

## 지난 32년간 파나마 파리타만 망그로 숲의 변화

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### A 32-years Mangrove Land Cover Change Analysis. Study Case in Parita Bay, Panama

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Mangroves forests around the world have been experiencing a drastic loss. This decrease is attribute in part to changes in bio-climatic factors (e.g. rainfall, temperature, tidal range, extreme events, etc.) and to anthropogenic activities such as coastal development, agriculture, timber extraction, upstream discharge of contaminants, as well as aquaculture and salt-pan construction. Whereas remote sensing tools have contributed to detect mangrove vulnerable areas in order to respond with appropriate conservation policies. The principal aims of our study are to quantify the changes in mangrove cover and to identify possible drivers of its change. We present the first mangrove land cover-change analysis in Panama using satellite imagery after the year 2000, and the first in Parita Bay. Mangrove cover changes were determined for the past 32-year period (from 1987 to 2019) using Landsat satellite imagery. A supervised classification was employed to quantify changes in areas of different land cover-use types; and the NDVI (Normalized Difference Vegetation Index) was used to determine changes in greenness of mangrove canopy cover. Our study revealed mangrove cover in Parita Bay has increased by 4.7% during the last 32 years and seems to have a good health status reflected in the presence of high NDVI values. However, there was a 1.26% decline of mangrove cover at the first period (1987 to 1998), which coincide with low precipitation, high temperature, decline of higher-density NDVI (NDVI>0.46) and expansion of aquaculture and salt-pan by 95.88%. After the initial decrease of mangrove area, it increased 6% of its extent for the last two decades, and the annual increment rate was even greater for the last decade (0.43%). The increase of mangroves in Parita Bay may be favored by environmental variables such as precipitation regimes coupled with restoration projects developed in the region. In addition, mangroves in protected

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areas declined at an annual rate of -0.11%, while the unprotected mangroves have increased at an annual rate of 0.50% during the last decade (2009-2019). Our study suggests continuous management of mangrove forests is essential for the areas where the ecosystem vulnerability is high.

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