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continued on the back inside cover

Cover: Whale Shark *Rhincodon typus* and Reef - made with poster colours. © P. Kritika.

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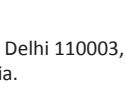

SHORT COMMUNICATION

Status of Swamp Deer *Rucervus duvaucelii duvaucelii* (G. Cuvier, 1823) in grassland-wetland habitats in Dudhwa Tiger Reserve, India

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Abstract: Swamp Deer is an endemic species of the Indian subcontinent, mainly inhabiting tall grasslands in river floodplains. Populations of the northern subspecies (*Rucervus duvaucelii duvaucelii*), restricted to the Terai regions of northern India and western Nepal, have undergone dramatic declines over the past two–three decades. In this communication, we present results from systematic population counts conducted in Dudhwa Tiger Reserve between 2021–2022. These counts were conducted at 11 sites, each with two–three independent observers. The exercises covered summer, monsoon, post-monsoon, and winter seasons. We found the largest congregations of Swamp Deer in June during the summer and February in winter. In the monsoon months of July–September the Swamp Deer tend to use Sal woodlands along with farmlands adjoining the reserve edge. This is part of an ongoing research project on long-term monitoring and conservation of the threatened alluvial grasslands of the central Terai in Uttar Pradesh, India. Institutionalizing these monitoring practices for frontline forest staff is essential for understanding long-term population dynamics of the threatened Swamp Deer to develop conservation protocols for grasslands and their fauna.

Keywords: Alluvial grasslands, population ecology, long-term monitoring.

In the fertile low lying marshy interspersion of woodlands, grasslands, and wetland region of the Himalayan foothills popularly termed as 'Terai' (Dinerstein 1979), alluvial floodplain grasslands have largely been transformed to productive agricultural land where sugarcane, wheat, and rice are cultivated. This has in turn led to decline in populations of grassland obligate herbivores like One-horned Rhinoceros *Rhinoceros unicornis*, Hog Deer *Axis porcinus*, Hispid Hare *Caprolagus hispidus*, and Swamp Deer among others (Dinerstein 2003; Strahorn 2009).

Swamp deer are endemic to Indian subcontinent, with present distribution restricted to select regions of India and Nepal, while the species is reportedly extinct from Pakistan and Bangladesh (Duckworth et al. 2015). There are three distinct subspecies of Indian Swamp Deer: the northern *R. d. duvaucelii*, the central Indian *R. d. branderi*, and northeastern *R. d. ranjitsinhi* (Schaller 1967). Of these, the distribution of *R. d. duvaucelii* is relatively wide, spanning the states of Uttar Pradesh & Uttarakhand in India, and the western Terai in Nepal.

Although the distribution of the northern population is widely extended, their major populations are restricted primarily within protected area (PA) boundaries (Paul et al. 2020), with some movement between major blocks of habitats along riverine corridors and agriculture land (Warrier 2019). This was not always the case. In the late

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1960s, the largest known congregations of Swamp Deer in India were reported from the grassland-agriculture mosaics, south-west of Dudhwa (Schaller 1967). The disappearance of these large herds is, at least in part, the outcome of the progressive conversion of grassland habitats in the Terai into agriculture and other land-uses, which are now perhaps a mere 20% of their original extent (Dinerstein 2003; Strahorn 2009). In all likelihood, it may also be attributed to the species being hunted, especially beyond PA boundaries (Ahmed 2007).

The largest extant population of the northern subspecies has been reported from Shuklaphanta National Park in Nepal (2,300 individuals) in a grassland of 60 km^2 area (Ghimire et al. 2019; Yadav 2021). However, grassland habitats within Dudhwa Tiger Reserve (DTR), inclusive of Dudhwa National Park (DNP), Kishanpur Wildlife Sanctuary (KWS) (cumulatively spanning 141 km^2) have reportedly supported only around 1,300 Swamp Deer individuals in recent decades (Qureshi et al. 1995; Ahmed 2007). On the other hand, De (2001) reported around 2,100 individuals in the same areas.

Although DNP and KWS were declared PAs to conserve Swamp Deer and its natural habitat (Singh 1978), assessments of population status and fine-scale distribution have been scant. Chanchani et al. (2014) noted that the detection of the species was very sparse, even when transects in habitats with known aggregations were carried out on elephant back.

There have been no systematic population assessments for Swamp Deer since the late 2000s. The species status may be increasingly precarious in its former strongholds such as Sathiyana grasslands within DTR (Sankaran 1989). Therefore, a status assessment of the species was conducted in grassland habitats within Dudhwa Tiger Reserve in order to develop long-term monitoring protocols.

Methods

Population counts were conducted between March 2021–February 2022. We identified 11 monitoring sites after discussion with park managers and frontline staff, followed by reconnaissance surveys by the field team (Image 1). The counts were conducted by two–three observers independently using high vantage points like elevated machans or tall trees, across the four distinct climatic seasons in the study area namely, summer (March 2021–June 2021), monsoon (July–September), post-monsoon (October–November), and winter (December 2021–February 2022). Across these monitoring sites, we made 53 survey visits in summer, 26 in monsoon, 23 in post-monsoon, and 60 visits in winter season. The low number of visits in both monsoon and post-monsoon seasons is attributable to the water logging and flooding which made the study area inaccessible. The data was compiled & analyzed by estimating mean & standard errors of Swamp Deer individuals counted at each monitoring site and climatic season using R programming software ver 4.1.1 (R Development Core Team 2021).

Results

Across the sampling sites, the highest mean congregations of Swamp Deer were documented at the 'Jhadi taal' site in KWS [179 individuals (SE = 23.2)] in the summers, followed by the site 'Rhino Reintroduction Area-I' in DNP (Figure 1). The same sites visited in the monsoon months indicated low counts which is attributable to the movement of Swamp Deer herds to woodlands, uplands, and farmlands abutting the boundaries of two PAs. This is supported by the signs recorded during unintentional visits in agricultural fields near two of our monitoring sites namely, 'Madrahiya grasslands and Rhino Reintroduction Area-I'. We encountered signs such as hoof marks and pellets of Swamp Deer from 10 villages surrounding two of our sites along the southern peripheries of DNP. However, we did not conduct any systematic signs surveys in the farmlands and other areas adjoining the PA boundaries.

Discussion

Low counts of Swamp Deer across the study area in the winter months can be attributed to flooding caused by unseasonal rains in October 2021. This unusual event led to the rise in water levels at major wetlands/grasslands (specifically Jhadi taal in Kishanpur) of the monitoring sites, rendering these habitats unsuitable for Swamp Deer. In addition, low detectability in the grasslands due to the tall grasses (which may get as high as 3–4 m in the peak dry season) in winters may have resulted in lower counts of Swamp Deer at these sites. The low detections of Swamp Deer individuals in the tall grasslands have also been emphasized in previous research attempts which in turn have been limited to encounter rates and count methods (Qureshi 1995; De et al. 2013). However, there still exist pertinent gaps in robust methodologies to understand the trends in abundance and population dynamics of this grassland ungulate over spatial and temporal gradients (Chanchani et al. 2014).

Swamp Deer are indicator species of the alluvial floodplains (Ahmed 2007; Singh & Prasad 2013). Many wetlands/swamps in the study area are threatened due

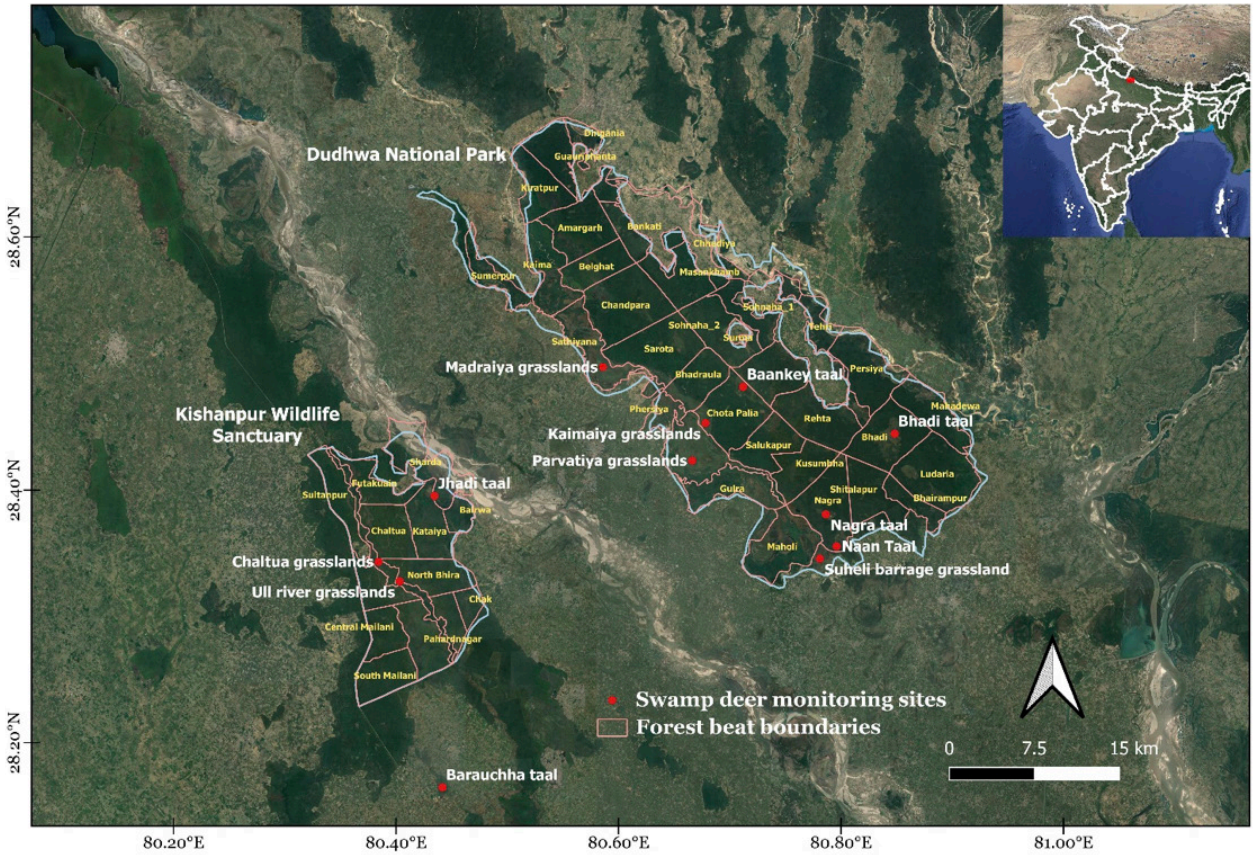

Image 1. Spatial locations of the Swamp Deer monitoring sites in the study area.

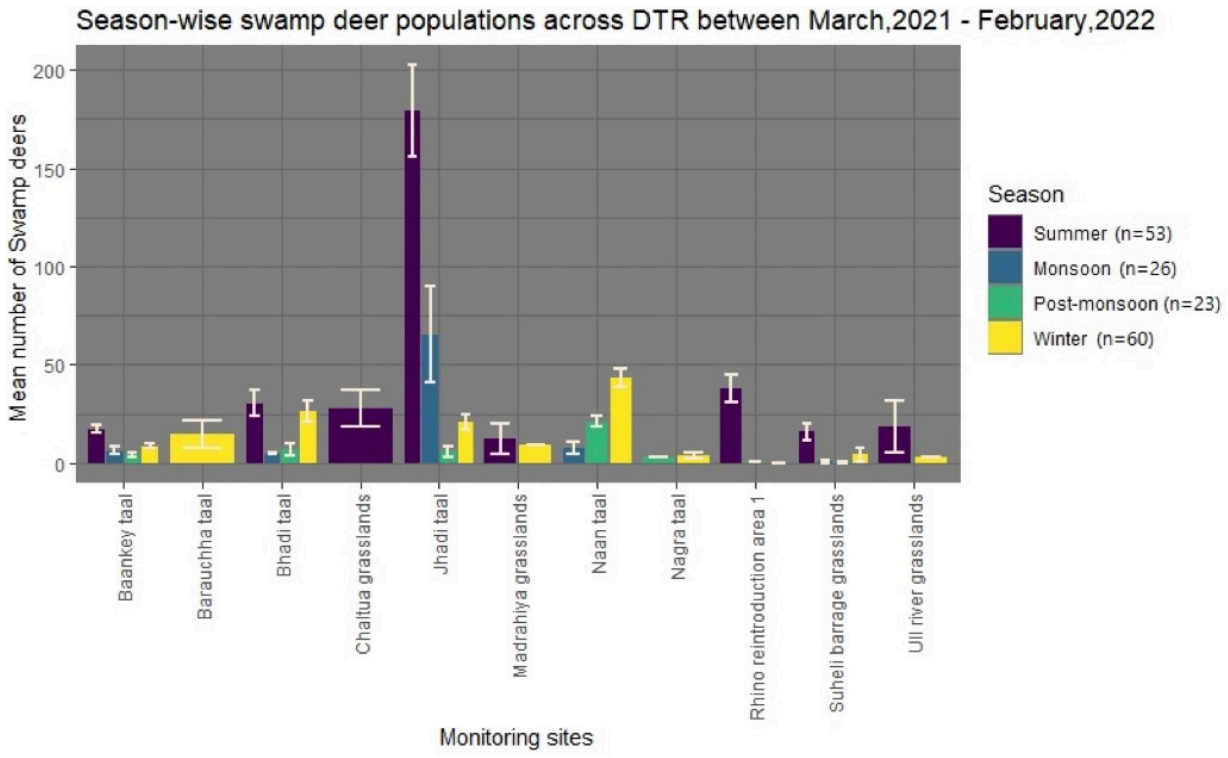

Figure 1. Swamp Deer counts across monitoring sites in Dudhwa Tiger Reserve (n: number of survey visits).

to the infestation of weeds such as Fox nuts *Euryale ferox* and Water Hyacinth *Pontederia crassipes* which need immediate interventions to secure these systems for dependent faunal species. In order to aid long-term research on the population dynamics of the Swamp Deer, the inclusion of monitoring exercises in the annual workplan of DTR administration is essential. Data collection can be facilitated by the use of simple electronic forms (both in English and native language), developed in discussion with experts, which can be preloaded on mobile devices of frontline staff. This valuable data generated through such efforts will help in designing necessary and robust conservation interventions for both the Swamp Deer and its threatened habitats in the Dudhwa landscape.

As part of our previous research work between 2019 & 2020, we assessed the probabilities of habitat use by Swamp Deer in grasslands within DTR (Rastogi et al. 2022). The results from the study revealed that about 30% of the overall grasslands were used by the species, with an occurrence probability of more than 40%. Therefore, gathering insights from previous work, we extended our survey jointly with the DTR administration, Uttar Pradesh Forest Department to monitor key grassland/wetland sites within the Dudhwa Tiger Reserve as part of this study in order to aid long-term conservation of the Swamp Deer.

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