Evaluating the threat of IUU fishing to sea turtles in the Indian Ocean and Southeast Asia using expert elicitation

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A B S T R A C T

Illegal, unreported and unregulated (IUU) fishing is a pervasive issue that affects economic, social, regulatory and environmental systems in all ocean basins. Research on the ecological impacts of IUU fishing has been relatively underrepresented, with minimal investigation into how IUU fishing may negatively affect populations of marine megafauna, such as sea turtles. To address this knowledge gap and identify priority areas for future research and management, we evaluated IUU fishing as a threat to a marine megafauna species group (sea turtles) in the Indian Ocean and Southeast Asia region (IOSEA). We designed and distributed an online survey to experts in the fields of sea turtle research, marine conservation, fisheries management, consulting and NGOs throughout IOSEA. Our results reveal that IUU fishing is likely to have potentially significant impacts on sea turtle populations in IOSEA through targeted exploitation and international wildlife trafficking. Addressing domestic IUU fishing needs to be actioned as a high priority within the study area, as does the issue of patrolling maritime borders to deter illegal cross-border transhipment. There is a demonstrable need to strengthen MCS and employ regional coordination to help build capacity in less-developed nations. Future research requirements include evaluating IUU fishing as a threat to sea turtles and other threatened marine species at multiple scales, further investigation into market forces throughout IOSEA, and examination of potential barriers to implementing management solutions. We advocate for introducing sea turtle-specific measures into IUU fishing mitigation strategies to help maximize the opportunity for positive outcomes in creating healthy ecosystems and stable communities.

1. Introduction

Illegal, unreported and unregulated (IUU) fishing is a multifaceted regulatory issue that occurs in every ocean basin (Sumaila et al., 2006). The economic losses resulting from unlawful extraction of fisheries resources are believed to be substantial (Agnew et al., 2009; Nurhakim et al., 2008; WWF, 2016), and the drivers and loopholes that perpetuate IUU fishing are numerous and highly diverse (Flothmann et al., 2010; OECD, 2005; Schmidt, 2005). The environmental impacts of IUU fishing have been discussed as being similar to overfishing, concerning the depletion of target stocks (Pomeroy et al., 2007), changes in trophic dynamics following unsustainable harvest (Field et al., 2009), and habitat damage caused by destructive fishing methods (McManus, 1997). IUU fishing includes a broad array of unlawful activities (Agnew et al., 2009), making it difficult to quantify empirically and frustrating efforts to assess the impacts of IUU fishing over spatial and temporal scales, as well as for different species.

While it has been suggested that IUU fishing also has negative consequences for marine megafauna species, such as sea turtles (MRAG, 2005; OECD, 2005; UNODC, 2016), the subject has not yet been rigorously investigated. To our knowledge, there has not been any specific assessment of IUU-related threats to sea turtles, despite numerous media reports of illegal sea turtle capture and trafficking by IUU fishing vessels (BOBLME, 2015). Indeed, alongside a growing awareness that criminal organizations are involved in the illegal harvest and trade of valuable fish species (Telesetsky, 2014; UNODC, 2011), Lindley and Techera (2017) observe that "less attention has been paid to the link between IUU fishing and organized crime" relative to trafficking of weapons, drugs and people. As such, the connection between IUU fishing and trafficking of marine wildlife such as sea turtles is one of interest from both a criminological and a conservation perspective.

The Indian Ocean and Southeast Asia region (hereafter IOSEA) provides a highly suitable context for examining the linkages between IUU fishing and sea turtles. Reports of IUU fishing in the Indian Ocean include illegal longlining and turtle mortality in Mozambique (Louro et al., 2006), conflict over fishery access in Somalia (Beri, 2011) and

decades of unchecked tuna exploitation by unlicensed foreign fleets (Anganuzzi and Secretariat, 2004). In Southeast Asia, hauls of illegally-caught, protected sea turtles have attracted worldwide media attention (Nuwer, 2016), and disputes over maritime boundaries and fishing rights in the South China Sea have been examined by the International Court of Justice at The Hague. Furthermore, the region's historical subsistence use of sea turtles (Frazier, 1980) is compounded by an increasing modern demand for wildlife products in East Asian markets (Lam et al., 2011). Given the current precarious status of sea turtle populations within IOSEA and worldwide (Wallace et al., 2011), knowledge of IUU fishing as a threat to sea turtles is urgently needed.

To improve our understanding of how threatened marine species are affected by IUU fishing fleets, we evaluated IUU fishing as a threat to a case study species group (sea turtles) in IOSEA. Our study elicits local/regional knowledge to outline the scope and gravity of the IUU-turtle problem, identifies key issues and knowledge gaps at regional and basin-wide scales, and uses these results to help guide future research and management action against IUU fishing in IOSEA and worldwide.

2. Materials and methods

2.1. Defining IUU fishing

The term 'illegal, unreported and unregulated fishing' encompasses a wide range of fishing contraventions (Bray, 2000; Kao, 2015) and is defined in the International Plan of Action to Prevent, Deter and Eliminate IUU Fishing (IPOA-IUU) (FAO, 2001). Here we use 'IUU fishing' to refer to all activities within Exclusive Economic Zones (EEZs) that are illegal and often unreported, as well as all illegal and unreported activities on the high seas that are under the jurisdiction of regional fisheries management organizations (RFMOs), after Agnew et al. (2008). Discards and mortality from legal fisheries were not included in this analysis.

2.2. Study area and designation of sub-regions

Our study area included every country with a marine coastline on the Indian Ocean, as well as Southeast Asia, the Philippines and China. Defining the study area to include Southeast Asia allowed us to complement existing organizational linkages between the two regions, such as the Indian Ocean and South-East Asian Marine Turtle Memorandum of Understanding (IOSEA-MoU), an intergovernmental conservation agreement ratified by thirty-five countries (IOSEA website, 2016).

We grouped countries into four sub-regions (Fig. 1): Southwestern Indian Ocean (SWIO) includes territorial waters in countries from South Africa to Kenya, plus the island nations of Comoros, Madagascar, Mauritius, Mayotte, Reunion and the Seychelles; Northwestern Indian Ocean (NWIO), Somalia to Iran, including countries with coastline on the Red Sea and Persian Gulf; Northern Indian Ocean (NIO), Pakistan to Bangladesh, including the Maldives and British Indian Ocean Territory; and Southeast Asia (SEA), Myanmar to Australia, including the Philippines and China. To maintain continuity with ongoing conservation programs, these sub-regional boundaries match those used within the IOSEA-MoU framework.

2.3. Rationale for using expert elicitation

Expert elicitation is an established technique used for gathering knowledge about data-limited topics, increasingly so in conservation science (Aipanjiguly et al., 2003; Martin et al., 2012; Teck et al., 2010). Conservation decision-making often occurs on short time scales and with limited or incomplete information (Cook et al., 2009), whereby expert knowledge becomes a highly useful resource for guiding management actions (Burgman et al., 2011). Indeed, previous studies have used expert elicitation to identify threats and priority conservation actions for sea turtles (Donlan et al., 2010; Fuentes and Cinner, 2010;

Klein et al., 2016), typically a challenging task due to sea turtles' complex life histories and circumglobal distributions (Bolten, 2003). As IUU fishing is unlawful and therefore difficult to study by conventional methods (Pramod et al., 2008), this approach enabled us to characterize the context of IUU-turtle dynamics on a large geographical scale, alleviate the research burden of gathering experimental evidence for each country, and allow for coordinated knowledge-gathering across broad geographic scales (White et al., 2005).

2.4. Scope of participants

Selected respondents included specialists in the fields of sea turtle conservation and fisheries and environmental management, from the sectors of government and/or academic research, policy making, consulting and non-governmental organizations (NGOs). Experts were identified in several ways: based on membership in the Marine Turtle Specialist Group of the International Union for the Conservation of Nature (IUCN-MTSG); referrals from colleagues working throughout the study area; attendance lists from relevant conferences and regional workshops; and by authorship of published literature and reports on IUU fishing- and turtle-related topics. When possible, at least one member of the IUCN-MTSG was contacted for each country.

2.5. Survey design

Our survey consisted of 38 multiple choice and open-ended questions (Appendix A). All question formats were designed to be as simple as possible (after White et al., 2005). Multiple choice questions used five-point Likert scales as quantitative indicators (Boone and Boone, 2012). In an effort to harmonize with previous studies of IUU fishing in the Asia-Pacific region (APEC, 2008), we sourced several questions from a 2008 survey employed by the Asia-Pacific Economic Cooperation forum (APEC). Questions were evaluated for compatibility with our research objectives prior to being included in the survey.

To encourage a high response rate, the survey was translated by bilingual native speakers into seven of the languages spoken in the region: Arabic, French, Bahasa Indonesia, Bahasa Malaysia, Portuguese, Swahili and Vietnamese. Languages were elected for translation based on prevalence (number of countries) and upon consideration that English was not likely to be widely spoken in those countries. Translated surveys were then back-translated by another native speaker to verify continuity of meaning.

2.6. Survey dissemination and data analysis

We used the SurveyMonkey online platform to distribute our survey and collect responses. Surveys were emailed to respondents between November 2015 and May 2016 as each language version became available. Completed survey data were exported from SurveyMonkey in an Excel spreadsheet for each language version. Data were pooled in the first instance before being grouped by sub-region for additional analysis. Descriptive statistics were generated for each question in order to determine the most common answer choice or choices.

3. Results

3.1. Survey completion metrics and respondent profiles

After sending 107 survey invitations, we received 49 completed surveys from 30 of the 44 countries in IOSEA, representing 68% of IOSEA countries and a 46% response rate overall (Fig. 1). The greatest number of responses came from the SWIO region (n = 16), followed by SEA (n = 14), NWIO (n = 10) and NIO (n = 9). The most-represented region was NIO (responses received from 83% of countries), followed by SWIO (82%), SEA (64%) and NWIO (56%). The number of responses received per country ranged from 0 to 6, with a mean of 1.6 responses.