

# A first compilation of harrier roost counts from India suggests population declines of wintering birds over 30 years

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The Indian subcontinent is a major wintering area for many migrant birds from Central Asia and Russia and has experienced unprecedented landscape changes over the last two decades. The effects of these changes on the population of bird communities, especially on raptors, are unknown or poorly assessed. Migrant harriers *Circus* spp. that require large open grassland, savannahs or sparse scrubland to roost and forage in their wintering quarters, have become scarce in recent times. The species composition and abundance of harriers at historically documented roost sites, when monitored across years, can provide valuable information on their demographic status since data from their possible breeding locations in Russia is not readily available. Here, we collate published and unpublished information on various harrier roosts using predefined protocols to assess trends in the counts of harriers in protected and unprotected sites across the Indian subcontinent. Harrier counts across all sites, both protected and unprotected, showed a declining trend over the period 1985–2015. Limited species-specific data from two sites show a significant decline in Western Marsh Harrier *Circus aeruginosus* but not in Pallid Harrier *C. macrourus* and Montagu's Harrier *C. pygargus*. These may be early signs of population declines at a continental scale, and we urge the development of more robust systematic ways, along with the current method, to monitor harrier populations. There is a need for improvement of international collaborations with researchers in the breeding areas to conduct studies on long range migrants and to set up a national conservation plan to protect harriers and grasslands.

Key words: harrier, roost, counts, grassland, population trends, protected area, migration

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Changes in the populations of migratory land birds are driven by complex factors that are not completely understood (Faaborg *et al.* 2010). Several ecological conditions in the wintering areas – we adopt a northern hemisphere perspective regarding seasons throughout this paper – have been shown to influence spring migration phenology, survival rates and population changes in migratory bird species (Peach *et al.* 1991, Bairlein & Henneberg 2000, Norris *et al.* 2004, Schaub *et al.* 2005, Grande *et al.* 2009, Eraud *et al.* 2013). The declines in raptor population observed throughout the Sahel region in Africa are associated with extensive changes in land use (Thiollay 2006, Wilson & Cresswell 2006, Trierweiler & Koks 2009), including severe over-

grazing of grasslands, loss of soil and deforestation for agricultural expansion (Chomitz & Griffiths 1997, Wardell *et al.* 2003, Wood *et al.* 2004, Mortimore & Turner 2005, Reij *et al.* 2005, Buij 2012). These changes suggest that environmental conditions in the wintering range of Eurasian raptors are greatly impoverished. Further, climate change and subsequent environmental changes may contribute to deteriorating environmental conditions in these areas (Simmons *et al.* 2004, Grande *et al.* 2009).

India is a stronghold of wintering harriers breeding in Asia and has one of the largest roosts in the world for Pallid Harriers *Circus macrourus* and Montagu's Harriers *Circus pygargus* (Clarke *et al.* 1998). India is also known





Montagu's Harrier *Circus pygargus* on a plot marking for housing development. Much of the grasslands in South India are converted to real estate (photo M.B. Prashanth, 30 November 2016).

to harbour the highest diversity of non-breeding harriers (Simmons 2000). However, the status of the Asian harriers wintering in the Indian subcontinent is poorly known, mainly because monitoring of breeding populations of these harriers in Asia is very scarce. Even though population data is limited, most species are suspected to be on the decline (Naoroji 2006). Globally, populations of 10 out of 16 harrier species are in decline worldwide, even though only two are listed as endangered, one vulnerable and one near threatened (IUCN 2017).

The major wintering sites for harriers in India are changing at the landscape level, as such sites are in Africa (Brink & Eva 2009). Most critical is the size and availability of grasslands in India; they are not as extensive as in Africa and only 1% are protected, while the rest are highly degraded (Anonymous 2007). Grasslands are categorized as 'wastelands' by the government of India, a term inherited from colonial times, and are prioritized for developmental acquisition (Anonymous 2007, Vanak *et al.* 2013). Large parts of Western India and South-Central India, traditionally covered by dry savannahs, are rapidly changing due to

urbanization and industrialization. Such changes may lead to the loss of suitable areas for harrier roosts, thereby leading to a decline in their populations. Long-term studies in Africa have shown that human induced disturbance can result in the decline of raptors (Thiollay 2006, Anadón *et al.* 2010).

Counting birds at a single point limits the understanding of patterns at a large scale, but such counts have been used to document raptor presence (Kennedy & Stahlecker 1993) and community diversity (Manosa & Pedrocchi 1997), to estimate occupancy (McLeod & Andersen 1998), and have been used as a population monitoring tool (Geissler & Fuller 1987, MacKenzie *et al.* 2002). Alternatively, roost counts have been used to document trends in wintering harriers (Hirano *et al.* 2010), and falcons *Falco* sp. (Palatitz *et al.* 2015).

In this study, we collate published data on roosting harriers from the Indian subcontinent starting from the mid-1980s when studies on harriers were initiated. We collected field data over several years, to determine trends in the population of wintering harriers across the Indian subcontinent and provide insights for future monitoring and ecological studies. The specific objec-

tives of the study were to determine (1) the general trend in the composition and numbers of harriers at roosting locations across India over the last two decades, (2) if trends are similar across the different roosts in the Indian subcontinent, and (3) if protection of grasslands influences such trends in harrier counts.

## METHODS

We collated information on harrier roosts from a variety of sources including the internet, library search, peer reviewed publications, unpublished data collected by experienced observers, forest department records and observations by TG. The collected records and field surveys cover 30 years, from 1985 to 2015. The methods used for counting and estimating birds at all sites followed those described in Verma (2004) and Ganesh & Kanniah (2000).

Harrier census records for the large roost at Velavadar National Park, which is spread over 35 km<sup>2</sup>, were obtained from the state forest department (Akhtar 1995, Parmar 2009, Gujarat Forest Department pers. comm.). The park contains approximately 10 km<sup>2</sup> of managed grasslands, while the remainder is overgrown by sparse tree cover. All counts for Velavadar National Park followed the methods outlined in Clarke *et al.* (1998).

Species-specific counts were affected by identification of juvenile and female Montagu's, Pallid and Hen Harriers *Circus cyaneus* under low light at roosting time and in flight; identification was not always possible. Grey males were confidently identified except in a few places. Unidentified females or juveniles were categorized under the respective age or sex categories and not under species.

Counts done between 1 November and 31 January (from 1 October in western India) of each season were considered for the analysis. This period coincides with the highest roost counts and accounts for variation in peak counts at each site (own unpubl. data). In Western Indian sites (Velavadar), peak counts occur in October of each year while in southern India they are usually in December. If multiple counts were carried out in a given period we only included the highest one. Count data were available from Western India, Central India (the Deccan region) and South India, and own unpublished data were available for some roosts in the Deccan region (Figure 1). In all, we obtained information for 15 roost sites spread over Western India, South-Central India (Deccan) and South India and occurring in the states of Rajasthan, Gujarat, Maharashtra,



**Figure 1.** Locations of harrier roost sites in India. Sites with more than five years of data are depicted with black dots and sites with less than five years of data with light grey dots.

Andhra Pradesh, Karnataka and Tamil Nadu (Table 1). Only sites with data from five or more years were considered for the detailed analysis. These roost sites are predominantly the ones occupied by dryland harriers – Montagu's and Pallid Harriers – and in one case (Hessarghatta, Karnataka) dominated by Western Marsh Harriers *Circus aeruginosus*. Roost counts were log-transformed for regression analyses (Lloyd-Evans & Atwood 2004). We used a general linear model to determine how counts (the response variable) vary with years in sites with five or more years of data. We included roost site as a random factor in the model to test for differences between roosts inside protected areas and those outside. We used R software (v. 3.3.2; R Core Team 2016) and Microsoft Excel (v. 2010) for all statistical analysis.

## RESULTS

Five species of harriers were recorded across the 15 roost sites (Table 1). These include Montagu's Harrier, Pallid Harrier, Western Marsh Harrier, Pied Harrier *Circus melanoleucos* and Hen Harrier. The Montagu's, Pallid and Western Marsh Harriers were the most



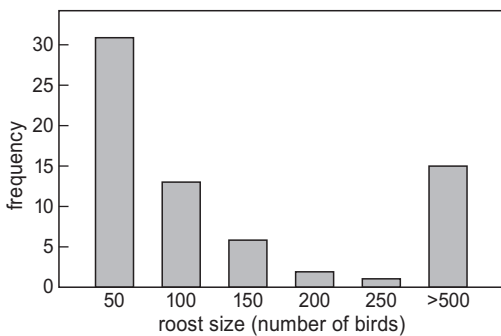
Grasslands inside protected areas are transforming to wooded savannah due to lack of management, making them unsuitable for harriers and other grassland birds (photo M.B. Prashanth, Rollapadu, 14 October 2016).

**Table 1.** Particulars of visited roost sites, years counted and minimum and maximum number of birds included in the analysis.

Sites	Area protected	Present existence	Years	No. years	Number		Source
					Min.	Max.	
Dreamland 50 ha, Nannaj Bustard Sanctuary (NBS)	No	No	2009–2010	2	32	43	Kasambe & Mhaske 2011
Akola	No	No	2003–2004	2	72	200	Verma 2004
Alwal	No	No	1986–1993	7	65	217	Ganesh & Kanniah 2000
Keoladeo National park (KNP)	Yes	Yes	1996–1999	4	54	132	Verma 2002
Hessarghatta	Ni	No	2005–07, 09, 2012–14	7	4	111	Verma 2006, own obs.
Mardi 100 ha, Nannaj Bustard Sanctuary (NBS)	Yes	Yes	2006–2011	6	22	65	Kasambe & Mhaske 2011
Mysore-airport	No	No	2002	1	73	73	Thejaswi <i>et al.</i> 2004
Rollapadu Bustard Sanctuary (RBS)	Yes	Yes	1985–1997, 2004, 2015.	14	1000	1000	Rahmani & Manakadan 1987, Clarke & Prakash 1997, own unpubl. data
Talchapper Wildlife Sanctuary (TWS)	Yes	Yes	2008, 09	2	25	28	Verma 2010
Vagaikulam	No	Yes	2014	1	45	45	Own unpubl. data
Vellavadhara National Park (VNP)	Yes	Yes	1992, 1997, 2001–09	10	979	3000	Akthar 1995, Clarke <i>et al.</i> 1998, Parmar 2009
Vijaynarayanam	No	Yes	2014	1	50	50	Own unpubl. data
Wadala, Mahundhi	No	No	2004, 06, 11	3	4	145	Kasambe & Mhaske 2011
Yedathore	No	No	2000	1	37	37	Thejaswi <i>et al.</i> 2004
Yellandhura lake	No	unknown	1998	1	67	67	Thejaswi <i>et al.</i> 2004

common, and were observed at all the roosts sites, while Pied and Hen Harrier were rarely encountered. Six sites had data for five or more years and were used for further trend analysis. These were Velavadhar National Park (VNP, Western India), Alwal (Deccan), Nannaj (Deccan), Wadala (Deccan), Rollapadu (Deccan) and Hessarghatta (Deccan).

The frequency distribution of roost sizes, with all harrier species combined for all roosts, including multiple counts at the same site, are highly skewed towards small roosts (in the range of up to 50 birds), which accounts for 60% of the sites. At the other extreme, large roosts of above 500 birds account for 21% of the sites (Figure 2). Some of the roosts holding



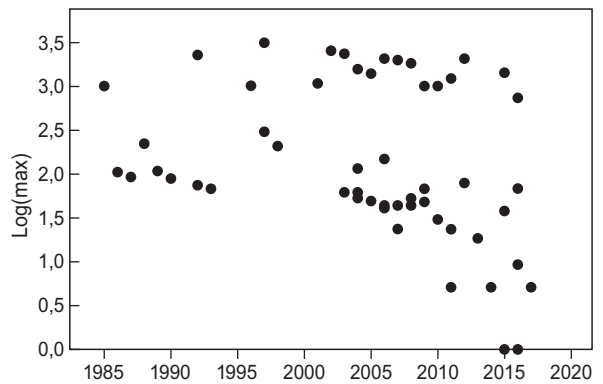
**Figure 2.** Frequency distribution of harrier roost sizes (total numbers of combined species) in India in the period 1985–2015.

100–200 birds, such as Alwal, Akola, Wadala or Hessarghatta (all in the Deccan region), no longer exist while the location or existence of many smaller roosts (<50 birds) is not known (Table 1).

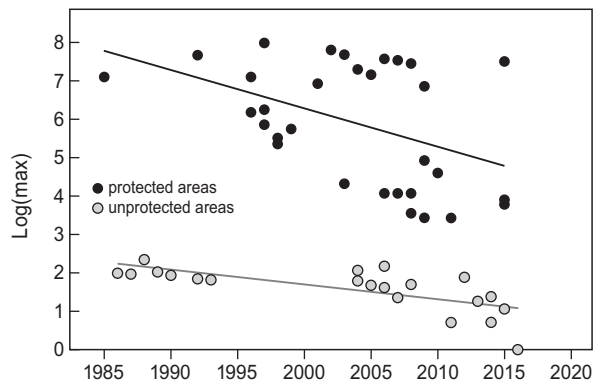
**Trends in roost counts and comparison between protected and non-protected areas**

The Linear Mixed Effect Model (LMEM), based on all six sites and species combined, detected a significant negative relationship between year and counts (Figure 3, Table 2).

We tested the effect of year and protection status of the roost (protected or not) on counts with roost site included as a random factor (random intercept model) and interaction between year and protection status as an explanatory variable in the analysis to determine whether the trend for year is different for protected and unprotected areas. In this analysis all species were combined. The trend was not different between protected and unprotected areas (Table 2), and the trends in both protected and unprotected areas are for a decline over years (Figure 4).



**Figure 3.** Harrier roost size as a function of time. Numbers of all species combined. Data from 53 observations collected at six roost sites. Roost size refers to the maximum number counted. The relationship is not significant:  $r = -0.329$ ,  $F_{53} = 5.94$ ,  $P = 0.018$ .

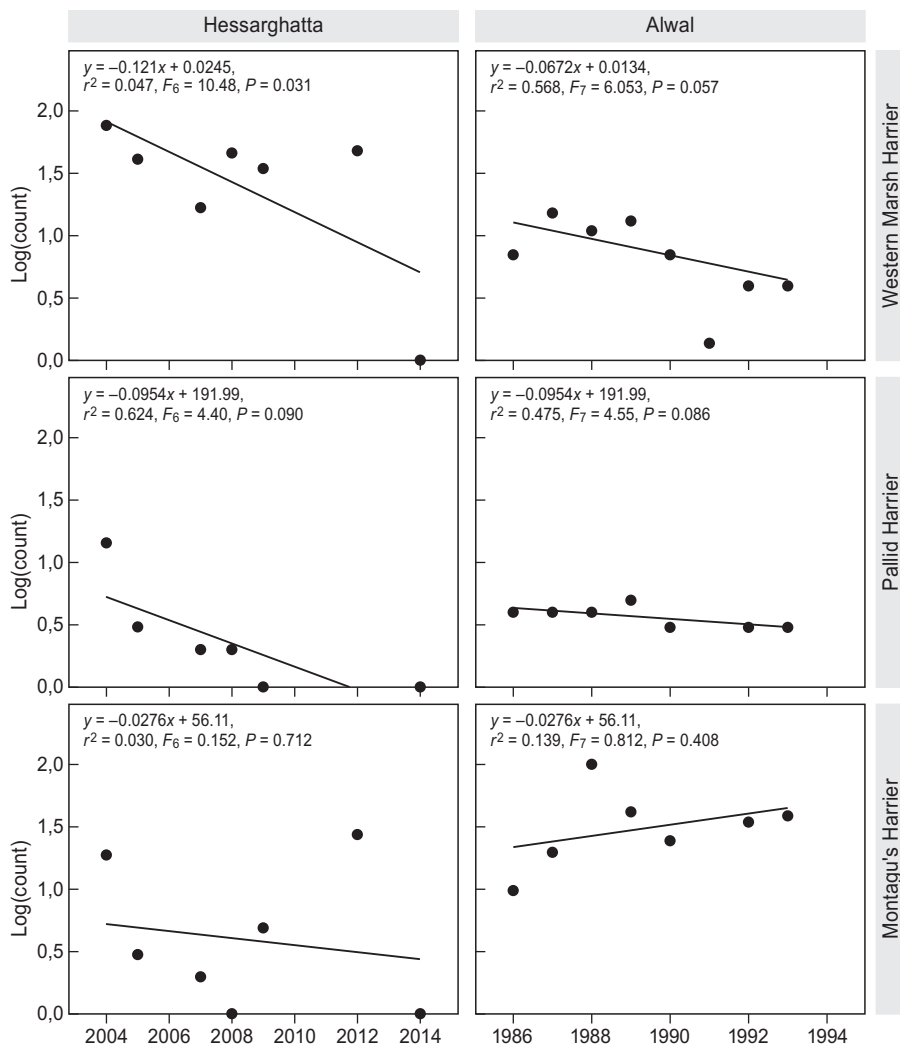


**Figure 4.** Comparison of 30-year trends in harrier numbers in roosts at protected and unprotected areas in the Indian sub-continent. Equation protected areas:  $y = -0.1003x + 206.9$ ,  $r^2 = 0.197$ ,  $F_{30} = 7.10$ ,  $P = 0.01$ , and unprotected areas:  $y = -0.0383x + 78.304$ ,  $r^2 = 0.492$ ,  $F_{19} = 17.33$ ,  $P = 0.001$ .

**Table 2.** Summary of the Linear Mixed Effect Model  $\log(\text{maximum number}) = \text{year} + \text{PA} + \text{year} \times \text{PA}$ , random =  $\sim 1 \mid \text{roost}$ , with roost as the random effect, where PA stands for protected area. The model incorporates the log-transformed maximum roost counts of all harrier species combined and years with the presence of the roost within or outside the protected area as an interaction term.

Fixed effect	Estimate	SE	df	t-value	P-value
Intercept	142.119	31.136	53	4.564	0.000
Year	-0.070	0.015	53	-4.51	0.000
PA	-62.9637	34.8074	4	-1.80	0.145
Year $\times$ PA	0.0319	0.0173	53	1.83	0.072

Random effects: SD of intercept (roost) = 0.6720, SD of residuals = 0.2963 ( $n = 61$ , number of groups = 6).



**Figure 5.** Trend analyses for numbers of Western Marsh, adult male Pallid and adult male Montagu's Harriers at roosts in Hessarghatta and Alwal in the period 1985–2015.

There was a median count of 125 harriers in protected areas, while in unprotected areas the median count was 48. Of the six sites with over five years of data, three sites were located inside a protected area, and three outside. Velavdhar National Park (VNP) and Rollapadu Bustard Sanctuary have been known to hold large numbers of birds, with VNP continuing to hold over 1000 birds (2015 census); however, this is no longer the case at Rollapadu where numbers have been less than 100 (own unpubl. data). Alwal, Wadala and Hessarghatta are unprotected sites and all are no longer active. Alwal was converted to a plantation and Hessarghatta, which was a farm, was abandoned by the birds possibly due to changes in management practices in the roosting area. Wadala may have been abandoned

due to land use change nearby (own unpubl. data). In addition, sites like Akola, and many in the Deccan region are no longer attracting harriers (G. Jathar, A. Verma and A. Shivaprakash pers. comm.). This indicates that protected areas are important for harrier roosts to persist in an area.

### Species trends

At two sites, Alwal and Hessarghatta, detailed age and species composition of the harriers, including grey birds (males of Montagu's and Pallid), 'ringtails' (females and juveniles) and Western Marsh Harrier (males, females, juveniles), were recorded on a regular basis for six or more years by TG which allowed for a comparison of trends between species. The trend analysis for

Alwal (1987–1994) shows that patterns may not be uniform across species. Male Montagu's Harriers, which constitute 40% and 44%, and male Pallid Harriers, which constitute 4% and 42% of the ringtails in Alwal and Hessarghatta, respectively, did not show a significant decline over the monitored years. Marsh Harriers declined significantly in Hessarghatta, where they constituted 75% of counts, but not in Alwal where they accounted for only 9% of counts (Figure 5).

## DISCUSSION

### Are harrier populations declining in India?

Numbers of individuals recorded at a given site are considered valid data to assess changes in population size (Geissler & Fuller 1987, MacKenzie *et al.* 2002). Harriers are communally roosting species, and repeatedly use the same place over time (Limiñana *et al.* 2012, Terraube *et al.* 2012, Trierweiler *et al.* 2014). This provides a good opportunity to assess relative changes in the counts at roosts as a measure of population change across years. While we observed a general declining trend in counts at all monitored roosts, the most dramatic changes were noticed at one of the largest roosts, Rollapadu Bustard Sanctuary, where the initial estimate of 1000 birds in the mid-1990s declined to less than 100 birds in 2016.

There has not been much published information on the Rollapadu site since Clarke & Prakash (1997), but based on our own visits and other sources (H. Taher pers. comm.) we can confirm that in recent years few harriers (<100 birds) come to roost even during the peak season. The Alwal roost site has been completely lost due to the development of a plantation, while the roost in the Nannaj area has experienced relatively less change in land use compared to other sites, but harrier numbers have still fallen and some roosts disappeared in 2016. Numbers have also fallen in the case of Hessarghatta, which is now deserted. The world's largest roost, at Velavadhur National Park, also seems to have decreased in size over the last 20 years, as mentioned by local media sources (Parmar 2009). However, more recent estimates show a contrary trend (Forest Department unpubl. data), which suggests a possible recovery; but this needs to be confirmed.

Do the observed declines in numbers at monitored roost counts indicate population decline or a desertion of certain sites? Although this is hard to answer, given that all monitored sites have shown a decline in numbers (whether statistically significant or not) and that this decline has been observed both inside and outside

protected areas, our results point to a general fall in harrier numbers rather than a change in distribution. The roost sites sampled are roosting areas used historically by many generations of birds, and harriers are known to show site fidelity (Verma 2002, Limiñana *et al.* 2012, 2015, Terraube *et al.* 2012). Loss of grasslands in such sites could mean that harriers are forced to move to other sites. Other sites in the vicinity could be enclosed farms and large private land holdings where change in land use may be frequently encountered. Additionally, a higher proportion of wintering harriers could be roosting individually or in small numbers, making monitoring more difficult, especially in areas where there are scattered patches of grassland in a grassland-agriculture matrix. While it is possible that new roost sites have sprung up over the years, the decline happening in the most suitable (core roosting area) such as in protected areas and extensive grassland habitats is probably indicative of a true population decline in the wintering range. Local intrinsic factors such as habitat loss or modification are known to decrease numbers of raptors (Thiollay 2006). Grasslands both in the breeding and non-breeding areas of harriers are threatened (Bragin 2003, Katzner *et al.* 2005). Extensive land use changes in India since the last few decades have transformed dry grasslands and their surroundings in the country. There are very few extensive, unfragmented grasslands left, especially in the Deccan region (Vanak 2013), but even these sites are heavily grazed by livestock. Enhanced irrigation facilities and availability of technology such as excavators and earth moving machinery has led to changes in habitat and in crop type from dry millet based to water intensive paddy, banana or sugar cane, reducing foraging areas for the birds. It is considered that the behaviour of migrant raptors, and other birds, is to some extent 'hard-wired', which may reflect a rather strong endogenous (genetic) control of migration, and that subtle differences in landscape may not play an important role (Berthold 1996). However, the extensive land use and landcover change happening in the wintering quarters, especially around prominent roost sites, could apparently have some effect on the counts as seen in Alwal and Hessarghatta. Alwal has seen the complete disappearance and transformation of the site whereas the areas around Bangalore city (Hessarghatta) have also come under rapid urbanization (Bharath *et al.* 2013). Climate could also be a major driver of such changes and may lead to drought becoming more common in the dry areas (Trenberth 2011, Guhathakurta *et al.* 2014) leading to poor grass cover and possibly lower prey availability in many parts of the country.

A key factor leading to population fluctuations in harriers is prey abundance (Terraube *et al.* 2012, Augiron *et al.* 2015) in both breeding and wintering areas. In India, Montagu's Harriers constitute 80–90% of all wintering harrier species (Rahmani & Manakadan 1987, Akthar 1995). This species relies on grasshoppers (Acrididae) in winter (Clarke 1996), and their abundance is often correlated with grasshopper density (Augiron *et al.* 2015). Many roosting sites, such as Velavadhar, Rollapadu, Nannaj and Akola, are close to massive agricultural areas growing millet and cotton crops which are known to harbour high grasshopper density and favourable foraging sites for the harriers (Clarke 1996). Cotton crops are sprayed intensively with pesticides and the birds not only find less prey but are susceptible to mortality by being at the top of the food chain (Garbach *et al.* 2014). Mortality at roost sites has regularly been observed (own obs.) and also reported from Rollapadu (Mathew 2007), and local paucity of prey due to intensive pesticide use may also be a cause of lower counts at roosts. More detailed research on habitat use by harriers, their prey and foraging strategies, with corresponding land use change can be achieved by tracking birds (Marra *et al.* 1998, Schlaich *et al.* 2016).

#### **Local, regional and continental influences on different species**

There could be several reasons for the decline of harriers in the wintering areas, ranging from failure in breeding to loss of habitat. Our study shows a declining trend at roosting sites for Pallid and Marsh Harriers, but not for Montagu's Harrier (Figure 5). However, in places such as Rollapadu, Nannaj and VNP, which have also experienced declines, the majority of the roosts comprise of Montagu's (Rahmani & Manakadan 1987, Akthar 1995, own unpubl. data), and therefore this species may also be declining. Most of the Pallid and Montagu's Harriers wintering in India may come from northern, central and eastern Kazakhstan, Russia and southern Asia. Populations of Pallid Harriers in northern Kazakhstan are considered stable (Bragin 1999, 2003) and the species is locally abundant (Sanchez-Zapata *et al.* 2003). The breeding success of Montagu's Harriers in Kazakhstan has also been stable during a three year study period (Terraube *et al.* 2010) and Western Marsh Harriers have increased in many places or are stable (Birdlife International 2015). However, the Asian population of Montagu's Harriers is considered to contain a significant part of the global breeding population, but their population status is not known (Ferguson-Lees & Christie 2006). In the subcontinent,

the Montagu's Harrier was the most abundant species, with 70–80% of the total numbers in places where we could document species composition, followed by Western Marsh Harrier and Pallid Harrier. There is a need for species level monitoring in the sampled sites. In the two sites mentioned here, Alwal and Hessarghatta, Montagu's and Pallid Harriers did not show a significant negative trend, but the data either come from early in the monitoring period (Alwal) or from a site having a low abundance of these species (Hessarghatta). Currently, the spatial distributions of the harrier roosts are concentrated in the Deccan region and western part of the country. If the numbers are decreasing in such sites, are there perhaps better sites further south or further east in the country? These areas are largely forested, but deforestation and seasonal agricultural expansion could be attracting these birds and small roosts may be present. Due to the lack of any regular monitoring or frequent sightings by birdwatchers in these areas, it is not possible to test this hypothesis.

#### **Conservation of harriers in the Indian subcontinent**

Declines in harrier numbers at roost sites are happening both inside and outside protected areas. Unprotected roost sites are ephemeral and subject to changes in land use; for example, seven of the ten unprotected sites (Table 1) were lost due to land use changes and all others are threatened by developmental activities. These ephemeral sites are strongly influenced by the intensity of grazing and spring time burning of grass (own pers. obs.) that possibly affects the harriers before they migrate. This forces birds to occupy suboptimal habitats, including exposed tilled fallow fields or small grass areas very close to human dwellings, both of which expose them to predators (own pers. obs.). Wintering harriers depend on the vegetation cover and food availability across the season, which also means a larger area is used in the winter (Trierweiler *et al.* 2014). Identification and protection of such sites used in winter is essential for conservation of the species. Therefore, protected areas, even if small, are critical for harriers, in addition to surrounding grassland and scrubland which are occupied by the birds once grass is burnt or heavily grazed.

This study indicates that harriers wintering in the Indian subcontinent are probably declining. This highlights the need for the conservation of harriers in the region to be addressed. There is also a need for a national conservation strategy that should include systematic and long-term monitoring of harrier populations at the species level through roost counts and road



transects in selected areas across the subcontinent. Reliable data on population sizes and trends need to be given a higher priority in the future to clarify global population trends of the species from Asian populations and to assess conservation goals. There is also a need to facilitate and foster international collaborations to tag and track harriers (currently permits are difficult to come by) of the major species (Montagu's, Pallid and Marsh Harrier) to determine their movements in the wintering habitats, but also to map migration routes and in particular stopover sites as done for European harriers migrating to Africa (Terraube *et al.* 2012, Trieweler *et al.* 2014). We also need to initiate studies on Pied Harrier and Eastern Marsh Harrier *Circus spilonotus*, which winter in India but are poorly studied. Finally, harriers can be a flagship species for the conservation of grassland patches that can attract popular attention and induce local efforts to protect and conserve grasslands.

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## SAMENVATTING

Het Indiase subcontinent is een belangrijk overwinteringsgebied voor veel trekvogels uit Centraal-Azië en Rusland. Het gebied heeft de afgelopen twintig jaar ongekende landschapsveranderingen ondergaan. De effecten van deze veranderingen op de overwinterende vogels (met name roofvogels) zijn niet bekend of slecht onderzocht. Uitgestrekte open graslanden en savannes met schaars kreupelhout, het leefgebied van overwinterende kiekendieven *Circus* spp., zijn de afgelopen tijd echter schaars geworden. Soortensamenstelling en talrijkheid van kiekendieven op historisch gedocumenteerde rustplaatsen kan waardevolle informatie verschaffen over de aantalsontwikkeling, aangezien gegevens van de Russische broedlocaties niet direct beschikbaar zijn. In dit artikel geven we informatie over verschillende slaappleaatsen van kiekendieven op het Indiase subcontinent. De gegevens zijn verzameld met behulp van vooraf vastgestelde protocollen. We beoordelen de aantalsontwikkeling op beschermde en onbeschermde locaties. De aantallen kiekendieven vertoonden tussen 1985 en 2015 op zowel beschermde als onbeschermde gebieden een dalende trend. Voor de Westelijke Bruine Kiekendief *C. aeruginosus* was de afname in aantallen in een van de twee gedetailleerd onderzochte gebieden significant. Dit was niet het geval voor de Steppenkiekendief *C. macrourus* en de Grauwe Kiekendief *C. pygargus*. De resultaten van ons onderzoek laten zien dat er mogelijk sprake is van een aantalsafname op continentale schaal. We pleiten voor de ontwikkeling van robuustere systematische methoden om kiekendieven te monitoren. Het is van belang dat de samenwerking met onderzoekers in de broedgebieden wordt verbeterd. De noodzaak om een nationaal instandhoudingsplan op te zetten voor het behoud van graslanden en kiekendieven is groot.

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