PRELIMINARY OBSERVATION OF DEPREDATION BY BOTTLENOSE DOLPHINS ON THE KING MACKEREL TROLL FISHERY IN FLORIDA

by

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ABSTRACT

Conflicts between marine mammals and fisheries can be attributed to spatial overlap and resource competition between cetaceans and fisheries and/or behavioral learning among marine mammals. In the present study, I documented depredation by bottlenose dolphins (*Tursiops truncatus*) in Florida's king mackerel troll fishery. Depredation refers to the behavior in which predator species remove or damage fish on fishing lines or in nets. I conducted twenty-six surveys of charter and commercial fishermen in Islamorada, Florida and twenty-three along Florida's east coast from Fort Pierce south to Lake Worth Inlet, and I observed dolphin behaviors from working vessels in these two study sites. All survey respondents indicated they had observed bottlenose dolphins depredating bait or catch. Fishermen reported that king mackerel was the species most often taken by bottlenose dolphins. From behavioral observations, I found that dolphins took 6% of king mackerel caught by charter fishermen and 20% of fish caught by commercial fishermen. I attributed these differences to seasonal variation in fish distribution or gear differences between vessel types. Preliminary tests demonstrated that a modification to the outrigger planar will successfully deter bottlenose dolphins from engaging in depredation, without causing a reduction in catch.

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1.0 INTRODUCTION

1.1 Depredation

Depredation is the removal or damaging of hooked fish or bait on fishing gear by predator species. Depredation from marine mammals causes adverse interactions between fishermen and marine mammals (Donoghue et al 2002). Evidence of depredation exists in several pinniped and cetacean species (NRC 2003, Yano and Dahlheim 1994, Donoghue et al 2002, Reeves et al 2001).

A recent increase in reports of depredation by marine mammals may be attributed to an increase in fishing effort, spatial overlap and resource competition between cetaceans and fisheries, and/or behavioral learning among marine mammals (Donoghue et al 2002). With a rapidly growing human population, fishing in coastal regions will continue to increase, causing even greater conflicts between fisheries and marine mammal populations throughout the world's oceans (Read 2003).

Depredation may cause adverse effects on both fisheries and marine mammal populations; however, most current reports of depredation remain anecdotal in nature. Marine mammals cause damage to fishing gear, decrease yield in value and amount, and reduce catch by dispersing fish (Reeves et al 2001). The reduction in catch due to depredation events may lead to increased fishing effort and unknown ecosystem impacts (SPREP 2002). Depredation may be beneficial to marine mammals in the form of increased foraging success (SPREP 2002). However, changes in behavior, habitat, and distribution may result as marine mammals use areas with high fishing activity (Reeves et al 2001). Harmful consequences of depredation for marine mammals include injury or

mortality from entanglement with fishing gear or from retaliatory measures of angry fishermen.

My purpose in this study was to document the extent, nature, and cost of depredation by bottlenose dolphins (*Tursiops truncatus*) in the king mackerel (*Scomberomorus cavalla*) charter and commercial fisheries in Florida. I also attempted to understand the conditions under which the interactions occur and to work with fishermen to identify potential tools to deter dolphins from engaging in depredation. For instance, Noke and Odell (2002) devised a technique to secure a bungee cord across a crab pot door, which prevents dolphins from tipping crab pots, opening the pot door, and taking bait fish. Melvin et al (1999) demonstrated a reduction in seabird depredation of and entanglement in salmon gillnets by combining acoustic devices with visual mesh panels strategically placed in the upper portion of the gillnet.

1.2 King Mackerel

King mackerel (*Scomberomorus cavalla*) is a coastal species, distributed in the western Atlantic Ocean along the east coast of the United States from Massachusetts to Brazil and in the Gulf of Mexico and Caribbean Sea (Gold et al 2002). Two genetic stocks of king mackerel are believed to inhabit the waters near Florida, one migrating along the Atlantic coast and one in the Gulf of Mexico (Gold et al 2002).

Current management of king mackerel is based on these two migratory stocks (Schaefer and Fable 1994). The Magnuson-Stevens Fishery Conservation and Management Act (1976, amended in 1996) established regional councils to manage fish populations. The South Atlantic Fishery Management Council manages king mackerel in federal waters to the east of Florida and to the south and east of the Florida Keys while

the Gulf of Mexico Fishery Management Council regulates the king mackerel fishery on Florida's west coast and to the west and north of the Florida Keys (Waters et al 2001).

In the Florida Keys, the two migratory stocks mix during the winter months (Gold et al 2002). For stock assessment purposes, however, king mackerel in the Florida Keys from November through March are assumed to be from the Gulf migratory stock. Therefore, stock assessments fail to consider the number of Atlantic stock king mackerel caught by fishery operations in this area.

Fishing quotas established by the regional councils do not take into account fishery-related mortality that results from depredation (NMFS 1996). This lack of knowledge could potentially have profound impacts on the king mackerel stocks.

1.3 King Mackerel Fishery

King mackerel are caught by a type of fishing called trolling. While trolling, a fishing boat moves slowly through the water, dragging several fishing lines—either on fishing poles as in a charter boat or from reels as on commercial boats. Both charter and commercial vessels utilize outriggers which allow a line to be held out on each side of the boat to prevent entanglement with other lines. The fishing lines can be set at a variety of depths. By selecting the size of hooks, lures, or live bait that is placed on the fishing lines, fishermen can target desired species and limit the bycatch of undesired species (Alverson et al 1994). Bycatch by trolling is relatively small compared to other fishing types such as trawling and gillnets (Alverson et al 1994). Bycaught fish can generally be released with a high probability of survival for the fish since trolling is an active type of fishing.

Depredation by dolphins on trolling vessels is usually characterized by a strong jerk of the line and dolphins sighted either approaching or swimming away from the vessel. The dolphin may leave the head of the fish, or it may take everything, including the fishing hook. For commercial fishermen who are pulling the fishing line in with their hands and with gear on the floor of the boat, depredation carries a serious risk of injury.

Commercial fishing operations in the United States during 2001 yielded over 4.8 million pounds of king and cero mackerel (*Scomberomorus regalis*), a mackerel species with a similar distribution as king mackerel. This fishery was valued at almost seven million dollars; over four and a half million of those dollars worth of king and cero mackerel were caught in Florida (NMFS 2002). In Florida during 2001-2, commercial fishermen caught nearly 112,500 fish from the Atlantic king mackerel stock while recreational fishermen reported catching almost 195,000 fish from the same stock (NMFS 2003).

2.0 METHODS

2.1 Study Sites

I selected two Florida coastal regions, Islamorada in the Florida Keys and the eastern coast from Fort Pierce south to Lake Worth Inlet, for this study (Chart 1). These regions represent areas in which fisheries for king mackerel exist during at least part of the year. Islamorada draws tourists each year to charter one of the many boats that comprise its charter fleet while the east coast of Florida boasts a thriving commercial king mackerel fishery.

On the east coast, I worked from small commercial marinas and from private docks from Fort Pierce to Lake Worth Inlet, with a concentration in Jupiter, Stuart, and

Fort Pierce. In Islamorada, I worked in the three main marinas: Holiday Isle, Whale Harbor, and Bud and Mary's.

2.2 Surveys

From March through June 2003, I administered social surveys using the face-to-face method (Appendix 1) (Rea and Parker 1997). I selected captains of offshore fishing charter boats or commercial king mackerel fishermen in the study sites to participate in this study. Due to the multi-use nature of fishing vessels, I included commercial, charter, and recreational as options of vessel type on the survey.

2.3 Dolphin Observations

I conducted dolphin observations from the flying bridge of the charter boats and in the stern of the commercial vessels. I took GPS coordinates every 30 minutes with a handheld Garmin 45 GPS unit. During each 30-minute interval, I recorded vessel activity including transit to and from fishing grounds or active fishing. I further categorized the fishing activity, depending on the target species of the 30-minute interval.

For each 30-minute interval, I recorded the behavior and estimated the number of dolphins present. I defined dolphin behavioral categories as:

Depredation- a dolphin was observed eating or trying to eat bait or catch off of the fishing line
Entanglement in fishing gear- a dolphin became entangled in a fishing line
Begging- a dolphin approached a vessel in order to gain food
Eating discarded bait-a dolphin ate rejected or used bait that was thrown off a fishing vessel
Feeding or milling near the boat but not interacting- a dolphin was in the same area as a fishing vessel but did not seek food or become entangled in gear
Following boat- a dolphin was actively following or pursuing a boat
Passing/being passed by boat- a dolphin was observed traveling or was passed by the vessel as it moved to or from fishing grounds, and the dolphin neither followed nor interacted with the vessel

2.4 Impact on King Mackerel Fishery

To assess the extent and impact of depredation on the king mackerel fishery, I recorded the type of fishing gear, the number and species of fish caught, and the number and species of fish lost or damaged due to depredation during each 30-minute interval. I attributed lost fish to bottlenose dolphin depredation if I observed dolphins following the boat or chasing the fish. I recorded the species of the fish if a definitive part of the fish was retrieved or if I observed the fish before depredation occurred.

I also recorded the fishermen's response to depredation. The categories of response included leaving fishing grounds, ignoring dolphin depredation, throwing objects or shooting, cutting fishing line, or increasing boat speed.

2.5 Experimental Testing of Deterrence Device

During this study, I worked with fishermen to devise and test a deterrence device to be used on outriggers of commercial fishing vessels. The device utilizes a planar that is used on outrigger lines. An outrigger release clip is secured to the back of the planar (Diagram 1). The bait line passes through the outrigger clip, which releases when a fish bites on the bait (Diagram 1). The clip also releases a metal wire that is attached to the bait line (Diagram 1). The wire travels towards the fish and flaps around the fish when reaching the end of the bait line, making it difficult for a dolphin to approach the fish. The dolphin can most likely detect the metal wire and not wanting to bite into the wire, the dolphin leaves the fish alone.

I tested the device on commercial fishing vessels in Fort Pierce during December, 2003 and January, 2004. I randomly placed the device on one of two outriggers. I noted the outrigger, time, and GPS coordinates for each event. An event occurred when the

fishing line was placed in or taken out of the water and when a fish was caught or depredated. I recorded the number and species of each fish that was caught, taken, or damaged.

a  b. 

Diagram 1: Device a. The device is created with an outrigger clip secured to the back of a planar, the metal square. b. The wire that releases when a fish bites the bait line will travel to the end of the bait line, shown here as a pink lure and hook.

3.0 RESULTS

3.1 Surveys

I collected surveys from twenty-six king mackerel boat operators in Islamorada and twenty-three operators along Florida's east coast. Several individuals indicated that their boats serve multiple purposes, or the individuals operate different types of boats during different parts of the year (Table 1).

	Vessel Type		
Study Sites	Commercial	Charter	Recreational
Islamorada	1	23	3
East Coast	17	12	2

Table 1: Vessel type and study sites of survey respondents.

All interviewed fishermen responded that they saw or interacted with bottlenose dolphins while fishing. Two of the fishermen who answered yes to this question chose to

stop the survey at this question. One fisherman said the behaviors in question occurred underwater so he could not explain the interactions while the other fisherman responded that the dolphins were just eating which is a natural behavior.

Of the forty-seven fishermen that continued the survey, all respondents indicated they observed dolphins taking bait or catch (Figure 1). Other interactions that were reported included entanglement in fishing gear (10.6 %), begging (4.2 %), and eating discarded bait (10.6 %) (Figure 1). Ninety-seven percent of participating fishermen reported that king mackerel were taken by bottlenose dolphins. King mackerel was the species most often selected as being taken by bottlenose dolphins. Other fish reportedly taken by bottlenose dolphin include amberjack (*Seriola fasciata*), blackfin tuna (*Thunnus atlanticus*), and Spanish mackerel (*Scomberomorus maculatus*) (Figure 2).

Over fifty percent of the fishermen responded that the interactions with bottlenose dolphins occurred almost every day or several times per week (Figure 3). In Islamorada, the fishermen indicated that winter was the season with the highest number of bottlenose dolphin interactions (Figure 4). Along Florida's east coast, most interactions occurred during spring (Figure 4). Almost ninety percent of fishermen said that depredation occurred between three and twelve miles offshore while about twenty-five percent of respondents observed this behavior within three miles of shore (Figure 5).

Over three-fourths of survey respondents (76.6%) indicated they believed that bottlenose dolphin conflicts with fishing efforts had increased over the past several years (Figure 6). Over ninety-four percent of commercial fishermen compared with about twenty-five percent of charter and recreational fishermen indicated that bottlenose dolphin depredation was causing economic loss (Figure 7). A Mann Whitney test

indicated a significantly higher perceived economic loss from depredation for commercial fishermen than for charter fishermen ($p < 0.001$).

3.2 Dolphin Observations

I made observations from five charter boats in Islamorada. Along Florida's east coast, I conducted observations from four charter boats and four commercial boats. I spent a total of 41 hours in Islamorada and 85 hours along Florida's east coast conducting dolphin observations. The behaviors observed by dolphins include taking or attempting to take catch, following the boat, feeding or milling near boat with no interactions, and passing by the boat (Figure 8). All of the observations in which bottlenose dolphins were following the vessel occurred when the vessel was fishing for king mackerel. All fifteen of the fish taken or damaged were king mackerel. Depredation by bottlenose dolphins was characterized by an abnormal jerk on the line after a fish was known to have taken the bait.

For charter fishermen, six percent of the king mackerel catches were taken or damaged by bottlenose dolphins (Figure 9). Depredation events occurred more frequently on commercial fishing vessels. Bottlenose dolphins took 19.7 percent of the king mackerel caught by commercial fishermen (Figure 9).

I observed thirteen depredation events from commercial vessels and one from charter vessels on Florida's east coast and off of Islamorada. All of the depredation events occurred while fishing for king mackerel. Only one depredation event occurred in Florida's state waters within three nautical miles from the shore while all other depredation events occurred between three and twelve nautical miles offshore.

The number of dolphins observed while depredation occurred ranged from one to four dolphins; however, other dolphins were often in the same area, following or engaging in depredation of nearby fishing vessels.

3.3 Photo-identification

Photography of bottlenose dolphin dorsal fins during depredation proved to be impossible due to the nature of the interaction. Bottlenose dolphins remained too far from the vessel to allow for dorsal fin identification. When a fish was caught, the dolphins would swim towards the boat with their dorsal fins directly below the surface in order to take the fish. After taking the fish, the dolphins would surface away from the boat.

3.4 Impact on King Mackerel Fishery

I attributed a total of fifteen lost or damaged fish to bottlenose dolphin depredation. Loss of gear also resulted from depredation, including line, lures, hooks, and occasionally planars.

Fishermen typically responded to depredation by leaving fishing areas or by ignoring the bottlenose dolphins. In one instance, I observed a charter boat captain shooting a gun into the water to protect his catch and fishing gear. I also observed the use of bird bangers, a sound-creating device similar to a gun shooting blanks, to avoid depredation. Anecdotal accounts of the use of seal bombs, guns, and bird bangers were also reported by commercial and charter fishermen.

3.5 Experimental Testing of Deterrence Device

Two depredation events could be attributed to bottlenose dolphins while the deterrence device was being tested; one event occurred when the device was out of the

water and one occurred on a line without the device. In three cases when the device was in use, bottlenose dolphins approached a king mackerel on the fishing line to take it but appeared to leave the fish alone when they detected the device.

The number of fish caught per hour for each outrigger was 1.48. A t-test demonstrated no significant difference exists between the rate of fish caught by each outrigger, without a device ($p=0.99$). I also conducted a t-test to compare the number of fish caught per hour by an outrigger equipped with the device (1.40) with one without the device. The device did not cause a reduction in catch of targeted species ($p=0.83$).

4.0 DISCUSSION

In the present study, I documented depredation in both the king mackerel charter and commercial troll fisheries in southeastern Florida. *All* commercial and charter fishermen indicated that they experienced bottlenose dolphins taking their bait or catch. During observations, approximately one in every five fish caught by commercial fishermen was lost to bottlenose dolphins, although only six percent was lost by charter fishermen. This difference in depredation rates can be attributed to seasonal variation in fish distribution or gear differences. I conducted half of the charter boat observations in Islamorada during the spring, but fishermen in Islamorada reported that most conflicts with dolphins occur in the winter. Due to the highly migratory nature of king mackerel and the mixing of the South Atlantic and Gulf stocks in the winter in the Florida Keys, I anticipate that a higher depredation rate would be observed in the charter fishery in winter (Gold et al 2002). I observed commercial fishing operations along Florida's east coast during the season with the most reported conflicts. Depredation rates along the east

coast may be even higher in the spring rather than at the end of spring and summer when my observations were made.

Additionally, commercial fishermen specifically target king mackerel while charter boats are generalists. Charter boats use fishing gear that targets a variety of fish species including amberjack (*Seriola fasciata*), barracuda (*Sphyraena obtusata*), and bonito (*Sarda sarda*). The higher depredation rates encountered by commercial fishermen may result from the regular capture of king mackerel compared to the various species caught by charter boats during a fishing trip.

Bottlenose dolphins may prefer king mackerel, an oily fish that may be an important source of fat, over other species caught by charter boats such as bonito and barracuda (Sargent et al 2001). In addition to king mackerel, species that were reported as taken include Spanish mackerel, amberjack, and blackfin tuna. I did not observe depredation of these species, most likely since they were rarely caught during this study; however, depredation has been reported from the Spanish mackerel fishery (Read et al 2003).

I observed bottlenose dolphins following the fishing vessels in this study only when they were engaged in fishing for king mackerel. Dolphins depredated only king mackerel. These observations indicate a possible bottlenose dolphin preference for king mackerel or a learned, successful feeding strategy. Barros (1993) conducted a thorough investigation on the feeding ecology of eastern Florida bottlenose dolphins and did not find king mackerel in the diet of these animals. The bottlenose dolphins observed in this study appeared healthy; therefore, I believe it is unlikely that the dolphins engaged in depredation due to a necessity for food. In addition, king mackerel troll fishermen have

reportedly observed female bottlenose dolphins "teaching" their calves how to depredate, indicating a behavioral transmission of knowledge. Therefore, I believe depredation of king mackerel by bottlenose dolphins results from a learned behavior for a low-energy foraging strategy rather than a preference for king mackerel.

Over three quarters of interviewed fishermen reported increasing conflicts with bottlenose dolphins, including depredation events, in recent years. The frequency of these interactions most likely result from a combination of factors including behavioral learning among marine mammals, increases in fishing effort, and spatial overlap and resource competition between cetaceans and fisheries (Donoghue et al 2002). In addition, an upsurge in depredation may be correlated to a rise in troll fishing effort that resulted from the July 1995 statewide ban of gillnets in Florida (Wells et al 1998).

The increase in depredation places bottlenose dolphins in close proximity to fishing vessels and gear, posing serious threats to their safety. Although not observed in this study, entanglement in and ingestion of fishing gear by bottlenose dolphins could potentially result from depredation. I observed a loss of fishing line and hooks due to depredation. Monofilament fishing line does not degrade rapidly and can cause behavioral changes, injury, or death to marine mammals through entanglement in or ingestion of fishing gear (Mann et al 1995). Previous research has documented the deaths of bottlenose dolphin calves through entanglement (Well et al 1998) and of mature adults through ingestion of line (Gorzelany 1999).

Harmful effects of fishing gear may pose a greater risk through entanglement and ingestion to young animals due to their playfulness, curiosity, inexperience, and unrefined motor skills either through depredation or interactions with discarded fishing

gear (Mann et al 1995, Wells et al 1998). As previously mentioned, king mackerel troll fishermen have reportedly observed female bottlenose dolphins "teaching" their calves how to depredate, which may threaten the well being of these calves.

Although a low depredation rate observed on charter boats suggests a low risk of conflicts to bottlenose dolphins, trash and used fishing gear discarded from these vessels may also endanger these animals. Management agencies have placed the majority of their time and energy into regulating commercial fisheries and largely have ignored the potential impacts of charter and recreational fishermen (Wells et al 1998). Management to reduce the negative consequences of fishery and marine mammal conflicts needs to address the activities of charter and recreational vessels, including the disposal of trash and fishing line (Wells et al 1998).

Fishermen also suffer from these conflicts with marine mammals in the form of economic loss due to lost or damaged gear and catch. Commercial fishermen reported a significantly higher economic loss than charter boat fishermen due to depredation. My observations confirm the potential for high economic loss by commercial fishermen due to lost fishing gear and depredation. Due to the cost to commercial fishermen, risk to marine mammal safety, and depredation ignored in fishing quotas, I investigated gear modification as a potential solution to reduce these conflicts (NMFS 1996). Gear modification has proven successful in decreasing depredation and bottlenose dolphin mortality through entanglement in the blue crab fishery in Florida, in reducing seabird bycatch in coastal gillnet fisheries, and in reducing sea turtle entanglement in shrimp trawlers (Noke and Odell 2002, Melvin et al 1999, Crowder et al 1994).

My preliminary tests demonstrated that a modification to the outrigger planar will successfully deter bottlenose dolphins from engaging in depredation, without causing a reduction in catch. I found no significant difference between the number of fish caught by each outrigger, indicating the deterrence device can be placed on either outrigger. While seasonality and a short testing period may influence results, I observed lower rates of depredation while using the deterrence device. Fishermen on Florida's east coast indicate spring, not winter when the tests were conducted, as the season with the highest number of depredation interactions. The deterrence device utilizes fishing gear already owned by most fishermen, thereby, reducing the cost of the gear modification. The deterrence device lessens the high cost of depredation by decreasing the detrimental interactions between fishermen and bottlenose dolphins.

The deterrence device could prove beneficial in reducing or perhaps eliminating fishery related injury or mortality of bottlenose dolphins in the king mackerel troll fishery that may result from retaliatory measures of some fishermen. The 1994 amendments to the Marine Mammal Protection Act of 1972 (MMPA) allow an operator of a fishing vessel to deter a marine mammal from damaging the gear or catch. However, potentially harmful methods, such as guns and seal bombs observed and reported in Florida's king mackerel fishery, are strictly prohibited (NOAA 1995). Violations of the MMPA could threaten the existence of the king mackerel fishery. Thus, the deterrence device gear modification offers an inexpensive solution to remove the need for illegal retaliatory measures and their associated harmful consequences. I recommend the deterrence device as a strategy for reducing depredation and its adverse effects on fishermen and bottlenose dolphins.

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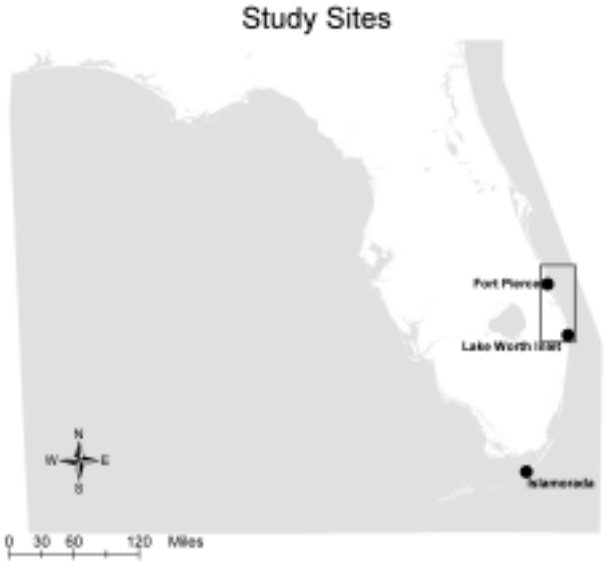

Chart 1: Surveys and observations were conducted in Islamorada in the Florida Keys and from Fort Pierce south to Lake Worth Inlet.

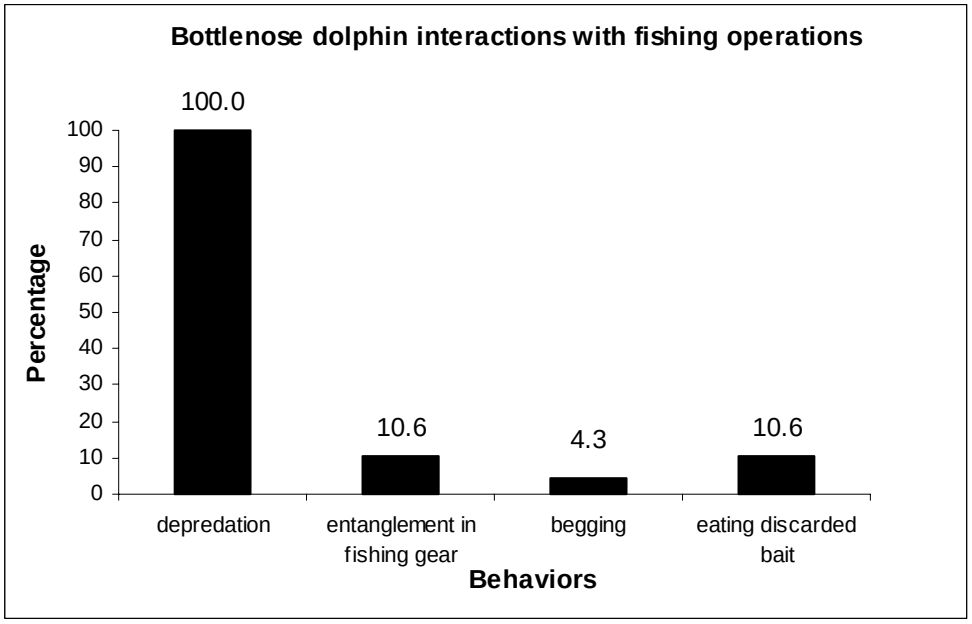

Figure 1: The percentage of bottlenose dolphin interactions with fishing operations as reported by surveyed commercial and charter fishermen.

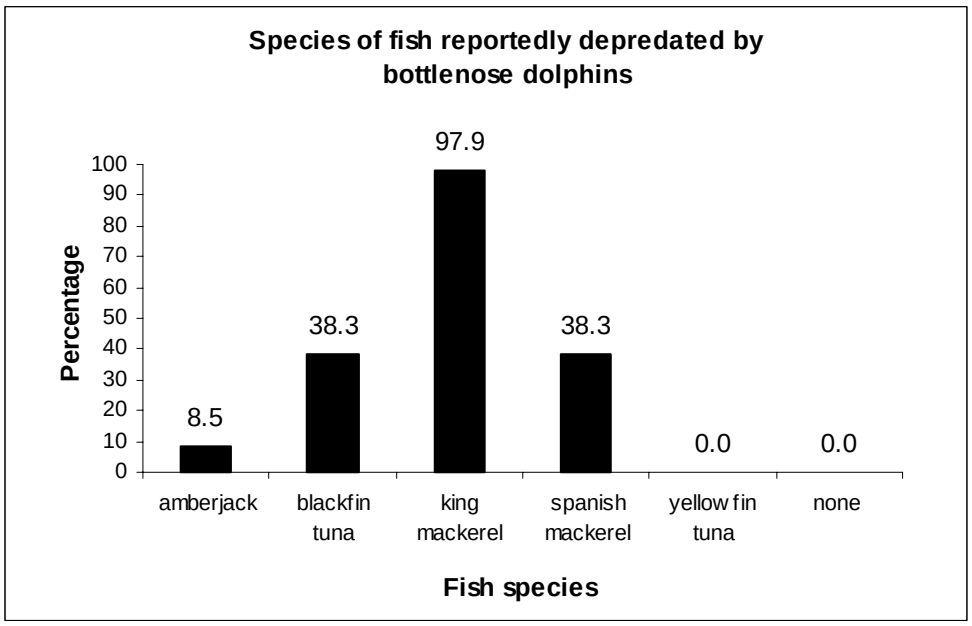

Figure 2: Fish species that fishermen reported were taken by bottlenose dolphins. No individuals reported depredation of yellowfin tuna, and all of the fishermen reported depredation of at least one of the listed fish species.

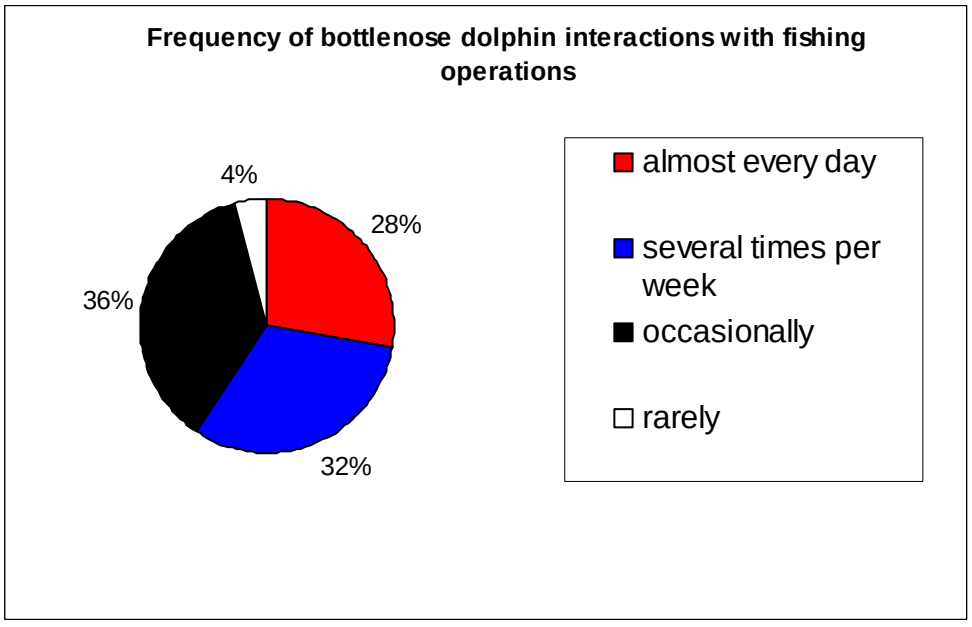

Figure 3: Frequency of bottlenose dolphin interactions with fishing operations that were reported by surveyed fishermen.

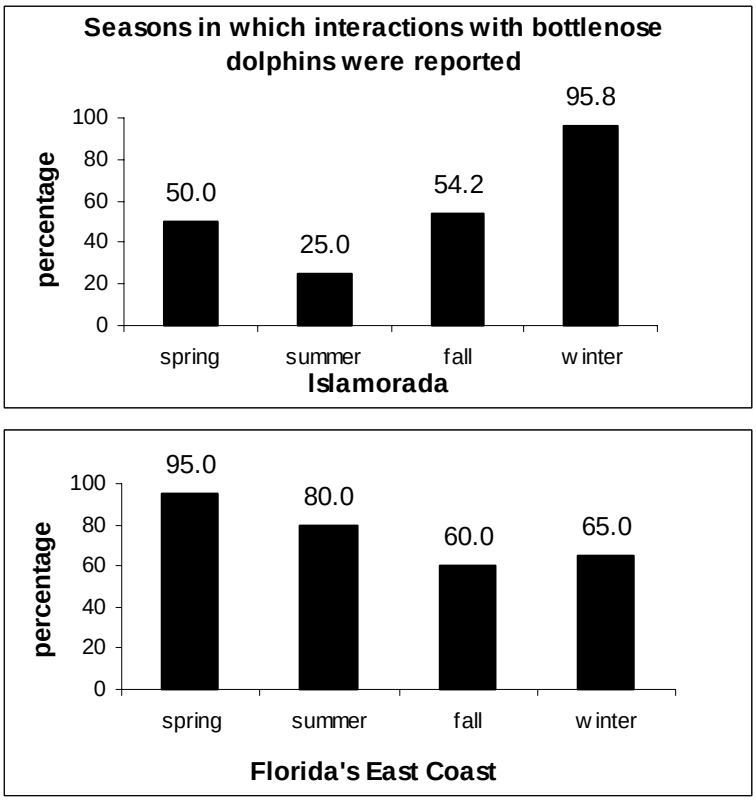

Figure 4: Seasons in which fishermen reported interactions with bottlenose dolphins.

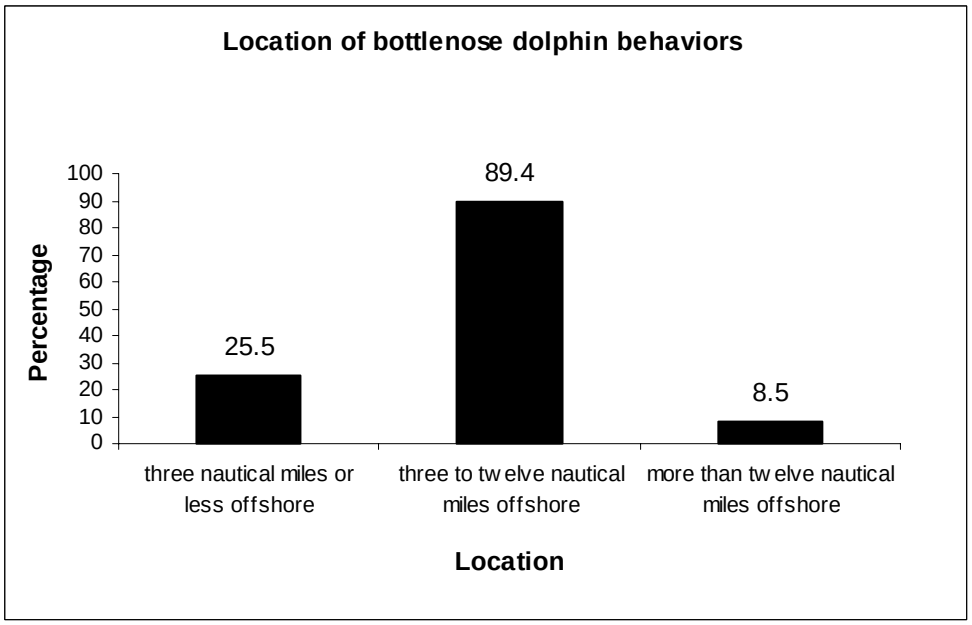

Figure 5: Location of interactions with bottlenose dolphins as reported by surveyed fishermen.

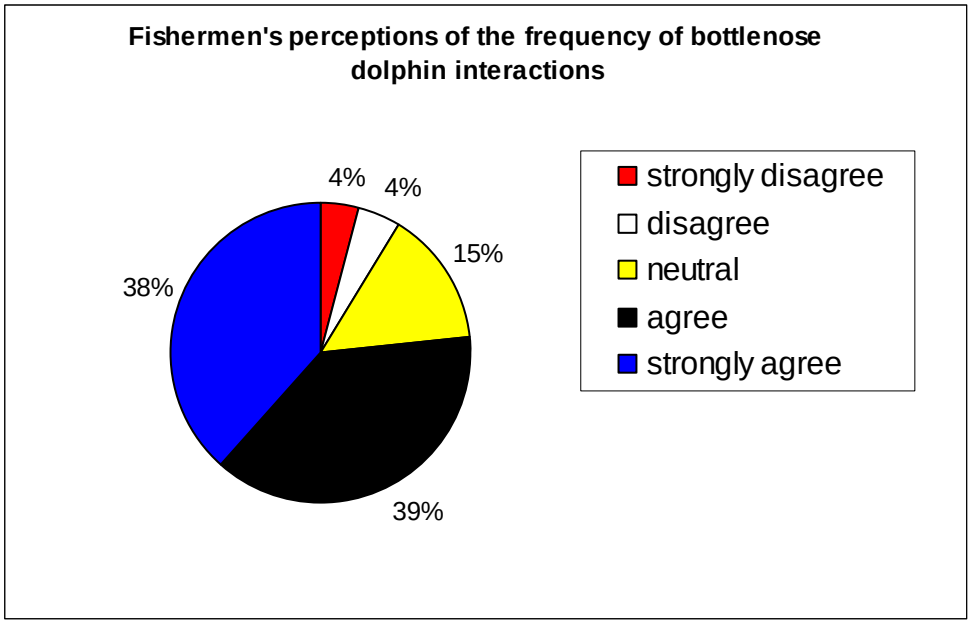

Figure 6: Fishermen's response to the statement: Bottlenose dolphin conflicts with my fishing efforts have increased over the past several years.

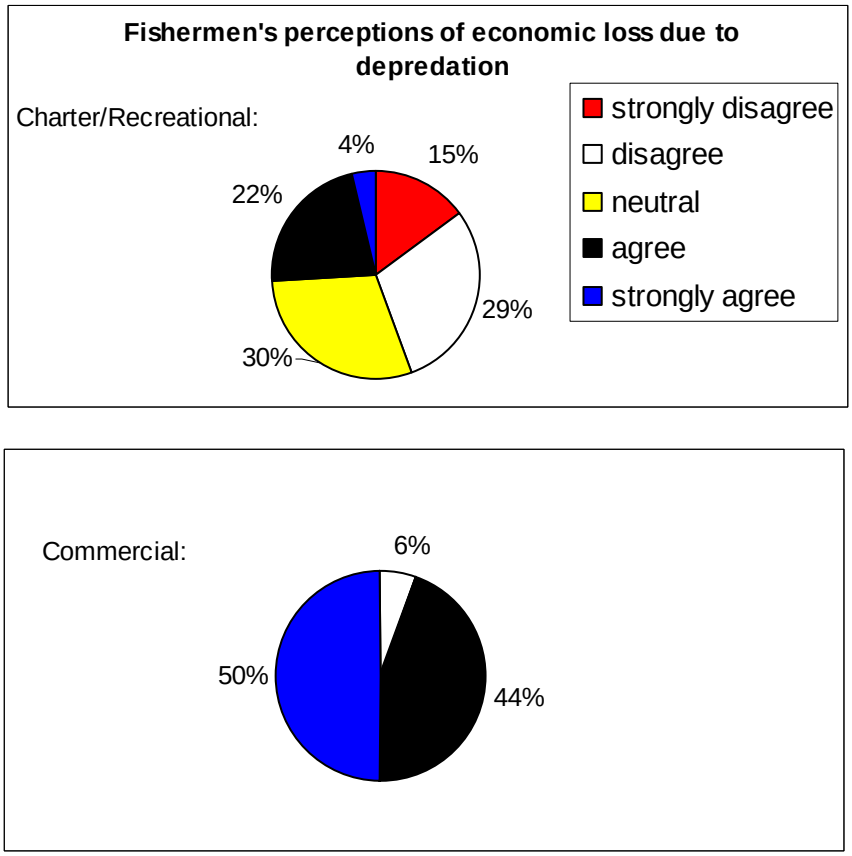

Figure 7: Fishermen's perceptions that interaction with bottlenose dolphins led to economic loss due to depredation.

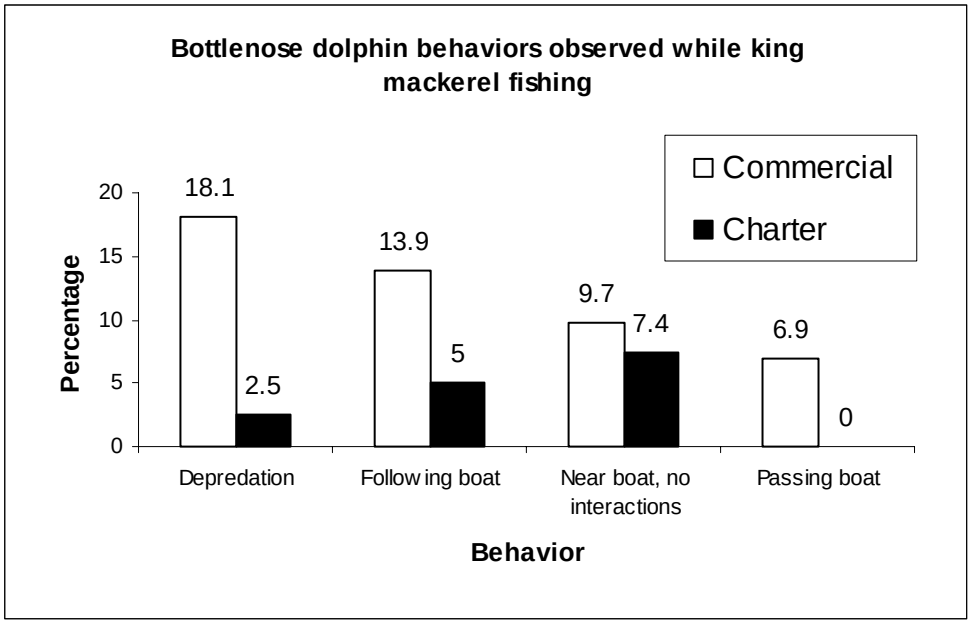

Figure 8: Bottlenose dolphin behaviors observed while vessel was engaged in king mackerel fishing.

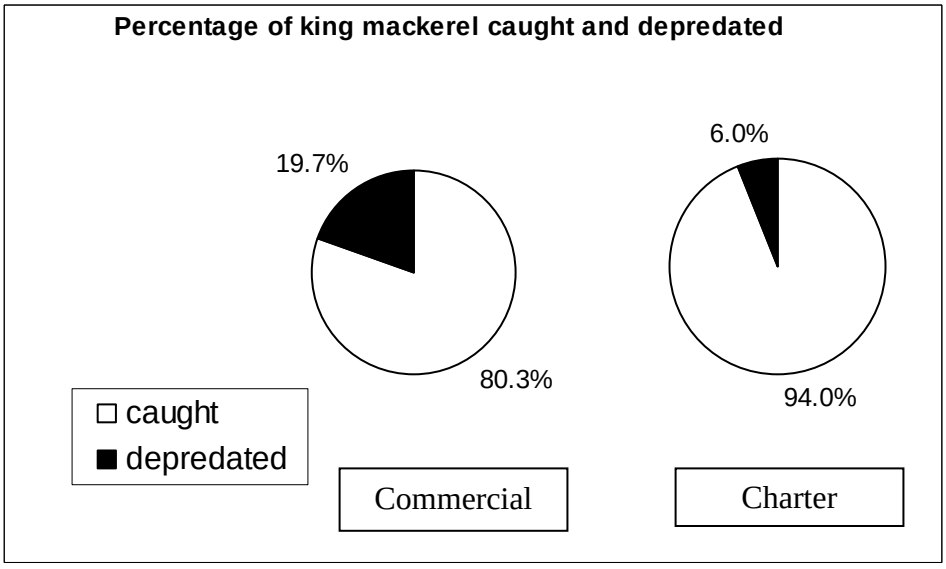

Figure 9: Percentage of king mackerel that was caught and depredated during observations on commercial and charter fishing vessels.

APPENDIX 1

You have been asked to participate in a survey concerning your interactions with marine mammals, such as dolphins and whales, while fishing. You participation in this survey is voluntary and will take approximately 10-15 minutes. The information gathered from this survey will be used for a master's project in conjunction with Duke University and will NOT be used to add regulations to your fishing activities. There are no correct or incorrect responses, so please feel free to express your opinions. You are free to skip any questions. I can guarantee that the answers you give me will be confidential-in no way will the information you provide me be connected with your name.

If you have any questions about your rights as a research participant at Duke University, please contact the chair of the Human Subjects Committee at (919) 684-3030.

If you agree to participate in this study, please continue the survey. If you do not agree to participate in the study, return the survey to the interviewer.

1) Which port do you fish from?

2) Which category below best represents the areas that you fish for King Mackerel (Kingfish)?

- ☐ Offshore three nautical miles or less
- ☐ Three to twelve nautical miles offshore
- ☐ More than twelve nautical miles offshore

3) Please indicate the type of fishing boat you operate.

- ☐ Commercial
- ☐ Charter
- ☐ Recreational

4) Which species of fish do you fish for? Please check all that apply.

- ☐ Amberjack
- ☐ Blackfin Tuna
- ☐ King Mackerel (Kingfish)
- ☐ Spanish Mackeral
- ☐ Yellowfin Tuna
- ☐ None of the above

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5) Which types of fishing gear do you use? Please check all that apply.

- ☐ Lure
- ☐ Live Bait
- ☐ Longline
- ☐ Gillnet
- ☐ Trawl
- ☐ Troll

Other

The next questions refer to the bottlenose dolphin which is the marine mammal commonly referred to as porpoise to avoid confusion with dolphin fish.

6) Do you see or interact with bottlenose dolphins, commonly referred to as porpoise, while fishing? If you answer yes, please continue to the next question. If you answer no, you have completed the survey. Thank you for your time.

- ○ Yes
- ○ No

7) Which behaviors of bottlenose dolphins do you observe while fishing? Please check all that apply.

- ☐ Stealing bait or catch
- ☐ Entanglement in fishing gear
- ☐ Begging
- ☐ Eating discarded bait
- ☐ None of the above

Other

8) If you see any of the behaviors listed in question 7, how often do they occur?

- ○ Almost every day
- ○ Several times a week
- ○ Occasionally
- ○ Rarely
- ○ Other

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9) If you see any of the behaviors in question 7, please explain where they most often occur.

- [ ] Three nautical miles of less offshore
- [ ] Three to twelve nautical miles offshore
- [ ] More than twelve nautical miles offshore

Other

10) For the behaviors selected in question 7, do believe that:

- [ ] Only a few dolphins are involved?
- [ ] All dolphins engage in the behaviors?
- [ ] No opinion

11) Which types of fish do bottlenose dolphins steal most often?

- [ ] Amberjack
- [ ] Blackfin Tuna
- [ ] King Mackerel (Kingfish)
- [ ] Spanish Mackeral
- [ ] Yellowfin Tuna
- [ ] None of the above

12) When do most of your interactions with bottlenose dolphins occur? Please check all that apply.

- [ ] Spring
- [ ] Summer
- [ ] Fall
- [ ] Winter

13) Which months do the majority of your interactions with bottlenose dolphins occur?

Please select the description that best describes how you feel about the following statements:

14) Bottlenose dolphin conflicts with my fishing efforts have increased over the past several years.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
○	○	○	○	○

15) Bottlenose dolphins are causing economic loss to my business by stealing bait and/or catch.

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

16) How do you respond to a bottlenose dolphin interfering with your fishing efforts? Please check all that apply.

- ☐ Cut fishing line
- ☐ Move to a different fishing ground
- ☐ Allow dolphins to eat bait/catch
- ☐ Increase boat speed
- ☐ Throw objects/shoot gun to scare dolphin
- ☐ None of the above

Other

17) Please feel free to add additional comments regarding your conflicts with bottlenose dolphins.

18) Have you had the following problems:

- ☐ Turtle caught in cast net?
- ☐ Birds hooked on lines?
- ☐ None of the above

Other

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Thank you for your participation in this study.