



Biological Monitoring Program Based on Indicator Species of Ecological Integrity in the National Park

"Sistema Arrecifal Veracruzano" (Veracruz Reef System)



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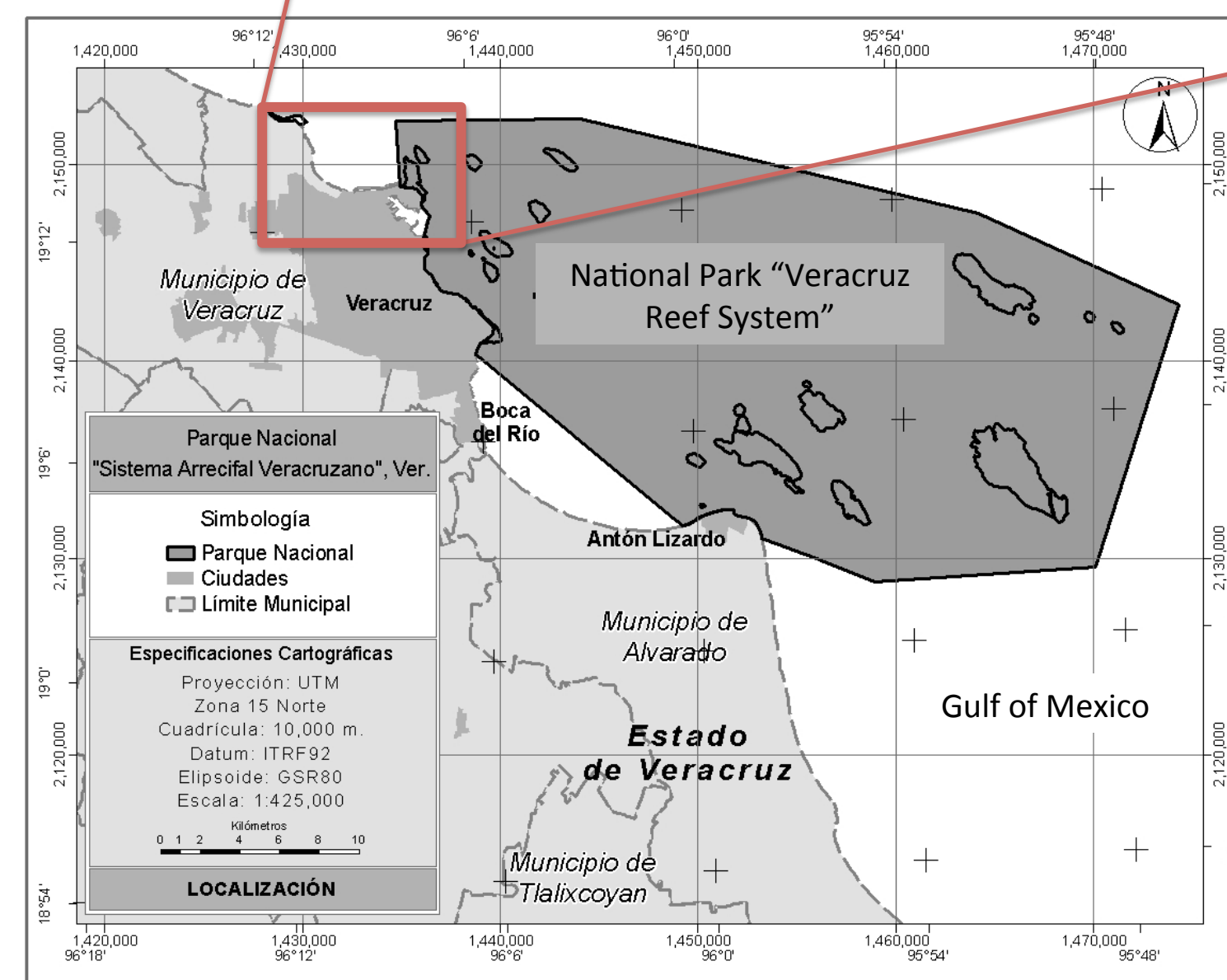
Veracruz has approximately 700 km of coastline, sustaining diverse ecosystems and a high biodiversity both near to the coast and offshore. However, the interactions between these resources and human activities are not well studied. Specifically, the Veracruz Reef System (VRS) has been studied regarding their corals structure, oceanography, and fisheries among others (Salas-Pérez y Granados-Barba, 2008; Del Moral-Flores *et al.*, 2013; Ortiz-Lozano *et al.*, 2013); however, is necessary to assess in detail internal and external ecosystem interactions. Good examples of bio-indicator groups are marine vertebrates, specifically sea turtles, sharks and dolphins, which coastal natures allow direct and indirect interactions with human activities. These interactions could generate negative effects in their populations (Bossart, 2006; Sazima *et al.* 2003).



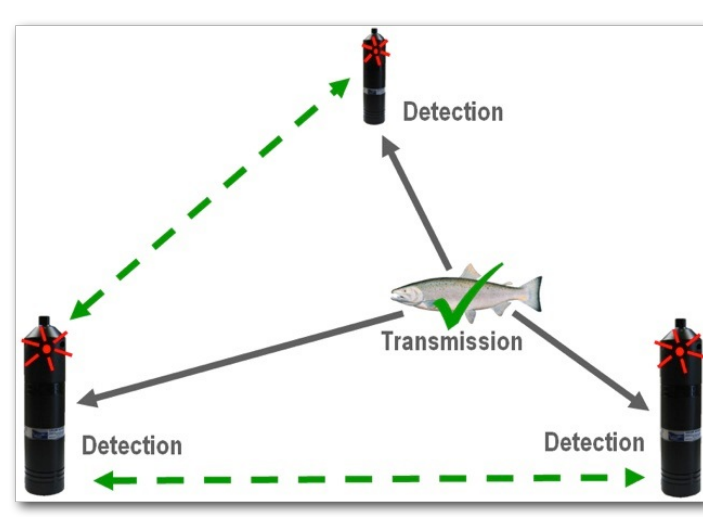
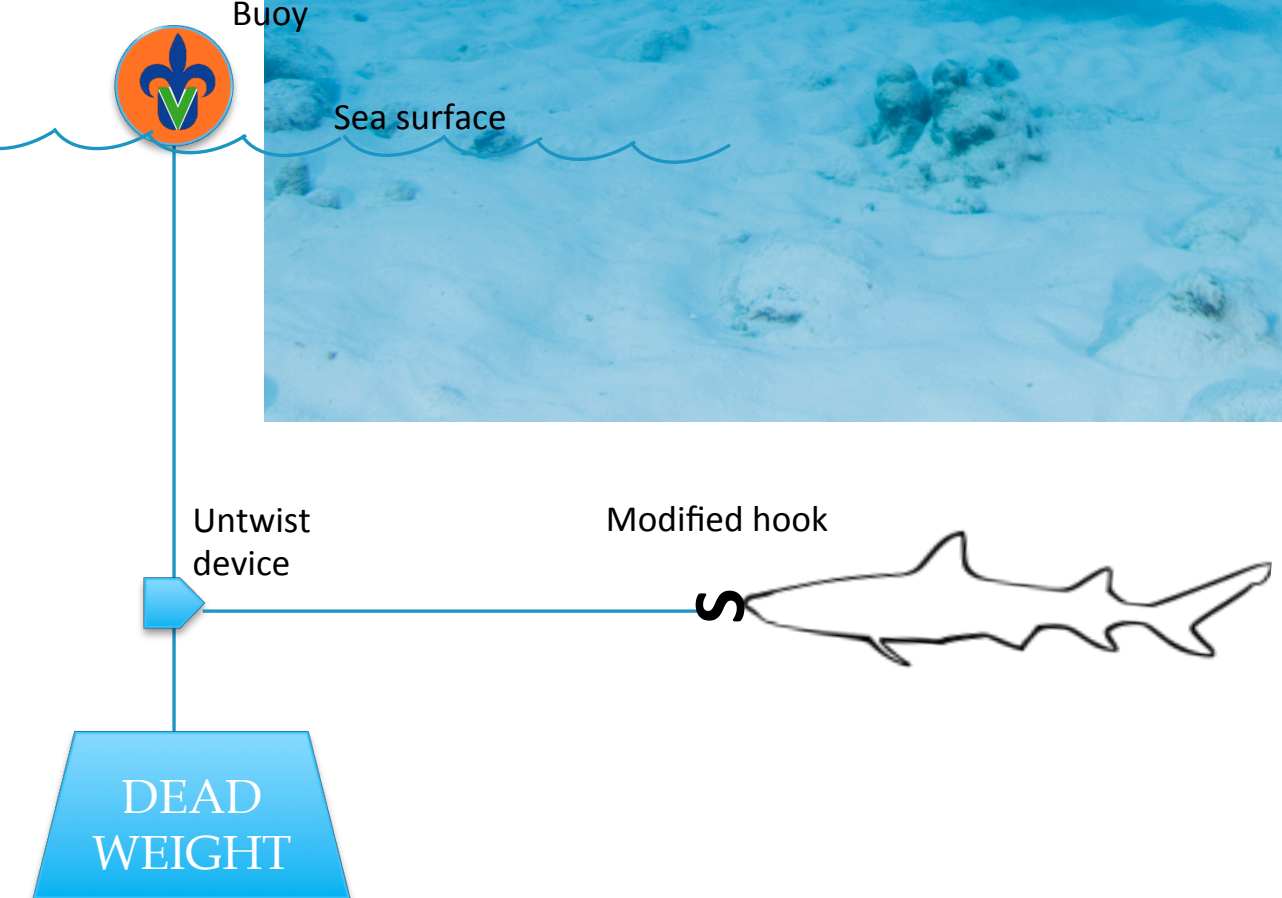
That's why, it is important to open a research line which integrates different types of information, that allow us to evaluate and analyze the relationships between the reef ecosystem, the marine vertebrates, and the upcoming human activities. In this proposal, the first systematic efforts of an integral monitoring program are detailed in order to set a baseline of information and to assess these populations previously, during and after the port's construction works.

OBJECTIVES

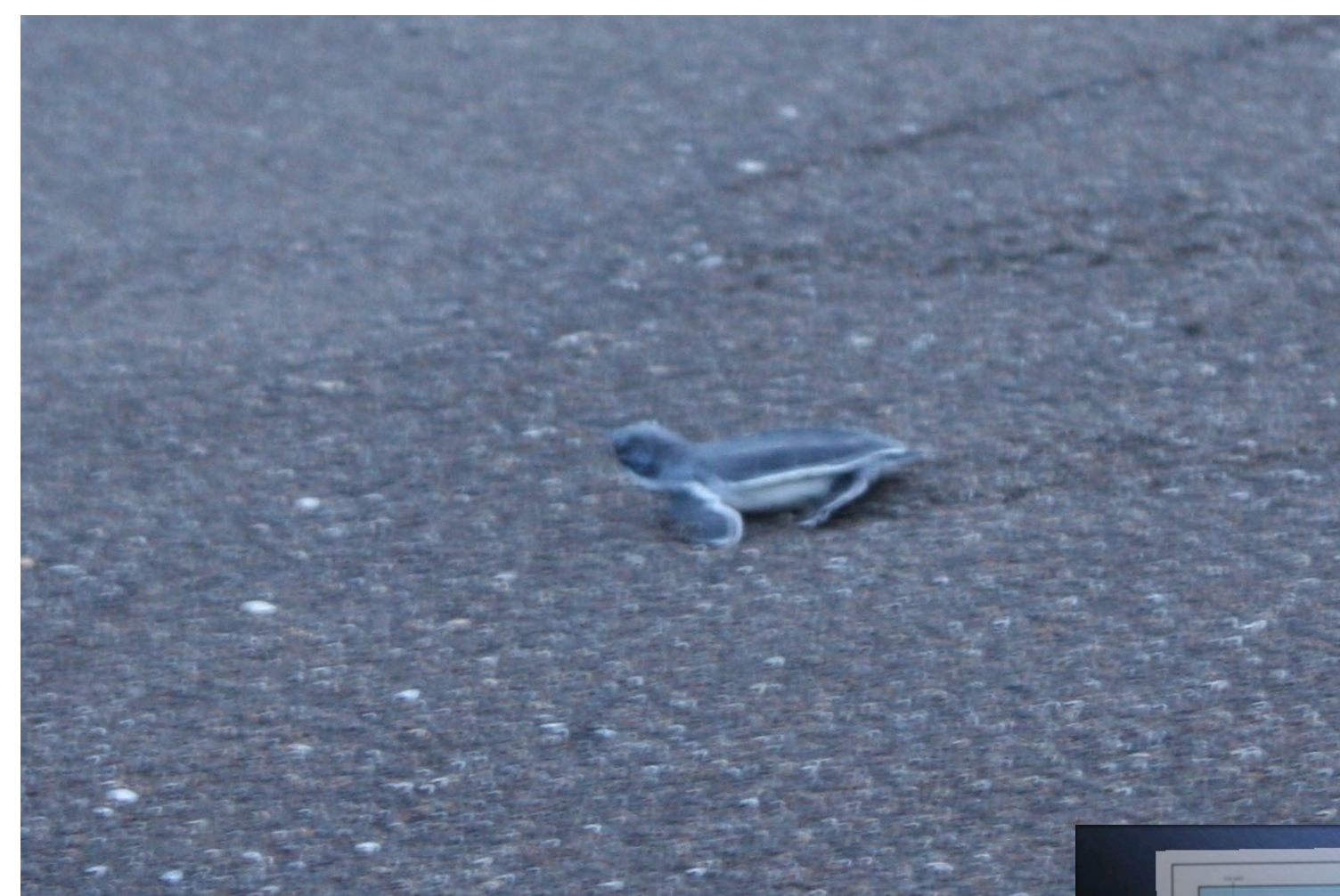
- To estimate sea turtles, sharks and dolphins distribution and abundances inside the PNSAV.
- To compare densities and distributions between the delimited reef zones.
- To estimate physiological stress, and concentrations of persistent organic pollutants (POP's), and heavy metals (HM) in the three studied taxa.
- To determine hematological indicators of stress and other blood parameters in sea turtles and sharks.
- To conduct behavioral studies in the dolphin population regarding interactions with human activities.
- To know trophic activity of sea turtles, sharks and dolphins, through stable isotopes analysis.
- To compare population, physiological and behavioral parameters at the three stages of the port's expansion construction.



SHARKS

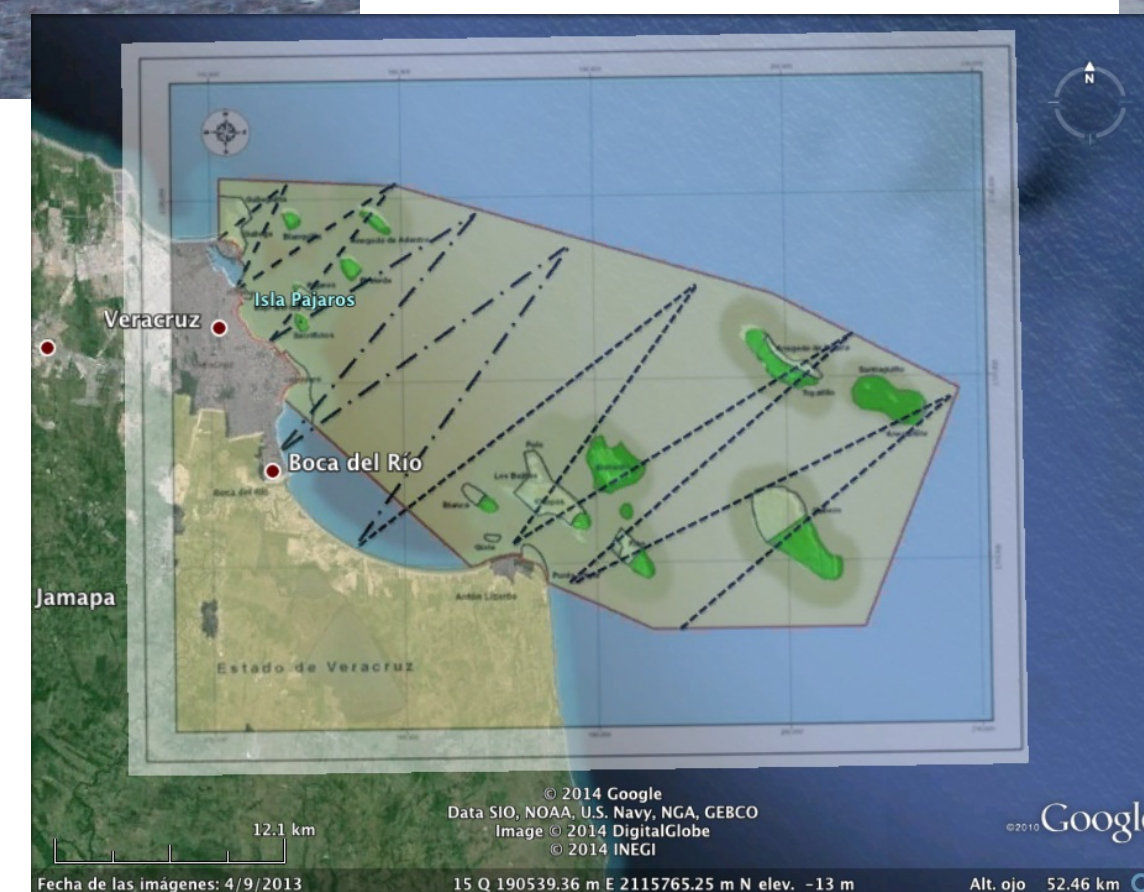


SEA TURTLES



$$N = D \cdot A$$

(Buckland *et al.*, 2001)



DOLPHINS



- Water quality parameters
- Morphometric measurements
- Photo-identification pictures
- Vemco tags: VR9, VR16, VR100 Receptor
- Acoustic reception stations: Vemco-VR2W
- Abundance, distribution and density maps
- Biopsy/blood samples (i-STAT1; Brooks *et al.* 2012)
- POP's and HM analyses (UV)
- Stable isotope analyses

- Water quality parameters
- Morphometric measurements
- Photo-identification pictures
- Abundance, distribution and density maps
- Biopsy/blood samples (Vitros DT60, comercial kits)
- Corticosterones: radioimmunoassay
- POP's and HM analyses (UV)
- Stable isotope analyses

- Water quality parameters
- Photo-identification pictures
- Abundance, distribution and density maps (Ansman *et al.*, 2013)
- Biopsy samples
- Ethological methods (*ad libitum*, focal group)
- POP's and HM analyses (UV)
- Stable isotope analyses

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