located in the ecotone between mangroves and the mainland, has been invaded by mangroves or has become lagoons (Figures 3 and 4). In field observations, it is shown the proliferation of *Eleocharis muatata* (L.) R. *et* S. stands towards the north of the access road in the last 10 years, from 2000 to 2010, in areas within and between the mangrove swamp and tide line, but were depth is less than 50 cm.

This can be explained by the fact that the low salinity area in the northern access road to the village (Figure 1), due to the sea water solution that makes the river Mala Fama as well as the sediment clogging of these areas, which can not be removed during heavy rain shower for the effect of dam made by the road. *E. mutata* (L.) R. *et* S., has become, in many places, the representative species in the phase boundary between the marsh and the mainland (Figure 4).

In the terrestrial zone, the main changes are associated with the actions taken by man. Between 1956 and 1977 the sub-coastal evergreen forest cover decreased by 4.57 times due to logging and the clearing made in the late 60s to transform the land in "productive" areas and use them mainly on ranching (Figures. 2 and 3). At present, the vegetation of this area is dominated by *Dichrostachys cinerea* (L.) Wight *et* Arn., *Copernicia gigas* Ekman, *Copernicia hospitals* Mart., *Copernicia yarey* Burret, *Brya ebenus* (L.) DC. and *Byrsonima crassifolia* (L.) H. B. K., in the shrub layer, and *Leptocoryphium lanatum* (HBK) Nees, *Andropogon* cf. *leucosthachyus* Kunth and *Setaria gracilis* Kunth, in the herbaceous layer. The tree layer is absent in the savanna with only remnants of the original forest near the river Mala Fama, with trees more than 15 m in height.

A significant element of vegetation as part of the landscape is that in some lagoons located in savanna, distant sometimes several hundred meters from the edge of the mangrove, *Rhizophora mangle* trees are growing together with *Typha domingensis* Pers in the outer part of the lagoon. This shows that, despite the proximity of the tide line, the flow of groundwater through karst promoting conditions for this type of vegetation.

Pools of small size, 30 m in diameter, located near the water line, bands of vegetation are observed indicating salinity; *Eleocharis mutata* (L.) R. *et* S. to the periphery, while towards the center are *Eleocharis insterstincta* (Vahl.) R. *et* S. and *Nymphaea ampla* Griseb., showing the spontaneous emergence of freshwater aquifers.

4 Conclusions

The observed changes in vegetation during the period 1956 - 2010 reflect the area's natural changes and human actions and constitute a valuable tool to declare the surrounding zones of the coastal village of Playa Florida as a Zone under Coastal Integrated Management, preserving biodiversity values and human activity.

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