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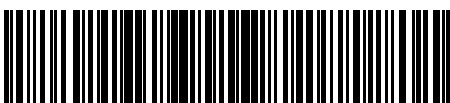
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# An Assessment of the Scale, Practices, and Conservation Implications of Florida's Charter Boat-Based Recreational Shark Fishery

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**ABSTRACT:** *Recent conservation efforts have advocated for SCUBA diving ecotourism as a nonconsumptive alternative use of sharks. Although generally overlooked by conservation advocates, another nonextractive use is catch-and-release fishing, which remains poorly characterized for shark fishing. In this study, we use a combination of website content analysis and surveys of charter boat captains to assess the scale of Florida's charter boat shark fishing industry. We further examine the knowledge, attitudes, and practices of charter boat captains whose clients fish for sharks in Florida. We show that recreational charter boat shark fishing occurs throughout the state but is heavily concentrated in the Florida Keys. Shark fishing is often the most expensive trip offered, suggesting that sharks are economically important to the charter boat fishing industry. Florida's charter boat shark fishers who show a strong conservation ethic toward sharks practice catch and release commonly. Our results suggest that although some species are better candidates for catch-and-release fishing than others due to inherent physiological vulnerabilities to postrelease mortality, Florida's charter boat shark fishery can augment the recent "ecotourism conservation" argument that sharks may be worth more alive than dead.*

## INTRODUCTION

Populations of many shark species are declining around the world, primarily due to overexploitation and bycatch by extractive commercial fisheries (Ferretti et al. 2010). Population declines in some species have exceeded 90% in recent decades (Baum et al. 2003). Seventeen percent of all known species of chondrichthyans are considered at risk of extinction by the International Union for Conservation of Nature Red List (Camhi et al. 2009), and species that use pelagic habitats are particularly threatened (Dulvy et al. 2008). Sharks can play important roles in structuring marine communities, and their loss is predicted to have negative ecological effects (Heithaus et al. 2008; Ruppert et al. 2013). These issues are raising mounting concerns about shark biodiversity and conservation among wildlife managers,

## Evaluación de la escala, prácticas e implicaciones de conservación de la pesquería recreativa de tiburón basada en botes de alquiler

**RESUMEN:** *actualmente, los esfuerzos de conservación han abogado por el ecoturismo mediante buceo SCUBA como una alternativa no consumista en cuanto al uso de los tiburones. Algo que generalmente ha pasado desapercibido por los conservacionistas en cuanto al uso no extractivo de los tiburones es la pesca de captura y liberación, la cual continúa estando pobremente caracterizada para el caso de los tiburones. En este estudio se utiliza una combinación de análisis de contenido de páginas web y sondeos a los capitanes de embarcaciones para evaluar la escala de la industria pesquera de Florida basada en botes de alquiler. Así mismo se examina el grado de conocimiento, actitudes y prácticas de los capitanes de botes de alquiler cuyos clientes pescan tiburones en Florida. Se muestra que la pesca recreativa de tiburones basada en botes de alquiler existe a lo largo de todo el estado pero se concentra principalmente en los cayos de Florida. La pesca de tiburón puede ser el viaje de pesca más costoso que se ofrece, lo que sugiere que los tiburones son económicamente importantes para la industria pesquera basada en botes rentados. En Florida, aquellos pescadores que mostraron una mayor ética de conservación hacia los tiburones, habitualmente practican la pesca de captura y liberación. Los hallazgos sugieren que si bien algunas especies son mejores candidatos para la pesca de captura y liberación debido a su inherente vulnerabilidad fisiológica a la mortalidad que ocurre tras la liberación, la pesquería de tiburones en Florida basada en botes rentados puede abonar al argumento de la conservación ecoturística de que los tiburones valen más vivos que muertos.*

scientists, policymakers, and environmentalists (Simpfendorfer et al. 2011).

Sharks are targeted by commercial fisheries worldwide for meat and for their fins, which are traded internationally for use in shark fin soup. A delicacy in traditional Chinese culture, shark fin soup can sell for hundreds of dollars a bowl, resulting in high economic incentives to exploit sharks solely for their fins (Clarke et al. 2006).

However, many nonextractive users depend on sharks for their businesses, raising additional concerns among stakeholders about their conservation. In the Republic of Palau, sharks



Photo credit: Neil Hammerschlag / [www.SharkTagging.com](http://www.SharkTagging.com)

**The Internet contains data that out-of-state tourists use to select and hire charter boats and is useful for examining both the scope of the shark charter fishing industry and its relative economic value.**

are more valuable to the local SCUBA diving economy than to local fishers (Vianna et al. 2012), and in French Polynesia, a single sicklefin lemon shark (*Negaprion acutidens*) can be worth over \$2 million in its lifetime (Clua et al. 2011). Gallagher and Hammerschlag (2011) found 376 SCUBA diving ecotourism operations worldwide that offer shark diving encounters, and customers are often willing to pay more to dive with sharks than any other animal. Recent conservation advocacy, termed here “ecotourism conservation,” has used the economic premise that many species of sharks can be worth more to local economies alive than dead as an argument for protecting them from extractive fishing.

Although often overlooked in the conservation advocacy community, another potential nonextractive use of sharks is catch-and-release fishing (Cowx 1999; Ditton and Holland 2002). Catch and release is growing in popularity in the recreational fishing community (Arlinghaus and Cook 2007). Surveys demonstrate that some recreational fishers are more interested in the challenge or excitement associated with catching large fish than in eating their catch, and many fishers report that they enjoy their fishing experience just as much when their catch is released unharmed (Sutton and Ditton 2001). Babcock (2008) reported that most recreational shark fishing worldwide is catch and release, but despite growing popularity, frequency, economic impacts, and the motivations for this practice have not been studied previously. The catch-and-release shark fishing industry may represent additional support for ecotourism conservation advocacy by documenting additional situations where sharks may be more valuable alive than dead.

Florida is a global recreational fishing destination, resulting in over \$8 billion in sales generated in 2011 (National Marine Fisheries Service [NMFS] 2011). The United States has one of the largest recreational shark fisheries in the world, and the state of Florida has one of the largest recreational shark fisheries in the United States (Schmied and Burgess 1987; Fisher and Ditton 1993; Figueira and Coleman 2010). This makes Florida an ideal location to

study the scale, practices, economic importance, attitudes, and conservation policy implications of recreational shark fishing.

A major component of Florida’s recreational fishing sector is charter boat fishing, where customers hire a boat and captain to take them fishing for a day, typically using rods and reels (Browder et al. 1981; Ditton et al. 1992; Leeworthy and Morris 2010). Charter fishing can also have large indirect economic impacts; because customers often travel from other states or countries to fish, they benefit local economies by purchasing hotel rooms and food in addition to paying the charter boat fee (Browder et al. 1981). Sharks have long been a target of charter boat fishing in Florida (Fisher and Ditton 1993; Figueira and Coleman 2010), but the motivations for recreational shark

fishing remain poorly understood. The goals of this study were to characterize the recreational shark fishery within the state of Florida using content analyses of websites and voluntary surveys. Specifically, we focused on assessing the scale of the fishery, establishing whether catch and release was commonly practiced, determining which shark species are targeted, and ascertaining the knowledge and attitudes of charter boat fishers toward the ecosystem role and population status of sharks.

## METHODS

Tourism is a major component of online commerce, and the Internet is one of the primary sources that tourists use to plan vacations and excursions (Werthner and Ricci 2004; Milano et al. 2011). Moreover, the Internet contains data that out-of-state tourists use to select and hire charter boats and is useful for examining both the scope of the shark charter fishing industry and its relative economic value. Accordingly, we used a leading Internet search engine ([www.google.com](http://www.google.com)) to identify charter boat businesses for this study (search terms in Appendix I). To be included in our analysis, charter boat companies had to explicitly mention the catching of sharks on their website.

We performed a content analysis of each of identified charter boat business website, focusing on several variables. The first was whether charter boats offered special shark fishing trips (and if so, what such trips cost, reported in U.S. dollars) or whether they simply listed sharks as a type of fish sometimes caught during normal fishing operations. The shark species that the charter boat websites identified that they catch most commonly was noted and also whether a charter boat advertised catch-and-release practices, catch-and-kill practices, or neither. The analysis also documented how shark fishing trips were promoted as a proxy for the charter boat captain's attitude toward sharks. The location where charter boats was based was noted, and many results were analyzed both statewide and regionally.

To further examine details regarding the knowledge, attitudes, and practices of charter boat captains who fish for sharks in Florida, we submitted a voluntary online survey to the 137 captains identified by our Google search. The survey consisted of 21 multiple-choice or short-answer questions modified from Anderson (2005) and was distributed to the captains of all identified charter boat businesses (see Table 1 for questions).

In addition to website content analysis and the surveys submitted to charter captains described above, we searched the National Oceanic and Atmospheric Administration's Marine Recreational Fisheries Statistics Survey (MRFSS; [www.sefsc.noaa.gov/about/mrfss.htm](http://www.sefsc.noaa.gov/about/mrfss.htm)) and Marine Recreational Information Program (MRIP; [www.st.nmfs.noaa.gov/st1/recreational/queries](http://www.st.nmfs.noaa.gov/st1/recreational/queries)) databases. These databases include survey results from questions submitted to anglers (not captains of charter vessels as elsewhere in this study).

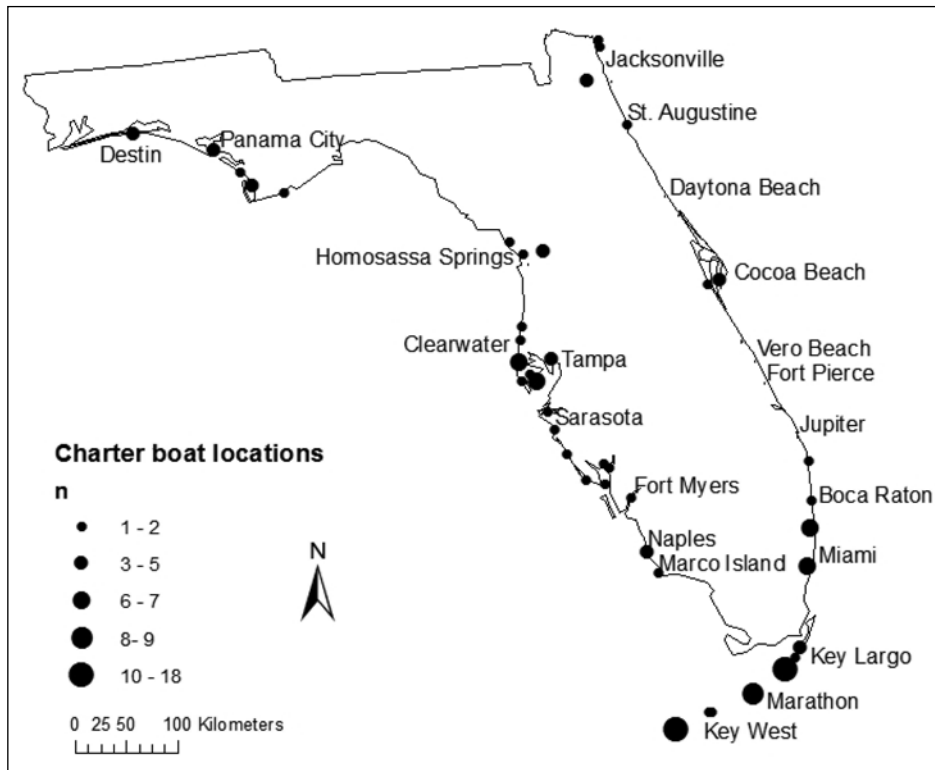
MRFSS was utilized to determine the total number of trips taken by recreational anglers on charter boats throughout Florida in the year 2012. MRIP was utilized to determine the

**Table 1. Questions included in the voluntary survey distributed to all identified charter boat captains. Multiple-choice questions are indicated by (MC); other questions are free response.**

- Where is your charter boat business located within the state of Florida? (MC)
- Optional: provide the name of the city where your business is located.
- Does your charter boat business offer specialized shark fishing trips? (MC)
- How does the cost of your shark fishing trips compare to other fishing trips you offer? (MC)
- If a shark trip is offered, how much do you charge (for a 1/2-day trip for six people)?
- Are shark fishing trips a large component of your business? (MC)
- To the best of your knowledge, what aspects of shark fishing most appeal to your clients? Please select all that apply. (MC)
- Which species of sharks do you catch most frequently? Please list any that you consider to be commonly caught.
- Which species of sharks (if any) do clients express a desire to catch in advance of the trip? (MC)
- Of the species of sharks you catch, which (if any) are clients most excited about catching?
- Please indicate which of the following statements is true concerning your catch-and-release fishing practices with respect to sharks. (MC)
- If you do not always practice catch-and-release when fishing for sharks, what factors into your decision? Please check all that apply. (MC)
- If you practice catch-and-release when fishing for sharks, what motivates this decision?
- Please indicate which statement is most applicable concerning your client's views on catch-and-release fishing for sharks. (MC)
- To the best of your knowledge, how healthy are shark populations in your local area? (MC)
- To the best of your knowledge, how healthy are shark populations in the state of Florida? (MC)
- To the best of your knowledge, how healthy are shark populations in the United States? (MC)
- To the best of your knowledge, how healthy are shark populations worldwide? (MC)
- If you reported any shark population declines, to the best of your knowledge, what is the cause of these declines?
- Is a healthy population of sharks important to you? (MC)
- Why is a healthy population of sharks important, somewhat important, or not important to you?



Photo credit: Neil Hammerschlag / [www.SharkTagging.com](http://www.SharkTagging.com)



**Figure 1.** Locations of charter boat businesses in Florida whose websites reference catching sharks. Relative sizes of symbols represent the number of businesses in each location.

total number of reported individual sharks that were caught (and the number released alive) by anglers fishing from charter boats throughout Florida in the year 2012. Every shark species identified by charter boat captains (in survey responses or websites) as being commonly caught by the anglers was searched in MRIP.

## RESULTS

### Location and Cost

We identified 137 charter boat companies that reference catching sharks on their website (Figure 1). These businesses are found throughout the state of Florida but are heavily concentrated in the Florida Keys (Figure 1). Twenty-five of the identified charter boat captains completed the voluntary survey (Table 1). A query of the National Oceanic and Atmospheric Administration’s MRFSS database shows that in 2012, anglers took 842,756 charter boat fishing trips throughout Florida, though this includes all trips and not just shark-focused trips.

Thirty-three websites (24%) advertised a specific, targeted shark fishing trip. Prices varied based on location, length of trip, and number of people in the fishing party. Prices ranged from \$300 to \$2,800 with a median price of \$775 (Table 2). In 29 cases (88%), the shark fishing trip was the most expensive trip offered by that charter boat company. Fifty-one businesses (37%) did not list prices or types of available trips on their websites.

**Table 2.** Number of charter boat businesses and average cost of fishing by region. Cost is reported in U.S. dollars and standardized for a 1/2-day fishing trip for six people.

Region	N (websites)	N (survey)	Mean cost (survey)	Min/max cost (survey)
Northeast Florida	7	1	\$400	N = 1
Central (Atlantic)	5	0	No responses	No responses
Southeast Florida	16	3	\$550	\$450/\$650
Florida Keys	58	13	\$561	\$400/\$700
Southwest Florida	33	3	\$600	\$450/\$750
Central (Gulf)	5	2	\$550	\$500/\$600
Panhandle	14	3	\$213	\$40 (3 people max)/\$350

**Table 3.** Responses to the survey question “Are shark fishing trips a large component of your business?” There were 22 responses to this question.

Answer	Response count	Response percentage
“I book a few shark fishing trips each year, and several other types of fishing trips are more regularly requested.”	9	40.9
“Shark fishing trips are occasionally requested, though they are a minor component of my total annual business.”	6	27.3
“Yes, customers often request shark fishing trips, though a few other types of fishing trips are more regularly requested.”	5	22.7
“I almost never book shark fishing trips.”	2	9.1
“Yes, the majority of trips I book are shark fishing.”	0	0

The cost of shark fishing provided by survey respondents (a 1/2-day trip with six passengers was used as a standard; 53.6% of all charter boat trips on the Atlantic coast of Florida are 1/2-day trips according to Holland et al. 2012) ranged from \$250 to \$750, with a median cost of \$550. Twenty of 25 respondents (80%) indicated that shark fishing trips are “priced similarly to most other trips,” one indicated that shark fishing is more expensive, and four indicated that it is less expensive. Survey respondents also indicated that shark fishing is an important component of their business, though not the largest (Table 3).

## Catch and Release

Fourteen websites (10%) included a clearly stated exclusive catch-and-release policy, and 19 survey respondents (82% of 23 responses to the multiple-choice question “Please indicate which of the following statements is true concerning your catch-and-release fishing practices with respect to sharks”) indicated that they “always practice catch and release when fishing for sharks.” Additionally, 13 survey responses (65% of 20 responses to the multiple-choice question “Please indicate which statement is most applicable concerning your client’s views on catch-and-release fishing for sharks”) indicate that “Most clients are happier to release the fish they catch,” and the remaining seven indicated that clients are “just as happy” to release the sharks. Selected excerpts from website catch-and-release policies and survey responses are provided in Table 4.

Only two websites (1.4%) listed a catch-and-kill policy. Of these, one (located in the Panhandle) indicated that sharks were killed for food, and the other (located in Miami) indicated that sharks were killed for sport. Two survey respondents (8.6% of 23 responses to this question) indicated that they “almost always” practice catch and release, and two (8.6%) indicated that they “sometimes” practice catch and release (an additional two did not answer the question). When asked what factored into the decision not to practice catch and release, five survey respondents indicated that shark species influences the decision (55% of nine responses to this question), three (33%) indicated that the clients’ wishes are important, and one (11%) indicated that seeking an International Game Fishing Association world record requires landing the shark. The MRIP database shows that, overall, only 68% of all sharks caught in Florida by these anglers were released alive, though Great Hammerhead (*Sphyrna mokarran*) and Scalloped Hammerhead (*Sphyrna lewini*) sharks (these species are grouped as hammerhead in the MRIP database; Compagno et al. 2005), Lemon Sharks (*Negaprion brevirostris*), and Tiger Sharks (*Galeocerdo cuvier*) had release rates of approximately 100% (Table 5).

## Motivations

Based on survey responses, the aspects of shark fishing that most charter boat captains believed most appealed to their clients were “the challenge and excitement of catching a large fish”; “getting a photograph to show friends and family” was the second most common choice (Table 6.) Moreover, “obtaining fish to eat” was the least common choice as a motivation

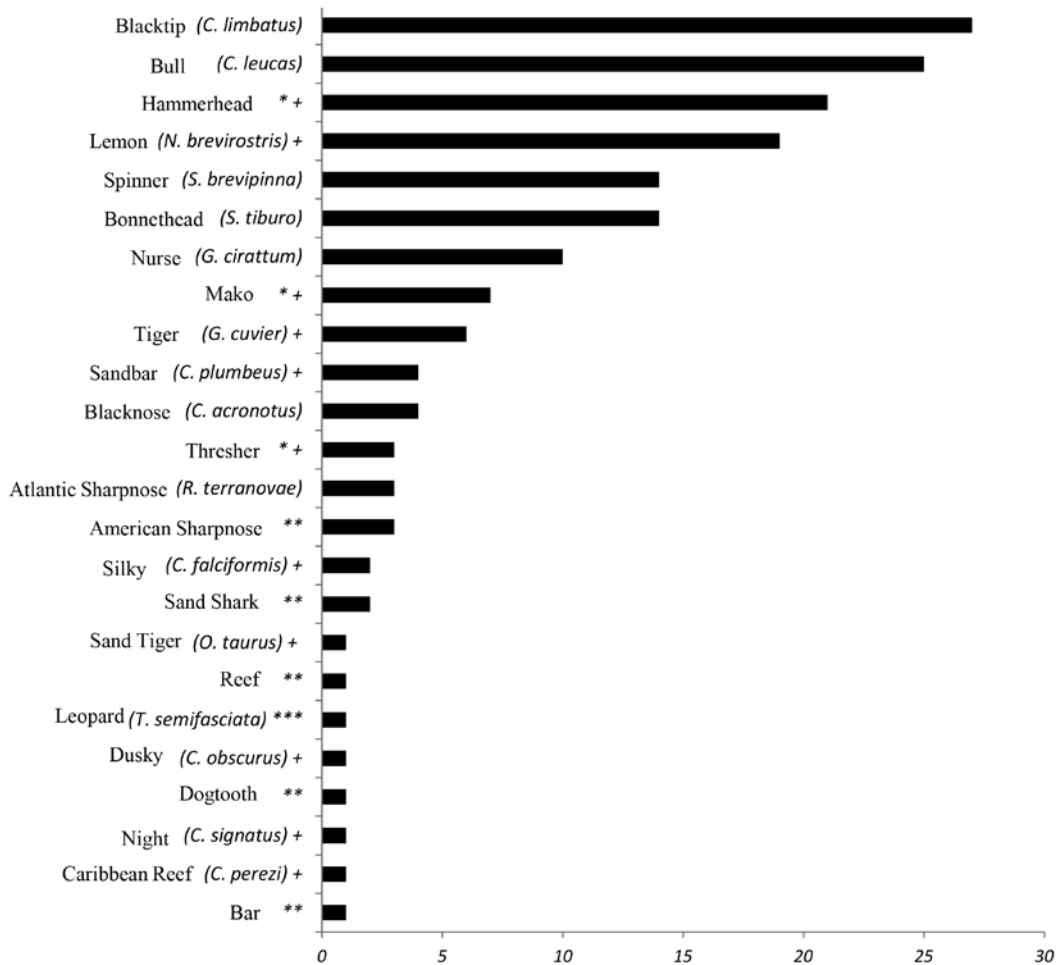
**Table 4. Selected excerpts from website catch-and-release policies and responses to the survey question “If you practice catch and release when fishing for sharks, what motivates this decision?”**

Website catch-and-release policies
Catch-and-release shark fishing is great for families seeking a fun, eco-friendly day on the water.
All sharks are released unharmed. If a replica is desired we can get one done for you without killing the shark.
Times have changed. The “Jaws” craze is over, and with a greater public consciousness toward conservation, catch-and-release fishing has become the norm rather than the exception.
Shark fishing is strictly catch and release.
Most Florida Keys fishing guides all release sharks that are caught for sport so they can live to play again and handling them near the boat is done in the best interest of the shark.
Sharks help maintain the balance of marine life in the shallow flats as well as the open ocean. So when we catch these powerful fish we always practice catch and release so they may continue to do their job.
Catch and release is utmost important to keep up the survival of the species and our numbers here in Key West.
We practice fishing conservation. We like to release all fish that are not being eaten or mounted.
Catch and release is promoted when shark fishing to preserve this incredible rich fishery for many years to come.
Sharks are very hardy and can recover from a fight better than other species of fish that we release.
Game fish that are not very tasteful like shark are released.
We release for the future.
The future of fishing in our area is the smart management of our resource.
We recommend that our anglers who are lucky enough to catch a shark or billfish, and would like to have a trophy of their fish, choose to release their fish and have an exact replica built from a mold.
The fish gets to survive this ordeal and go on to create more hammerheads for all of our futures.
Survey responses
“There’s simply no need to kill the sharks. When a client wants a wall mount, that’s easily done with a simple measurement of the shark.”
“Why would I kill them???”
“Respect for the sharks and conservation.”
“I know the importance of keeping every species of shark in the ocean. Man is already affecting natural selection enough by killing mostly large and desirable fish and leaving weak and undesirable fish.”
“This is a fun family trip ... you are only allowed 2 per vessel and besides all they really want is the picture and always happy to release them.”
“Declining or already declined shark population.”
“No need to kill something you are not going to eat.”
“Marina rule—no dead sharks on property except mako to avoid bad press.”

for shark fishing. Many charter boat companies advertise shark fishing on their websites using wording that suggests challenge and excitement (Table 7).

## Species Captured

Fourteen websites (10%) list specific species of shark that they commonly catch, and the remainder simply state “sharks.” Of those 14, only 2 sites listed relative frequency of species capture (both had “hammerhead” sharks listed among the more commonly caught species), whereas others listed commonly



**Figure 2.** Frequency of a species being included on a list of commonly captured species either on a website or in a survey response. \*There are multiple species of hammerhead, thresher, and mako. \*\*This is not a scientifically recognized species. \*\*\*This species is not found in the Atlantic Ocean and has likely been misidentified. +Fishermen are legally required to release these animals if captured (for hammerheads *S. lewiniand* and *S. mokaran*, Tigers *G. cuvier*, Sandbar *C. plumbeus*, Lemon *N. brevirostris*, and Silky Sharks *C. falciformis*, this applies only to Florida waters).



**Table 5. Data from MRIP database showing approximately how many of each species of shark were caught in 2012 by charter boat anglers in Florida and how many were released alive. Search terms are “species,” “2012-2013,” “Florida,” “all regions combined,” “number of fish,” and “charter boat.” PSE is “proportional standard error,” and the MRIP website notes that PSE > 50 indicates an imprecise estimate.**

Species	# Observed harvest	# Release alive	Total # caught	% Released alive	PSE
Hammerhead		33,733	33,733	100	44.4
Lemon Shark		5,291	5,291	100	38.6
Atlantic Sharpnose Shark	19,214	110,827	130,041	85.22465991	22.2
Nurse Shark	483	37,470	37,953	98.72737333	22.2
Spinner Shark	1,438	10,000	11,438	87.42787201	78.9
Blacktip Shark	136,741	159,486	296,227	53.83911662	21.5
Silky Shark	232	162	394	41.11675127	77.7
Black-nose Shark	8,683	2,472	11,155	22.16046616	41.7
Sandbar Shark	32	904	936	96.58119658	102.4
Bull Shark	1,778	3,664	5,442	67.32818817	47.1
Tiger Shark		2,420	2,420	100	71.4
Thresher Shark	0	0	0		
Reef Shark	0	0	0		
Total				68.6%	

**Table 6. Results of the survey question “To the best of your knowledge, what aspects of shark fishing most appeal to your clients? Please select all that apply.” There were 23 survey respondents who answered this question.**

Answer	Response count	Response percentage
The challenge and sport of catching a large fish	22	95.7
Getting a photograph to show friends and family	13	56.5
Experiencing new and different things	9	39.1
Experiencing natural surroundings, being outdoors	7	30.4
Trying to obtain a trophy fish	6	26.1
Getting away from the demands of other people	4	17.1
Obtaining fish to eat	2	8.7

**Table 7. Examples of wording evoking challenge and excitement used to advertise shark fishing on charter boat websites.**

The toothy beasts of the Florida Keys often surprise even seasoned anglers with their fight and acrobatics.
It's challenging. These creatures strike savagely, make long drag-scorching runs, and in some cases, will explode from the water in a leap worthy of the most highly touted gamefish.
Shark fishing is just plain exciting. You're targeting a powerful creature with an attitude ... a fish that when provoked would just as soon bite you as look at you.
A front row seat to raw naked aggression.
When it took the bait all aboard said it was a once in a fishing lifetime sight.
Imagine the thrill of fighting one of the most feared predators of the sea.
For the angler who would like to do battle with a prehistoric fish of unbelievable strength.
Bring your big boy pants for this fishing.
Want to tangle with something really big? Shark fishing may be the way to go for your day on the water.
Sharks are an amazing and unique apex predator.
They rival Tarpon in the amount of adrenaline pumping excitement you can get.

**Table 8. Selected responses to the question “Why is a healthy population of sharks important to you?”**

Economic reasons
Shark fishing is a huge part of my business.
Brings more customers.
Quick and reliable fishing action makes for a better charter business.
Very important—so we can continue to fulfill our clients' desires to fish for them.
Ecological reasons
“Indicates healthy fish stocks.”
“All part of the ecosystem.”
“Balance of nature.”
“They were created to be here and serve the purpose they were created for.”
“Because it's natural to have an abundance, and because they are part of the ecosystem and food chain.”
“I am for preserving all natural species. I do not want to see any species of sharks disappear or decline. I would prefer to have the oceans as God intended them to be.”
“To keep a natural balance in the marine ecosystem.”
“They were here before us, we do need to respect them, and it is my future.”
“To keep the ocean in balance.”
“An indicator of the health of the marine world is the health of shark populations. Having large predators in the ocean as a part of natural selection has made the oceans as fruitful as they were.”
“Keep the oceans clean.”
“Not to upset the balance of predator vs. prey.”





Photo credit: Christine Shepard / [www.SharkTagging.com](http://www.SharkTagging.com)

captured species without indicating relative frequency. Our results revealed that several species whose harvest is legally prohibited in Florida and in U.S. waters (due to concerns about declining population status) were included on this list of commonly captured species (Figure 2). Additionally, several groups of related species were included together by charter boat captains, and several species names not scientifically recognized were mentioned (Figure 2). The most common responses to the survey question “Which species of sharks (if any) do clients express a desire to catch in advance of a trip” were Bull Sharks (*Carcharhinus leucas*, eight responses) and hammerheads (seven). The most common responses to the question “Of the species of sharks you catch, which (if any) are clients most excited about catching” were also Bull Sharks (eight) and hammerheads (10).

Data from the MRIP database indicated that recreational charter boat anglers in Florida throughout 2012 caught over 550,000 sharks. According to the MRIP database, the four most common species reported as caught by anglers were Atlantic Sharpnose Sharks (*Rhizoprionodon terranovae*), Nurse Sharks (*Ginglymostoma cirratum*), hammerhead sharks, and Blacktip Sharks (*Carcharhinus limbatus*; Table 5).

### The Importance of Sharks and Their Population Status

Seventeen of 22 captains (77%) who responded to the survey indicated that a healthy population of sharks was “very important”

to them, and five (22.7%) indicated that it was “somewhat important.” Captains provided both ecological and economic reasons for the perceived importance of sharks. Selected responses are provided in Table 8.

Captains perceive local shark populations as healthier than the global average (Figure 3). The most commonly reported causes of the perceived population declines were “overfishing” (three responses), “commercial fishing” (three responses), “bycatch” (three responses), “longlining” (two responses), and “shark fin soup/shark finning” (two responses).

### DISCUSSION

As a global destination for recreational fishing, Florida is an ideal location to study the scale, practices, and conservation implications of the charter boat shark fishing industry, as well as the knowledge and attitudes of participants. The search engine methods used in this study resulted in the identification of 137 charter boat businesses that interact with sharks in Florida; they occurred throughout the state but were heavily concentrated in the Florida Keys. This is likely to be a conservative estimate, because there are over 3,500 charter boat business registered throughout the state (K. Maxwell, Florida Fish and Wildlife Conservation Commission, personal communication), though Holland et al. (2012) noted only 234 charter boats operating on the Atlantic Coast of Florida. Any Florida-based charter boat that fishes for sharks in federal waters requires an NMFS Highly Migratory Species Charterboat/Headboat (CHB)



Photo credit: Neil Hammerschlag / [www.SharkTagging.com](http://www.SharkTagging.com)

permit (K. Brewster-Geisz, National Marine Fisheries Service, personal communication). As of 2006 there were 673 CHB permits issued to charter boats based in the state of Florida, more than any other state, and more than 16% of all CHB permits issued for the eastern seaboard, Gulf Coast, and Caribbean combined (NMFS 2006). Charter boats that operate only within state waters need no special permit in addition to their charter boat license to interact with sharks (A. Pody, Florida Fish and Wildlife Conservation Commission, personal communication), though Holland et al. (2012) noted that offshore fishing trips (i.e., into federal waters) are the most common type of trip offered by charter boat captains on the Atlantic coast of Florida. It is likely that there are charter boat businesses in Florida that interact with sharks that were not identified by the search methods used in this study. Though a satisfactory percentage of captains responded to our survey and all regions of Florida identified as shark fishing hotspots by the website content analysis were represented in survey responses, it is possible that captains who do not practice catch and release systematically chose not to respond to this survey. If this is the case, it would bias results related to the frequency with which catch and release is practiced. Regardless, the charter boat businesses identified by this study can provide valuable insight into a poorly studied system, and additional research focusing on more detailed questions can improve our understanding further.

Though no captains who responded to the survey reported that shark fishing comprises the majority of their business, responses suggest that sharks are an important component of

the overall fishing. Holland et al. (2012) found that for charter boats based on the Atlantic coast of Florida, between 43.3% and 60% of trips targeted sharks, though often in addition to other species. Shark fishing is often the most expensive type of fishing offered, and the median cost of 1/2-day shark fishing trips listed on websites (\$775) is almost as expensive as the 2004 average cost of full-day charter fishing (\$894; NMFS 2006). This suggests that shark fishing is economically important to Florida's charter boat fishing industry, though more thorough economic analysis would provide additional insight.

Captains surveyed in this study report that catch-and-release fishing is commonly practiced when fishing for sharks, with few exceptions, but data derived from the MRIP database (overall release rate of 68% for sharks in Florida) suggest that this may not be the case for all species. Additionally, in 2010, 85% of charter boat captains in the South Atlantic region of the United States stated that less than one-quarter of their trips (targeting any species, not just sharks) were exclusively catch-and-release (Holland et al. 2012). Regardless, this represents a significant change in attitudes and practices, because large sharks were once commonly landed as trophies in this region (e.g., Figure 1a in McClenachan 2009).

Charter boat captains included in this study have among the highest support for catch and release of any studied group of anglers. All charter boat captains interviewed in this study reported that their clients are either happier (65%) or just as happy (35%) to release the sharks they catch. Though it is important



to note that this study surveyed charter captains, whereas other studies surveyed the client anglers themselves, this is among the highest values ever recorded for angler willingness to release. In comparison, only 61% of Texas catfish anglers reported that they were just as happy to release (Hunt and Hutt 2010). Agreement with the statement “I am just as happy if I don’t keep the fish I catch” on a 1- to 5-point Likert scale varied, with a mean of 2.45 for low-consumptive recreational fishermen (Fedler and Ditton 1986), a mean of 3.24 for Texas-based tournament anglers (Loomis and Ditton 2011), and mean of 4.7 for trout anglers in Tennessee (Hutt and Bettoli 2007).

**In this study, charter boat captains reported that the most common perceived motivation of their clients for fishing sharks was the “challenge and sport of catching a large fish,” and the least common was “obtaining fish to eat.”**

In this study, charter boat captains reported that the most common perceived motivation of their clients for fishing sharks was the “challenge and sport of catching a large fish,” and the least common was “obtaining fish to eat.” Similarly, Fisher and Ditton (1993) found for non-charter boat anglers that “adventure and excitement” and “the experience of the catch” were among the most significant motivations for shark fishing and that “obtaining fish to eat” ranked among the least significant. These motivations are different from most other studied

groups of anglers (Holland and Ditton 2011). In contrast, recreational fishers who fish in on the Great Barrier Reef, Australia, consider experiencing natural surroundings to be the most significant motivation for fishing and regard excitement to be the least important (Sutton 2006). Trout fishers in Tennessee consider the challenge to be important but far less important than experiencing natural surroundings and only slightly more than obtaining fish to eat (Hutt and Bettoli 2007). Rock lobster (*Jasus edwardsii*) divers in Tasmania valued catching lobsters to eat more than the challenge or adventure of the catch (Frijlink and Lyle 2010). Loomis and Ditton (2011) found that

sport fishers are more likely to value the relaxation and chance to be outdoors associated with fishing, whereas competitive tournament fishers are more likely to value the experience and challenge. Among Texas black bass (*Micropterus* spp.) fishers, tournament anglers ranked

“for the challenge or sport” and “to experience adventure and excitement” higher and ranked “to obtain fish for eating” lower than nontournament fishers. By this measure, recreational charter boat fishers targeting sharks in Florida are more similar to competitive tournament fishers. Of the 22 saltwater fishing motivations studies reviewed by Falk et al. (1989), recreational shark fishers and some competitive tournament fishermen were the only ones for whom “sport/challenge” was ranked as the highest motivation for fishing.



Charter boat captains believe that local shark populations are healthy, whereas globally shark populations are in decline. Though the United States in general and state of Florida specifically do indeed have healthy shark populations relative to many other parts of the world (Fowler et al. 2005), this perception among charter boat captains may be influenced by additional factors. This includes potential failure to acknowledge that local recreational fisheries can have a significant impact on population declines (which can occur in other taxa; see Coleman et al. 2004), as well as potential fear of restrictive regulations impacting their business. Techniques such as focus group discussions could address this perception in more detail.

Though this study focused on a large and important group of the recreational shark fishing industry, many other anglers fish for sharks. Charter boat captains' clients are likely from different socioeconomic groups than land-based shark fishers who fish from beaches and bridges, and recreational shark fishers who use their own boats may differ from either of these groups. Motivations, knowledge, attitudes, and practices of each group should be assessed separately. Though the sample size of responses to our survey was relatively low (25 respondents of 137 identified charter boat operations), potentially impacting our results and interpretation, all responses were consistent with our website content analysis, suggesting that we were indeed able to correctly characterize the nature of the charter boat shark fishing industry.

Both the website content analysis and survey responses revealed that most of the charter boat captains included in this study have a strong conservation ethic. Captains commonly practice catch and release, value sharks for their ecosystem services and the challenge they represent, and are concerned by declining shark populations. Charter boat captains and their clients may represent an as-yet untapped ally in shark conservation and management policy negotiations, and conservation advocacy nongovernmental organizations would be wise to explore this possibility.

The list of shark species reported as commonly caught by charter boat captains largely matches what is found by local scientific surveys (Torres et al. 2006; Heithaus et al. 2007; Wiley and Simpfendorfer 2007; Shiffman and Hammerschlag, unpublished data), but there are noteworthy exceptions. Specifically, nurse sharks appear to be significantly underrepresented by charter boat captains in the reported catch based on local abundance. We speculate that these species are likely caught but not advertised because they may be considered to be relatively less exciting due to their size and often sedentary, docile behavior. This is supported by the fact that unlike our survey and website content analysis of charter boat companies, the MRIP database of surveyed anglers showed that nurse sharks are one of the most common species captured by anglers on charter boats. Both websites and respondents listed hammerheads among the most commonly caught species of sharks. Although hammerheads are the third most common taxa reported (along with one

of the two species most commonly requested and the species customers are most excited about catching), these sharks are rare in Florida state waters (Torres et al. 2006; Shiffman and Hammerschlag, unpublished data). The discrepancy between natural abundance and catch rate suggests that charter fishermen may be specifically targeting Great Hammerheads and Scalloped Hammerheads. Both local species are considered endangered by the International Union for the Conservation of Nature Red List ([www.iucnredlist.org](http://www.iucnredlist.org)), and concerns about population declines resulted in a 2012 harvest ban in Florida waters ([www.myFWC.com](http://www.myFWC.com)). However, charter boat captains are likely highly advertising hammerheads because they are large and exciting, as well as one of the species most commonly requested by customers.

Assessments of how sharks respond physiologically to fishery interactions are becoming increasingly common (e.g., Furshin and Szedlmayer 2004; Herberer et al. 2010). Brill et al. (2008) noted that Sandbar Sharks (*Carcharhinus plumbeus*) can recover their blood oxygen transport ability rapidly postcapture, and Atlantic Sharpnose Sharks had postrelease survival of approximately 90% (Gurshin and Szedlmayer 2004). Using experimental catch-and-release methods throughout the Florida Keys, Gallagher et al. (2014a) documented a wide range in the physiological stress responses and postrelease survival of five coastal shark species, all of which are listed by the charter boat captains in this study as commonly caught by their anglers. The study found that Bull Sharks, Tiger Sharks, and Lemon Sharks exhibit relatively low postcapture physiological stress levels (low whole-blood lactate and  $p\text{CO}_2$  levels) and high postrelease survival rates following fishing, suggesting that they have low vulnerability to fishing capture stress (Gallagher et al., in press). Conversely, Blacktip Sharks and Great Hammerheads showed high physiological disruption and low survival following release (Gallagher et al., in press).

In fact, Great Hammerheads showed some of the highest mortality rates reported in the literature for any shark even at low hooking durations (Gallagher et al., in press). Additionally, several studies have found that Great Hammerheads and Scalloped Hammerheads have among the highest at-vessel mortality rates of any species encountered in both pelagic and bottom longline fisheries, likely due to pronounced capture stress response (Morgan and Burgess 2007; Morgan and Carlson 2010). Due to their abnormally severe reaction to capture stress as well as high mortality rates after being caught, Great and Scalloped Hammerheads are not good candidates for eco-friendly catch-and-release fishing. Moreover, both Great Hammerheads and Scalloped Hammerheads are being considered for listing under the U.S. Endangered Species Act, which, if successful, would impact how charter boat fishermen interact with these animals. Accordingly, we argue that Great Hammerheads and Scalloped Hammerheads (and all hammerhead species) should not be targeted by anglers if the desired fishing outcome is survival. Species-specific handling guidelines requiring the immediate release of “hammerheads” (without first “fighting” them to bring them to the boat and without posing for a photograph) may help reduce mortality of these endangered animals (Cooke

and Suski 2005; Gallagher et al. 2014b). In order to more fully evaluate the conservation benefit of this industry and whether it truly represents a nonconsumptive usage of sharks, future research should continue to assess the species-specific postrelease shark survival after exposure to recreational fishery interactions (Cooke et al. 2005, 2012).

Given the economic benefits of catch-and-release shark fishing, our results suggest that under certain circumstances, Florida’s charter boat shark catch-and-release fishing industry may help further the recent “ecotourism conservation” argument that sharks may be worth more alive in their natural environment than dead in a fish market (Gallagher and Hammerschlag 2011; Vianna et al. 2012). However, for this argument to be valid, the shark species commonly caught by these anglers must not suffer significant mortality or experience major losses in fitness after being released. By these criteria, many shark species are good candidates for catch and release. However, due to their endangered status and extreme stress reaction, Great Hammerheads and Scalloped Hammerheads are not, which makes the potential targeting of these sharks by charter fishermen a conservation concern.

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**Appendix 1. Search terms used to identify charter boat fishing businesses on Google.com. Every permutation of “fishing term” and “location term” was searched.**

Fishing term		
Shark fishing	Charter boat shark fishing	Fish for sharks
Location term		
Florida	South Florida	Florida Keys
Northwest Florida	Northeast Florida	North Florida
Florida Panhandle	Southwest Florida	Southeast Florida
Central Florida	Gulf coast of Florida	Jacksonville, Florida
St. Augustine, Florida	Daytona Beach, Florida	Cocoa Beach, Florida
Vero Beach, Florida	Jupiter, Florida	Boca Raton, Florida
Miami, Florida	Key Largo, Florida	Islamorada, Florida
Marathon, Florida	Key West, Florida	Marco Island, Florida
Naples, Florida	Fort Myers, Florida	Sarasota, Florida
Tampa, Florida	Clearwater, Florida	Homosassa Springs, Florida
Panama City, Florida	Destin, Florida	

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