Biological Conservation 201 (2016) 20–28

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/bioc

Ongoing decline of shark populations in the Eastern Red Sea

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ARTICLE INFO

Article history:
Received 24 February 2016
Received in revised form 18 June 2016
Accepted 20 June 2016
Available online xxxx

Keywords:
Baited Remote Underwater Video system (BRUVs)
Baselines
Elasmobranch
Longline surveys
Indian Ocean
Rays

ABSTRACT

Information on the abundance and diversity of Red Sea elasmobranchs is notoriously scarce, even though sharks are among the most profitable fisheries of the region. Effective conservation would ideally entail baselines on pristine conditions, yet no such data is available for the Red Sea. To collect distribution and abundance data on Red Sea elasmobranchs, we conducted a dedicated longline and Baited Remote Underwater Video system (BRUVs) sampling program along the entire Red Sea coast of Saudi Arabia over the course of two years. Both survey techniques were opportunistically employed at central and southern Saudi Arabian (SA) Red Sea reef systems. In addition, BRUVs were employed in the northern SA Red Sea and at selected reef systems in Sudan. Shark catch per unit effort (CPUE) data for BRUVs and longline surveys were compared to published data from non-Red Sea reef systems. This comparison revealed CPUE estimates several orders of magnitude lower for both survey methods in the SA Red Sea compared to other reef systems around the world. Catch per unit effort values of BRUVs on Sudanese reefs on the contrary were within the range of estimates from various locations where sharks are considered common. We argue that decades of heavy fishing pressure on Red Sea marine resources has significantly altered the community structure of SA Red Sea reefs. There is an urgent need to establish effective management strategies for species of highest conservation concern. Our results have the potential to be used as a baseline, if such management strategies were to be established.

1. Introduction

The central Red Sea has recently been identified as one of three main hotspots for greatest extinction risk of elasmobranch species worldwide (Dulvy et al., 2014). Of the 29 shark and 28 ray species currently known to occur in the Red Sea (Golani and Bogorodsky, 2010; Spaet et al., 2011), 50% and 40% respectively are globally classified as threatened and another 15% and 36% as Data Deficient by IUCN Red List criteria (IUCN Red List 2015). In 2008, a royal decree prohibiting all shark-fishing activities was enacted by the Saudi Arabian (SA) Ministry of Agriculture in an effort to protect the country's shark resources. Despite this law, elasmobranch landing surveys along the SA Red Sea coast have indicated unsustainable targeted and bycatch elasmobranch fisheries and a significant lack of mature specimens for the majority of species in the landings (Spaet and Berumen, 2015). In addition, SA Red Sea waters are regularly poached by vessels from Yemen (pers. observ.), which is among the top 20 elasmobranch fishing nations globally (Lack and Sant, 2009).

Unsustainable fishing and overexploitation of shark resources coupled with a severe lack of enforced protection strategies is a common scenario in the Arabian Seas region (Henderson et al., 2007; Moore, 2011; Jabado et al., 2015). Such regional overexploitation of marine resources is especially worrisome in light of shared stock structures, as demonstrated genetically for a range of the most commonly landed shark species throughout the region (Spaet et al., 2015). If shark stocks do not have the capacity to be replenished by individuals from adjacent unexploited areas, fisheries may risk the loss of whole populations. Yet, despite being one of the most economic and profitable fisheries of the region (Hariri et al., 2002; Tesfamichael and Pitcher, 2006), there is a critical lack of information on nearly all aspects of Red Sea shark diversity, abundance, ecology and biology (Spaet et al., 2012). This lack of baseline information on elasmobranch populations hinders attempts to quantify changes in the local ecology due to environmental fluctuations or increasing anthropogenic influences.

To stabilize exploited shark populations and to rebuild potentially depleted populations in Red Sea waters, it is essential to combine data obtained through fisheries-dependent surveys with data collected beyond the range of commercial fisheries. Fisheries-independent survey methodologies offer the possibility to calculate catch per unit effort (CPUE) estimates, which are frequently used by fisheries scientists to estimate relative abundance of targeted or bycatch species based on the assumption that abundance is proportional to CPUE (Hilborn and Walters, 1992). To obtain the most accurate and precise results on the status of elasmobranchs, CPUE data should ideally be collected using a variety of survey methods over broad geographic ranges. Additionally,

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http://dx.doi.org/10.1016/j.biocon.2016.06.018
0006-3207/

data on migratory patterns, biology and population structure of stocks should be obtained to facilitate interpretation of CPUE data. Baited Remote Underwater Video system (BRUVs) (Robbins et al., 2006; Ruppert et al., 2013; White et al., 2013) and longline surveys (Simpfendorfer et al., 2002; Pikitch et al., 2005; Dale et al., 2011) are frequently used as standardized fisheries-independent techniques to examine the abundance and distribution of mobile elasmobranchs. Despite inherent limitations in each of the methods, data from studies combining the two techniques have shown that they compare well to each other and are highly complementary for monitoring needs (Brooks et al., 2011; Santana-Garçon et al., 2014a; McLean et al., 2015).

In the present study, we combined long-term, spatially stratified BRUVs and longline sampling with the aim to (1) provide baseline data on the relative abundance and distribution of elasmobranchs in Red Sea waters, (2) compare the abundance and diversity of elasmobranchs in exploited SA Red Sea waters to relatively pristine reef systems in Sudan and (3) compare the abundance of sharks in Red Sea waters to published abundance data obtained by BRUVs and longline surveys in non-Red Sea reef systems. To achieve these goals, BRUVs and longline surveys were conducted at coral reef areas along the SA Red Sea spanning 1100 km of latitudinal coastline and at four selected reef systems in Sudan.

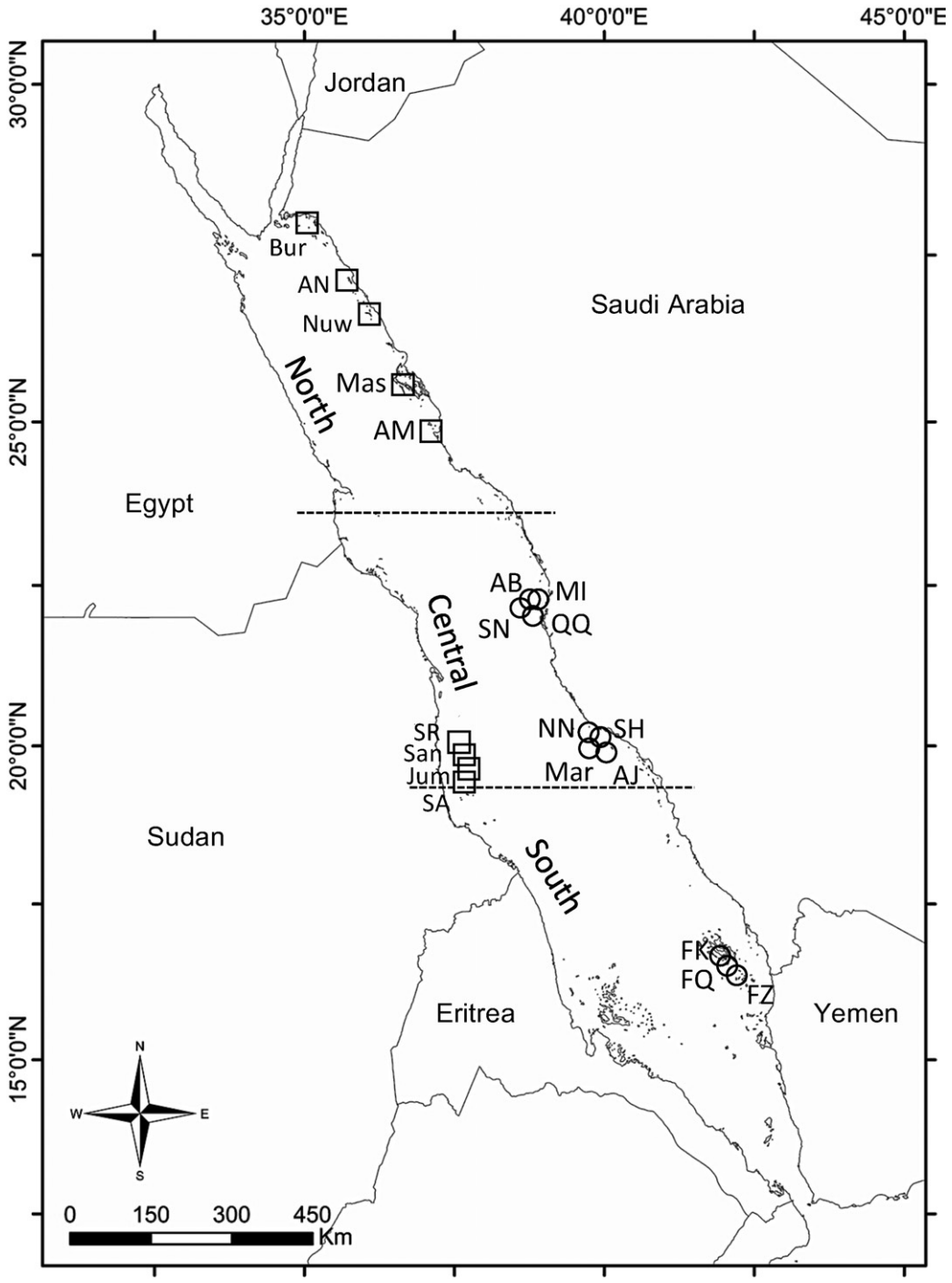

Fig. 1. Sampling locations of Baited Remote Underwater Video system (BRUVs) and longline surveys along the Red Sea coasts of Saudi Arabia and Sudan conducted between March 8th 2011 and March 19th 2013; circles: BRUVs + longlines and squares: BRUVs only. See Table 1 for details.