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An interview-based approach to assess marine mammal and sea turtle captures in artisanal fisheries

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ABSTRACT

Recent case studies have highlighted high bycatch mortality of sea turtles and marine mammals in artisanal fisheries, but in most countries there are few data on artisanal fishing effort, catch, or bycatch. With artisanal fisheries comprising >95% of the world's fishermen, this knowledge gap presents a major challenge to threatened species conservation and sustainable fisheries initiatives. We report on results from an intensive pilot study to evaluate whether interview surveys can be effective in assessing fishing effort and threatened species bycatch. Fisheries and bycatch data from interviews with >6100 fishermen in seven developing countries were collected in <1 year for approximately USD $47,000, indicating that this approach may rapidly yield coarse-level information over large areas at low cost. This effort provided the first fisheries characterizations for many areas and revealed the widespread nature of high bycatch in artisanal fisheries. Challenges to study design and implementation prevented quantitative estimation or spatial comparisons of bycatch during this pilot research phase, but results suggested that annual sea turtle bycatch may number at least in the low thousands of individuals per country. Annual odontocete bycatch may number at least in the low hundreds per country. Sirenian bycatch occurred in all study areas but was frequent only in West Africa. We discuss lessons learned from this survey effort and present a revised protocol for future interview-based bycatch assessments.

1. Introduction

The intentional or accidental catch of marine mammals and sea turtles in fisheries can pose significant threats to populations (Lewison et al., 2004; Kappel, 2005). Populations of these taxa are especially vulnerable to mortality from anthropogenic sources because of their slow maturity and reproduction rates (Musick, 1999; Heppell et al., 2000). For many years, attention to the bycatch issue has focused almost exclusively on industrial fisheries (Soykan et al., 2008). However, recent evidence has highlighted the potential for artisanal fisheries in developing countries to have significant negative impacts on these taxa (e.g., Lee Lum, 2006; Peckham et al., 2007, 2008; Jaramillo-Legorreta et al., 2007; Mangel et al., 2010). These case studies suggest that greater attention to impacts of artisanal fisheries on large marine vertebrates is needed. Artisanal fisheries are globally ubiquitous and may account for >95% of the world's fishers (Pauly, 2006), so the scope of this issue may be enormous.

Two types of information are needed to quantify and spatially characterize fisheries bycatch: a measure of fishing effort and a bycatch rate (e.g., number individuals taken per unit of fishing effort). It is generally accepted that the most accurate method to quantify bycatch rates involves using independent observers on board fishing vessels to record information on per-vessel fishing effort

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(e.g., fishing trip duration, number of gear-sets per trip), target catch, and bycatch (Alverson et al., 1994; Kennelly, 1999; NMFS, 2004). Given complementary information about the size of the fishing fleet (e.g., number of vessels) and per-vessel effort (e.g., number of trips or gear deployments), bycatch per unit effort can be extrapolated to the entire fishery to estimate total bycatch (Rago et al., 2005).

Unfortunately, whereas these types of data are available for many industrial fleets, artisanal fisheries typically are data poor (Kelleher, 2005; Salas et al., 2007; Chuenpagdee and Pauly, 2008; McCluskey and Lewison, 2008). Many artisanal fishing boats in developing countries are not registered, and the number of registered boats may not represent the number of active fishers (Chuenpagdee et al., 2006), so national and global fisheries statistics may not provide an accurate picture of fishing capacity or activity. The costs of implementing observer programs in developing countries are often prohibitive, especially given that artisanal fisheries consist of large numbers of boats distributed diffusely (as opposed to in centralized ports) along the coasts. In contrast to specialized industrial fleets that consistently target the same species and have finite fishing seasons, artisanal fisheries are generally flexible, dynamic and operate much of the year (Salas et al., 2007). Therefore, season-specific estimates of per-vessel effort or bycatch may not be applicable to other vessels or to other times of the year. Small boat sizes typical of artisanal fisheries also make on-board observing logistically difficult; there simply may not be enough room to accommodate observers. Vessel logbooks may be employed as a low-cost alternative to observer programs in industrial fisheries and in some countries may provide useful fishing effort information. However, catch and bycatch data are from logbooks are often incomplete or suspect (Kennelly, 1999; NMFS, 2004; Walsh et al., 2005). In fisheries that consist of thousands of vessels with little or no management infrastructure logbooks are not kept.

In the absence of empirical datasets, researchers have increasingly relied on the knowledge of local fisherman to better understand artisanal fisheries and their interactions with coastal ecosystems (Johannes et al., 2000; Drew, 2005; Close and Hall, 2006). Despite the limitations of social survey data (Kennelly, 1999; Huntington, 2000; Gilchrist et al., 2005), interviews have provided useful information about marine mammal and sea turtle bycatch in both artisanal and commercial fisheries when observer data were limited or not feasible to collect (Silva and Best, 1996; Van Waerebeek et al., 1997; Godley et al., 1998; D'Agrosa et al., 2000; Amir et al., 2002; López et al., 2003; Carreras et al., 2004; Lee Lum, 2006; Karamanlidis et al., 2008). But most interview-based bycatch studies have been somewhat restricted in spatial scale or have focused on particular fisheries not necessarily representative of those in the broader geographic area. These limit the generality of inference drawn from bycatch estimates or other described characteristics of the fisheries. Moreover, typically sparse descriptions of interview methodology (White et al., 2005) and lack of standardized interview protocols (Neis et al., 1999; Davis and Wagner, 2003) mean that data reliability is difficult is to assess and that results across studies may not necessarily be comparable, since numerical estimates based on indirect approaches such as interviews have been shown to vary with the methodology used (Lien et al., 1994; Gomm, 2004; Fowler, 2009).

Researchers, managers, and conservation organizations have limited resources and therefore need to make strategic decisions about how to most effectively focus their work and funding. Substantial information gaps about the magnitude and distribution of large vertebrate bycatch in artisanal fisheries prevent timely informed decision-making. Recognizing that it is not feasible to comprehensively fill these global knowledge gaps through dozens or hundreds of intensive field studies, we explored whether rapidly implemented, low-cost, standardized interview surveys could be effective for assessing fishing effort and bycatch. If so, these could be used as a first step in a prioritization process. A growing body of research has favored using local knowledge over more expensive and time-consuming methods to characterize rapidly occurring environmental threats and establish conservation priorities (Balram et al., 2004; Gavin and Anderson, 2005; Jones et al., 2008; Anadón et al., 2009).

In this paper, we describe results and lessons learned from a large pilot study of a rapid bycatch assessment protocol. The study uses interview surveys with fishermen, implemented using consistent methodologies across multiple countries within one or more large geographic regions to collect comparable information on artisanal fisheries effort, gear use, and bycatch of vulnerable taxa. For the purpose of this paper, we refer to 'bycatch' of marine mammals and sea turtles as all captures occurring outside of direct-harvest fisheries for these taxa; this is consistent with a recently proposed definition of the term by Davies et al. (2009).

We developed and implemented an interview survey protocol in seven developing countries. Multiple locations were chosen to evaluate the protocol across a range of cultures infrastructure, fisheries types, bycatch characteristics, in-country research teams, and to evaluate the scope and scale of challenges to this approach. Our objectives were to: (1) characterize gear use and fishing effort of artisanal fisheries and obtain semi-quantitative estimates of bycatch of marine mammals and sea turtles that are comparable across regions; (2) determine if the protocol could be implemented cost-effectively, over a relatively short time frame; and (3) document lessons learned to improve the usefulness of surveying fishermen to collect bycatch and fishing effort data in artisanal fisheries.

2. Methods

2.1. Surveys

In-person surveys were conducted during 2007 and 2008 in fishing communities from seven countries: Sierra Leone, Cameroon, Nigeria, Tanzania, Comoros, Malaysia, and Jamaica. We chose these countries to provide a spatially heterogeneous global sample (two in West Africa, three in East Africa, one in Asia, one in Caribbean) and where existing collaborations increased our confidence in successfully implementing surveys in a low-cost, rapid manner.

Our surveys consisted of three components: long questionnaire, short questionnaire and a port description form (Appendix 1). The long and short questionnaires included mostly closed questions and were completed in-person with fishermen at landing sites; they included questions about fishers' practices, gear use, and bycatch of marine mammals and sea turtles. Relatively short (<30 min) closed-question surveys have generally been recommended for collecting quantifiable or factual information (Huntington, 2000; Fowler, 2009; Gomm, 2004; White et al., 2005). The short questionnaire was a subset of the long questionnaire and was intended for fishermen with only 5–10 min to spare for an interview, so as to maximize the amount of bycatch information collected. It contained questions on type of gear used, how many marine mammals and sea turtles were caught per month or year, and what the fishermen did with captured animals. The long questionnaire also included more detailed questions about fishing gear usage, target species catch, boat specifications, and seasonality and location of fishing effort. It was designed to be used with fishing community leaders and to be completed in approximately 20–30 min. The port description forms did not involve interviews; field workers used them to record boat-count estimates and a general characterization of each visited fishing port or village (e.g., gear types used, boat descriptions, general physical description of the landing site).