Effects of Sea Level Rise on Fishable Area and Mangrove Habitat in Kemps Creek

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Introduction
Over the past century the global sea level has risen 0.1-0.3 meters due to climate change (Risess et al., 2004). If the rise in predicted IPCC sea level negatively impacts and stresses mangrove ecosystems, local fish species may also be negatively impacted. One example of a species that thrives in mangroves is bonefish (Kaufmann, 2000), which live and breed in mangroves. Mangroves provide protection from predators for bonefish because they can hide in the mangrove roots and shallow water (MacDonald, 2009). Benefish also have a large impact on local Bahamian economies, which may be entirely dependent on the revenues from recreational bonefishing when other sources of income are absent (Ault, 2008). Every year approximately 8,000 tourists visit the Bahamas for the sole purpose of fishing this species.

The purpose of this study was to create a topographical map of the tropical flats environment of Kemps Creek. The hypothesis was that rising sea level would cause a decrease in fishable area and suitable mangrove habitat.

Methods

All data collected was inserted into a Geographic Information System (GIS). GIS was used to create a detailed topological map, which properly portrayed the elevation and habitat types of the creek. The GIS map was then overlaid with transects, signifying the high tide line and providing a benchmark for all elevation measures. Transects were laid out on a shoreline transect by an observer (See Figure 3). Substrate and vegetation type were also recorded (See Table 1).

In order to get a detailed map of Kemps Creek, elevation, substrate, and vegetation, data was collected. The elevation data was taken relative to cinderblocks along transects, signifying the high tide line, and providing a benchmark for all elevation measures. Elevation measurements were taken at each individual waypoint along a transect chosen by an observer (See Figure 3). Substrate and vegetation type were also recorded (See Table 1).

Table 1. Defined vegetation and substrate types.

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Island Mangrove</td>
<td>Bare Sand</td>
</tr>
<tr>
<td>(OIM)</td>
<td></td>
</tr>
<tr>
<td>High Density Mangrove</td>
<td>Rock Slab</td>
</tr>
<tr>
<td>(HD)</td>
<td></td>
</tr>
<tr>
<td>Sparse Kudzu</td>
<td>Rock Stun</td>
</tr>
<tr>
<td>(SK)</td>
<td></td>
</tr>
<tr>
<td>Algae (A)</td>
<td>Rock Slab</td>
</tr>
</tbody>
</table>

Results

Fishable Area (See Figure 8)
Low sea level rise projection: 0.9 square km increase by 2050 0.00 square km increase by 2100 Median sea level rise projection: 0.17 square km increase by 2050 0.08 square km increase by 2100 High sea level rise projection: 0.23 square km increase by 2050 0.03 square km decrease by 2100

Suitable Mangrove Habitat (See Figure 9)
Low sea level rise projection: 0.00 square km change by 2050 0.00 square km change by 2100 Median sea level rise projection: 0.00 square km change by 2050 0.06 square km decrease by 2100 High sea level rise projection: 0.03 square km decrease by 2050 0.06 square km by 2100

Discussion

The increase in fishable area at low sea levels did not support our initial predictions, however, higher levels of sea level, observed fishable area decreased. As predicted sea level rose it created more available fishing area, while other existing areas remained wadeable. Over time, and with increased sea level, existing fishable area got too deep, therefore making a large amount of area no longer fishable, and creating an overall net loss of fishable area.

The data predates that mangroves will shift their habitat upward as sea levels rise, because mangroves tend to live in the upper half of the intertidal zone, which would cause them to shift with the rising sea level (Gillman, 2006). These shifts may be obstructed by landmarks, such as Queen’s Highway on the south side of Kemps Creek, which would prevent mangroves from shifting upward and therefore causing the decrease in suitable mangrove habitat found in our data.

In our results, we did not take into consideration sedimentation. It is possible that an area that is currently rock substrate could fill in with sand in the future and become either a suitable mangrove habitat or a fishable area, possibly causing the trend to be leveled off or continue to increase.

This sea level rise of 1 meter is projected to occur:
By 2010 with low estimation of sea level rise
By 2025 with medium estimation of sea level rise
By 2100 with high estimation of sea level rise (See Figure 7)

Literature Cited


Gillman, L.M. 2006. Assessment of intertidal response to projected relative increase in sea level and associated indicators of potential change. Landscape, Climate and Estuarine Change and Environmental Quality.

Acknowledgments

A special thanks to Kit Hayard and Jeff Stein for their understanding support. Another thanks goes out to Anamaria Cvetkovic for being a great research spirit. We would also like to thank the University of Illinois for making this research possible. Finally, a thanks to Stephanie Avelis and all the CIT interns for their help throughout the semester.