

# Marine litter sources, fate and concentrations in the Bay Islands of Honduras

## Fuentes, destino y concentraciones de los desechos marinos en las Islas de la Bahía de Honduras

## Sources, devenir et concentrations des déchets marins dans les Îles de la Baie du Honduras

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### EXTENDED ABSTRACT

#### INTRODUCTION

Marine litter is defined as any persistent man-made solid material discarded in marine and coastal environments (UNEP, 2021). Plastic debris is the primary component of marine litter and poses a significant environmental threat. In the western Caribbean, it is estimated that thousands of tons of plastic waste flow into the region each year from the Motagua River and various Honduran rivers (Kikaki et al., 2020). Despite the importance of this issue, only 66 peer-reviewed studies on marine litter have been published in the Caribbean from 1980 to 2020, with just four focusing on mangroves (Kanhai et al., 2022). Research indicates that mangrove forests trap marine litter through their aerial root systems, often exhibiting higher concentrations of debris than beaches. Although studies on the effects of plastics in mangroves are limited, findings suggest that plastic accumulation can obstruct root growth and adversely affect the associated fauna (Martin et al., 2019). Therefore, the objectives of this study are to determine the current concentration, composition, and origin of marine litter present in the mangrove forest of Roatan Island in the Bay Islands of Honduras, and analyze the composition and abundance of litter in the digestive system of a post-mortem American Crocodile (*Crocodylus acutus*).

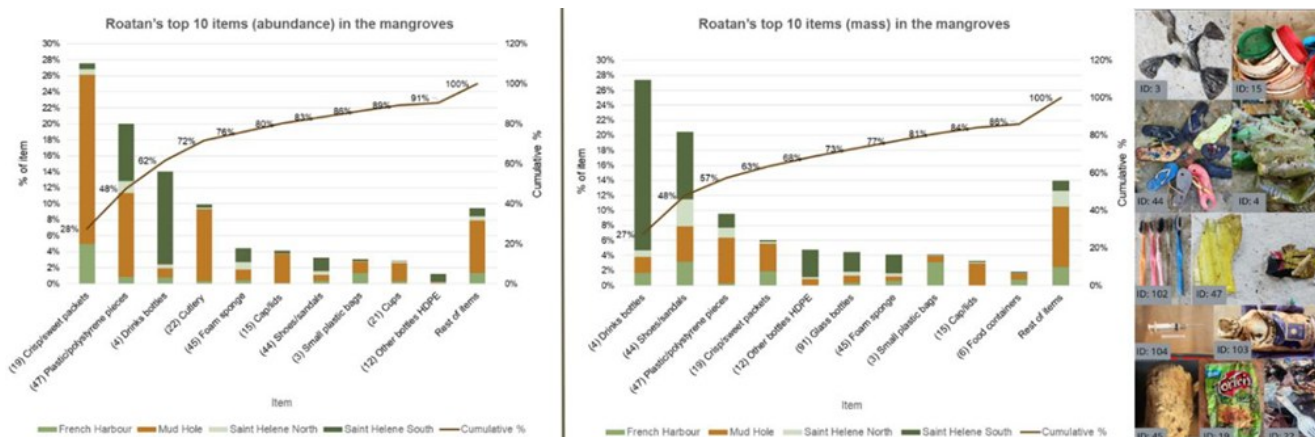
#### METHODS AND STUDY SITE

The study sites is located in the Bay Islands National Marine Park. The Bay Islands belong to Honduras and are home to the second largest coral reef ecosystem, the Mesoamerican reef and three wetlands designated of international importance by the Ramsar convention of wetlands. For this study we focused on the island of Roatan, in four mangrove forest dominated by red mangrove (*Rhizophora mangle*) where we sampled along the seaward edge. We established five 5x5 m quadrats at each of the four mangrove sites. All litter items larger than 5 cm within the quadrats were collected, counted, weighed, and categorized according to OSPAR standards (OSPAR, 2010). We also recorded label information, including the brand and country of origin for the items that provided this data. Additionally, we performed an exploratory principal component analysis (PCA) to visualize the similarities in litter composition between the mangrove forests and the debris found in the crocodile.

#### RESULTS AND DISCUSSION

A total of 3,417 litter items were recorded across the four sites. Plastic was the most abundant category, comprising 97% of the total litter, followed by sanitary waste, which included a high number of toothbrushes, and metal, which was primarily cans. The mean litter concentration in the mangrove forest of Roatan ranged from 1.43 to 15.81 items/m<sup>2</sup>. These concentrations varied quite a bit, and we believe this could be due to factors like topography, root density, elevation, currents, and wind. Factors that will consider in our future analysis. The top ten items out of the sixty-nine identified across all sites account for over 85% of the total marine litter, both in terms of abundance and mass (See figure 1). Specifically, the four most abundant items—crisps and sweet packets, plastic and polystyrene pieces, drink bottles, and cutlery (including straws)—together represent an astonishing 76% of the total litter we reported. These results are concerning, as the Roatan municipality has banned single-use items such as straws, expanded polystyrene, plastic bags, and plastic bottles since 2019. The continued presence of these items in our ecosystems jeopardizes the effectiveness of these plastic ban policies, which are subject to renewal with each new municipal government in Roatan.

In terms of country of origin and parent company, we identified the country of origin for 2.2% of the total litter (74 items). Guatemala was the most frequent source (39%), followed by Honduras (37%). We also found some interesting contributions from Jamaica, Haiti, and Mexico. Notably, 63% of the litter came from foreign countries, while the remaining 37% may not all originate from Roatán, Honduras, as significant amounts of marine litter flow from the Honduran mainland (Kikaki et al., 2020). For parent companies, we identified brands for 2.6% of items, with Grupo PDC (operating in Central America and Peru) being the most frequent, followed by Coca-Cola and Colgate-Palmolive. In 2022, an American crocodile



**Figure 1.** The graphs display the item names along with their OSPAR ID numbers on the x-axis, accompanied by images for better visualization on the right. On the y-axis, we represent the percentage of each item found at different sites, while the curve illustrates the cumulative percentage of all litter documented in this study. Importantly, the top ten items out of the sixty-nine identified across all sites account for over 85% of the total marine litter, both in terms of abundance (left graph) and mass (right graph).

was found dead in the community of French Harbour in Roatan. Mangrove forests are the primary habitat of crocodiles in the Bay Islands. The necropsy revealed 20 litter items in its digestive system, including plastic bags, forks, straws, metal hooks, and 70 cm sacs. Our analysis showed that the crocodile and the French Harbour site shared a similar litter composition, with plastic bags playing a major role in the PCA clustering (See Figure 2).

### CONCLUSIONS

Five years ago, the municipality of Roatan banned straws, bottles, plastic bags, and expanded polystyrene. Yet, in our study we found these items among the top 10 in terms of both abundance and mass. Interestingly, 63% of the items with a recognizable country of origin came from foreign sources. This highlights the urgent need for policies to be expanded to a regional level to effectively prevent plastics from infiltrating our ecosystems. Finally, marine litter is already impacting wildlife associated with mangrove ecosystems in Roatan. The case of the crocodile, which contained litter similar in composition to that found at the French Harbour site, underscores the serious consequences of plastic pollution for local fauna.

### LITERATURE CITED

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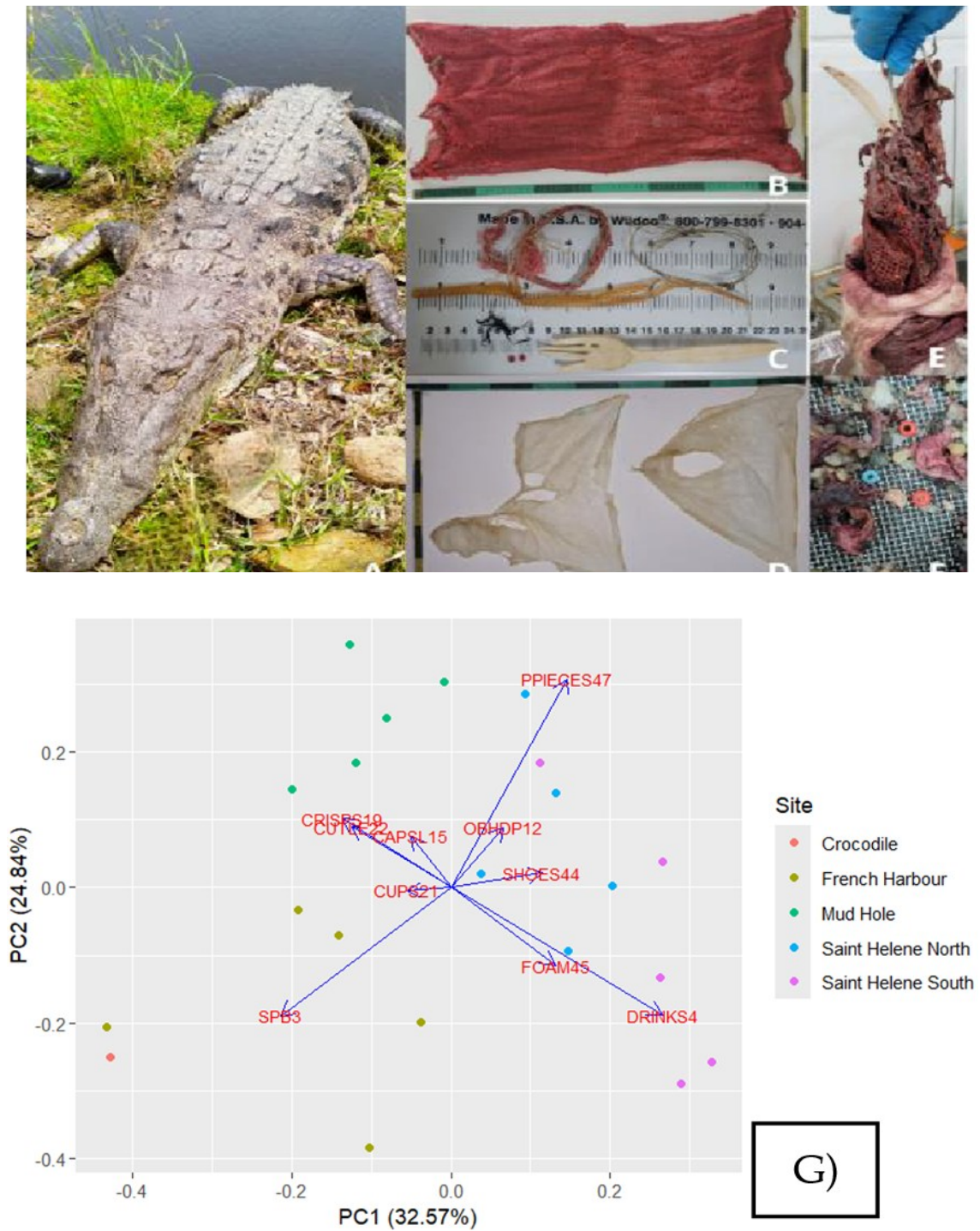
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**KEYWORDS:** Marine Litter, Mangrove Forest, Plastic Pollution, Bay Islands



**Figure 2.** A) American crocodile carcass with illustrations of the items found in its stomach. B), C), and D) Examples of the items found inside the stomach. E) Extraction of items from the stomach. F) Examples of microplastics (plastics <5 mm) found in the stomach. G) PCA results indicated that the crocodile and the French Harbour site cluster together, suggesting they share a similar litter composition. Importantly, it seems that plastic bags (code: SPB3) are a significant factor driving this clustering.