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Habitat Response of Obligatory Grassland Birds In Irrigated and Rainfed Agricultural Landscapes of Solapur District, Maharashtra, India

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Abstract

The Indian subcontinent supports approximately 13% of the world's avian diversity, yet certain regions remain understudied, particularly the Deccan Peninsula. This region, characterized by extensive grassland and savanna ecosystems, encompasses 33% of the Endemic Bird Areas (EBAs) and 31% of the Important Bird Areas (IBAs) within the subcontinent. Among the key regions for grassland avifauna, the Solapur district is of significant ecological importance, particularly for the conservation of the Great Indian Bustard (*Ardeotis nigriceps*) and other grassland-obligate bird species. However, increasing anthropogenic pressures—including intensive agricultural practices, shifts in cropping patterns, overgrazing, urban expansion, and infrastructure development—have contributed to extensive habitat degradation over recent decades. These transformations have negatively impacted grassland bird populations, particularly obligate species adapted to open landscapes. This study examined the habitat associations of obligate grassland bird species in response to rainfed and irrigated agricultural landscapes in the Solapur district. Findings indicate a positive correlation between obligate species and grassland or dryland agricultural cover, whereas irrigated agricultural areas and human settlements were associated with a decline in these species. These results highlight the critical need for systematic, long-term ecological studies to inform conservation management strategies and policy interventions aimed at preserving grassland-specialist bird species within this rapidly transforming landscape.

Keywords: Anthropogenic Pressure, avifauna, biodiversity, migratory. Ecology.

Introduction:

India is recognized as a megadiverse nation, supporting approximately 13% of the world's avian diversity (Grimmett *et al*., 2016; Rasmussen & Anderton, 2005). The Deccan Peninsula, a major biogeographic zone, is characterized by extensive grassland ecosystems that dominate its landscape. Although traditionally considered relatively species-poor in terms of overall biodiversity, this region harbors a significant proportion of Endemic Bird Areas (33%) and Important Bird Areas (31%) within its arid and semi-arid zones

(BirdLife International, 2020). The Solapur district, located within this peninsular region, supports a unique assemblage of avifauna, with grasslands serving as essential foraging and roosting habitats for both resident and migratory bird species (Hippargi *et al.,* 2012). However, in recent decades, these habitats have undergone significant degradation due to increasing anthropogenic pressures, including agricultural intensification, urban expansion, and shifts in land-use patterns. These transformations have resulted in a concomitant decline in grassland-dependent bird populations.

Methodology:

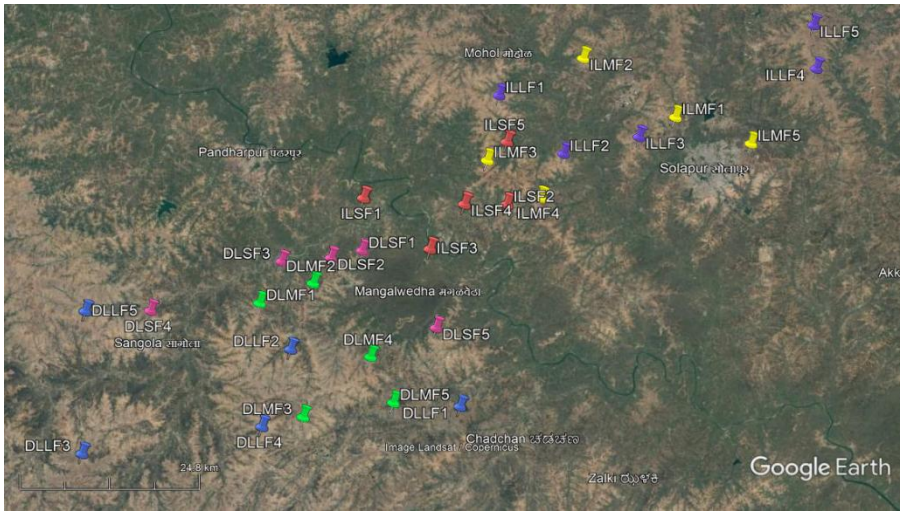


Figure 1: Satellite image of study area

Study Area

The study was conducted in the Solapur district of Maharashtra, India, geographically positioned between 17.10° to 18.32°N latitude and 74.42° to 76.15°E longitude. The district encompasses a total area of 14,844.6 km², which includes 11,480 km² of agricultural land, 380 km² of land with potential for agricultural development, 690 km² of non-agricultural land, 720 km² of grassland, and 1,260 km² of barren land.

Site Selection and Classification

A preliminary survey was conducted to identify areas with potential anthropogenic disturbances affecting grassland bird populations. A total of 30 study sites (Table 1) were selected and classified into two primary land-use categories: dryland and irrigated land. Dryland sites were predominantly rainfed, relying on monsoonal precipitation, whereas irrigated sites utilized water sources such as borewells, rivers, and dams, and were primarily cultivated with cash crops. Further classification based on water availability designated 15 sites as drought-prone or dryland and 15 sites as irrigated, particularly within the Bhima River Basin. Additionally, site fragmentation was assessed, with sites categorized into small, medium, or large fragment sizes.

Sampling Design and Data Collection

A total of 90 sampling points were systematically generated within the selected grassland fragments using QGIS, ensuring a minimum inter-point distance of 500 m within each fragment. The point count method (Hamel et al., 1996; Ralph et al., 1995, 1993; Bibby et al., 2000) was employed to conduct avian surveys. Observations were carried out under favorable weather conditions between 0600 and 0900 hours, coinciding with peak avian activity. Data collection was conducted across all seasons to ensure comprehensive temporal coverage. Field data were meticulously recorded, including date, time, weather conditions, geographic coordinates, bird abundance, distance from the observer, behavioral observations, sex, and habitat characteristics. Geographic coordinates were precisely documented using a Garmin eTrex 10 GPS device. Avian observations were facilitated using Olympus 8×40 and Nikon 10×50 field binoculars. Additionally, photographic documentation was conducted using a Canon EOS 70D camera equipped with Canon EF 55–250 mm IS, Canon EF 18–135 mm IS, and Canon EF 400 mm lenses. Species identification was carried out with reference to standard ornithological field guides (Ali, 2012; Grimmett et al., 2016).

Covariates and Data Analysis

A supervised image classification of a Landsat 7 satellite image (acquired in January 2017) was conducted using QGIS 2.18.1 (QGIS Development Team, 2016) to delineate the study area. Habitat covariates,

including the percentage cover of grassland, wooded grassland, dryland agriculture, irrigated agriculture, and settlements, were quantified at two spatial scales (100 m and 1000 m radii) around sampling points. These landscape metrics were computed using the R package 'landscapemetrics' (Hesselbarth et al., 2019) to facilitate spatial analysis of habitat composition and configuration.

Correlation Analysis and Variable Selection

Correlation coefficients (r) and variance inflation factors (VIF) were computed to evaluate collinearity among habitat covariates. All variables exhibited correlation coefficients (r) < 0.60 and VIF < 3 (Ieno & Zuur, 2015), indicating the absence of significant multicollinearity. As a result, all variables were retained for subsequent analyses.

Species Abundance and Diversity Analysis

Pearson's correlation coefficients were calculated to evaluate the relationships between habitat covariates and species abundance. The statistical significance of these relationships was assessed using a p-value threshold of 0.05. Species diversity and richness across different habitat types were estimated using the R package 'BiodiversityR' (Kindt & Coe, 2005).

Bird Species Classification

Bird species were categorized based on their dietary habits: insectivorous, carnivorous, granivorous, and omnivorous. Additionally, species were classified into three categories according to their dependency on grassland: obligatory, facultative, and generalist. Obligatory grassland birds exclusively or predominantly utilize grasslands for breeding or feeding. Facultative grassland species prefer grasslands disproportionately, but less so than obligatory species. Generalist species do not prefer any particular habitat(s).

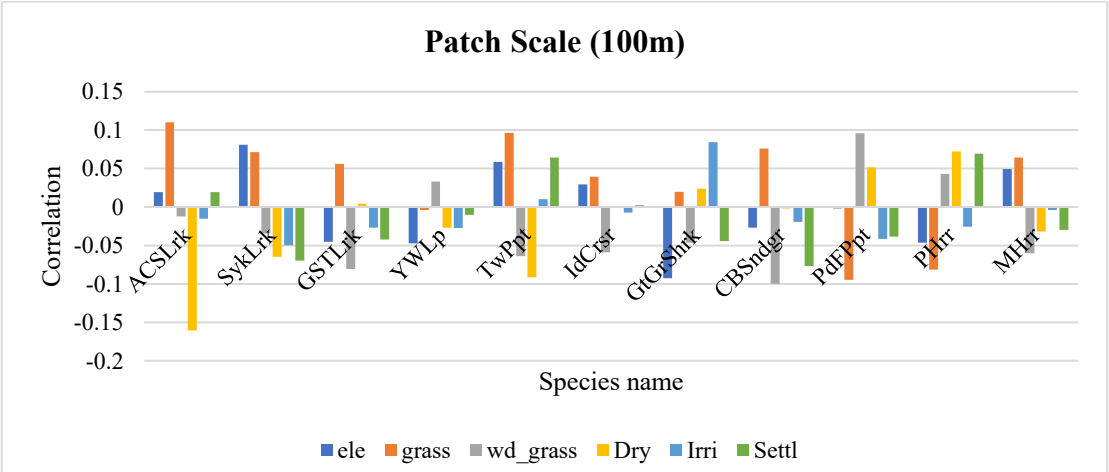
Data Analysis Software

All data analysis was performed using Microsoft Excel (version 2019 16.0.6742.2048) and R software (R Core Team, 2019).

RESULTS:

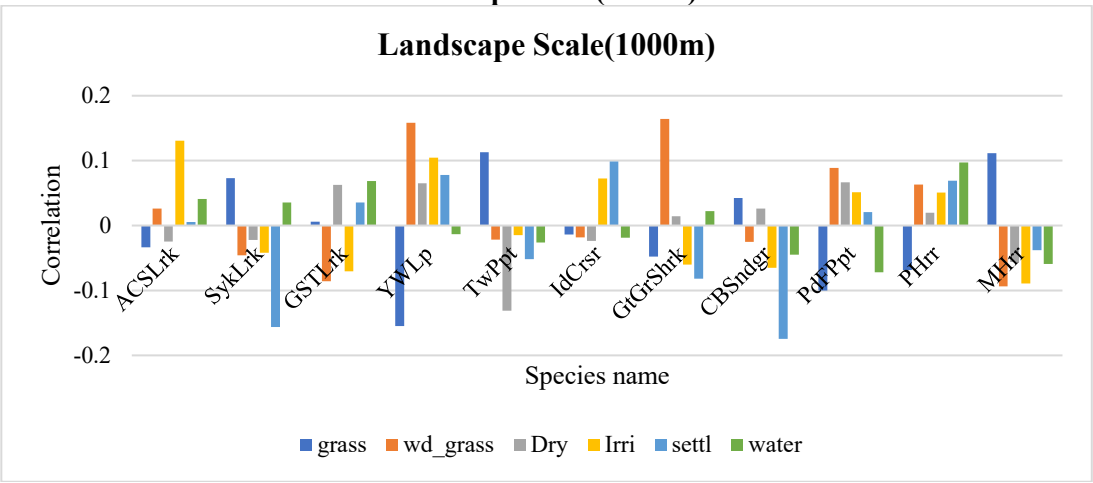
An avifaunal survey conducted in Solapur district documented a total of 17 obligate grassland bird species (Table 2), including four migratory species (23.5%) and 14 resident species (76.5%). Notably, two species, the Laggar Falcon (*Falco jugger*) and Pallid Harrier (*Circus macrourus*), are classified as Near Threatened, while the Great Grey Shrike (*Lanius excubitor*) is categorized as Vulnerable according to the International Union for Conservation of Nature (IUCN) Red List. To ensure statistical robustness, a subset of 11 species with observation frequencies exceeding 10 was selected for further analysis. A comprehensive assessment of habitat associations was conducted at both patch and landscape scales, revealing distinct patterns of species distribution in response to various environmental variables (Table 3).

Figure 2: Correlation coefficient between obligatory grassland birds and habitat at patch scale (100m)



*ele: Elevation, grass: Grassland, wd_grass: Wooded grassland, dry: Dryland, irri: irrigated Land

Figure 3: Correlation coefficient between obligatory grassland birds and habitat covariate at landscape scale (1000m)



*grass: Grassland, wd_grass: Wooded grassland, dry: Dryland, irri: irrigated Land

The Ashy-crowned Sparrow Lark (*Eremopterix griseus*) exhibited a positive association with elevation, grassland cover, and settlement cover at the patch scale, while displaying a negative correlation with wooded grassland, dryland agriculture, and irrigated land cover. However, at the landscape scale, the species demonstrated a significant positive association with irrigated agricultural land. Sykes's Lark (*Galerida deva*) showed a positive correlation with elevation and grassland cover at the patch scale, whereas it exhibited negative associations with wooded grassland, dryland agriculture, irrigated land, and settlement cover. At the landscape scale, the species displayed positive associations with grassland and water availability, while maintaining negative correlations with wooded grassland, dryland agriculture, irrigated land, and settlement cover. The Greater Short-toed Lark (*Calandrella brachydactyla*) exhibited a negative correlation with elevation, wooded grassland, irrigated land, and settlement cover at the patch scale, while demonstrating a positive association with grassland cover.

At the landscape scale, the Greater Short-toed Lark (*Calandrella brachydactyla*) exhibited positive associations with elevation, dryland agriculture, settlement cover, and water availability, while demonstrating negative associations with wooded grassland and irrigated land.The Yellow-wattled Lapwing (*Vanellus malabaricus*) displayed a negative correlation with elevation, grassland cover, dryland agriculture, irrigated land, and settlement cover at the patch scale, while showing a positive association with wooded grassland. Conversely, at the landscape scale, the species demonstrated positive associations with wooded grassland, dryland agriculture, irrigated land, and settlement cover. The Tawny Pipit (*Anthus campestris*) exhibited positive associations with elevation, grassland cover, irrigated land, and settlement cover at the patch scale, while showing a negative association with wooded grassland and dryland agriculture. At the landscape scale, the species was positively associated with grassland cover. At the landscape scale, the species demonstrated positive associations with irrigated land and settlement cover. Great Grey Shrike (GGS) exhibited a negative association with elevation, wooded grassland, and settlement cover at the patch scale. Conversely, at the landscape scale, the species showed positive associations with wooded grassland, dry land, and water. Chestnut-bellied Sandgrouse (CBS) displayed a positive association with grassland cover at the patch scale. At the landscape scale, the species exhibited positive associations with grassland cover and dry land. Paddy-field Pipit (PFP) showed a negative correlation with elevation, grassland cover, irrigated land, and settlement cover at the patch scale, while being positively associated with wooded grassland and dryland. Conversely, at the landscape scale, the species demonstrated negative associations with grassland cover and water, and positive associations with wooded grassland, dry land, irrigated land, and settlement cover. Pallid Harrier (PH) exhibited a negative correlation with elevation, grassland cover, irrigated land, and settlement cover at the patch scale, while being positively associated with wooded grassland and dry land. Montagu's Harrier (MH) displayed a positive correlation with elevation and grassland cover at the patch scale, while showing negative associations with wooded grassland, dryland, irrigated land, and settlement cover. At the landscape scale, the species exhibited a positive association with grassland cover.

Discussion:

The findings of this study underscore the significance of habitat fragmentation and land-use patterns in shaping the distribution and abundance of grassland bird species. Specifically, smaller fragments amidst irrigated fields exhibited elevated levels of degradation due to intensified human disturbance, resulting in heightened predation risk and competition with generalist species. Ashy-crowned Sparrow Lark exhibited a significant positive association with elevation, grassland cover, and settlement cover at the patch scale. Conversely, the species demonstrated a negative correlation with wooded grassland, dry land, and irrigated land cover. These findings are consistent with previous studies, which have reported that ACSL prefers open and grazed grasslands (Hipparagi *et al.*, 2012; Manakadan, 2014). In contrast, Sykes's Lark displayed a positive correlation with elevation and grassland cover at the patch scale. However, the species' high occupancy during summer was unexpected, and may be attributed to increased detection probability and food availability in open habitats. Greater Short-toed Lark migrates to India during the post-monsoon season, coinciding with ample food availability. However, their abundance declined as winter arrived, potentially due to decreasing food availability. The habitat preferences of Yellow-wattled Lapwing were characterized by a significant positive association with wooded grassland and a negative correlation with elevation, grassland cover, dry land, irrigated land, and settlement cover. These findings are consistent with previous studies, which have reported that YWL prefers open and dry areas for breeding and foraging (Hipparagi *et al.,* 2012; Manakadan, 2014; Narawade *et al.,* 2010; Sethi, 2010). Indian Courser is an obligatory grassland species that breeds in grasslands with sparse bushes and shrubs. The species' avoidance of irrigated landscapes and cultivated fields, and its strong association with grasslands, are consistent with previous studies (Ali & Ripley, 1981; Munjpara, 2012). Great Grey Shrike is a habitat specialist species that favours agricultural croplands and scrublands on hillocks (Pande *et al*., 2004). The species' avoidance of small fragments entrapped in irrigated and agricultural croplands suggests a threat response to habitat fragmentation (Brambilla *et al.,* 2007). Chestnut-bellied Sandgrouse breeds in dry and uncultivated areas (Ali & Ripley, 1981; Sumant *et al.,* 2019; Pande, 2012; Narawade *et al.,* 2020). The species' highest occupancy was recorded during summer, potentially due to the open and dry habitat conditions. Pallid Harrier and Montagu's Harrier are sympatric species with distinct dietary preferences. Pallid Harrier is a rodent specialist, while Montagu's Harrier is a generalist species (Samant *et al.,* 1995; Verma, 1996; Buij, 2012). The species' populations are declining due to habitat loss and fragmentation, as well as illegal hunting during migration (Verma, 2005; Verma & Sharma, 2013; Saravanan, 2021). In conclusion, the findings of this study highlight the importance of conserving grassland habitats and mitigating the impacts of habitat fragmentation and land-use change on grassland bird populations.

Conclusion:

The rapid conversion of open landscapes to croplands and orchards poses a significant threat to the obligatory species of grassland birds in Solapur district. Habitat destruction and fragmentation can lead to population decline, isolation, and extinction.

Recommendations for Future Research:

A comprehensive study on migrant and resident grassland bird species in Solapur district is necessary to develop the conservation action plan and policy interventions for long-term preservation of the grassland bird diversity. Key research areas include:

1. Habitat selection: Investigating habitat utilization and selection patterns among different bird species.

2. Population dynamics: Examine population trends, abundance, and distribution in response to human disturbances.

3. Behavioural patterns: Studying adaptations to changing environmental conditions, including migration patterns, foraging strategies, and breeding habits.

4. **Conservation actions and policies:** The data and information generated from these focused studies can be used to develop the pragmatic conservation action plan and policies for grassland birds in specific and ecosystem in general.

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Table 1: GPS Coordinates of study sites

Sr. no	Site ID	Hab	Longitude	Latitude	Nearest village/city	Taluka	Points
1	DLLF1	DL	75.584349°	17.338659°	Soddi	Mangalwedha	4
2	DLLF2	DL	75.364457°	17.412539°	Khupsangi	Mangalwedha	4
3	DLLF3	DL	75.093312°	17.276694°	Hatkar Mangewadi	Sangola	4
4	DLLF4	DL	75.327244°	17.312356°	Autadewadi	Mangalwedha	4
5	DLLF5	DL	75.097471°	17.461151°	Sonalwadi	Sangola	4
6	DLMF1	DL	75.324478°	17.472326°	Laxmi Dahiwadi	Mangalwedha	4
7	DLMF2	DL	75.393784°	17.497997°	Kacharewadi	Mangalwedha	4
8	DLMF3	DL	75.381029°	17.325183°	Bhose	Mangalwedha	4
9	DLMF4	DL	75.468353°	17.403075°	Bhalwani	Mangalwedha	4
10	DLMF5	DL	75.498044°	17.343692°	Bavachi	Mangalwedha	2
11	DLSF1	DL	75.457203°	17.540021°	Mangalwedha	Mangalwedha	2
12	DLSF2	DL	75.416788°	17.530649°	Sharad Nagar	Mangalwedha	2
13	DLSF3	DL	75.352764°	17.526026°	Marapur	Mangalwedha	2
14	DLSF4	DL	75.182414°	17.461952°	Sangola	Sangola	2
15	DLSF5	DL	75.553334°	17.440390°	Donaj	Mangalwedha	2
16	ILLF1	IL	75.635075°	17.740770°	Dhok Babhulgaon	Mohol	4
17	ILLF2	IL	75.718782°	17.665172°	Dadpur	Mohol	4
18	ILLF3	IL	75.817159°	17.686899°	Hiraj	North Solapur	4
19	ILLF4	IL	76.048283°	17.775093°	Tandulwadi	North Solapur	4
20	ILLF5	IL	76.044881°	17.831384°	Deokurli	North Solapur	4
21	ILMF1	IL	75.864720°	17.712524°	Kegaon	North Solapur	4
22	ILMF2	IL	75.744742°	17.788667°	Lamboti	Mohol	2
23	ILMF3	IL	75.619981°	17.656782°	Aundhi	Mohol	2
24	ILMF4	IL	75.689307°	17.608387°	Kamti	Mohol	2
25	ILMF5	IL	75.962969°	17.678302°	Mulegaon	North Solapur	4
26	ILSF1	IL	75.459209°	17.608131°	Nepatgaon	Pandharpur	2
27	ILSF2	IL	75.645361°	17.599635°	Wagholiwadi	Mohol	2
28	ILSF3	IL	75.545634°	17.542330°	Brahmapuri	Mangalwedha	1
29	ILSF4	IL	75.590410°	17.600222°	Inchgaon	Mohol	2
30	ILSF5	IL	75.645626°	17.680534°	Kurul	Mohol	2

***Hab:** Habitat; **DL:** Dryland; **IL:** Irrigated Land; **L:** Large; **M:** Medium; **S:** Small

Table 2: Checklist of obligatory species of grassland birds of Solapur district

Sr. No.	Order	Family name	Abbre	Common name	*Scientific name*	2017 IUCN Red List category	Status	Feeding Habit	No. of obs.
1	Galliformes	Phasianidae	RQl	Rain Quail	*Coturnix coromandelica*	LC	R	Omnivorous	7
2	Galliformes	Phasianidae	RcBsQl	Rock Bush-quail	*Perdicula argoondah*	LC	R	Omnivorous	2
3	Falconiformes	Falconidae	LgFlcn	Laggar Falcon	*Falco jugger*	NT	R	Carnivorous	1
4	Accipitriformes	Accipitridae	PHrr	Pallid Harrier	*Circus macrourus*	NT	M	Carnivorous	16
5	Accipitriformes	Accipitridae	MHrr	Montagu's Harrier	*Circus pygargus*	LC	M	Carnivorous	15
6	Charadriiformes	Turnicidae	BrBtQ	Barred Buttonquail	*Turnix suscitator*	LC	R	Omnivorous	4
7	Charadriiformes	Charadriidae	YWLp	Yellow-wattled Lapwing	*Vanellus malabaricus*	LC	R	Insectivorous	54
8	Charadriiformes	Glareolidae	IdCrsr	Indian Courser	*Cursorius coromandelicus*	LC	R	Insectivorous	29
9	Pterocliformes	Pteroclidae	CBSndgr	Chestnut-bellied Sandgrouse	*Pterocles exustus*	LC	R	Granivorous	25
10	Columbiformes	Columbidae	RdClDv	Red Collared Dove	*Streptopelia tranquebarica*	LC	R	Frugivorous	1
11	Caprimulgiformes	Caprimulgidae	IndNtj	Indian Nightjar	*Caprimulgus asiaticus*	LC	R	Insectivorous	1
12	Passeriformes	Laniidae	GrtGrShrk	Great Grey Shrike	*Lanius excubitor*	VU	R	Carnivorous	28
13	Passeriformes	Alaudidae	GSTLrk	Greater Short-toed Lark	*Calandrella brachydactyla*	LC	M	Granivorous	55
14	Passeriformes	Alaudidae	ACSLrk	Ashy-crowned Sparrow-lark	*Eremopterix griseus*	LC	R	Granivorous	70
15	Passeriformes	Alaudidae	SykLrk	Sykes's Lark	*Galerida deva*	LC	R	Granivorous	56
16	Passeriformes	Motacillidae	PdFPpt	Paddyfield Pipit	*Anthus rufulus*	LC	R	Insectivorous	24
17	Passeriformes	Motacillidae	TwPpt	Tawny Pipit	*Anthus campestris*	LC	M	Insectivorous	37

Table3: Correlation between habitat and obligatory species of grasslands of Solapur

Sr. No.	Spe. Name		Patch Scale						Landscape Scale					
			Elevation	Grass	Wooded Grass	Dryland	Irrigation	Settlement	Grass	Wooded Grass	Dryland	Irrigation	Settlement	Water
1	**RQ**	**Corre**	**-0.121**	**-0.106**	**0.103**	**0.058**	**0.045**	**-0.019**	**-0.126**	**0.085**	**0.124**	**0.031**	**-0.021**	**-0.041**
		p-value	0.046	0.080	0.088	0.340	0.460	0.746	0.038	0.162	0.040	0.608	0.722	0.497
2	**CK**	**Corre**	**0.107**	**0.130**	**-0.104**	**-0.095**	**0.046**	**0.016**	**0.205**	**-0.157**	**-0.124**	**-0.116**	**-0.111**	**-0.051**
		p-value	0.078	0.032	0.087	0.118	0.445	0.788	0.000	0.009	0.040	0.056	0.068	0.401
3	**PH**	**Corre**	**-0.046**	**-0.081**	**0.043**	**0.072**	**-0.025**	**0.069**	**-0.068**	**0.063**	**0.019**	**0.050**	**0.068**	**0.097**
		p-value	0.445	0.181	0.480	0.237	0.674	0.255	0.260	0.300	0.746	0.406	0.259	0.111
4	**MH**	**Corre**	**0.049**	**0.064**	**-0.060**	**-0.031**	**-0.003**	**-0.029**	**0.111**	**-0.093**	**-0.056**	**-0.089**	**-0.038**	**-0.059**
		p-value	0.419	0.293	0.323	0.601	0.949	0.627	0.067	0.125	0.355	0.144	0.532	0.331
5	**BBQ**	**Corre**	**-0.074**	**-0.072**	**0.121**	**-0.010**	**-0.020**	**-0.039**	**-0.045**	**0.105**	**0.017**	**-0.002**	**-0.058**	**0.021**

		p-value	0.224	0.237	0.045	0.862	0.736	0.519	0.452	0.084	0.772	0.963	0.340	0.727
6	**YWL**	**Corre**	**-0.047**	**-0.003**	**0.033**	**-0.027**	**-0.027**	**-0.010**	**-0.154**	**0.158**	**0.065**	**0.104**	**0.077**	**-0.013**
		p-value	0.437	0.947	0.588	0.657	0.656	0.867	0.010	0.009	0.284	0.086	0.202	0.830
7	**IC**	**Corre**	**0.029**	**0.039**	**-0.058**	**0.000**	**-0.007**	**0.002**	**-0.013**	**-0.018**	**-0.023**	**0.072**	**0.098**	**-0.018**
		p-value	0.629	0.520	0.335	0.990	0.903	0.969	0.824	0.767	0.696	0.235	0.106	0.757
8	**CBS**	**Corre**	**-0.026**	**0.075**	**-0.099**	**-0.001**	**-0.019**	**-0.076**	**0.042**	**-0.025**	**0.026**	**-0.065**	**-0.174**	**-0.044**
		p-value	0.659	0.213	0.102	0.974	0.750	0.207	0.485	0.678	0.668	0.287	0.003	0.462
9	**SB**	**Corre**	**-0.088**	**-0.104**	**0.175**	**-0.027**	**-0.020**	**0.024**	**-0.106**	**0.127**	**0.063**	**0.018**	**0.023**	**-0.029**
		p-value	0.147	0.087	0.003	0.656	0.737	0.684	0.081	0.035	0.298	0.760	0.699	0.630
10	**IB**	**Corre**	**-0.277**	**-0.095**	**0.211**	**-0.069**	**-0.058**	**-0.036**	**-0.193**	**0.219**	**0.060**	**0.203**	**0.007**	**-0.011**
		p-value	3.56E-	0.119	0.000	0.252	0.338	0.553	0.001	0.000	0.324	0.000	0.902	0.853
11	**RTL**	**Corre**	**-0.133**	**-0.201**	**0.090**	**0.215**	**-0.056**	**0.019**	**-0.185**	**-0.063**	**0.205**	**0.214**	**0.054**	**-0.038**
		p-value	0.028	0.000	0.137	0.000	0.358	0.748	0.002	0.296	0.000	0.000	0.375	0.532
12	**GSTL**	**Corre**	**-0.045**	**0.055**	**-0.080**	**0.004**	**-0.027**	**-0.042**	**0.005**	**-0.085**	**0.062**	**-0.070**	**0.035**	**0.068**
		p-value	0.457	0.360	0.186	0.944	0.658	0.490	0.925	0.159	0.305	0.249	0.561	0.261
13	**ACSL**	**Corre**	**0.019**	**0.110**	**-0.012**	**-0.160**	**-0.015**	**0.019**	**-0.033**	**0.025**	**-0.024**	**0.130**	**0.005**	**0.040**
		p-value	0.753	0.071	0.838	0.008	0.802	0.750	0.583	0.670	0.688	0.032	0.927	0.505
14	**SK**	**Corre**	**0.081**	**0.071**	**-0.034**	**-0.064**	**-0.049**	**-0.069**	**0.072**	**-0.045**	**-0.022**	**-0.041**	**-0.156**	**0.035**
		p-value	0.183	0.242	0.574	0.288	0.413	0.254	0.232	0.454	0.717	0.494	0.010	0.563
15	**OSL**	**Corre**	**-0.072**	**0.001**	**0.051**	**-0.053**	**-0.022**	**-0.025**	**-0.112**	**0.127**	**0.060**	**0.043**	**0.024**	**-0.011**
		p-value	0.233	0.977	0.399	0.382	0.713	0.680	0.065	0.035	0.319	0.478	0.687	0.850
16	**PFP**	**Corre**	**-0.001**	**-0.094**	**0.095**	**0.051**	**-0.041**	**-0.038**	**-0.100**	**0.088**	**0.066**	**0.051**	**0.020**	**-0.071**
		p-value	0.974	0.120	0.116	0.397	0.496	0.526	0.101	0.146	0.276	0.403	0.731	0.239
17	**TP**	**Corre**	**0.058**	**0.096**	**-0.063**	**-0.091**	**0.010**	**0.064**	**0.112**	**-0.021**	**-0.130**	**-0.014**	**-0.051**	**-0.026**
		p-value	0.338	0.113	0.295	0.134	0.868	0.293	0.063	0.723	0.031	0.807	0.398	0.667

***Abbreviation**: **RQ**: Rain Quail Rain Quail, **CK**: Common Kestrel, **PH**: Pallid Harrier, **MH**: Montagu's Harrier, **BBQ**: Barred Buttonquail, **YWL**: Yellow-wattled Lapwing, **IC**: Indian Courser, **CBS**: Chestnut-bellied Sandgrouse, **SB**: Singing Bushlark, **IB**: Indian Bushlark, **RTL**: Rufous-tailed Lark, **GSTL**: Greater Short-toed Lark, **ACSL**: Ashy-crowned Sparrow Lark, **SL**: Sykes's Lark, **OSL**: Oriental Skylark, **PFP**: Paddyfield Pipit, **TP**: Tawny Pipit

Pallid Harrier *Circus macrourus*

Montagu's Harrier *Circus pygargus*

Yellow-wattled Lapwing

Indian Courser

Chestnut-bellied Sandgrouse

Great Grey Shrike

Ashy-crowned Sparrow Lark

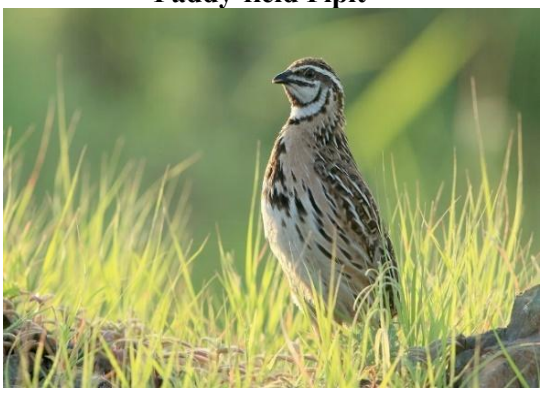
Sykes's Lark

Greater Short-toed Lark

Indian Bushlark

Laggar Falcon

Paddy-field Pipit



Tawny Pipit Rain Quail

Rock Bush Quail

Barred Buttonquail

Red Collared Dove

Indian Nightjar