Preliminary Data on Hawksbill Turtle (*Eretmochelys imbricata*) Bycatch in an Artisanal Gillnet Used Near Jaragua National Park, Dominican Republic

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ABSTRACT

Bycatch is a significant issue affecting fisheries management today and the incidental mortality of sea turtles in many fisheries is an important and often controversial conservation problem. Empirical data on the bycatch of turtles are lacking in artisanal and other small-scale coastal fisheries. For 10 days we conducted informal interviews with fishers, fishing net surveys, searched for strandings, and deployed fishing nets to quantify turtle bycatch in an artisanal fishery in the Dominican Republic. Our study area was a major feeding ground for hawksbill turtles within a Caribbean UNESCO Biosphere Reserve with artisanal fishers soaking nets daily. We calculated a catch per unit effort of 0.75 turtles/day (SD ± 0.96) from four experimental fishing trials using a bottom gillnet. With this CPUE and the daily bottom gillnets we encountered in surveys, we estimate a bycatch rate of ~1 turtle/day for our study area. We call for other rapid assessments that would aim to begin to quantify turtle bycatch from artisanal and other small-scale coastal fisheries to facilitate policy and management action protecting this critically endangered marine animal.

KEY WORDS: Sea turtles, Jaragua, Dominican Republic, bycatch, hawksbill

Cuantificación de la Captura Incidental de Tortuga Carey en una Pesquería Artesanal en el suroeste de la República Dominicana

La captura incidental es un problema importante que afecta el manejo de pesquerías y la mortalidad de tortugas marinas, constituyendo un tema de conservación controvertido. Existen muy pocos datos empíricos de captura incidental de tortugas marinas en pesquerías artesanales. Durante 10 días realizamos entrevistas a pescadores, inspecciones de redes de pesca y busquedas de varamientos, así como colocamos redes de pesca para cuantificar directamente la captura incidental de tortugas en una pesquería artesanal de la República Dominicana. El área de estudio fue un sitio de alimentación importante para tortuga carey (*Eretmochelys imbricata*), ubicado dentro de una Reserva de la Biosfera de la UNESCO. Allí los pescadores colocaban sus redes a diario. Calculamos una captura por unidad de esfuerzo de 0.03 tortugas/h (DE ± 0.04) y estimamos una alarmante captura incidental de ~1 tortuga/día. Es preciso hacer otras evaluaciones que cuantifiquen esta captura incidental en pesquerías artesanales para contribuir a las acciones de manejo y políticas de conservación para esta especie críticamente amenazada.

PALABRAS CLAVES: Tortugas, jaragua, Republica Dominicana, captura incidental, carey

INTRODUCTION

A major problem affecting sea turtle populations worldwide is their incidental capture during fishing activities, commonly referred to as bycatch. Studies reporting on the bycatch of turtles have mostly used data from large-scale fisheries (Henwood and Stuntz 1987, Carreta *et al*. 2005, Zeeberg *et al.* 2006). In some cases, the data have led to regulation to minimize turtle mortality, and several large industrial fisheries now use bycatch reduction devices (Henwood *et al.* 1992, Crowder *et al.* 1994, Watson *et al*. 2005). Turtle bycatch from artisanal fisheries, small-scale operations carried out by people who often rely on fishing to provide food for their families (Schoor 2005), are often overlooked in comparison to larger scale fisheries (Lewison and Crowder 2007).

In general, policy and management actions are delayed until conclusive evidence of the problem becomes available (Lewison *et al*. 2004). Small-scale fisheries account for 50 of the world's 51 million fishers (Berkes *et al*. 2001), but data on turtle bycatch from most of these are scant or evidence is anecdotal. As general indicators of turtle bycatch and mortality in artisanal and other small-scale coastal fisheries, some studies have examined the incidence of stranded turtles along coasts (Orrego Vásquez 2005, Koch *et al*. 2006), whereas others have interviewed local fishers (Chan *et al*. 1988, Lee Lum 2006). Very few studies have directly examined turtle bycatch in artisanal fisheries (Cheng and Chen 1997, Eckert and Eckert 2005, Bell *et al*. 2006).

The coast of Jaragua National Park in southwestern Dominican Republic is an important feeding area for juveniles of the *critically endangered* hawksbill turtle (*Eretmochelys imbricata*) (IUCN 2006, Meylan and Donnelly 1999). During the last ten years (1996 to 2006), observations on the size of hawksbill turtles encountered during in-water surveys along the coast of the park strongly indicate that the majority of individuals are juveniles (31 cm, SD ± 7, in straight-line carapace length, hereafter referred to as length) (León and Diez 1999, Y.L. Unpubl. data). Recapture rates have been low: 30 % of the 991 turtles tagged in the area during yearly surveys (10-year period) have been recaptured once, 0.7 % have been recaptured twice, and 0.1 % three times (Y.L. Unpubl. data). The extent that low recapture rates are a result of mortality or from migration away from the area is unknown. In this study, we conducted a rapid assessment of

turtle bycatch from the common gillnets used by artisanal fishers in the region of Jaragua National Park. This was done to provide initial data to begin facilitating policy action and the management of this artisanal fishery.

MATERIALS AND METHODS

In May 2006, five local fishers (four at Cabo Rojo and one Haitian fisher at Trudillé) and four ex-fishers (at Cabo Rojo) were asked if they had ever caught turtles in their nets (Figure 1). The interviews were conducted as informal conversations, so that the fishers would not be apprehensive. We inquired about the gear used, their catch, and the occurrence of turtle bycatch.

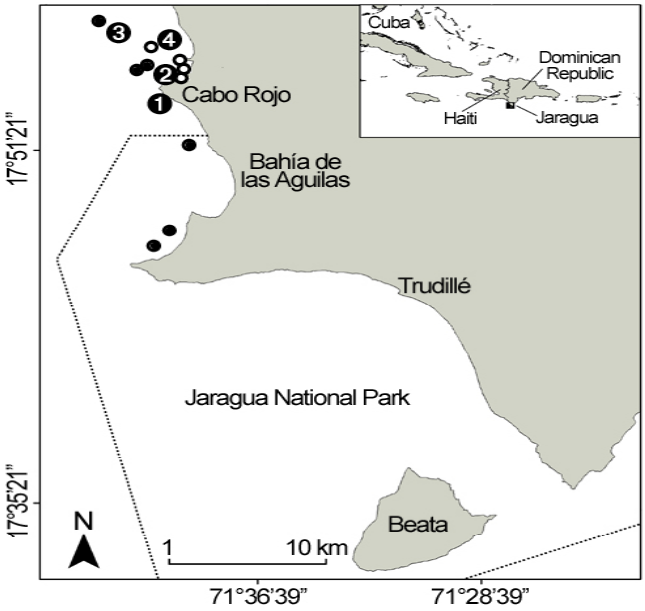

Figure 1. Survey area in the southwestern Dominican Republic. Small circles (O,l) are the locations where local fishing nets were encountered. Open circles (O) represent gillnets we inspected for bycatch, whereas closed circles (l) represent nets unavailable for inspection. Numbers in larger circles (e.g., Ê) are the locations where we conducted experimental bycatch trials outside Jaragua National Park (the line, represents the marine park boundary). Beach surveys for stranded turtles were made at Bahía de las Aguilas (4.4 km) and Trudillé (14 km).

To estimate how frequently gillnets were being deployed in the area, we used a small motorboat for ~2 hours/dday for 10 days (6-16 May 2006) to search for fishing nets within and near Jaragua National Park (particularly fishing areas near Cabo Rojo, Bahía de las Aguilas, and one trip to Trudillé) (Figure 1). These surveys were generally made in the morning or late afternoon, when fishers usually deployed or retrieved their nets, and 12 - 15 km along the coast were covered each day. When possible, the surveyor used SCUBA or snorkeled to inspect deployed nets, noting any captured turtles, net length, mesh size, and depth of the net. Any boat with fishers in the process of retrieving their net was also inspected for bycatch. During the same 10 - day period, we also made three surveys of the 4.4 km beach at Bahía de las Aguilas and one survey of the 14 km beach at Trudillé to look for stranded turtles (i.e., dead turtles washed up on the shore).

Finally, on 12-16 May 2006, we deployed a typical bottom gillnet (from a Cabo Rojo fisher) at four different sites near Cabo Rojo and outside the marine area of Jaragua National Park (Figure 1). The sites were areas where we had seen fishing with bottom nets, and at the same time areas where hawksbill turtles had been captured in previous population surveys over the last 10 years. Our experimental gillnet consisted of two sections of equal length, but with different mesh sizes (7.5 and 9 cm stretched mesh lengths), tied together end-to-end for a total length of 640 m. Each deployment, made at dusk with the assistance of a local fisher, was for 24 hours, and the deployment depth varied from 5 to 18 m. We used SCUBA or snorkeled to inspect the gillnet during these bycatch trials. The first inspection after deployment of the gillnet was made the following dawn, after 10 - 12 hours of soaking during the night. Thereafter, we inspected the net four times, at about two hour intervals during the day until its removal at dusk. Inspections took 40 minutes to one hour, and all the fish captured were removed and weighed.

RESULTS

Interviews

The local fishers and ex-fishers that were questioned reported that bycatch of turtles was extremely rare in their bottom monofilament gillnets (same type of net we tested). In contrast, they stated that turtles were often caught by trammel nets (*trasmallos*). Trammel nets are generally less selective as they consist of three layers of netting, a loose inner panel (monofilament with small mesh size) sandwiched between two taut layers (multifilament twine with large mesh size). They also said trammel nets were increasingly being used. During an experimental bycatch trial, the fisher who assisted us on the boat stated that nearby fishers had told him that a trammel net had just caught "many" turtles while we were inspecting our experimental gillnet underwater (Figure 1, near trial 3).

Surveys

During the boat surveys, 10 bottom gillnets and 1 trammel net were encountered (Figure 1; Table 1a). No turtles were observed in the three gillnets that we were able to inspect, or in a forth that was inspected in part (~25 % of this net was checked; Figure 1, near trial 4). Four nets were not inspected because we did not want to appear to be interfering with the activities of unknown fishers, since this could compromise potential future cooperation with them. Three nets (including the trammel net with "many" turtles)

were not inspected as they had been retrieved before we had come to check on them. During beach surveys, one stranded juvenile hawksbill (20 cm in length) was found in one of three beach surveys conducted at Bahía de las Aguilas and none was found in the one survey at Trudillé. This dead juvenile hawksbill had injuries to its flippers that may have been caused by monofilament netting.

Gillnet trials

No turtles were caught in the first two deployments of the 640 m gillnet used in the experimental bycatch trials (Table 1b). In our third trial we found one turtle (26 cm in length) in the 7.5 cm mesh section of the net during the second inspection in the morning. It was released about 75 m from the net but was later caught again, this time in the 9 cm mesh section of the net during the last inspection of the evening. Finally, two hawksbills were captured in the fourth deployment, one turtle (24 cm in length) in the 7.5-cm mesh and a second (19 cm in length) in the 9 cm mesh. Unfortunately, the latter two turtles drowned just before the net was retrieved. Trials were not continued thereafter. All four captures of turtles were during daylight hours. The catch per unit effort (CPUE), based on the three turtles captured during the four 24 hour deployments of the net (thus excluding the second capture of the same individual), was 0.75 turtle/day (SD ± 0.96).

DISCUSSION

Our assessment of turtle bycatch in artisanal gillnets used at Jaragua National Park provides a preliminary estimate of 0.75 hawksbills caught per day, as an average of one gillnet per day was found during the boat surveys and three turtles were caught in the four 24-h bycatch trials. These observations highlight an important conservation issue for the Dominican Republic and indicate the need for a more detailed study of turtle bycatch from the common gillnets used in this region.

Future studies should also consider the different methods and impacts of various types of nets. Our interviews with fishers and prior observations suggest that trammel and lobster nets (*chinchorro langostero*) are more likely to catch turtles than the common gillnets. For example, we discovered a lobster net with seven dead juvenile hawksbills in August 2005. This net functions by attracting lobsters and other scavenging crustaceans to feed on rotting prey entangled in the net. It has a reduced number of floats in comparison to the common gillnet making it less taut so that it is more likely to ensnare turtles. The longer deployment times of lobster nets would also increase the probability of turtles drowning if captured. These nets can be left in the water for days, whereas typical bottom gillnets usually soak for 4 hours at a time (with repeated soakings), but may be left for up to 24 hours.

Table 1.

a) Gillnets deployed by fishers available for inspection during 10 days of surveys in May 2006

Net length (m)	Mesh size (cm)	Distance offshore (km)	Net depth (m)	Fish caught* (kg)	Approx. time of deploy-ment	Approx. time(s) of inspection	Turtles caught
~600	7.5	<1	3-18	<5	afternoon	16:00	0
~600	7.5	<1	3-12	<5	morning	16:00	0
~600	7.5	1	15-20	<5	evening	18:00,21:30	0
~400**	6	3	n/a	n/a	afternoon	19:00	0

b) Experimental bycatch trials with the gillnet measuring 640 m in length (12-15 May 2006)

Trial	Distance offshore (km)	Depth de-ployed (m)	Fish caught after 24 h (kg)	Hawksbills caught	Turtle length (cm)
1	<1	7-10	10	0	0
2	<1	7-9	16	0	0
3***	6	11-18	30	1	26
4	2	7-10	10	2	19, 24

* mass of fish caught at the time we inspected the net
** net was only inspected in part (~25%)
*** same hawksbill juvenile was caught twice

The time of day when nets are deployed may also influence the number of turtles caught. For example, all the turtles caught in our gillnet trials occurred during daylight (although our CPUE estimate was for 24 hours). Since hawksbills are less active during the night (van Dam and Diez 1996), one should consider deploying nets at night when fishing, and take this period of reduced activity into account when calculating CPUE for hawksbills. Our trials made with a common gillnet were useful because they provided evidence that these nets are a likely risk to hawksbill juveniles despite (1) interviews that indicated turtle bycatch was extremely rare in this type of gillnet, and (2) the absence of turtles in the three common gillnets inspected, or in a fourth that was inspected in part (all nets having been deployed by local fishers). The gillnet trials also indicated that any other experimental net trials to be continued in this area should be inspected at intervals of less than an hour to avoid turtle mortalities.

Given the high density of juvenile hawksbills in this feeding area, León and Diez (1999) suggest that hawksbills from this region could aid in the recovery of depleted areas in other parts of the Caribbean. A recent study by Bowen *et al*. (2007), using a mixed–stock analysis of genetic data for hawksbill turtles throughout the Caribbean (including the Dominican Republic), strongly suggests that harvests in feeding areas have an important impact on numbers of hawksbills in nesting colonies. It is likely that turtle mortality from bycatch in our study area may prevent some migrations from occurring. Because of difficult economic conditions and pressing social issues in southwestern Dominican Republic, we do not recommend any measures at this time that would dispossess artisanal fishers in the name of conservation. Rather, we urge for problem-based approaches to this conservation issue using more quantitative observations while working with fishers, the community, and other collaborators to mitigate turtle bycatch.

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