The Shark Fin Trade Elimination Act of 2017: Has It Protected *Galeorhinus galeus a*nd Other Threatened Sharks Within California From Unregulated Fishing?

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ABSTRACT

Sharks are a critical species within ocean ecosystems whose populations are currently threatened with decline. The purpose of this research project was to determine if the Shark Fin Trade Elimination Act (SFTEA) of 2017 has been effective in lowering instances of shark catch in six major shark species within California waters; *Galeorhinus galeus* (Soupfin), *Notorynchus cepedianus* (Broadnose Sevengill), *Carcharodon carcharias* (Great White), *Triakis semifasciata* (Leopard), *Alopias* (Thresher), *Hexanchus griseus* (Sixgill). I used public shark catch postings on Instagram of the selected species as my data source. I conducted six Wilcoxon sum rank tests were conducted for each species; Soupfin shark p-value= 0.2, Leopard Shark p-value= 0.4, Thresher Shark p-value= 0.1, Great White Shark p-value= 1, Sevengill p-value= 0.07652, Sixgill p-value= .3537. In all instances, the null hypothesis was not rejected. Thus, I concluded the SFTEA of 2017 was not effective in lowering catch rates in all selected individual species of sharks. Then, total shark catch numbers for all six species in a single Wilcoxon test were then cumulatively tabulated from the years 2016-2018 and 2019-2021; results produced a p-value of 0.1. This signified that the summative impact of SFTEA did not lower shark catch numbers across all shark species as a whole. Stricter protection policies for threatened shark species and adherence to current policies is vital for future conservation efforts to combat unsustainable declining population rates.

KEYWORDS

conservation policy, sport fishing, pier fishing, Soupfin, threatened species

INTRODUCTION

One of the major problems plaguing our ocean ecosystems is overfishing, causing a loss of biodiversity and extinction of marine life (Bascompte, Melián and Sala 2005). Existing trophic cascades highlight the interconnectedness of oceanic food chains and with continued overfishing practices, that is cumulative to ecosystem collapse. Ecologists focus on the top-down approach to viewing these food chain structures in the context of top predators such as shark populations. The top-down approach consists of populations in higher trophic levels influencing the population of lower trophic levels. Historical abundance of large consumer species was much larger in comparison to recent observations within oceanic ecosystems (Jackson 2001). Furthermore, the fish species involved most strongly interacting with the tritrophic food chain are sharks as top predators (Bascompte, Melián and Sala 2005). Continued loss of key species within the predatorial trophic levels is detrimental to populations in lower trophic levels. With overfishing of species occurring in both higher and lower trophic levels, trophic cascades will continue to pose an ongoing threat to the future of oceanic health. For these reasons, it is critically important that illegal and unreported instances of fishing performed outside of allotted jurisdiction are subjected to penalties for their lack of accountability in the ongoing overfishing crisis.

One of the most vital creatures in maintaining stable ocean ecosystems are sharks. As of 2021, one quarter of shark and ray species are threatened with extinction due to overfishing (Nosal Et. al 2021). Shark protection is essential for our ocean ecosystems, especially along the coast of California, which has sensitive ecosystem food webs and an abundance of unique species. Since sharks are apex predators, they help to regulate population levels of lower prey species and prevent trophic cascades. It is important to highlight that the majority of shark species are particularly vulnerable to overfishing due to the fact it takes many years to reach sexual maturity (FWS 2021). A 2013 study found that estimates of the average exploitation rate of sharks ranged between 6.4% and 7.9% of sharks killed per year (Worm et al 2013). These values exceed the average rebound rate for many shark populations, which averaged 4.9% per year across 62 species (Worm et al 2013). This begins to explain the ongoing declines in most shark populations for which data exists (Worm et al 2013). With this rate of decline in the majority of shark species worldwide, many of which are already critically at risk, we will continue to see devastating effects within oceanic ecosystems.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was enacted in 1975, becoming the only treaty to ensure that international trade of plants and animals does not threaten their survival in the wild (FWS 2021). The Shark Conservation Act of 2010 was enacted in the United States to strengthen shark protection, as it barred white sharks from being finned and left for dead (Shark Stewards 2021). Even with these legislative acts, continued instances of shark catches off the California coast persist. More recently, the Shark Fin Trade Elimination Act of 2017 (SFTEA) was enacted to, "make it illegal to possess, buy, sell, or transport shark fins or any product containing shark fins, except for certain dogfish fins" (Congress.gov). Soupfin sharks have historically been hunted for their fins, which are used as the main ingredient in the traditional asian delicacy shark fin soup. With the species being currently listed as vulnerable according to the Department of Fish and Wildlife, this act was passed to penalize offenders who catch and kill these sharks as part of the lucrative fin trade.

The purpose of my study is to determine the effectiveness of the SFTEA in reducing shark catch instances off the California coast. This project will explore if there is any significant difference in the proportion of shark catches across these selected species before and after the implementation of the SFTEA. I incorporated data collection from my active shark protection work carried out by Shark Stewards. Shark Stewards is a Berkeley-based nonprofit focused on shark conservation efforts and community education. By using data sourced from Instagram, I determined if social media catch data has been influenced by the growing number of users on the platform. Specifically, how has the growth of social media increased the postings of shark catch on media sources? It is possible that assessing Instagram user growth and post instances by year may show increased trends in catch simply due to an increase in users on the site. The analysis will instead compare the number of posts proportionally to the amount of users on the site within a given year and determine if there are significant differences in the number of shark catch posts. Secondly, I will be utilizing a Wilcoxon test to determine if the SFTEA has had any significant impact in reducing the catch prevalence within Galeorhinus galeus (Soupfin Shark) populations, the specific target of the act. The final focus of research will be to assess the impact of the SFTEA on all 6 chosen shark populations within California; *Galeorhinus galeus* (Soupfin), *Notorynchus cepedianus* (Broadnose Sevengill), *Carcharodon carcharias* (Great White), *Triakis* *semifasciata* (Leopard), *Alopias* (Thresher), *Hexanchus griseus* (Sixgill).

METHODS

Social media data

The social media data set that I analyzed is publicly available Instagram user statistics. Highlighted below, the figure shows the number of Instagram users per year globally between the years 2013-2021 (Figure 1). The raw data headed 'Instagram users per country' was used to calculate that approximately 26.92% of Instagram users live within the United States. 'Instagram users per year within the United States', was calculated by taking the total number of Instagram users per year globally multiplied by 0.2692, the proportion of users based within the United States. I used Instagram users within the United States as a baseline of possible individuals who could post shark catches within the range of my study.

To normalize the shark catch data to growth patterns of Instagram users over time, the year 2021 was set to serve as a baseline of current users of the platform. To calculate the proportion of Instagram users per year for each individual year, I divided the number of total users per year by the number of total users in the year 2021. The final formula performed individually for each year, 2016-2020 is (#users per year)/(# users in 2021). 'Normalized Intsagram Values' highlights the normalized proportion of Instagram users within the United States by year. These proportional values were then multiplied by the total number of shark catches for each year.

Instagram users by country	
India	140,000,000
United States	140,000,000
Brazil	99,000,000
Indonesia	85,000,000
Russia	56,000,000
SUM	520,000,000
	0.2692307692
We can assume roughly 26.92% of users are within the US	

Instagram users per year United States	
2013	29615385
2014	53846154
2015	99615385
2016	134615385
2017	188461538
2018	269230769
2019	296153846
2020	350000000
2021	403846154

Instagram Users Per Year Globally	
2013	110,000,000
2014	200,000,000
2015	370,000,000
2016	500,000,000
2017	700,000,000
2018	1,000,000,000
2019	1,100,000,000
2020	1,300,000,000
2021	1,500,000,000

Normalized Instagram Values	
2013	0.07333333333
2014	0.1333333333
2015	0.2466666667
2016	0.3333333333
2017	0.4666666667
2018	0.6666666667
2019	0.7333333333
2020	0.8666666667
2021	1

Figure 1. Instagram User Normalization Data. Raw data used to calculate the proportion of users within the United States that are possible users who can post shark catch within California. Data then normalized proportionally by year to account for user growth within Instagram over the study duration.

Shark catch data collection

The current shark catch data set contains roughly 756 data points of catches posted on social media sites ranging in year and species. This report was limited to the most populous species along the California coastline; *Galeorhinus galeus* (Soupfin), *Notorynchus cepedianus* (Broadnose Sevengill), *Carcharodon carcharias* (Great White), *Triakis semifasciata* (Leopard), *Alopias* (Thresher), *Hexanchus griseus* (Sixgill). The range of dates for this selected project are any catches logged between January 1, 2014 and December 31, 2021.

The shark catch data was sourced in two ways: by computer programming and manually by relevant hashtags. The data is partially sourced by searching individual relevant hashtags on Instagram such as #sharkcatch and #sharkfishing and manually logging any relevant posts that highlight shark catch within California. Information gathered and manually inputted into a collaborative google spreadsheet are post link, species, date posted, and location. On the Shark Stewards team, we had a professional programmer who volunteered to create a Python algorithm to scout relevant hashtags and location settings to target public postings of shark catches in California. Using this software, he created a spreadsheet of output data subject to constraint by location, hashtags, date posted, and by relevant words cited in the caption such as “shark”. The output data was then manually checked to verify if it was a shark catch in California. Roughly 25% of the data was a verified shark catch in California, making it an efficient way to source data. The range of the data includes sharks caught off piers and the shoreline within the state of California.

The number of catches for the six chosen individual shark species were calculated and highlighted in the figure below (Figure 2). The leftmost chart titled total per year by specific species is raw data points summing the number of catches found on Instagram. The rightmost chart titled Instagram normalized catch data per species is the normalized data that was used for calculations within my study. To calculate the normalized catch value for every individual species, I divided each value in the leftmost chart by the corresponding normalized proportional value from figure four for each individual year. This calculation created a normalized catch value to be able to use in data analysis that accounts for the growth in Instagram user base over the course of my study.

I explored if there are significant differences in shark catch levels across different shark species due to the implementation of the SFTEA. Wilcoxon sum rank tests were used across different shark species to analyze if there was any significant variation of impact on any direct shark species. The Wilcoxon test was utilized over the traditional t-test due to the shark catch data not following a normal pattern of distribution. For each individual species, I completed an individual Wilcoxon test using R software for each year from the years 2014-2017 to highlight catch numbers before the implementation of the act. Then, a second test was performed using data from the years 2018-2020 to highlight post implementation. This process was repeated for every shark species of interest; Soupfin, Sevengill, Great White, Leopard, Thresher and Sixgill sharks.

Total per year specific species per year	
Year 2016	
Soupfin	1
Great White	0
Seven Gill	0
Six Gill	0
Leopard	6
Thresher	1
Year 2017	
Soupfin	9
Great White	6
Seven Gill	0
Six Gill	0
Leopard	20
Thresher	10
Year 2018	
Soupfin	7
Great White	18
Seven Gill	9
Six Gill	1
Leopard	30
Thresher	18
Year 2019	
Soupfin	20
Great White	14
Seven Gill	14
Six Gill	0
Leopard	154
Thresher	66

Instagram Normalized Catch Per Species	
Year 2016	
Soupfin	3
Great White	0
Seven Gill	0
Six Gill	0
Leopard	18
Thresher	3
Year 2017	
Soupfin	19.28571429
Great White	12.85714286
Seven Gill	0
Six Gill	0
Leopard	42.85714286
Thresher	21.42857143
Year 2018	
Soupfin	10.5
Great White	27
Seven Gill	13.5
Six Gill	1.5
Leopard	45
Thresher	27
Year 2019	
Soupfin	27.27272727
Great White	19.09090909
Seven Gill	19.09090909
Six Gill	0
Leopard	210
Thresher	90

Year 2020	
Soupfin	25
Great White	11
Seven Gill	24
Six Gill	4
Leopard	129
Thresher	64
Year 2021	
Soupfin	14
Great White	3
Seven Gill	16
Six Gill	8
Leopard	26
Thresher	28

Year 2020	
Soupfin	28.84615385
Great White	12.69230769
Seven Gill	27.69230769
Six Gill	4.615384615
Leopard	148.8461538
Thresher	73.84615385
Year 2021	
Soupfin	14
Great White	3
Seven Gill	16
Six Gill	8
Leopard	26
Thresher	28

Figure 2. Shark Catch Data. Raw collection data, which simply includes the number of each species caught from Instagram per individual year is listed in the leftmost chart titled "Total Per Year Species Per Year." The rightmost chart titled "Instagram Normalized Catch Per Species" is the normalized catch data used in my study analysis, proportionally adjusted to account for Instagram user growth over the last six years.

RESULTS

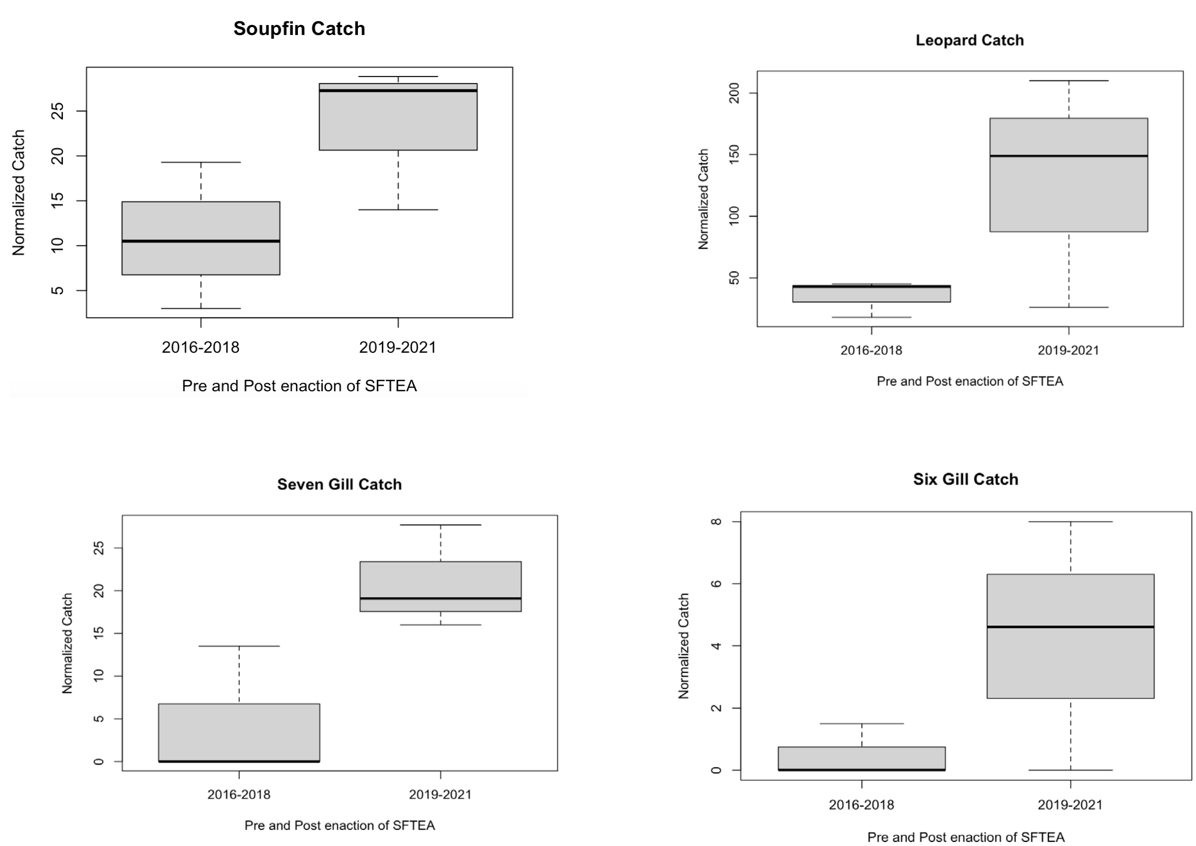
Social media normalization

Looking into publicly available Instagram user growth is important to draw conclusions for the social media mined shark catch data. A comparison of the number of posts per year to the proportion of users was calculated to see if there are any significant differences in the total number of posts. My calculation found the Instagram user proportion in 2016 to be 0.246, 2017 to be 0.466, 2018 to be 0.666, 2019 to be 0.733, 2020 to be 0.866, and 2021 to be 1. By normalizing the social media data to growth of users, we are able to accurately account for the number of catches relative to active users of a given year.

Shark catch data analysis individual species

The results of the pre enactment versus post enactment Wilcoxon rank sum test for the Soupfin shark are as follows: W=1 p-value = 0.2. I found that the results of the pre enactment t-test for the Leopard Shark are as follows: W=2 p-value= 0.4. I found that the results of the pre enactment t-test for the Thresher Shark are as follows: W=0 p-value= 0.1. I found that the results of the pre enactment t-test for the Great White Shark are as follows: W=5 p-value=1. It is important to note for the Great White shark specifically, there was no difference in catch postings pre and post enactment of the SFTEA. I found that the results of the pre enactment versus post enactment Wilcox rank sum test for the Sevengill shark are as follows: W=0 p-value=0.07652. I found that the results of the preenactment versus post enactment Wilcoxon rank sum test for the Sixgill shark are as follows: W=2 p-value= 0.3537.

From these results, I am able to conclude that since the p-value of all tests for every individual species was above 0.05, the null hypothesis is rejected and therefore the implementation of SFTEA has not made a significant difference in reducing catch of all shark species since its enactment in 2017. The box plots below visualize the results of the Wilcoxon tests (Figure 3).



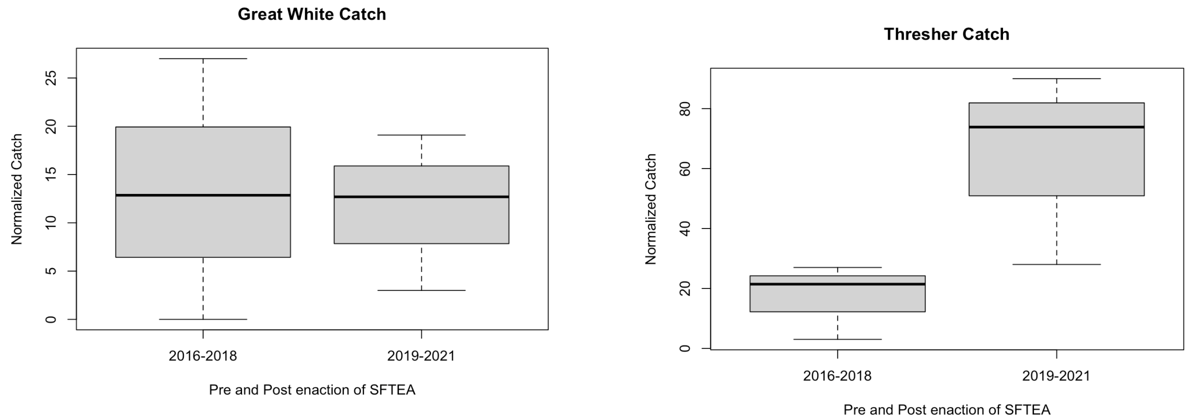


Figure 3. Box plot results of Wilcoxon sum rank tests for each individual species. Six Wilcoxon tests were run for every individual species within the study to determine individual effects of the passage of the SFTEA on catch rates.

Shark catch data analysis all species

To test if the implementation of the SFTEA had an overall positive impact on reducing shark catch rates across all species, a Wilcoxon test was used to assess the whether pre and post enactment. From the years 2016-2018, and 2019-2021, I combined the total normalized number of shark catches of all six chosen species during each individual year. A Wilcoxon sum rank test was run with a result of W=0 and p-value = 0.1. From these results, I am able to reject the null hypothesis and conclude that implementation of the SFTEA has not significantly lowered the instances of shark catch across all species.

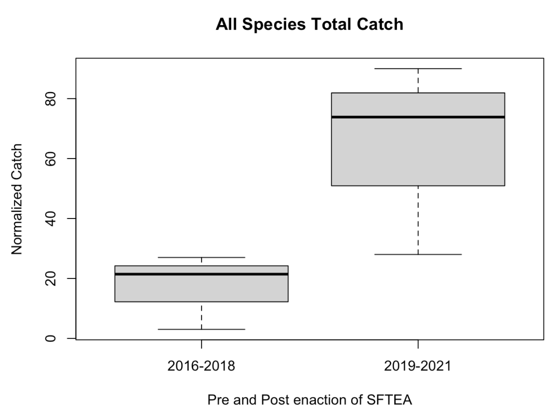


Figure 4. Box plot results of Wilcoxon sum rank tests for all species summed. Wilcoxon test ran to determine if the cumulative sum of all species highlighted any significant difference due to the SFTEA.

DISCUSSION

Using the Instagram shark catch data normalized to user growth, I was able to conclude that there was no significant difference in catch numbers of Soupfin Shark populations after the passage of the SFTEA. The other Wilcoxon tests of five shark species of interest, Great White, Sixgill, Sevengill, Thresher, and Leopard similarly highlighted no statistically significant change in shark catch numbers after implementation of the SFTEA. When catch numbers combined were calculated for all six species combined in a single Wilcoxon test from 2016-2018 and 2019-2021, the test results produced a p-value of 0.1. My overall results highlight the current policies in place are insufficient in protecting threatened sharks within California.

Social media analysis

With the growth of social media over the last decade, it is apparent an untapped data source of shark catches off our coasts was publically available for collection. A study of this nature related to shark catch has not been conducted before. Due to the continuous growth of Instagram users, it was important to normalize my data to account for user growth. Without normalization, a higher catch number for each year would skew my shark catch data to seem as if there were significantly more instances of catch versus increased prevalence of users on the site with the ability to publicly post their catches. An additional question related to social media data is to determine if there are truly more shark catches occurring after the passage of the act or if individuals are simply more comfortable with posting catches of protected shark species due to lack of social and legal consequences for posting. Many of the comments pertaining to major shark fishing accounts praise and commend these fishermen for catching these large sharks.

With the passage of the SFTEA, I expected to see a lower catch rate in the proportion of Soupfin sharks being caught after enactment. However, results suggest there was no significant difference in catch numbers before and after its passage. Therefore, protection of these threatened sharks is not being enforced. Even with specific national policy, there is a lack of deterrence for these fishermen who publicly post pictures of themselves catching sharks. After statistical test analysis for all six species, there was no statistically significant difference in catches before and after the passage of SFTEA. Although the act is not as specifically targeted to protect these other five species, with a strict ban on shark finning, we would expect to see a decrease in the number of catches of other species, which did not occur.

Current regulations

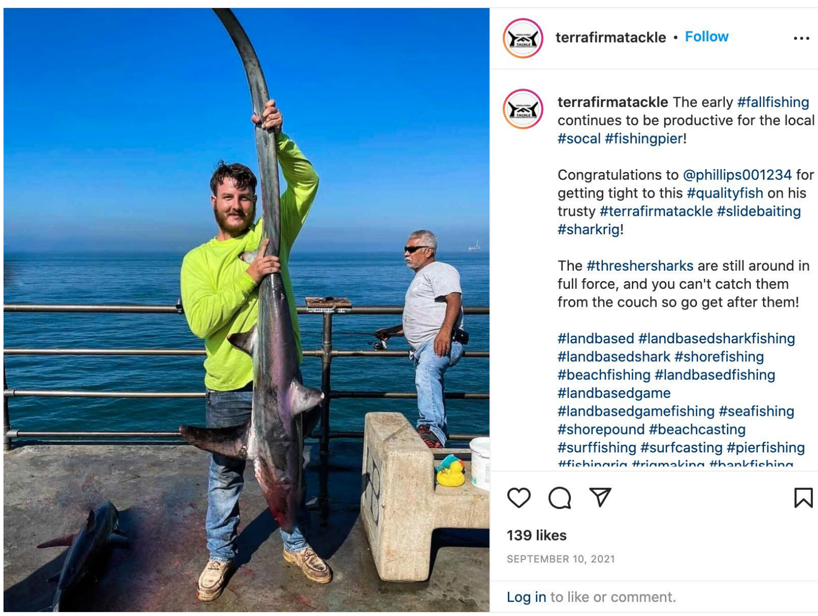
The 2022-2023 California Ocean Sport Fishing Regulations (COSFR) fail to protect threatened shark species from sport fishing. Currently, the daily limit on catch for Soupfin shark is one fish per person (Sec. 28.49). The Leopard shark daily catch limit is 3 under 36 inches per person (Sec. 28.56). Great White take or possession is completely prohibited (Sec. 28.06). For Sixgill and Sevengill sharks, the daily catch limit is one of each species (Sec. 28.95). There is a daily two catch limit on thresher sharks per day (Sec. 28.42). Although it might be legal to sport fish for all but Great White sharks in California, with declining populations of all studied species it is completely unsustainable to allow for continued sport fishing. The average rate of shark decline is estimated between 6.4% and 7.9% of each shark population per year whereas population replacement averaged only 4.9% per year (Worm et al 2013). Without current population data available for each species, the gradual decline of shark populations within our ocean ecosystems may go unnoticed.

Limitations

One of the limitations associated with this study is a lack of available population data on shark species within California as of 2022. The most recent mark recapture study of Great White sharks in California was in the year 2015: *Estimating apparent survival of subadult and adult white sharks (Carcharodon carcharias) in central California using mark-recapture methods*. (Kanive P., Rotella J. 2015). For the Leopard shark in California, the most recent population estimate available was conducted in 1992 by GM Cailliet and only included the ocean off the central California coast. There are no available studies modeling population estimates for Soupfin, Thresher, Sixgill, and Sevengill sharks within California.

Another limitation of this study is the current laws that protect the catch and release of Great White sharks in California. Currently, a fisherman is able to catch and release any protected shark species in California, as long as they claim they were not directly targeting that species and release it back to the ocean. California Department of Fish and Wildlife marine enforcement district assistant chief, Mike Stefanak, agrees that the language regulating Great White catch is not clear as, "proving that an angler was fishing specifically for great whites is 'very difficult.'" (Bland). A problem with this catch and release sportfishing is in some cases the shark is fatally wounded as it is reeled in upon a pier or beach.

Another major problem associated with current sport fishing laws within California is the risk to the public that comes with baiting juvenile sharks to public piers where individuals recreate. When sport fishermen bait for sharks occur on public piers, those in the water are at risk of being inadvertently bitten. In 2015, on the Manhattan Beach pier, a group of sport fisherman baited a juvenile white shark which bit distance swimmer Steven Robles who was exercising near the pier (LA Times). It is a continued risk to public safety to allow the continued practice of shark baiting and fishing near public piers in California. The current law allows any individual to possess a California sport fishing permit that allows for fishing off of any public pier. The photo embedded on the left is an Instagram post taken from the Huntington Beach pier of two Thresher sharks caught during the daytime while below the pier individuals recreate by swimming and surfing. Related to environmental equity, being able to access public piers to fish for subsistence is not the target of this policy. Responsible subsistence fishing is not the major cause of shark population decline. Direct sport fishing targeting threatened shark species is posing a threat to the future of shark populations in California. Come October 2022, the shark catch data from this study will be presented to California Fish and Wildlife, proposing new regulations to end baiting for large sharks off of public piers which places the public at risk.



Conclusion

My research concluded that the SFTEA did not lower the shark catch rate of any of the six selected species of sharks within California between the years 2016-2021; *Galeorhinus galeus* (Soupfin), *Notorynchus cepedianus* (Broadnose Sevengill), *Carcharodon carcharias* (Great White), *Triakis semifasciata* (Leopard), *Alopias* (Thresher), *Hexanchus griseus* (Sixgill). Current COSFR sport fishing laws lack protections for all species of sharks whose populations are in decline. It is essential that conservation efforts to protect shark populations rapidly improve, otherwise we are at risk for losing critical shark species within our ocean ecosystems.

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