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ORIGINAL ARTICLE

Contribution of citizen science to improve knowledge on marine biodiversity in the Gulf Region

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Abstract Monitoring marine biodiversity is costly and practical solutions have to be implemented to identify species and their preferred habitats, particularly in this era of rapid global change. Citizen science has proven to be effective and with high potential for monitoring efforts, and has been extensively applied to biodiversity. We have used the citizen science approach to engage the general

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public and stakeholders to contribute improving the current knowledge of sea snake biodiversity in Qatar and the Gulf Region. Logistic regression analysis using demographic data from interview surveys conducted in Qatar has indicated that the people having seen more sea snakes are older than 30 years and are Qatari citizens and/or fishermen from India.

Of the ten species of sea snakes listed in the literature to be present in the Gulf Region, most of them have been reported for Qatar, Bahrain, United Arab Emirates and Saudi Arabia. However, the number of species present is often assumed based on their occurrence within the Arabian Gulf rather than on actual captures and appropriate identification. The creation of marine reference biological scientific collections to properly identify the species and make accurate biodiversity inventories is an urgent priority for the countries in the Gulf region. To this end, contributions by stakeholders and the general public for this study have proven to be very useful. However a larger networking with local and international scientists and stakeholders is still needed to adequately survey the country's current biodiversity, identify research priorities and eventually provide the scientific input needed to assist biodiversity management related to renewable resource management and marine conservation in the Arabian Gulf Region.

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1. Introduction

Sea snake species are a diverse group with more than 60 species described that are often abundant in coral-reef ecosystems (Rasmussen et al., 2011; Rezaie-Atagholipour et al., 2016). They are considered ecological indicators of the health status of coral reefs (Brischoux et al., 2009) where they play an important role as both predators and prey (Brischoux and Bonnet, 2008). In recent decades, sea snake populations have been under threat due climate change, coastal development and water pollution (Bonnet, 2012; D'Anastasi et al., 2016). They also get entangled in the nets laid by trawlers and are susceptible to unintentional excessive catch as fishing byproduct (Courtney et al., 2010; Van Cao et al., 2014). Apart of this, sea snake venom is very important to the medicine market and their populations are highly affected by trade. All factors together may lead to local extinction as sea snake populations are highly localised (Singh, 2016).

Sea snake assemblages have been reported to be in dramatic decline in the Indo-Pacific region (Fry et al., 2001; Goiran and Shine, 2013). However, information about the status of sea snake assemblages from the Arabian Gulf, is still scarce (Heatwole, 1999).

Biodiversity field surveys are very expensive and time-consuming, thus new approaches for data collection and analysis have been developed in the last decades, including citizen science (Edgar et al., 2016; Gelcich et al., 2014). Citizen science has a high potential for biodiversity monitoring studies, and it has been extensively used by bird-watchers worldwide (Bennun et al., 2004) and also for terrestrial biodiversity (Smart et al., 2005). In the marine realm, citizen science has mainly focused on iconic animals inhabiting accessible coastal environments such as cetaceans (Scott and Parsons, 2004) or corals (Branchini et al., 2015a,b), but has also included other marine species (Scott and Parsons, 2004; Luksenburg and Parsons, 2014). In this study we have integrated the citizen science approach by conducting interview surveys and by engaging stakeholders to produce better-informed and context-based baseline biodiversity information about sea snakes in Qatar.

2. Methods

2.1. Interview surveys

Interviews were conducted following recommendations for best practice (White et al., 2005; Windle and Rolfe, 2011). Between January and May 2013, 655 interviews were conducted in 8 different ports and coastal areas of Qatar (Fig. 1), and between January to July 2016, 73 people were interviewed in Doha and in the northern area of Dukhan (Al Reem Biosphere Reserve). A questionnaire linked to photos of the 10 sea snake species likely occurring in the Gulf Region was used to know the response from people. During the interviews we asked the following questions:

1. Have you seen some of these snakes in Qatar? Please point the species looking at the photos.
2. Where did you see the snakes? When people did not know the location, we asked if snakes were seen offshore or along the coast.
3. How many years have you been living in Qatar?
4. What is your country of origin?

During the interviews we also included socio-demographic information of the respondents (e.g., Nielsen, 2011; Berrens et al., 2003; Canavari et al., 2005; Luksenburg and Parsons, 2014). We considered the gender (male, female) and the age group by eye, as people often were not comfortable responding about their age (> 30 years as adult, < 30 as young and < 15 as children. Young and children were pooled in the analyses due to small sample size for children). We also included information about the social sector of the people interviewed, including (a) fisherman (people inside fishing boats or in the port repairing the fishing nets), (b) sport (people practicing fishing, scuba diving, spear fishing, sailing, recreational boats and yachts), (c) general public (people walking along the coast line and staff from Ministries, petrol companies, universities and other institutions).

The interviews conducted in 2016 were all done to adult men from the general public without considering additional

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