Utilizing DNA Barcoding to identify species sold across the Caribbean and improve conservation

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Introduction

• The Caribbean contains the highest concentration of marine species in the Atlantic Ocean and is a hotspot of marine biodiversity.[1]
• In recent decades, marine ecosystems throughout the Caribbean have experienced a substantial decline in fish abundances.[2]
• Overexploitation of fish continues today despite conservation efforts partly due to illegal, unregulated, and unreported fishing and fish mislabeling.[3]
• In previous studies, fish products were found to be mislabeled and sold as less desirable species, endangered and threatened species, and species that can be dangerous to consume.[4]
• Seafood fraud negatively impacts ecosystems, fish, consumers, and honest fishers, restaurants, and markets.
• Without better management, population recovery is unlikely.
• DNA barcoding allows us to identify fish which we would otherwise not be able to identify, for example a fish fillet or fish oil.
• DNA barcoding is a tool for determining which species are vulnerable to overfishing.

It is difficult and often inaccurate to identify a species based on its fillet

Groups fillet	Cobia fillet

Cod fillet

Methods

• Fish and shark products were purchased from fish markets, restaurants, and supermarkets in Belize, Guatemala, Honduras, St. Kitts, and St. Maarten. Products ranged from cooked dishes to raw fillets and fish oil.
• Approximately 1 gram of tissue was collected and preserved in 95% ethanol.
• Genomic DNA was extracted from sample tissue.
• Cytochrome oxidase I (a common gene used for barcoding) was amplified for each sample using polymerase chain reaction (PCR).
• PCR products were ran on a 1% agarose gel to confirm amplification of the correct fragment.
• Purified PCR products were sequenced.
• BLAST, or Basic Local Alignment Search Tool, was used to identify samples by species

Results

<table>
<thead>
<tr>
<th>Product label</th>
<th>Product identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snapper (38) 11%</td>
<td>Hogfish (1), Black grouper (4), Black triggerfish (4), Barracuda (3), Gray angelfish (3), Nassau grouper (2), Swordfish (2), Common dolphinfish (2), Snook (2), Ocean triggerfish (1), Horse-eye jack (1), Greater amberjack (1), Yellow jack (1), Bar jack (1)</td>
</tr>
<tr>
<td>Groupers (8) 25%</td>
<td>Cobia (4), Mutton snapper (1)</td>
</tr>
<tr>
<td>Snook (8) 25%</td>
<td>Yellow snapper (1), Red grouper (2)</td>
</tr>
<tr>
<td>Cod (6) 5%</td>
<td>Cubera snapper (1), Black grouper (1), Barracuda (1), Snook (1)</td>
</tr>
<tr>
<td>Shark (5) 20%</td>
<td>Cobia (1), Scalloped hammerhead shark (1), Tawny shark (1), Greater amberjack (1), Cubera snapper (1)</td>
</tr>
<tr>
<td>Yellowtail amberjack (4) 0%</td>
<td>Hogfish (1), Mutton snapper (1), Greater amberjack (1), Cobia (1)</td>
</tr>
<tr>
<td>Cubera snapper (2) 50%</td>
<td>Atlantic goliath grouper (1)</td>
</tr>
<tr>
<td>Salmon (2) 0%</td>
<td>Amberjack (1), Cobia (1)</td>
</tr>
<tr>
<td>Barracuda (1) 0%</td>
<td>Cobia (1)</td>
</tr>
<tr>
<td>Yellowfin Tuna (1) 0%</td>
<td>Japanese amberjack (1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
</tr>
<tr>
<td>Violet</td>
</tr>
<tr>
<td>Yellow</td>
</tr>
<tr>
<td>Blue</td>
</tr>
<tr>
<td>Green</td>
</tr>
<tr>
<td>Black</td>
</tr>
<tr>
<td>Gray</td>
</tr>
</tbody>
</table>

- The market label is in the “What you bought” column.
- The identification is in the “What you got” column. Correct IDs are not shown.
- The number in parentheses shows how many samples were bought or identified.
- The percentage shows how often the sample of that species was labeled correctly.

Percent mislabeled by country

- Red is “No”, not mislabeled.
- Green is “Unknown”. The sample collected was not originally labeled.
- Blue is “Yes”, mislabeled.

Thank-you to the following, without whom this research would not be possible:


Acknowledgements

Conclusions and Discussion

• 31% of the 107 samples tested were found to be mislabeled. However, 11% of the samples collected were not labeled to begin with.
• 89% of the 38 samples sold as snapper were mislabeled.
• Species such as scalloped hammerhead shark contain mean mercury concentrations that exceed the regulatory limit of 1 mg kg⁻¹, yet were being sold as a fish that is safe to consume (cod in this case).[5]
• Threatened and endangered species were being sold as highly sought-after products such as snapper and grouper.
• Accurate labeling is required for effective conservation efforts and for consumer health. Better inspection and regulations are recommended.

Citations