be a nomadic dispersal rather than a distinct migratory pattern. It is probable that the majority of the birds disperse into southern India, along the Deccan plateau (see also Jerdon 1864). Recent records during the post and pre-monsoon months are also scanty but corroborate this interpretation.

The distribution and status of the Lesser Florican in Rajasthan

Historical

Though there is a considerable amount of literature on the distribution of the Lesser Florican from other parts of its breeding range, there are ~~but~~ a few accounts from Rajasthan. Those records that exist (Table 1) indicate that the Lesser Florican was once a common monsoon visitor to many parts of eastern, southern and central Rajasthan. The districts where the maximum number of floricans were said to occur in were Chittaurgadh, Bhilwara, Pali, Ajmer, and Banswara, and some parts of Nagaur, Jodhpur, Tonk and Bharatpur.

The Lesser Florican was a very common monsoon visitor to Rajasthan. For instance in the Sindla - Kharadi *jod* in Pali district, the erstwhile King of Jodhpur and his guests often shot over 100 florican's in a mornings shoot (TS Kalyanpura, per comm.). I also have seen pictures from this and other such areas where over 15 floricans were shot by a party of four or five guns.

Table 1 Past Records of the Lesser Florican in Rajasthan

	Place	Florican details	Date/Season	Source
1.	Sambhur Lake	Male	July 19	Adams 1873
		Female	Start of rains	Adams 1874
2.	"Rajpootana"	--	Sept-Oct.	Barnes 1886
	"Rajpootana"	Very Common	--	Barnes 1891
	"Rajpootana"	Breeds	July-Sept.	Jerdon 1864
3.	Pinwada Seroi, Pali Dt.	Breeding	Monsoons/	FS Rathore pers comm
4.	Athun Ganeshpur, Naseerabad, Ajmer Dt.	Breeding	August 1983	Saxena & Meena 1985
5.	Gagwana, Arain, Mangaliyawas, Ramsar, Goyla, Ratakot & Bandar, Ajmer Dt.	Breeding	Monsoons	Saxena & Meena 1985
6.	Sorson Buld, Baran Dt.	Female	Monsoon	Bharat Singh pers comm
7.	Near Shahpura, Bhilwara Dt.	2 males, breeding	Monsoon, 1986	Sankaran *et. al* 1992
8.	Kalsas, Sangamer, Bhilwara	7 males, breeding	Monsoon, 1984	Sankaran *et. al* 1992

Present

Between 1994 and 1996, the Lesser Florican was found to occur in isolated

pockets in its former breeding range in Rajasthan. However, through most of this region, only few floricans, mostly in ones and twos occur. Only 4 locations are now known to get a fairly sizeable population of floricans during the monsoon (Table 2). These are:

1. Pratapgadh tehsil, Chittaurgadh District. This is the most important area in southern Rajasthan. Those areas of the malwa Platea that occur in this tehsil, locally called 'pathar' are important for floricans. There are two areas in this tehsil which get a large number of floricans. The most important area is near Pratapgadh town and is the agricultural and grassland habitat mosaic of the villages of Bated, Bajrangadh, Akaypur, Gandher, Silarpura, Belara, Kultana and Bileshri. This area gets at least 30-50 male floricans during a good monsoon. The second area has not yet been surveyed and is the Malwa Plateau area beyond Damodar village.

2. Bali tehsil, Pali district. This is the most important area in central Rajasthan. The areas agricultural and grassland areas around Boya, Bali, Perawa, Danda, Kurna and Dari probably get upto 60-70 male floricans during good monsoons.

3. Ajmer district. The third area in Rajasthan which gets a large number of floricans is Ajmer district within which there are at least three important sites. The most important is the grassland / cropland habitat of Gagwana, 8 km from Ajmer on the Ajmer - Jaipur rd. This grassland alone gets 15 - 20 male floricans during a good monsoon. This area extends as cropland to Kishangadh and beyond and the entire belt gets a few floricans. The second important area is the Shaunkaliya Bustard Area from where 10-20 male floricans are reported to breed during the monsoons.

Sites to be conserved for people and the Lesser Florican in Rajasthan

Management of Grassland Sites

The management requirement for the sustainable utilisation of grasslands for people and the Lesser Florican is simple. The Grassland is protected from 1st July to 31st October. After which the grass is harvested. Subsequent to the completion of grass harvest, grazing may be permitted. Under no circumstance should grazing be permitted between 1st July and the completion of harvest. Tree plantations should be strictly prohibited. Lastly, weeds such as *Prosopis juliflora* or *Lantana* should be eradicated.

All identified sites should be treated as Grass Bheeds so that the system of protection during the monsoon and the subsequent harvest of grass is not temporary (as is the case with plantations) but will continue over the years.

Forest Department Owned Sites to be managed for Floricans and People

A. Banswada

Banswada district has a few areas which are important for florican. Lying as it does south, west and north of important florican areas, namely Pratapgadh, Ratlam and Dohad, any area developed and managed in this district will benefit the floricans. The following two sites have been identified:

1. Name: Mirch Ghatti plantation
   Block: Mirch Ghatti
   Range: Kushalgadh
   Area: 850 ha

This area is enclosed by Trench cum Mound (TCM) wall within which plantation work has been undertaken since 1975. As the area forms a single TCM enclosed unit it is ideally suited for protection. If protected it can easily have 12-15 male floricans during the monsoon. The area breaks up into:

Mirch Ghatti Block

	Year	Ha.	TCM	Trees	Grazing	Remarks
i	75-76	80	Yes	None	High	
ii	82-83	75	Yes	Few	Light	Protected by Kundia Samiti (JFM). Produces 30,000 kg of grass.
iii	89-90	60	Yes	Few	Light	Protected by Piplon samiti. Produces 40,000 kg of grass.
iv	90-91	100	Yes	Few	Light	Protected by Forest Department. Produces 100,000 kg of grass.
v	94-95	50	Yes	Few	Light	
vi	96	70	Yes	Few	Light	Kadana Pariyojana Mahe. (Compensatory afforestation).
vii	95	100	Yes	Few	High?	"
Kadwalia Potalia block (divided from Mirch Ghatti block by the Bajna-Patan rd)						
viii	91-92	50	Yes	No	V. High	DPAP
ix	78-79	100	Yes	No	V. High	
x	94-95	50	Yes	No	High	DPAP
xi	95-96	45	Yes	No	High	DPAP
xii	-	100	No			Blank forest land

Main problem: Grazing during the monsoon results in an inadequate growth of grasses for the floricans to successfully breed.

Action to be taken:

a. Declared as a Florican Conservation Area.
b. Appointment of 6-8 grass chowkidaars from July 1st to October 31st to strictly protect the grassland from grazing.
c. Permit harvest of grass by local villagers from 1st November onwards.
d. Funds for chowkidaars daily wages to be provided by Wildlife Department so as to ensure continuity of protection of the area.
e. No more plantation of trees. Some grass seeding should be done in the overgrazed plots.

2. Name: Jharnia Chaparia
   Block: Jharnia Chaparia
   Naka: Ambapura
   Range: Banswada
   Area: 390 ha

The Jharnia Chaparia area is an ongoing plantation area that if protected should attract a fair number of floricans. The area comprises of about 390 hectares of contiguous forest department land, of which about 240 hectares is enclosed by a TCM. The overall level of protection to the area is very good. The are breaks up into

Jharnia Chaparia Block

	Year	Ha.	TCM	Trees	Grazing	Remarks
i	92-93	50	Yes	Yes	Low	Grass cut by villagers.
ii	95-96	113	Yes	Yes	Low	Grass cut by Jharnia Chaparia samiti.
iii	95-96	45	Yes	Yes	Low	"
iv	95-96	30	Yes	Yes	Low	DPAP
v		150	No	No	High	Blank forest land

Main problem: None apparent

Action to be taken

a. Declared as a Florican Conservation Area.
b. Appointment of 6-8 grass chowkidaars from July 1st to October 31st to strictly protect the grassland from grazing.
c. Permit harvest of grass by local villagers from 1st November onwards.
d. Funds etc. to be provided by Wildlife Department so as to ensure continuity of protection of the area.
e. No more plantation of trees. Some grass seeding should be done in the overgrazed plots.

B. Bhilwara

Bhilwara district, and more particularly the tehsils of Shahpura and Baneda, is one of the four major florican areas in Rajasthan. The protection of any grassland in this district will benefit floricans. Two Forest Department owned grasslands, where floricans already occur, is proposed as areas to be taken up for Lesser Florican Conservation.

Table-2

Recent Lesser Florican reports and sightings in Rajasthan. 1994, 1995 & 1996

District	Taluk/ Village/ Range	Grasslands Name	area ha.	Own.	Hab.	No. reported in 1994/95 ♂	♀	R♂	199 ♂	♀
Ajmer	Gagwana	Gagwana *Bheed*	>100	2	GC	12	0	-	0	0
	Alaniyawas		?	2	C	-	-	-	1	0
	Shaunkhaliya		?	1,2	CGr	1	-	3-4	1	0
	Kishangadh	Dhani Rathodan	?	2	C	nv	-	-	nv	-
Banswada	Kushalgadh	Mirch Ghatti	*c* 750	1	G	nv	-	-	1	-
	Kushalgadh	Hathiadili	?	1,2	GCF	nv	-	-	0	0
	Banswada	Jharnia Chaparia	*c* 250	1	G	-	-	-	0	0
Bhilwara	Baneda	Bated	?	2	GC	nv	-	1	0	
	Baneda	Baldharkha	?	2	GC	nv	-	-	2	1
	Baneda	Ghasta ka Bheed, Dabla	?	2	GC	nv	-	-	2	0
	Baneda	Kalsas	?	1,2	GC	0	-	1.	nv	-
	Baneda/ Shahpura	Loolas/Mundetha/ Karamdas/Nowgawa Dikhola	>500	1,2	GC	1	0		0	0
	Shahpura	Jamoli	?	2	C	nv	-	-	5	0
Chittaudgadh	Pratapgadh	Bajrangadh/ Akaypur/Gandher/ Silarpura/Belara/ Kultana/Bileshri	?	1,2	GC	3	0	5	0	0
	Pratapgadh	Chiklad	?	1,2	GCP	nv	-	-	0	0
Pali	Bali	Boya	>500	1,2	GCP	nv	-	-	6	1
	Bali	Biroliya	?	1,2	GCP	nv	-	-	-	-
	Pali	Omkalli	?	2	GC	nv	-	-	0	0
	Pali	Sakadada	?	2	GC	nv	-	-	1	0

Areas that need to be surveyed

1. Bhamalou, Bhogadit, Cuchipila near Arain

Conserving the Lesser Florican in Rajasthan

Existing Management Practices of Protected Grasslands in Rajasthan

A. Grassland Owned by Forest Department

The grasslands owned by the Forest Department, in southern, central and eastern Rajasthan are managed in the following way.

Until some years ago, most Forest Department owned grasslands were protected strictly from grazing during the monsoon, and the grass was then harvested, baled and stored. In many such grasslands the machinery for baling and harvesting still exits (e.g. Bijowa Jod, pali district).

however, currently all grasslands are protected from livestock grazing from 1st July to 1st October, during which period, the grasslands are auctioned. After 1st October the lessee is permitted to either cut fodder, or graze the grassland. It is only in those years that a scarcity has been declared that the grassland is protected and hay harvest is done by the Forest Department.

B. Privately owned grasslands
These grasslands are either protected for their fodder, or are leased exclusively to a few cattle graziers.

Threats

A. Habitat Loss / Degradation
Few if any sizeable grasslands, suitable for the Lesser Florican, that are well protected exist in Rajasthan. Most of the erstwhile princely state owned grasslands have been distributed under the land ceiling act and are today croplands. Examples include those grasslands like the Sindla - Kharadi *jod* in Pali district, which belonged to the erstwhile state of Jodhpur. Those protected grasslands that continue to exist and are privately owned are being brought under the plough, e.g. Loolas, near Baneda, or are being leased to graziers, e.g. Ghasta ka Bheed, Dabla, Baneda.

Most of the Forest department grasslands are not optimally managed. Because grazing is permitted in the grassland after October 1st, and that the onus of protection rests with the *Tekhedaars* protection is generally lackadaisical during the early parts of the monsoon. Further, as the objective of many *Tekhedaars* is to graze livestock in the grassland, they allow their cattle to enter the grassland with the result that most grasslands are being grazed through out the monsoon. Therefore habitats that are ideal for the Lesser Florican do not have any because there is inadequate grass cover e.g. Guda Endala Jod, Pali District.

Prosopis juliflora has invaded most grasslands, and this constitutes the biggest management problem in most grasslands.

B. Hunting
Hunting of floricans continues to be a major problem throughout the species breeding range, and more particularly in Rajasthan. In the monsoon of 1996, I know of at least 18-20 Lesser Floricans that were shot in the areas that I surveyed.

1. Name: Dhani bheed
   Block: Shahpura (?)
   Range: Shahpura
   Area: 315 ha

The Dhani bheed is an existing Forest Department grass bheed, with TCM and watch tower, which is auctioned every year. It historically has been getting a large number of floricans, but it is currently undergoing severe grazing pressure. Lying as it does in Shahpura tehsil, throughout which floricans occurred in the past, it proper management will undoubtedly attract a large number of floricans.

Main problem: Grazing during the monsoon results in an inadequate growth of grasses for the floricans to successfully breed.

Action to be taken:
a. Declared as a Florican Conservation Area.
b. Appointment of 3-4 grass chowkidaars from July 1st to October 31st to strictly protect the grassland from grazing.
c. Permit harvest of grass by local villagers from 1st November onwards.
d. Funds etc. to be provided by Wildlife Department so as to ensure continuity of protection of the area.

2. Name: Karamdas A & B, Nowgawa, Dikhola
   Block: ?
   Range: Baneda
   Area: c. 600 + ha.

The Karamdas, Nowgowa, Dikhola grass bheeds, owned by the Forest Department, which are contiguous with the privately owned Loolas bheed and Mundetha bheed probably is the most important Government owned grass bheed as floricans already occur there. The protection however, particularly in the Government grass bheed is not adequate, with the result that there is a considerable amount of grazing pressures. With proper protection of the grassland area from grazing during the monsoons, a population of over 50 male floricans can be expected in the area.

Main problem: Grazing during the monsoon results in an inadequate growth of grasses for the floricans to successfully breed.

Action to be taken:
a. Declared as a Florican Conservation Area.
b. Appointment of 8-10 grass chowkidaars from July 1st to October 31st to strictly protect the grassland from grazing.
c. Permit harvest of grass by local villagers from 1st November onwards.
d. Funds for chowkidaars daily wages to be provided by Wildlife Department so as to ensure continuity of protection of the area.
e. No more plantation of trees.

C. Pali

Pali district has historically had a large number of floricans visiting it, particularly in years of good monsoons, and is the second of the four major florican areas in Rajasthan. This is also the district where a large number of sizeable Forest Department owned grasslands exists (called *jod*). Two important jods have been identified for Lesser Florican conservation.

1. Name: Bali jod
   Block: Bali (?)
   Range: Bali
   Area: *c.* 265 ha

Bali *jod*, owned by the Forest Department, lies within a very important florican area, namely Bali-Boya-Perawa, and adjacent to one of the most important florican areas in Rajasthan, the former Boya *jod*, which is now a mosaic of grassland and cropland. It was reported to formerly attract large numbers of floricans, but is thickly vegetated by *Prosopis juliflora*. If developed and managed optimally, this could easily have over 25-30 floricans during the monsoon.

Main problem: Excessive growth of *Prosopis juliflora*.
Grazing during the monsoon

Action to be taken:
a. Declared as a Florican Conservation Area.
b. Eradication of *Prosopis juliflora* by using heavy tractors and chains so as to uproot them.
b. Appointment of 6-8 grass chowkidaars from July 1st to October 31st to strictly protect the grassland from grazing.
c. Permit harvest of grass by local villagers from 1st November onwards.
d. Funds etc. to be provided by Wildlife Department so as to ensure continuity of protection of the area.

2. Name: Guda-Endala Jod
   Block: ?
   Range: Pali
   Area: 833.92 ha

Guda-Endala Jod used to be a very important site for both blackbuck, Lesser Florican and Great Indian Bustards about 25-30 years ago. However, due to excessive hunting and grazing pressures these species have vanished, though a few floricans are said to still visit the area. If managed well, Guda-Endala could easily be developed into an area like Veladavar National Park, which now attracts over 30 male floricans every year.

Main problem: Overgrazing during the monsoon
Excessive growth of *Prosopis juliflora*.

Action to be taken:
a. Declared as a Florican Conservation Area.
b. Eradication of *Prosopis juliflora* by using heavy tractors and chains so as to uproot them.
b. Appointment of 6-8 grass chowkidaars from July 1st to October 31st to strictly protect the grassland from grazing.
c. Permit harvest of grass by local villagers from 1st November onwards.
d. Funds etc. to be provided by Wildlife Department so as to ensure continuity of protection of the area.

D. Pratapgadh

Pratapghad tehsil of Chittaurgadh district is the third of the four most important areas for floricans in Rajasthan. Those parts of the Malwa plateau that come under Pratapgadh Tehsil are particularly important for floricans.

Virtually any area protected during the monsoon in the *Pathar* areas of Pratapgadh will attract floricans during the monsoon. Two Forest Department owned grassland areas have been identified for development as florican habitat.

1. Name: Lakhia bheed
   Block: Manorgadh Block
   Range: Pratapgadh
   Area: *c.* 100 ha

The Lakhia bheed is an existing Forest Department grass bheed, that lies adjacent to the most important florican belt of Pratapgadh division. By optimally managing this grassland, a population of between 8-10 males should breed here during good monsoons.

Main problem: Grazing during the monsoon

Action to be taken:
a. Declared as a Florican Conservation Area.
b. Appointment of 3-4 grass chowkidaars from July 1st to October 31st to strictly protect the grassland from grazing.
c. Permit harvest of grass by local villagers from 1st November onwards.
d. Funds etc. to be provided by Wildlife Department so as to ensure continuity of protection of the area.

2. Name: Gandher Radi
   Block: Kultana?
   Range Pratapgadh
   Area: *c.* 250 ha

Gandher Radi used to be a Forest Department protected forest / grass bheed. It is currently being overgrazed, though in some parts of it grass is being harvested. It is also the only (?) Forest Department owned land within the most important florican area in Pratapgadh tehsil. Its conservation should result in a congregation of over 15 male floricans during the monsoon.

Main problem: Grazing during the monsoon

Action to be taken:
a. Declared as a Florican Conservation Area.
b. Appointment of 8-10 grass chowkidaars from July 1st to October 31st to strictly protect the grassland from grazing.
c. Permit harvest of grass by local villagers from 1st November onwards.
d. Funds etc. to be provided by Wildlife Department so as to ensure continuity of protection of the area.
e. Clearing of bushes such as *Lantana* and *Prosopis*.

Private Owned / Revenue Areas important for floricans

A. Ajmer District

Ajmer district is the fourth of the four most important areas for the Lesser Florican in Rajasthan.

1. Name: Gagwana
   Location: 8 km from Ajmer on Ajmer - Jaipur Road
   Contact: Iftahaar Khan

Gagwana is a privately owned grassland cropland area that attracts very large number of floricans.

Main problem: Hunting of floricans.

Action to be taken: Appointment of one or two florican chowkidaars in consultation with the Gagwana village panchayat during the monsoon to curtail the high incidence of hunting that currently takes place there.
Constant monitoring and awareness programmes.

2. Name: Shonkaliya Bustard Area
   Location: Near Naseerabad

This is one of Rajasthans most important Great Indian Bustard Area and a few floricans also breed here during the monsoon.

Main Problem: There is no grassland area and floricans are breeding in the crop fields. There are a couple of plots / plantations but these are overgrazed.

Action to be taken: Development of a few well protected grassland plots.

B. Bhilwara

1. Name: Loolas
   Location: Near Baneda
   Contact: Kalyan Singh

Several florican breed in the privately owned Loolas grassland.

Main Problem: A part of the grass bheed has been leased to a company who are planting cops in it, which has resulted in loss of habitat.

Action to be taken: Development and better management of Forest Department grasslands that lie adjacent to this area.

2. Name: Dabla & Baldharka
   Location: Baneda Tehsil
   Contact: Ghanshyam Singh Rathore, Pradhan, Baneda
   Narendra Singh Rathore

Several florican breed in the privately owned grasslands and agricultural areas. A small population of Blackbuck of about 25-30 animals is also present.

Main problem: Hunting of floricans.

Action to be taken: Appointment of one or two florican chowkidaars in consultation with Ghanshyam Singh Rathore during the monsoon to curtail hunting.
Constant monitoring and awareness programmes.

3. Name: Jamoli
Location: On the banks of the Banas river, off the Shahpura-Jahjpur road.
Contact: Th. Surendrasinhji, Kr Narpat Singh

Several florican breed in the agricultural areas.

Main problem: Hunting of floricans.

Action to be taken: Appointment of one or two florican chowkidaars in consultation with the village panchayat during the monsoon to curtail hunting.
Constant monitoring and awareness programmes.

C. Pali

1. Name: Boya
Location: Bali Tehsil
Contact: Vikram Singh Sonigra

D. Pratapgadh

1. Name: Bajrangadh / Kultana / Gandher
Location: Near Pratapgadh

Several florican breed in the privately owned mosaic of grasslands and agricultural land.

Main problem: Hunting of floricans.

Action to be taken: Appointment of one or two florican chowkidaars in consultation with the local panchayats during the monsoon to curtail hunting.
Constant monitoring and awareness programmes.Several

E. Touh.

Habitat use in the Lesser Florican in a mosaic of grassland and cropland. The influence of grazing and rainfall

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Abstract

I studied effects of grazing and rainfall on habitat use in the lesser florican in a mosaic of grassland and cropland. I found that the most preferred habitat of the lesser florican are areas under grass cover. However, as a result of disturbance due to grazing the florican may temporarily prefer crop areas. In years of drought the lesser florican prefers irrigated cropland as these areas have sufficient vegetation cover. When grasses grow too tall, as in years of very well distributed rains, male florican shift their territories to areas of shorter vegetation, like cropfields of soyabean, and mud roads.

Introduction

To reproduce successfully, birds should do so when environmental conditions are most favourable (Earle 1981). Breeding seasons are, however, fixed for most species and the degree of variability in factors determining favourable environmental conditions will play a major role in breeding success. The link between rainfall and the breeding environment of birds has been documented, and nomadism, cessation or delays in breeding are characteristic adaptations of species exploiting environments with variable rainfall; the more unpredictable the rainfall, the more extreme the response (Moreau 1950, Keat and Marshall 1954, Sinclair 1978, Davies 1979, Berry and Crowe 1985, Manry 1985, DeSante and Geupel 1987). In this paper, I examine the effects of a varying monsoon and livestock grazing on the habitat use of the Lesser Florican in mosaic of grassland and cropland.

The lesser florican is an endangered endemic bustard of the Indian subcontinent. It breeds during the southwest monsoon, which normally begins by end June (Jerdon 1864, Baker 1921, Dharmakumarsinhji 1950, Ali and Ripley 1969). During this period, a distinct movement into Gujarat, eastern Rajasthan and western Madhya, where it congregates in areas of good rainfall, has been documented (e.g. Jerdon 1864, Sankaran *et al.* 1992). The primary breeding habitat are grasslands where sufficient grass cover is available during the breeding season. In western India, these grasslands are fragmented and patchily distributed and the majority of habitat available to the lesser florican is a mosaic of grassland and crop land.

Study area

I studied habitat use in the Lesser Florican the Sailana Kharmor Sanctuary (354 hectares; 23°31' N and 75°01' E; Fig. 1), near Sailana town, Ratlam district, western Madhya Pradesh. The Sanctuary is a mosaic of grassland, crop-fields and grazing lands and is bounded by three villages, Sailana, Adwanya and Gordhanpura. The grassland area within the sanctuary is about 200 hectares and is owned by agriculturists, and is known as the Naulakha *bheed*. The grassland is maintained and protected for its hay produce. Livestock grazing is usually permitted upto five weeks after the onset of the monsoon, the cattle thus exploit the first flush of vegetation. After this the grassland is strictly protected from grazing until the hay harvest is completed in November. Once hay harvest is completed, grazing is again permitted, and the livestock thus exploit the remaining grass stubble.

The Naulakha grassland has six main ridges and their spurs, all sloping towards the eastern corner of the sanctuary, where lies a perennial reservoir, Gordhansagar. The shallow valleys between the ridges channelise rainwater rivulets towards this water body and two other smaller reservoirs.

At the Sailana Kharmor Sanctuary, the habitat available to the Lesser Florican was of three types:

a) Grassland. This was the Naulakha grassland which covered about 200 hectares of pure contiguous grassland, almost devoid of trees. The grassland area conformed to the *Sehima nervosum - Chrysopogon fulvus* type that is the dominant grassland type in the Lesser Florican's breeding range. Other grasses include *Heteropogon contortus*, *Apluda mutica*, *Cymbopogon martini*, *Aristida funiculata* and species of *Bracharia*, *Eragrostris*, *Dicanthium*, *Pseudoanthesterea*, *Digitaria*, *Setaria* and *Bothriocloa*. Wild rice, *Oryza rufipogon* grows where water accumulates during the monsoon. *Butea monosperma* is a common bush, rarely growing into trees.

b) Crop fields. On the periphery of the grassland are the agricultural fields, both irrigated and rain fed, of the nearby villages. The predominant monsoon crops were Cotton *Gossypium* sp., Sorghum *Hordeum vulgare*, Maize *Zea maize*, and Soybean *Glycine max*. In winter Wheat *Triticum aestivum*, Bengal Gram *Cicer arietinum*, Garlic *Allium sativum*, Ajma (or Ajwain) *Trachyspermum ammi* and Poppy *Papaver somniferum*.

c) Grass patches in crop areas. These were small isolated patches of grass amidst the cropfields which had not yet been brought under the plough. These patches were small, ranging from 0.1 to 1.5 hectares and totally occupied only about 10 to 12 hectares. While grass patches should be classified under grassland, this distinction is made purely on the basis of location and size. Moreover, such a distinction is meant to contrast use between crop fields and areas under grass cover within crop areas.

Methods

The study extended over about 400 days between July 16 and October 6, 1985; June 22 and October 10, 1986; June 16 and October 1, 1987; June 24 and October 6, 1988.

All habitat types in the study site was scanned to locate lesser florican either by sighting or flushing them. Before territories were established, such scanning

of the study area was done every day and less frequently once territories were established and males became localised. Data on Lesser Floricans thus flushed, or located, was recorded primarily as to location in study area and habitat i.e. whether in crop field, grass patches or in the main grassland. Habitat use data was based purely on the habitat a florican was using when it was first located. Subsequent movement was not taken into account.

As habitat classes occurred in different proportions over the study area, the data for all habitats used have been normalised by dividing the data values with weights proportionate to the area under different habitats. Thus grasslands were quantitatively weighted as 15, crop as 5 and grass patches as 1. This was then standardised by converting values into percentage of total sightings for each habitat in a fortnight. Standardisation was necessary to make the data set comparable between years because the number of birds which were sighted varied between years and there was need to eliminate bias that arose out of this.

Results

Profiles of three monsoons 1986 - 1988.

1986: The monsoon began on time and the quantum was excessive (+49.03%).

1987: The monsoon was late and patchily distributed but quantum of rainfall was slightly above normal (+8.1%). Number of rainy days were 29, about -40%.

1988: The monsoon was on time and was uniformly disturbed. The quantum of rainfall was above normal (+16.1%).

Maximum grass growth rates and net height were seen in those years when the monsoon was on time or early (third week of June), and when rainfall was distributed throughout the season (up to October). Though 1986 had the maximum quantum of rainfall, the distribution was restricted more or less to the first half of the season, with the latter part being dry. This resulted both in lower grass growth rates and net height when compared with 1988 (Fig. 2). 1987 was a drought year with late commencement of rains and patchy distribution of rainfall. The late flush of growth in 1987 resulted from a few belated heavy showers (Fig. 2).

Livestock grazing was permitted at the Naulakha grassland for the first five weeks after the onset of the monsoon and was stopped subsequent to a week of heavy rainfall. 1987 was an exception, and grazing carried on for 11 weeks after the commencement of the monsoon, due to poor rainfall. The influence of livestock grazing during the early monsoon was similar for all years except 1987, when grass growth rates were the lowest (Fig 2).

I found that there are significant differences in habitat use patterns in the lesser florican both between years, due to differences in rainfall and its effect grass growth, and within a season, as a result of cattle grazing.

Within season changes in habitat use

In 1986, the Lesser Floricans used grasslands, grass patches and crop fields in a descending order of preference (Table 1). In 1986, fortnightly shifts in habitat preference showed maximum use of grasslands in the first fortnight. In the second fortnight, floricans used all three habitats similarly. In the following five fortnights both grass patches and the main grassland, were used the most and crop fields the least (Table 2.a; Fig. 3).

In 1987, all three habitats were used similarly (Table 1). In the first fortnight the grassland was used more than grass patches while crop fields were not used at all. In the second fortnight all three habitats were used similarly. In the third and fourth fortnights, crop fields were used almost exclusively. In the fifth fortnight all three habitats were used similarly, and in the sixth fortnight the grassland was used almost exclusively (Table 2.b, Fig. 3).

In 1988, the grassland was used the most while grass patches and cropfields were used similarly (Table 1). In the first two fortnights all the three habitats were used equally. In the third, fourth and fifth fortnights grasslands were used the most. In the sixth fortnight a shift was seen towards croplands, and in the seventh fortnight cropfields were used the most (Table 2.c, Fig. 3).

Between season differences in habitat use

Overall habitat use was similar in 1986 and 1988. The pattern in 1987 was different, with crop areas being used most frequently and grassland less frequently than in '86 and '88 (Table 3). In all three years grass patches did not show significant variation in intensity of use.

Discussion

A lack of disturbance and vegetation cover appear to be of greatest importance in habitat selection during the breeding season of the lesser florican.

During the monsoon the centre of disturbance shifts in the Sailana Kharmor Sanctuary. During the early monsoon, the main grassland was the most disturbed of the three types of habitat due to the presence of livestock and graziers. In this period, crop areas are relatively undisturbed because rains, wet slushy soil and freshly sprouting crops prevent farmers from working their fields. Once grazing is stopped the grassland is undisturbed. The cropfields soon become disturbed as farmers begin weeding, spreading fertilizers and spraying pesticides during dry spells. Grass patches are the least disturbed of all three types as these are neither grazed nor worked upon by farmers.

Subsequent to arrival, the floricans are mainly seen in the grassland. However, as the grassland is disturbed due to grazing during the early monsoon, the floricans began using crop areas. A reversal is seen with the cessation grazing, and due to the absence of disturbance, the grassland becomes the most used habitat types. That the Lesser Florican use crop areas primarily due to the disturbance by livestock in the grassland, was also seen by their movement away from the grassland into cropfields at about 0800 to 0900 hours, when the cattle start arriving into the grassland, and their movement back to grassland at about 1700 to 1800 hours when the cattle start leaving the grassland.

In 1986 and 1988, both high rainfall years, there was no significant variation in habitat use patterns. On the other hand, 1987 differed significantly because

of the lack of adequate cover and greater disturbance (due to an extended grazing period) in the main grassland as a result of drought. The cropfields had more vegetation cover (due to crop growth as a result of irrigation) than the grassland, and was relatively less disturbed. The few birds that were present in 1987 were seen almost exclusively in the cropfields. However once grazing was stopped, and late rains caused sufficient grass cover in the grassland, the floricans showed a shift towards increased use of the main grassland.

The optimal grass height range of the lesser florican is difficult to determine because the period of lowest grass heights are also when the grassland was being grazed. However, very tall grass is not preffered by floricans, and males which had territories in the grassland shifted to crop fields or paths and mud roads within the grassland when grasses grew too tall, as was the case in 1988 when a distinct shift to crop areas was seen at the end of the breeding season.

Conclusion

The preferred breeding habitat of the lesser florican are grasslands protected from livestock grazing during the monsoon. Choice of habitat, however, is determined by disturbance and, to a lesser extent, rainfall regimes. In normal years, depending on the location of greatest disturbance, birds used crop areas or grassland. While grazing took place in the grassland, the floricans used the crop areas more. But in crop areas the grass patches amidst cropfields were the preferred habitat. During drought conditions they were, however, more frequently seen in crop fields because of more vegetation cover as a result of irrigation. When grasses grow too tall, as in years of very well distributed rains or when the grassland is very well protected, male florican shift to areas of shorter vegetation, for example cropfields of soyabean.

In summation, under situations where adequate vegetation cover is available, the lesser florican utilises habitats or areas that are least disturbed. Under drought conditions, the lesser florican uses habitats that has greater vegetation cover. Very tall vegetation is not prefferred by the lesser florican.

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Table 1.
Variation in intra-year habitat use : 1986 to 1988
kolmogrov-smirnov two sample test results

		Grass		GPC	
		MD	p	MD	p
1986	Crop	0.791	<0.001	0.418	<0.001
	Grass			0.478	<0.001
1987	Crop	0.244	0.121	0.267	0.072
	Grass			0.111	0.921
1988	Crop	0.639	<0.001	0.194	0.448
	Grass			0.611	<0.001

Table 2. Comparison in habitat use patterns between fortnights of the breeding season (Kolmogrov-smirnov two sample test results)

Table 2.a. 1986

		Grass		GPC	
		MD	p	MD	p
Fortnight 1	Crop	0.875	<0.001	0.375	0.520
	Grass			0.625	0.049
Fortnight 2	Crop	0.300	0.664	0.200	0.962
	Grass			0.500	0.112
Fortnight 3	Crop	0.700	0.006	0.300	0.664
	Grass			0.700	0.006
Fortnight 4	Crop	0.857	0.006	0.286	0.919
	Grass			0.714	0.047
Fortnight 5	Crop	1.000	<0.001	1.000	<0.001
	Grass			1.000	<0.001
Fortnight 6	Crop	0.900	<0.001	0.900	<0.001
	Grass			0.800	<0.001
Fortnight 7	Crop	0.909	<0.000	0.091	1.000
	Grass			0.909	<0.001

Table 2.b. 1987

		Grass		GPC	
		MD	p	MD	p
Fortnight 1	Crop	1.000	<0.001	0.250	1.000
	Grass			0.750	0.125
Fortnight 2	Crop	0.250	1.000	0.500	0.500
	Grass			0.750	0.125
Fortnight 3	Crop	0.900	<0.001	0.600	0.030
	Grass			0.300	0.664
Fortnight 4	Crop	1.000	<0.001	1.000	<0.001
	Grass			0.100	1.000
Fortnight 5	Crop	0.167	1.000	0.500	0.333
	Grass			0.333	0.778
Fortnight 6	Crop	0.545	0.063	0.182	0.986
	Grass			0.545	0.063

Table 2.c. 1988

		Grass		GPC	
		MD	p	MD	p
Fortnight 1	Crop	0.333	0.778	0.167	1.000
	Grass			0.500	0.333
Fortnight 2	Crop	0.200	1.000	0.600	0.320
	Grass			0.800	0.080
Fortnight 3	Crop	1.000	<0.001	0.444	0.307
	Grass			0.556	0.111
Fortnight 4	Crop	1.000	<0.001	0.000	1.000
	Grass			1.000	<0.001
Fortnight 5	Crop	1.000	<0.001	0.000	1.000
	Grass			1.000	<0.001
Fortnight 6	Crop	0.750	0.125	0.250	1.000
	Grass			1.000	<0.001
Fortnight 7	Crop	1.000	<0.001	1.000	<0.001
	Grass			0.667	0.667

Table 3. Variation in inter-year habitat use in the lesser florican: 1986 to 1988. (Kolmogrov-smirnov two sample test results).

	Crop 87		Crop 88	
	MD	p	MD	p
Crop 86	0.422	<0.001	0.139	0.832
Crop 87			0.444	<0.001

	Grass 87		Grass 88	
	MD	p	MD	p
Grass 86	0.644	<0.001	0.167	0.640
Grass 87			0.667	<0.001

	GPC 87		GPC 88	
	MD	p	MD	p
GPC 86	0.178	0.440	0.111	0.961
GPC 87			0.167	0.640

Key For tables 1 to 3
Crop = Cropfields
Grass = Grassland (Naulakha)
GPC = Grass patches amidst Cropfields

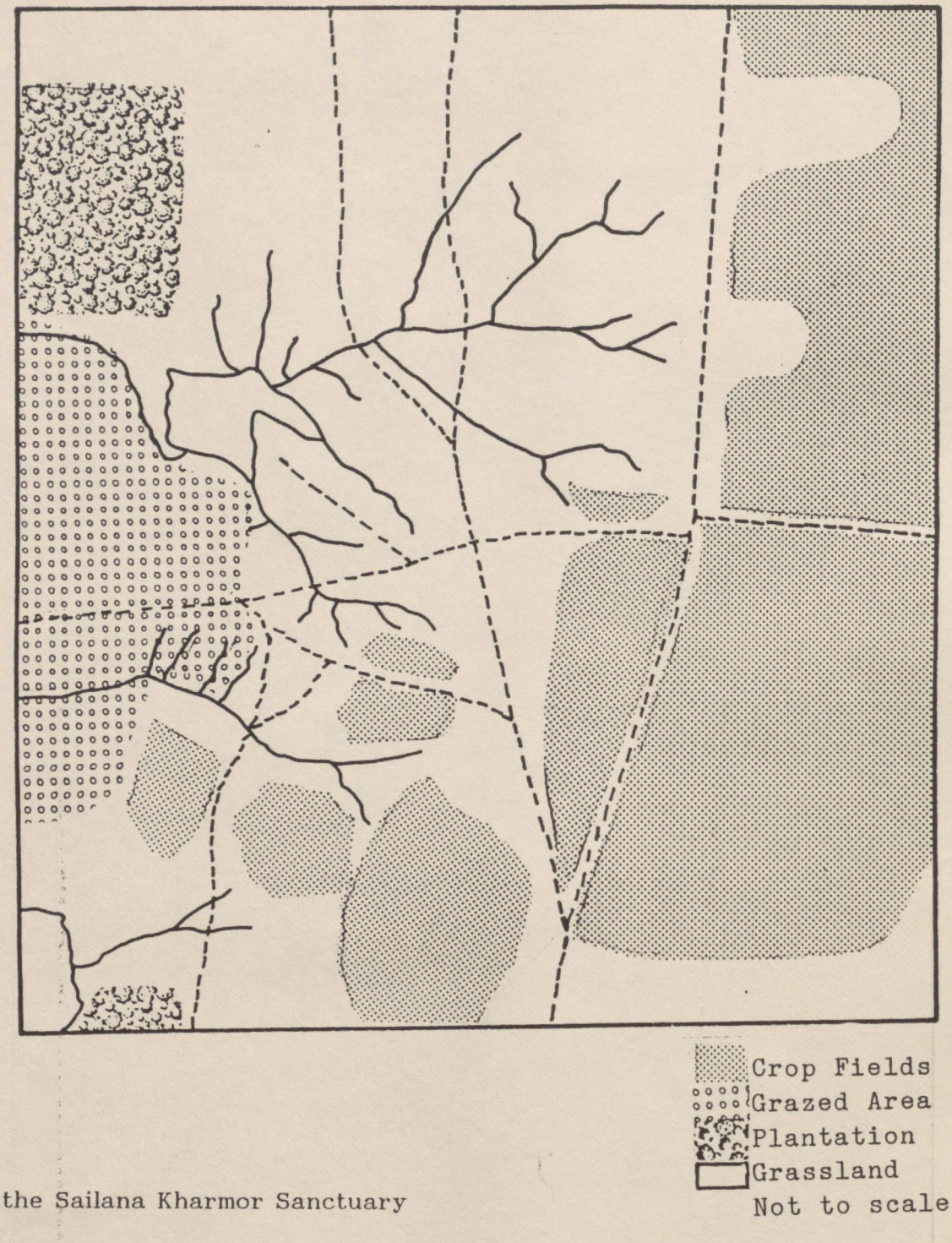


Figure 1. Map of the Sailana Kharmor Sanctuary

Figure 2. Rainfall, grass growth and grazing - Naulakha grassland

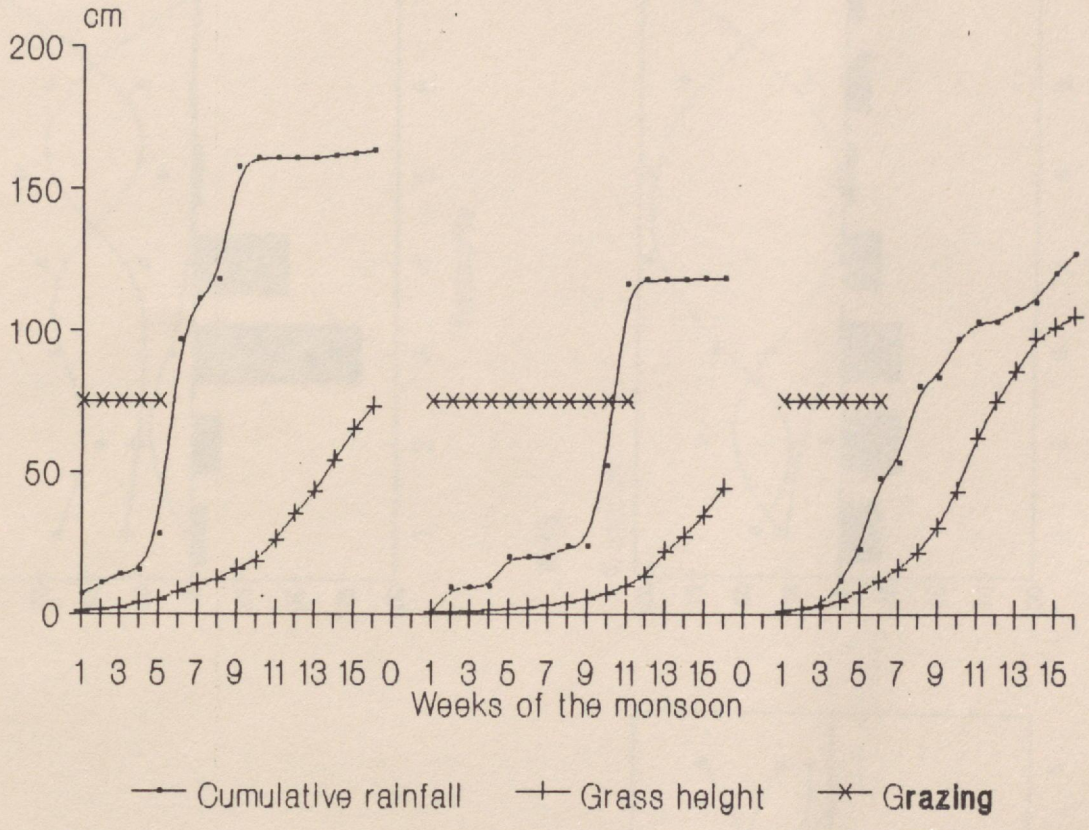
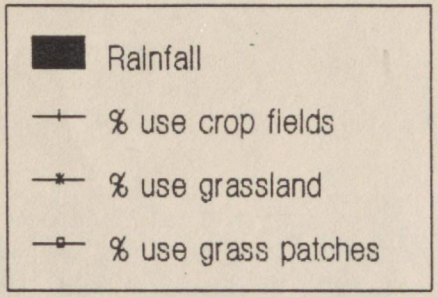


Figure 3. Fortnightly pattern of habitat use by the lesser florican under different monsoon conditions



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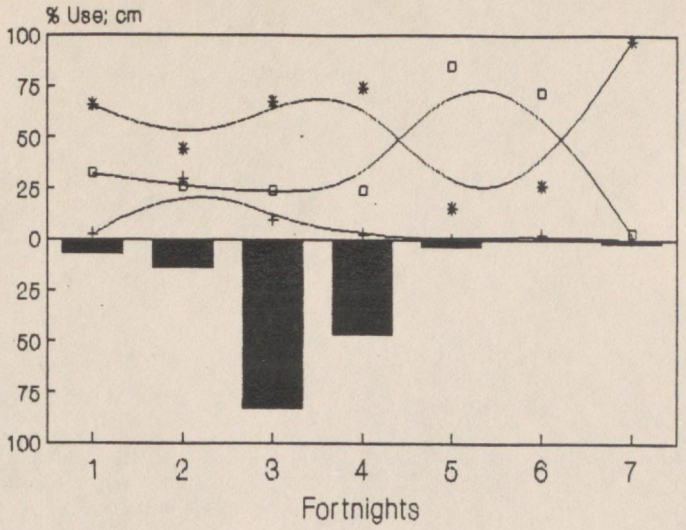

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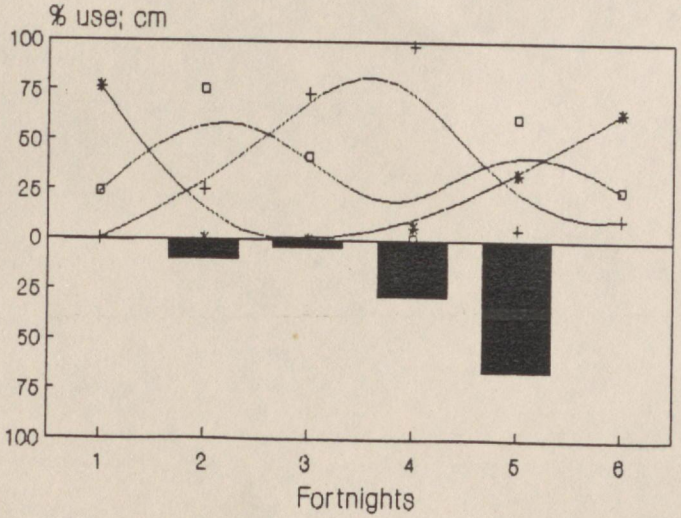

1988