Searching for Plastics Within Bahama Fish Specimens

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Introduction

- The objective of this project was to discover if Bahamas fish are consuming plastics.
- We hypothesized that if Bahamas fish are consuming plastics, than plastics will be found within their stomach contents.
- A similar study found that, "the ingestion rate of plastic debris by mesopelagic fishes in the North Pacific is estimated to be from 12000 to 24000 tons yr^{-1}. Similar rates of plastic ingestion by mesopelagic fishes may occur in other subtropical gyres."[1] We used this data as a basis to conduct our research.
- This experiment consisted of dissecting 143 fish stomachs from various species: 76 mahi-mahi, 5 barracuda, 3 yellowfin tuna, 8 wahoo, and 50 unknown species. These fish stomachs were obtained from the Cape Eleuthera Institute in the Bahamas.
  - Mahi-mahi are a highly migratory, schooling species of fish found in tropical waters up to 85m in depth around the world. Their diet consists primarily of smaller fish species, occasionally consuming squid and crustaceans.[2]
  - Barracuda are found near the surface in tropical waters around the world. They can prefer reef habitats, but adults are also found in the open ocean. Barracuda feed on fish, cephalopods, and shrimp.[3]
  - Yellowfin tuna are found across the globe in tropical waters. They are highly migratory, pelagic fish that can be found up to 250m in depth. Their diet consists of schooling fish, squid and crustaceans.[4]
  - Wahoo are a species of fish found in tropical waters around the world in depths of up to 20m. They are highly migratory and their preferred diet is fish and squid.[5]
- Since these fish are highly migratory and are frequently found in tropical waters known to experience high levels of plastic pollution, we reason that the fish in our study had a high chance of ingesting plastic due to their habitat.

Materials and Methods

Materials:

- Cotton Lab Coat
- Rubber Gloves
- 70% ethanol solution in spray bottle
- Clear scotch tape
- Calipers
- Combusted microscope slides
- Ruler
- Forceps
- Scalpels
- Scissors
- Dissection Pans
- Weighing Dishes
- Data Sheets/Clip Board
- Scale
- Combusted glass jars with lid

Methods:

After sorting through the specimens and verifying their ID tags with the data sheets provided by the Cape Eleuthera Institute, we began the dissections of the stomach samples.

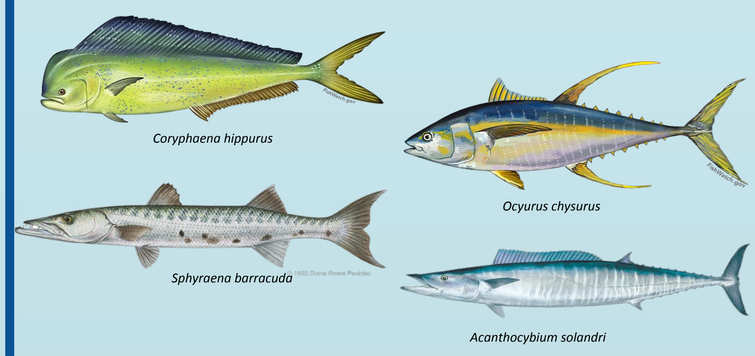
Each session was conducted under a laminar flow hood. After the table was cleaned with the 70% ethanol solution, we conducted three random tape life screenings, wrapped the taped slides in foil, and set them aside for later microscopic analysis.

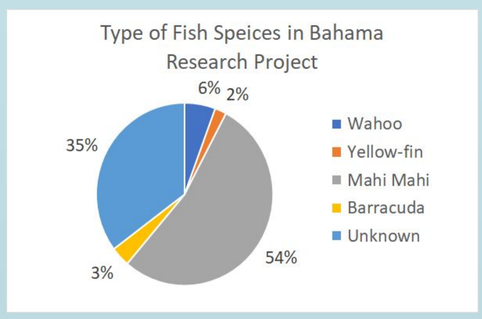
After thawing the frozen specimen, each specimen was placed into a fresh pour boat dish and weighed the weight was recorded. The specimen's length was then measured. Once the length was recorded on the data sheet, we cut the stomach from end to end and examined its contents searching for plastic.

All contents were sifted through looking for plastic pieces then recorded on the data sheet. The specimen was then weighed empty and immediately placed into a blasted glass jar and sealed. Each jar was labeled twice with the ID, Catch Date, Dissection Date, Final Weight, and slot was left for the 10% KOH solution needed for chemical digestion. Any items suspect of being plastic were stored separately in labeled glass jars for later spectroscopic analysis.

At the end of each dissection session, the jarred specimens were stored and frozen.

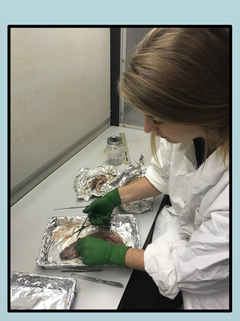
Results



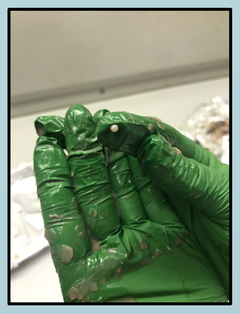


We dissected 143 fish specimens. Out of the 143 only 113 specimens were documented and identified. The majority of fish stomachs that we dissected were *Coryphaena hippurus.*

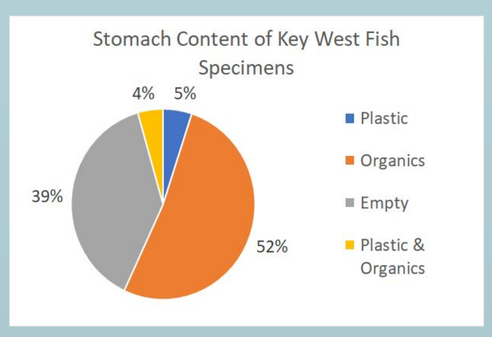
Partial *Cheilopogon melanurus* found in stomach of *Coryphaena hippurus*



Maria dissecting specimen stomach searching for plastic content



Potential plastic particle found in specimen



This chart depicts the content that was found across all the specimens. Over half our specimens were found with organic material in their stomach, several were found empty.

Stomach sample prior to being weighed and dissected

Specimens stored in labeled jars and ready for post dissection processing

Discussion

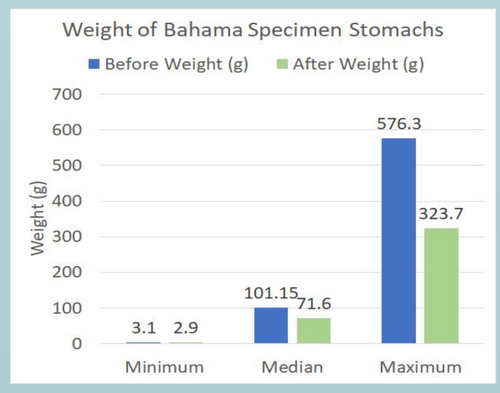
●Similar research has been conducted across all of the world's oceans, many of which found contrasting results to our research. One study examined plastic debris ingestion by marine catfish in South Western Atlantic estuaries. This research concluded that of a species studied, 33% had ingested plastic. Several individuals showed multiple different plastic fragments in their digestive tract[6]. Another research group examined the ingestion of plastic marine debris by longnose lancetfish in the North Pacific Ocean and found that 24% had ingested plastic marine debris[7]. Another study examined plastic ingestion by planktivorous fishes in the North Pacific Central Gyre and found approximately 35% of the fish had ingested plastic[8].

●This research protocol could be improved by completing the experiment from start to finish by one research group so that the data could stay organized and the entire gastrointestinal tract could be examined. In order to achieve results from the specimens and to identify plastic, more advanced techniques are necessary. Many organic specimens were difficult to distinguish from plastic debris and additional chemical testing is necessary to differentiate between them.

Organic particles that resemble plastic

- Furthermore, the protocol could be improved by chemically analyzing the entire GI tract, including all of the stomach contents. The protocol used in this experiment stated to visually inspect stomach contents and dispose of the organic contents. However, it is possible that using this protocol could result in small plastic pieces mistakenly be thrown away.

- During the dissections of the stomachs, many were found to be entirely empty. It is possible that this is a result of "barotrauma" which occurs when fish in the deep water are brought up to the surface rapidly. "Barotrauma can cause a fish's eyes to pop out of its head and its stomach to be pushed out of its mouth [along with the contents]"[9] .Given this possibility of skewed data, further research must be done in order to achieve more accurate results regarding the ingestion of marine plastic debris.



This graph depicts the minimum, median, and maximum weights for the specimens stomachs before and after dissection.

Conclusions

- Overall, the research was inconclusive regarding chemical testing in the stomachs of the 143 fish dissected. Finishing the protocol by completing KOH chemical analysis and spectroscopic analysis may lead to more conclusive results.
- Currents in which the Bahamas lay in do not carry a lot of plastic, could have causation of the lack of plastic not found.
- The implications of this research can give consumers an reasonable index on where the safest areas to obtain fish from.
- Laws should be established to prevent plastic pollution in order to protect marine life and areas.
- Further research needs to be conducted in order to better understand the severity of plastic marine debris ingestion as well as the implications of the issue on individuals, ecosystems and humans.

References

Image References:
https://www.http://www.dianepeebles.com/fishwatch.gov/profiles/
Experiment photos courtesy of group members
Article References:
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