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# Sea Turtle, Shark, and Dolphin Bycatch Rates by Artisanal and Semi-Industrial Fishers in Maio Island, Cape Verde

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Abstract. – **Marine animals including turtles, sharks, and dolphins are bycaught at an alarming rate worldwide, although the extent of this bycatch is rarely quantified. Here, we assess the frequencies of turtle, shark, and dolphin bycatch by fisheries operating artisanal and semi-industrial boats in the Island of Maio, Cape Verde. Among all interviews (*n* = 139), fishers reported higher shark bycatch (71%) than turtle (32%) and dolphin (9%) bycatch. However, we found no difference in turtle bycatch between artisanal and semi-industrial fishers. Artisanal fishers and semi-industrial fishers caught mostly loggerhead turtle (76%, 48%) followed by the green turtle (6%, 38%). We need further studies that specifically target bycatch and the type of gear used by fishers and verify whether the reported frequencies correspond to actual bycatch rates.**

Key Words. – ***Caretta caretta*; marine megafauna; loggerhead; marine mammals; small-scale fisheries; West Africa**

The world's fisheries (Kelleher 2004; Aish et al. 2005) discard an estimated 73 million tons of nontarget catch (bycatch) annually. Bycatch refers to the incidental taking of individuals of a species other than the target species for which the fishing gear was set (Lum 2006; Moore et al. 2010). Species accidentally caught that are deemed to have commercial value are usually kept. However, that is not always the case and some species are discarded at sea (Cook 2003). Bycatch occurs not only when fishing gear is being actively used, but also when it has been lost or abandoned, which is commonly known as ghost fishing (Reeves et al. 2013). In these circumstances, the animal swims away injured by the fishing gear or it is unable to free itself, and eventually dies.

The Millennium Ecosystem Assessment (MA) found that overexploitation, including bycatch, is currently the most widespread and direct driver of change and loss of global marine biodiversity (MA 2005). Other major drivers include habitat destruction, pollution, climate change, and the spreading of exotic species (Pauly et al. 2005; Brander 2008; Gilman et al. 2009). Many species of migratory megafauna have delayed reproduction and low fecundity, making their population vulnerable to bycatch of reproductively valuable, late juvenile and adult individuals, especially where they overlap with intense fisheries (Heppell et al. 2005; Peckham et al. 2007; Zydelis et al. 2009; Senko et al. 2013). Sea turtles, cetaceans, seabirds, elasmobranchs, and many fish species are particularly vulnerable to local population declines because of their slow reproduction rates (Food and Agriculture Organization of the United Nations [FAO] 1999a, 1999b, 2005; Gilman and Lundin 2009). As migratory species, they occupy a broad geographic range traversing international boundaries and oceanographic features. Because most large marine vertebrates occupy different ocean habitats during their different life stages, spatially distinct fisheries operations can have differential impacts on the same population of animals (Wallace et al. 2008). For example, shark species are often vulnerable as a result of their life history, which is characterized by low fecundity, slow growth, and late sexual maturity (Diop and Dossa 2011). In addition, they show a low capacity to recover once their population has been overexploited (Diop and Dossa 2011). It has been estimated that 73 million sharks are killed worldwide each year, either as direct targets or as bycatch (Diop and Dossa 2011). Moreover, bycatch in marine capture fisheries is putting some species in these groups at risk of extinction (FAO 1999a, 1999b, 2005; Gilman and Lundin 2009; Gilman et al. 2009), constituting a major challenge for the conservation of marine megafauna (Lewison et al. 2004). For example, cetacean species, particularly dolphins, are under increasing pressure due to bycatch, mainly from drift gillnets, purse seines, and midwater trawls (Lewison et al.

2004). For instance, bycatch in gillnets continues to affect many Odontoceti species; where 61 of 74 recognized species (82%) have reportedly been bycaught in some kind of fishing gear somewhere in their range since 1990, and 56 species (76%) have been bycaught in gillnets (Reeves et al. 2013).

Globally, bottom trawling, longline fishing, and gillnet fisheries are the primary sources of turtle, shark, and dolphin bycatch (Lewison et al. 2004). Marine megafauna interact with these and other types of fishing gear because they occupy broad geographic ranges, spanning geopolitical boundaries and oceanographic regions that support many different fisheries. For instance, the frequency of interactions (defined as accidental encounters with fishing gear that can result in injury and possibly death) depends on spatiotemporal overlap between critical habitat for a given species and fishing activities, encompassing a wide range of fishing methods and gear characteristics (Wallace et al. 2008).

For many years, attention to bycatch issues has focused almost exclusively on industrial fisheries (Soykan et al. 2008; Moore et al. 2010). However, recent evidence has highlighted the potential for artisanal fishers in developing countries to have significant negative impact on these large marine vertebrates (Pauly 2006; Moore et al. 2010). Artisanal fisheries are globally ubiquitous and may account for $> 95\%$ of the world's fishers (Pauly 2006; Moore et al. 2010), so the scope of this issue may be substantial (Moore et al. 2010). New telemetry data reveal that migratory megafauna frequent coastal high-use areas well within the range of small-scale fisheries, potentially producing high rates of bycatch mortality with grave conservation consequences for vulnerable populations (Block et al. 2005; James et al. 2005; Peckham et al. 2007). Therefore, it is crucial to determine the mortality rate due to bycatch and its impacts on marine populations in order to devise the most suitable conservation strategies (Cook 2003). As the removal of species from an ecosystem can cause it to change and as overfishing puts pressure on these species, bycatch can accelerate such effects. Such cumulative effects may result in the reduction of predatory species, increasing the abundance of scavengers, and increasing the number of species of smaller size with early maturity and higher reproductive rates (Cook 2003).

Five species of sea turtles have been observed in the Cape Verde archipelago. The loggerhead turtle (*Caretta caretta*), as part of the North Eastern subpopulations, is listed as endangered. The leatherback turtle (*Dermochelys coriacea*) and olive ridley turtle (*Lepidochelys olivacea*) are listed as vulnerable. The hawksbill turtle (*Eretmochelys imbricata*) is listed as critically endangered, and the green turtle (*Chelonia mydas*) is listed as endangered (International Union for Conservation of Nature [IUCN] 2016). The loggerhead turtle is the only species known to nest in significant numbers in the Cape Verde Islands, while the green turtle and the hawksbill turtle are known to feed in the archipelago's waters (Marco et al. 2011). Cape Verde supports the third largest population of loggerhead sea turtles (Marco et al. 2011). According to the National Directorate of the Environment, Cape Verde registered 29,249 nests during the 2012 turtle season (Direção Nacional do Ambiente [DNA] 2013). Even though sea turtles are protected by the National Decree laws n° 7/2002 and n° 53/2005 (Ministério do Ambiente, Habitação e do Ordenamento do Território [MAHOT] 2005; Merino et al. 2012), conservation efforts have faced many obstacles due to traditional consumption of their meat and eggs, and the belief in their medicinal value (Marco et al. 2011).

The most frequently captured sharks in Cape Verde are the smooth-hound shark (*Mustelus mustelus*), the tiger shark (*Galeocerdo cuvieri*), and the blue shark (*Prionace glauca*; MAHOT 2014). The National Resolution n° 56/2014 of 31 July, BO n° 18-Serie I, prohibits the capture of sharks exclusively to remove its fins, in addition to prohibiting the removal of shark fins onboard. Moreover, all the species protected from consumption and commercialization under Cape Verde's law are listed either as vulnerable or endangered under the International Union for Conservation of Nature Red List. Under this protection are the whale shark (*Rhincodon typus*), white shark (*Carcharodon carcharias*), hammerhead shark (*Sphyrna zygaena, Sphyrna lewini, Sphyrna mokarran*), basking shark (*Cetorhinus maximus*), oceanic whitetip shark (*Carcharhinus longimanus*), porbeagal shark (*Lamna nasus*), and thresher shark (*Alopias superciliosus*; MAHOT 2014).

Twenty-four cetacean species migrate through or reside in Cape Verde waters (MAHOT 2015). According to Cape Verde's law, n° 53/2005 section 41, it expressly prohibits the hunting and capturing of marine mammals in the maritime space under national jurisdiction with no spatial and temporal restrictions (MAHOT 2015). Unfortunately, there are no quantified data on the bycatch rate of any cetacean species in the country that we could include in this article, leading us to believe that this is the first study that tries to determine the bycatch impacts on cetaceans species.

The objective of this study was to assess and compare the impact of artisanal and semi-industrial fisheries on the frequency of bycatch of turtles, sharks, and dolphins around the island of Maio. Furthermore, we aimed at mapping the areas around Maio where sea turtle bycatch usually occurs.

## METHODS

*Study Area.* — Maio is the oldest island of the archipelago (Wadham 2011), and has the second-largest continental platform in the country, with water rich in phytoplankton as a result of the direct positive influence of the underwater current (Benchimol et al. 2008). Maio's coastal primary productivity thus supports both artisanal and semi-industrial fisheries, and the occurrence of turtles, sharks, and dolphins.

*Fishing Fleet.* — In the island of Maio, all fishing boats are artisanal, ranging from 3.5 to 6.5 m (Ministério das Infra-Estruturas e Economias Marítimas [MIEM] 2011), with 2–3 fishers onboard. The fishers target mainly bluespotted seabass (*Cephalopholis taeniops*), moray eel (*Muraenida* spp.), wahoo (*Acanthocybium solandri*), yellowfin tuna (*Thunnus albacares*), and the Atlantic emperor (*Lethrinus atlanticus*). On the other hand, the semi-industrial boats that fish around Maio usually come from the capital city of Praia, located in the island of Santiago, and are larger than 6.5 m (Ministério do Ambiente, Agricultura e Pesca [MAAP] 2004), usually carrying 10 fishers. They target mainly mackerel (*Decapterus* spp.), bigeye scad (*Selar crumenophthalmus*), and frigate tuna (*Auxis thazard*).

Based on the official 2011 census, Maio has 204 artisanal fishers and 68 registered artisanal boats (MIEM 2011). There are 30 semi-industrial and industrial vessels in Santiago Island, all of which fish in Maio (MIEM 2011). We interviewed 109 artisanal fishers from the island of Maio in addition to 30 semi-industrial fishers, from the island of Santiago that were operating in Maio.

*Structured Interviews.* — We conducted structured interviews with 52 questions in the local language of Portuguese Kriolu, from mid-January to mid-March 2014. We surveyed 8 fishing communities from Maio, and 6 semi-industrial boats at the island of Santiago's main landing port. From the 139 fishers approached for an interview, only 4 refused to participate. The interviewed fishers ranged in age between 19 and 61 yrs old, and their experience in fishing activities varied between 1 and 45 yrs. Interviews lasted 14 min on average. We started the interviews with a brief description of the purpose of the project. To help with the species identification, we provided photo identification for each species of turtle and shark found in Cape Verde. Fishers had some difficulty identifying dolphin species; therefore, we only provided one photo illustrating one species for general identification purpose.

To do statistical analyses and determine bycatch frequencies, we used data on fishers' profile and their fishing activity (i.e., age, years as fisher, fishing techniques, fishing location, and fishing duration). We coded responses of fishers as binary variables with 1 and 0 representing "yes" and "no" answers, respectively. We attributed the exact corresponding number to questions that required an exact answer, such as the number of fishers per boat at sea. Questions that dealt with intervals, such as the hours spent at sea, we coded as 1–2 hrs = 1, 3–5 hrs = 2, > 5 hrs = 3. To analyze the data, we used the chi-square test for association and the table for descriptive analyses from the Minitab 17 statistical model (Minitab Statistical Software). The dependent variable was whether the species was captured or not; and the independent variables were the age, years of experience, fishing effort (i.e., number of days per week at sea $\times$ number of hours per day at sea), and whether fishers had alternative jobs or not. Although fishers tended to keep turtles mostly to sell them in town for additional income, most commented that if they had an additional job besides fishing to support their families, they would not capture sea turtles. To test whether having a secondary job affects fishers' decision to keep a turtle or not, we also added this variable to the model.

## RESULTS

Among all fishers ($n$ = 139), 71% reported catching sharks, 32% reported catching turtles, and 9% reported catching dolphins. Those who reported catching turtles also reported catching sharks ($\chi^2$ = 26.012, degrees of freedom (df) = 1, $p < 0.001$). In addition, fishers who caught sharks also caught dolphins, ($\chi^2$ = 5.307, df = 1, $p$ = 0.021). However, there was no association between catching turtles and dolphins ($\chi^2$ = 0.017, df = 1, $p$ = 0.896).

The location of highest bycatch overlapped with the most intensely fished areas (Figs. 1 and 2). Banca was the fishing ground with the highest frequency of artisanal fishers who also reported the highest frequency of turtle bycatch (i.e., $\geq$ 35 artisanal fishers). On the other hand, Calheta was the fishing ground with the highest frequency of semi-industrial fishers that also reported the highest frequency of turtle bycatch (i.e., 10–14 semi-industrial fishers; Figs. 1 and 2).

Artisanal fishers in Maio use mainly line and hook, whereas semi-industrial fishers use mainly purse seines and surface longline (Table 1). Of the 6 semi-industrial boats surveyed, 5 use purse seines and 1 uses surface longlines. Although they were using different fishing gears, the frequency of turtle bycatch reports was not substantially different between artisanal (31%) and semi-industrial fishers (33%). The most reported turtle species captured per fisher was the loggerhead turtle with 76% and 46% of bycatch report by artisanal fishers and semi-industrial fishers, respectively, followed by the green turtle with 6% and 38% (Fig. 3). Regarding shark species, the most common reported species was the lemon shark with 38% and 35% by artisanal fishers and semi-industrial fishers, respectively, followed by the nurse shark with 27% and 14%.

Artisanal fishers reported fewer dolphin and shark bycatch than semi-industrial fishers (dolphins: $\chi^2$ = 6.267, df = 1, $p$ = 0.012; sharks: $\chi^2$ = 12.084, df = 1, $p < 0.001$), whereas turtle bycatch was unrelated to whether the vessel was artisanal or semi-industrial ($\chi^2$ = 0.050, df = 1, $p$ = 0.823). The use of nets predicts shark bycatch ($\chi^2$ = 40.417, df = 4, $p < 0.001$), but not turtle bycatch ($\chi^2$ = 6.817, df = 4, $p$ = 0.146).

Overall, using logistic regression models (Table 2), the bycatch of turtles, sharks, and dolphins was not

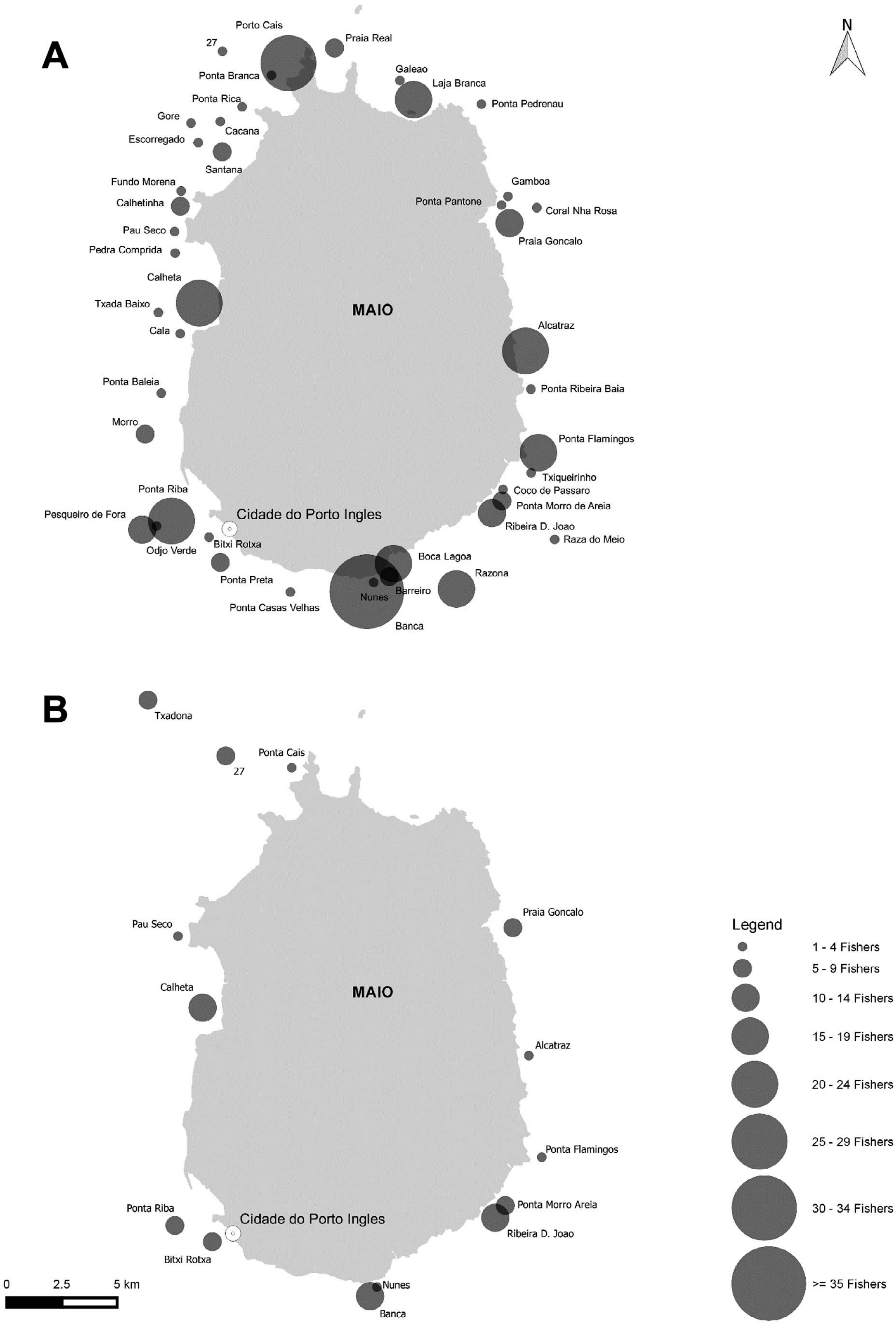


**Figure 1.** Frequency of fishers operating in fishing grounds in Maio, Cape Verde, by (A) 109 artisanal fishers (from Maio), and (B) 30 semi-industrial fishers (from Santiago).

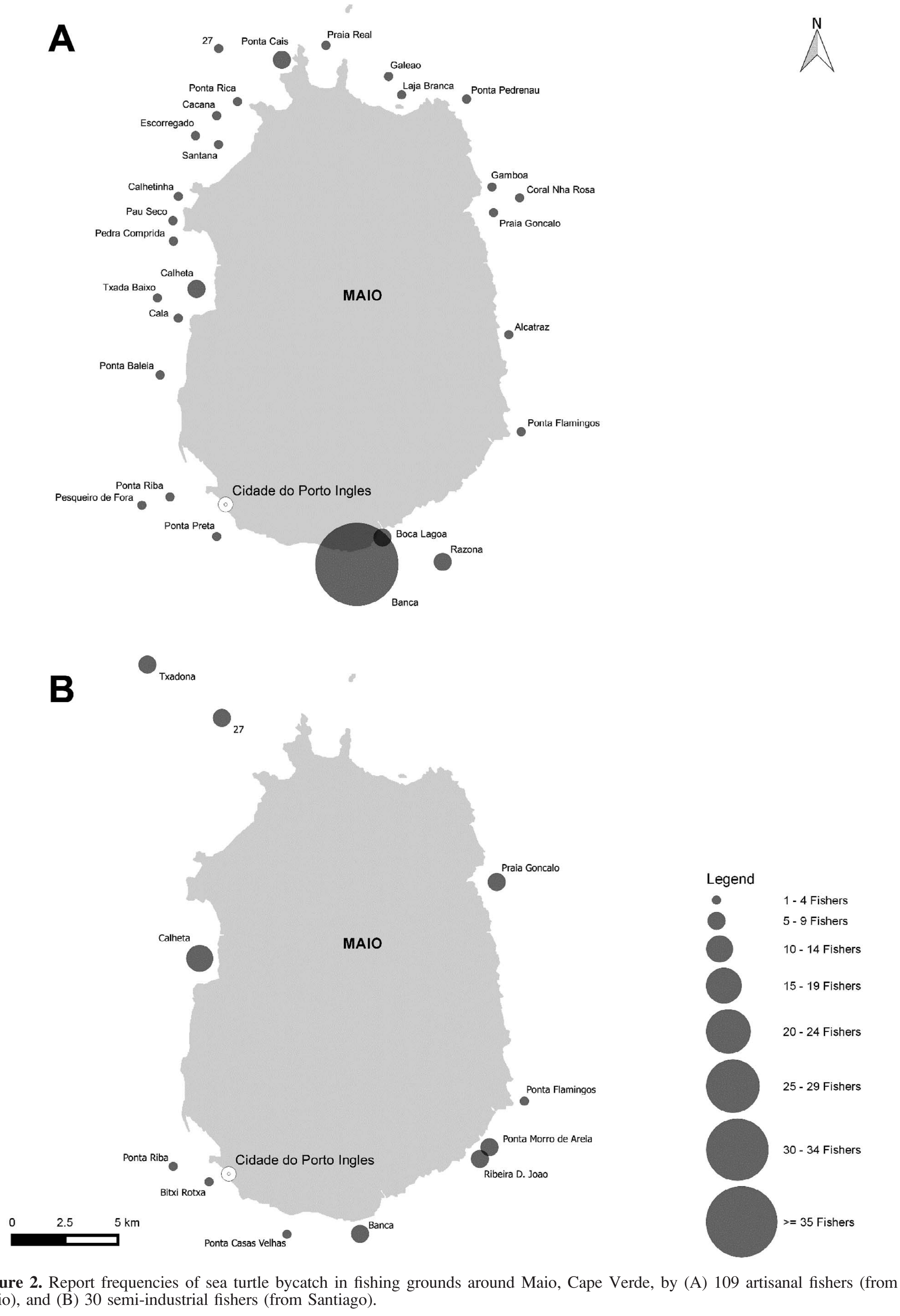


**Figure 2.** Report frequencies of sea turtle bycatch in fishing grounds around Maio, Cape Verde, by (A) 109 artisanal fishers (from Maio), and (B) 30 semi-industrial fishers (from Santiago).

**Table 1.** Fishing techniques used by fishers in the island of Maio, Cape Verde. Note that individual fishers may use several techniques, so the percentages add up to > 100. All fishers from Maio used artisanal boats, whereas all fishers from Santiago used semi-industrial boats. ($n$ = 109 artisanal fishers plus 30 semi-industrial fishers)

| Fishing technique | Maio (%) | Praia (%) |
|---|---|---|
| Line and hook | 77 | 7 |
| Free diving | 12 | 3 |
| Scuba diving | 12 | 0 |
| Nets | 0 | 97 |

**Table 2.** Logistic regression of 3 types of bycatch in the island of Maio, Cape Verde. The $R^2$ values for the whole model and $\chi^2$ and $p$-values for each explanatory variable are provided.

| Variable | $\chi^2$ | $p$ |
|---|---|---|
| Model 1. Response variable: turtle bycatch ($R^2$ = 3.63%) | | |
| Age | 0.68 | 0.411 |
| Other job | 3.34 | 0.067 |
| Years fishing | 2.36 | 0.125 |
| Fishing effort | 0.01 | 0.93 |
| Model 2. Response variable: shark bycatch ($R^2$ = 2.07%) | | |
| Age | 0.88 | 0.349 |
| Other job | 3.00 | 0.084 |
| Years fishing | 0.63 | 0.429 |
| Fishing effort | 0.07 | 0.788 |
| Model 3. Response variable: dolphin bycatch ($R^2$ = 4.12%) | | |
| Age | 1.55 | 0.213 |
| Other job | 0.47 | 0.493 |
| Years fishing | 2.41 | 0.12 |
| Fishing effort | 0.21 | 0.649 |

predicted by the fishers' age, years of experience, fishing effort, and whether or not they had alternative jobs.

## DISCUSSION

Loggerhead turtles have the highest number of bycatch reports by fishers, followed by green turtles. The overlap of fishing grounds with feeding areas of green turtles and mating areas of loggerhead turtles may be related to their high bycatch frequencies, when compared with other turtle species such as the leatherback, which is found in lower frequency in the area. We found differences when comparing turtle bycatch by fisheries type. Artisanal fishers were more prone to capture loggerhead turtles, whereas semi-industrial fishers showed higher probability to capture green turtles. The fishing grounds with the highest bycatch rate were different for artisanal and semi-industrial fishers. For instance, Calheta is possibly an important feeding ground for green turtles, which could be related to the high rate of bycatch of this species by semi-industrial fishers (Fig. 2). On the other hand, a 2012 sea turtle conservation campaign report, registered a greater loggerhead activity in the south region (DNA 2013). Hence, Banca shows a considerably high bycatch rate of loggerhead sea turtles by artisanal fishers. However, we need further research to support these claims because knowledge about the distribution of green turtles in the island of Maio is still scarce. Our study did not collect detailed data on the fishing gear used by artisanal and semi-industrial fishers. As a result, we do not have information on the type of hook used by artisanal fishers or the net mesh size used by semi-industrial fishers. Moreover, because we did not test the bycatch rate per fishing gear used, we are unable to determine why artisanal fishers captured more loggerhead turtles and why semi-industrial fishers captured more green turtles.

This study was the first of its kind in Cape Verde because it investigated bycatch rates across different species of marine megafauna by both artisanal and semi-industrial vessels. The most recent bycatch study, conducted in 2012, looked at bycatch rates of different

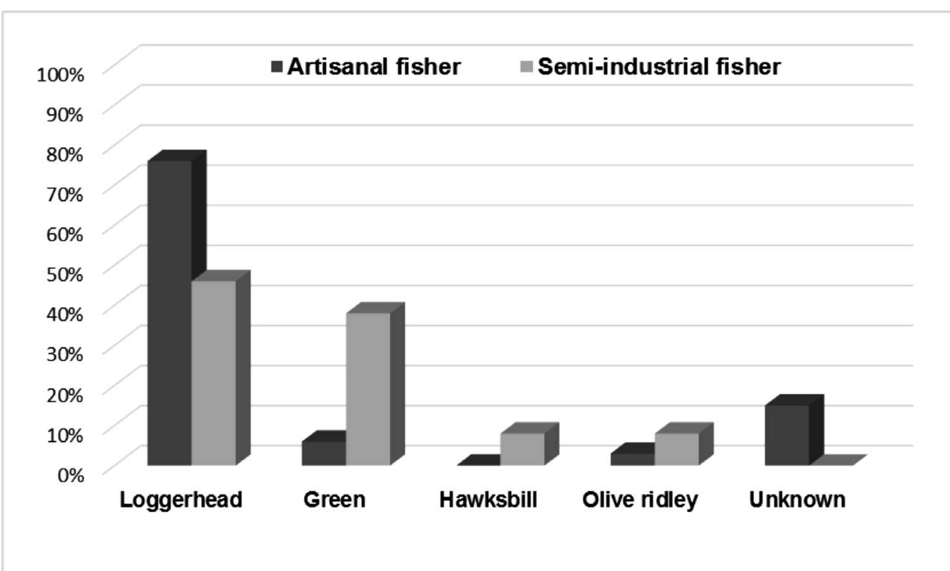


**Figure 3.** Report frequencies of turtle species bycatch by 109 artisanal fishers around Maio, Cape Verde (from Maio) and 30 semi-industrial fishers (from Santiago).

turtle species by artisanal fishers in Maio, Boavista, and Santiago islands, in which the most captured species, were also the loggerhead and green turtles (Monteiro 2012). This study provides interesting results that point to a pattern of bycatch rates across turtle species. However, we should consider these data carefully because of their limited scope. For instance, the data are based on only four interviews in Maio. In addition, the study did not present the bycatch results across turtle species separately for each island, which prevents us from making further comparison with our results in Maio. We hope that other similar studies will follow that study in presenting more detail about the type of gear used and the number of turtles captured per boat.

The statistical analyses could not determine whether there was a disparity on the frequency of reported turtle bycatch between artisanal and semi-industrial fishers. Owing to the existing national law protecting sea turtles, fishers showed some apprehension in responding to questions related to sea turtle bycatch, resulting in many fishers not admitting to catching turtles. As a result of the low bycatch numbers reported, the statistical analysis was unable to determine any differences in turtle bycatch rate between artisanal and semi-industrial fishers.

Although other fishing grounds, such as Porto Cais, had a higher percentage of fishers, they had lower bycatch rate that could be explained by the turtle distribution around the island, which may vary depending on the species.

Artisanal and semi-industrial fishers reported greater shark than sea turtle bycatch. Fishers often complained about having to fight off the sharks when they were fishing. Many times, instead of releasing the sharks, fishers decide to kill them to avoid repeated encounters. Moreover, fishers also kills sharks to avoid losing their catch or bait (Read 2008). Even though there are national laws protecting a few shark species, many fishers are unaware of their existence, which can explain their openness in admitting catching sharks. Shark–human conflict is the main reason for such a high frequency of shark bycatch in the island of Maio, which could be an indication that these fishing grounds may overlap with sharks' feeding grounds. Lemon and nurse sharks are the most frequently caught shark species in the island, suggesting that they are the most species commonly found around the fishing grounds of Maio, or that the fishing gear used and/or bait type are more prone to capturing these species. Based on our analyses, nets predicted shark bycatch, but not turtle bycatch. Different factors could explain such findings. For instance, the fishing gear and depth where fishers operate can have more impact on shark catches. A study that presented information on shark bycatch per gear used in fisheries showed that different gear type used at different depth leads to the bycatch and mortality of different shark species (Cosandey-Godin and Morgan 2011). For example, pelagic longlines had the highest mortality rates for night shark (*Carcharhinus signatus*), silky shark (*Carcharhinus falciformis*), and bigeye thresher shark (*A. superciliosus*), but tended to have lower mortality rates for tiger shark and blue shark. Bottom longlines had the higher mortality rates for sharpnose (*Rhizoprionodon terraenovae*) and blacktip shark (*Carcharhinus limbatus*; Cosandey-Godin and Morgan 2011). Another example is a study that examined bycatch rates of different sea turtle species by commercial gillnet gear in the US mid-Atlantic region, which found a correlation between sea turtle bycatch and latitude, sea surface temperature, and mesh size (Murray 2009). Moreover, generalized additive model analyses indicated that higher bycatch rates occurred in southerly latitudes, and that bycatch rates increased with increases in sea surface temperature and mesh size (Murray 2009). These studies indicate that we should take into account different variables when analyzing bycatch rate of marine megafauna.

Semi-industrial fishers reported a higher rate of dolphin and shark bycatch than artisanal fishers. Purse seines and surface longlines are used by semi-industrial fishers, and are among the leading causes of marine megafauna bycatch of (Lewison et al. 2004); thus, they possibly contributed to the high bycatch rates of dolphins and sharks. Determining the mortality rate of sea turtles, sharks, and dolphins with different fishing gear used by fishers in Cape Verde will provide crucial information for bycatch mitigation plans for these species. In addition, it is very important to take a closer look at all bycatch implications such as depredation, ghost fishing, and cryptic bycatch because they all directly or indirectly negatively affect marine megafauna.

Comparing artisanal and semi-industrial fishers' responses presented many challenges because of their different techniques and gears used. In our study, the sample size of semi-industrial fishers was considerably smaller than artisanal fishers and may not be representative. We thus suggest that on-board observations are crucial to corroborate the answers we obtained in the interviews.

Finally, the fishers' age, years of fishing experience, fishing effort, and whether they had alternative jobs did not influence turtle, dolphin, and shark bycatch. Even though many of the variables explained bycatch, other factors not accounted for in the analyses, such as the sea state, the weather conditions, soak time, and the bait used by fishers, may be of relevance.

Identifying dolphin species is challenging; thus, to ease the cognitive burden upon fishers, we did not include all dolphin species in our identification guides. Therefore, we could not gather detailed information on the bycatch rate across dolphin species. However, this study was the first to investigate dolphin bycatch in Cape Verde. Stranding and sighting reports provide most of the data collected on the dolphin species found around the archipelago. As a result, we lack more information on dolphin bycatch to compare with our study. We encourage other bycatch studies to include dolphin and other species, such as marine birds, mantas (*Manta* spp.), and mobulas rays (*Mobula* spp.), in order to produce valuable information on the bycatch of such marine megafauna in Cape Verde.

One important aspect to consider, especially in future studies and as a limitation of this project, is pseudoreplication during data collection. To maintain the fishers' anonymity, we did not identify interviewed fishers or the boats they operated. As a result, we possibly interviewed multiple fishers from the same boat, which has further limited our data analyses.

### Management Recommendations

Cape Verde is among the most important African countries regarding nesting and foraging areas for endangered sea turtle species. It is crucial to quantify bycatch rates in each of the major fisheries (Riskas and Tiwari 2013).

Immediate actions are required to help offset the mortality rate of marine megafauna. For instance, the use of circle hooks instead of the traditional J hooks, and changing bait from squid to fish have shown promising outcomes (Santos et al. 2012). Recent studies have shown great progress in using visual cues to help reduce sea turtle bycatch. For example, using light emitting diode (LED)–illuminated nets in gillnet fisheries can reduce green turtle bycatch by 63% (Ortiz et al. 2016). Aside from the illuminated nets with LED, light sticks have also shown promising results in reducing bycatch of green turtles by 60% without having a significant impact on the target catch and target values (Wang et al. 2010). These studies highlight the importance of using and understanding the sensory physiology of bycaught species as the foundation in the development of bycatch reduction technologies and suggests that similar technologies could be developed for other bycatch taxa (Southwood et al. 2008; Jordan et al. 2013; Martin and Crawford 2015). However, for this method or any other method to be effectively implemented, any future studies must take into account its cost and its implications for fishers, their target species catch, and the effect on other bycatch species (Ortiz et al. 2016).

Finally, fishers have an important role in the conservation of marine megafauna and reduction of bycatch. Fishers spend a significant part of their time at sea; therefore, over the years they have gained a significant amount of knowledge that is of great value to conservation. In order to gain their trust and make good use of their knowledge they should be made a part of conservation efforts. In addition, it is extremely important to find solutions that are affordable in order for them to be adopted by fishers. Moreover, onboard observers, combined with stricter inspection at all landing ports, will increase the effectiveness of monitoring, which is fundamental for future bycatch-mitigation plans.

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