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Original Research Article

Investigating patterns of tiger and prey poaching in the Bangladesh Sundarbans: Implications for improved management

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ABSTRACT

Poaching of tigers and their key prey threatens the survival of tigers across their range. This study investigated the methods, intensity, and driving factors of tiger and prey poaching in the Sundarbans Reserved Forest of Bangladesh, to help better design and direct future management interventions. The study identified a range of snaring methods used to catch prey and an approach to killing tigers by poisoning prey carcasses with a Carbofuran pesticide. We recorded six poisoned baits set to kill tigers and 1427 snare loops in 56 snare sets to kill tiger prey. With an average of 23 snare loops/snare set, this is equivalent to an estimated 6268 snare loops across the Sundarbans or 147 snare loops/100 km^2. Poachers selected sites that tended to be away from guard posts, and close to river banks, but were not influenced by protected area status or distance to the forest boundary. The current poaching pressure is likely to have contributed to a recent decline in relative tiger abundance. We recommend using better regulation of Carbofuran use across tiger range countries, and using remote camera traps set up around snares and poisoned baits to help authorities identify poachers for arrest. This study demonstrates a simple approach to investigating the methods, intensity and distribution of poaching, that could be replicated across all tiger landscapes to better direct mitigating actions and monitor changes in threat levels over time.

1. Introduction

Global tiger *Panthera tigris* populations have collapsed from an estimated 100 000 to 3500 tigers in just 100 years (Morell, 2007; Sanderson et al., 2006), and now occupy less than 7% of their historic range (Sanderson et al., 2006). The remaining tigers are mostly now restricted to small pockets of protected areas across their range (Walston et al., 2010b), and their

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numbers continue to decline in important areas despite significant conservation efforts by international agencies, local conservation groups and governments (Dinerstein et al., 2007; Seidensticker et al., 1999).

Poaching of tiger and prey has been identified as one of the major threats to tiger populations where they still persist (Aziz et al., 2013; Damania et al., 2003; Dinerstein et al., 2007; Goodrich et al., 2008; Jhala et al., 2008; Karanth and Stith, 1999; Wikramanayake et al., 2011). Tiger poaching is thought to be mainly driven by the international demand for tiger parts in traditional Asian medicine (Ellis, 2005; Jackson, 1990), while prey poaching may be driven by more localized demand (Damania et al., 2003; Mohsanin et al., 2013) and trade (Knapp et al., 2010; Madhusudan and Karanth, 2002).

However, due to the difficulty and risk involved in studying these covert and illegal activities (Karanth and Stith, 1999; Madhusudan and Karanth, 2002) it has been difficult to collect the information needed to address this problem across the 76 tiger conservation landscapes (Sanderson et al., 2006). Critical to assessing the level of tiger and prey poaching across each landscape, is the monitoring of the spatial scale and intensity of these threats to enable conservationists to design effective interventions, and to be able to monitor the impact of their activities (Duangchantrasiri et al., 2016; Hotte et al., 2016; Johnson et al., 2016; Stokes, 2010). To date, few studies have assessed the scale and spatial intensity of tiger and prey poaching to design improved law enforcement strategy at a specific site of Sumatra (Linkie et al., 2015; Rifaie et al., 2015).

To refine patrolling strategies and enhance evidence gathering efforts, it is also necessary to catalogue the specific methods that poachers employ (Karanth and Stith, 1999; Watson et al., 2013; Linkie et al., 2015). Previous studies have identified some site-specific poaching methods for tigers such as iron spring traps in India (Wright, 2010), traditional common wire cable, traps and gun in Sumatra (Linkie et al., 2015; Shepherd and Magnus, 2004; Treep, 1973), direct shooting in the Russian Far East (Goodrich et al., 2008), and poisoning by pesticides in Sumatra and India (Tilson et al., 2010; Treep, 1973; Wright, 2010) and explosive traps and snares in Laos and Cambodia (Johnson et al., 2016; O'Kelly et al., 2012). Likewise, the methods for prey poaching documented so far include guns and snares in India (Madhusudan and Karanth, 2002), snares in the Sundarbans (Jagrata Juba Shangha, 2003; Khan, 2004), and traps in Sumatra (Linkie et al., 2015).

The Sundarbans Reserve Forest (SRF) of Bangladesh currently has incomplete information on the scale, intensity, and methods of tiger and prey poaching. The SRF is part of the wider Sundarbans landscape, which is classified as a tiger 'source site' (Walston et al., 2010a) and a Class III Tiger Conservation Landscape of global priority (Sanderson et al., 2006). Tiger and prey poaching have been highlighted as key threats in this landscape for several decades (Ahmad et al., 2009; Aziz et al., 2013; Salter, 1984), and the nature and scale of local use or consumption of tiger and prey parts as well as people involved in tiger killing has recently been documented (Mohsanin et al., 2013; Saif et al., 2016, 2015). Over the last few years, law enforcement agencies have confiscated piles of tiger skins, bones, and live tiger cubs in the country (Table A.1; Fig. 1). A pilot study also managed to gain insight into the scale of general illegal activities in the SRF (Hossain et al., 2016), but data on tiger and prey poaching inside the forest are still lacking.

The objectives of our study in the SRF were, therefore, to (1) identify tiger and prey poaching methods, (2) assess the spatial intensity of poaching activities, and (3) identify the factors influencing the spatial distribution of poaching. To this end, we collected and analysed field data on tiger and tiger prey poaching incidents sampled from four representative areas of the SRF. We believe that our findings will be useful in developing focused patrolling and effective law enforcement strategies to secure the survival of tigers in the SRF, and present an approach that could be replicated across all landscapes where large carnivore and ungulate poaching are a threat.

2. Methods

2.1. Study site

The SRF is 6017 km^2, of which 1750 km^2 is water (Iftekhar and Islam, 2004) consisting of a maze of rivers and creeks that make most of the forest areas accessible by water-based vessels. The SRF is bordered on the south by the Bay of Bengal and on the west by the international boundary with India, demarcated by the Raimongal and Hariabhanga rivers. The north and east sides are bounded by districts of densely populated human settlements (Hussain and Acharya, 1994) (Fig. 2).

The SRF has a high diversity of floral communities comprising 330 plant species dominated by *gewa* (*Excoecaria agallocha*) and *sundri* (*Heritiera fomes*), and a diverse assemblage of vertebrate fauna including eight species of amphibians, 35 species of reptiles, over 300 species of birds, and 42 species of mammals (Islam and Wahab, 2005; IUCN-Bangladesh, 2001). The major ungulates which make up the tiger's prey are the chital (*Axis axis*), wild boar (*Sus scrofa*), rhesus monkey (*Macaca mulatta*) and barking deer (*Muntiacus muntjak*) (Khan, 2008).

The SRF is managed as a Reserve Forest and three areas within the forest are designated as wildlife sanctuaries: Sundarbans West (715 km^2), Sundarbans South (370 km^2), and Sundarbans East (312 km^2). These sanctuaries have been collectively declared a UNESCO World Heritage Site (Iftekhar and Islam, 2004). Administration of the SRF is overseen by three Divisional Forest Officers (DFO East, DFO West and DFO Wildlife) working under a Conservator of Forests based in Khulna. For management purposes, the SRF is delineated into 55 compartments under four ranges, with over 90 guard posts distributed across the forest (Ahmad et al., 2009) (Fig. 2).

The SRF provides a wide range of forest and aquatic resources which are fundamental to the wellbeing of local communities (Islam and Wahab, 2005; Tamang, 1993). Several million people earn their livelihood from the SRF by collecting fish, nypa palm (*Nypa fruticans*) and honey (Ahmad et al., 2009; Tamang, 1993). Fishing activities continue throughout the year but the collection of nypa palm and honey usually starts between February and April, and lasts for a few months. The