Changes in Curaçao's Fish Population Over the 20th Century

A recently published study looked to compare Curaçao's historical records of fish catches between the years 1905 and 2016. This study highlights shifts in both catch size and species composition. Understanding changes in fish populations will help researchers better understand the overall health of the ecosystem and help guide conservation efforts for the future.

The Caribbean Sea of today looks much different than it did 100 years ago. Early European explorers often noted the abundance of sea life, such as manatees, large sharks and sea turtles, within these waters (Cook, 1784). On the island of Curaçao, fishing has been an important part of the islands culture since as early as 2500 B.C. (Van Buurt, 2009). Starting around 1824, Dutch colonists begun using these waters for commercial fishing, marking the first-time fishing was used to generate income (Teenstra, 1837). The first scientific overview of the Curaçao fishing industry was first completed by Boeke in 1905 and then again in 1908 by Breeman (Boeke, 1907; Zaneveld, 1962). These studies were then repeated in 1955, and already fishermen were noticing a dramatic shift in the availability of certain fish. Common species such as Nassau groupers, king mackerels and blue marlins had become increasingly rarer (Zaneveld, 1962). Decades of human expansion, overfishing and decreasing water quality have led to a continuation of this shift within near shore environments, as large predatory fish become increasingly rarer or all together absent (McClenachan et al., 2010).

The Study

A 2019 collaborative study between CARMABI, University of Amsterdam, Department of Agriculture and Fisheries, Ministry of Health, Environment and Nature, Wageningen Marine Research, and independent researchers worked to compare changes in fish catches by commercial fishermen over the course of the 20th century. Four different areas were compared: fish caught by line, trap, and spear gun along with fish not targeted by fishermen. It is important to note that spearfishing has been illegal on Curaçao since 1976, therefore, data for recent years came from visual surveys of illegal catches (Debrot, 2013; Dilrosun, 2002). Comparisons for fish caught by line, trap and spear gun were completed by analyzing Catch Per Unit Effort (CPUE) to account for changes in fishing techniques, materials and the use of more efficient practices (Maunder & Punt, 2004). Data used to quantify fish not targeted by fishermen was compiled using in-situ reef fish counts from surveys conducted in 1969 and 2011 (Nagelkerken, 1970; Chamberland et al., 2011).

The Results

Line fishing saw an overall decrease in catch per fishermen per month (CFM) between the beginning and middle of the century, however, this trend reversed until CFM returned to its previous state when evaluated in 2016. Although catch sizes have returned to previous levels, the number of large reef-associated species has decreased drastically. Since the mid-1980s, the total number of tunas caught has increased, compensating for the decrease in other large pelagic species. When comparing species composition from 1905 to 2016, it can be seen that some species [Nassau grouper] have disappeared completely, while other species [blue marlin, dolphin fish, snappers and sharks] have declined significantly. On the other hand, some species [wahoo and gasby] have increased and newly targeted species [tuna] have become more common.

Fish traps and spearfishing have also decreased in popularity from their earlier introduction. Fish caught by fish traps declined by 46% between 1955 and 2008. Due to an increase in divers on the reef, who tend to damage traps in an attempt to free fish, along with increased regulations, traps

Comparison of fish composition from line fishing between 1905 and 2016 (Vermeij et al., 2019)

Year	Fishers	Fishing boats	Total annual catch	Composition of fleet			
	(total n)	(total n)	(in tons)	*Canoa*	Sailboat	Rowboat	Motorized boat
1905	1118*	311	1878*	300	0	7	4
1908	498	162	1245				
1959	652	332	750	40	27	217	48
1965	600	100	1100				
1984	450	145	944				
1998	390	255	900				
2001	390**	262	1050				
2016	183	239	692	0	0	32	207

* This number appears high because Boeke [25] also included all persons qualifying themselves as "seaman" as part-time fishers. The number of full-time fishers is 46 and we used the ratio of full to part-time fishermen in 1908 (1:3) to calculate the total number of fishers in 1905 (n = 184) and used this number in all calculations.
** The number of fishers reported for 2001 appeared low (n = 155) and we used the number for 1998 instead.

became an inefficient way to hunt for fish. By the early 1990s, less than 10% of fishermen opted to use traps while fishing (Van't Hof et al., 1995). A similar story can be told for spearfishing on the island, which experienced a decline of nearly 77% between the spear gun's introduction to the island in 1950s. In the beginning, spear guns were typically used to hunt large predatory fish such as groupers, jacks, barracudas and sharks, whereas now the entire catch is mostly comprised of small reef-associated fish.

Lastly, in-situ fish surveys also revealed important changes to the reef between 1969 and 2011. Overall, populations of non-cryptic fish groups and fish not traditionally targeted by fishermen remained either unchanged [brown chromis, bicolor damselfish] or decreased [redspotted hawkfish, cardinal fishes, glassy sweepers]. Fish that are targeted by fishermen, saw a much larger drop in population sizes. In general, fish which move around the water column experienced the least amount of change, or even increased in abundance whereas more stationary species, or species that depend on coral structures, saw an overall decrease in abundance.

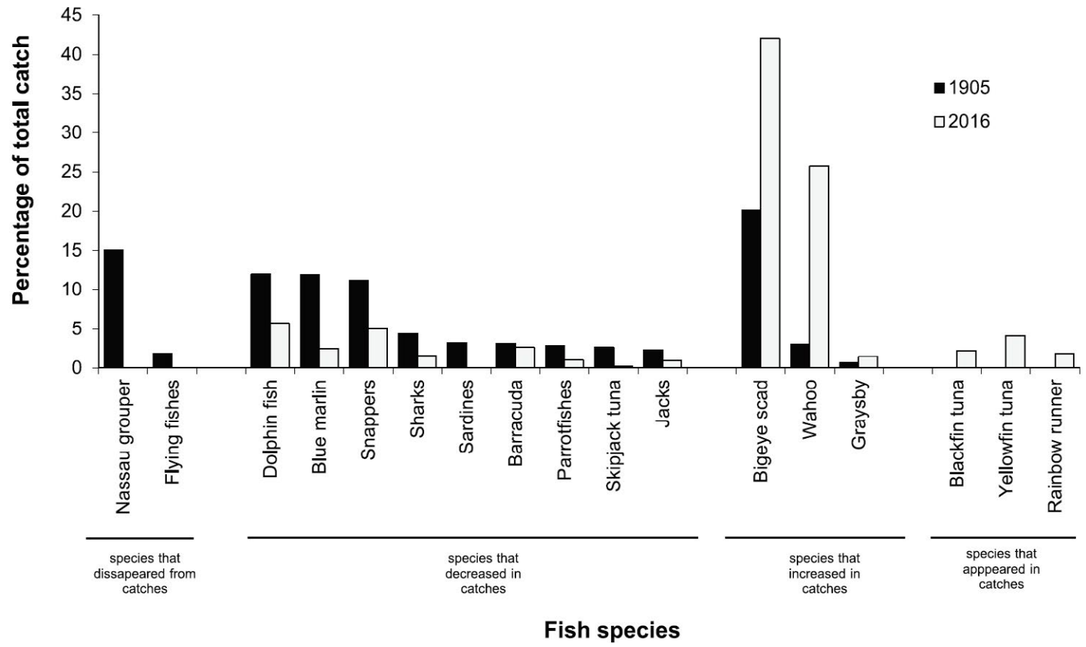
Overall Trends

In general, the last century saw a shift from near shore reef focused fishing to more deep-water pelagic fishing. The change in technology and practices led to a change in targeted fish species. Although direct comparisons over time can be difficult due to the wide variety of changes, on average, the CFM remained the same between 1905 and 2016, however, species composition and individual catch sizes did vary. It is also important to note, that although CFM remained roughly the same, this is only a measure per individual, overall, the estimated annual catch declined from nearly 2000 metric tons to 1000 metric tons over the century. This study also highlighted some alarming trends, such as the complete disappearance of some species, and the dramatic decrease in population levels of others.

Using total catch size based on weight can be a dangerous method for analyzing the health of the local fish stock, as a shift between populations can mask the results of overfishing of specific species. In fact, given the technological advancements over the past 50 years, one would expect an increase in total fish catch, however, this has not been the case. This hints that the total disappearance of large predatory fish by the mid-19th century already had major consequences for the entire reef ecosystem.

It is also important to note that certain species, not targeted by fishermen, also saw a notable decrease in populations over the last half century. This is particularly true for fish that depend on coral, indicating the important connection between the decline in coral populations around the island to the overall health of the ecosystem (Waitt Institute, 2017; De Bakker et al., 2016). Other forms of habitat degradation, such as loss of seagrass and mangroves, further contributes to the overall loss of fish diversity and population around the island, as these are important nursery and feeding grounds for many species of fish (Debrot et al., 2008). This study highlights the complexities involved in studying entire ecosystems, and demonstrates the importance of monitoring and conservation efforts at all levels. Comparing historical values of fish catches, although insightful, is not enough to fully understand the changes taking place within the near shore environments. Understanding the complex relationships between fish species and their environments is necessary for creating a more comprehensive conservation plan in the future.

Comparison of fish composition from line fishing between 1905 and 2016 (Vermeij et al., 2019)



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