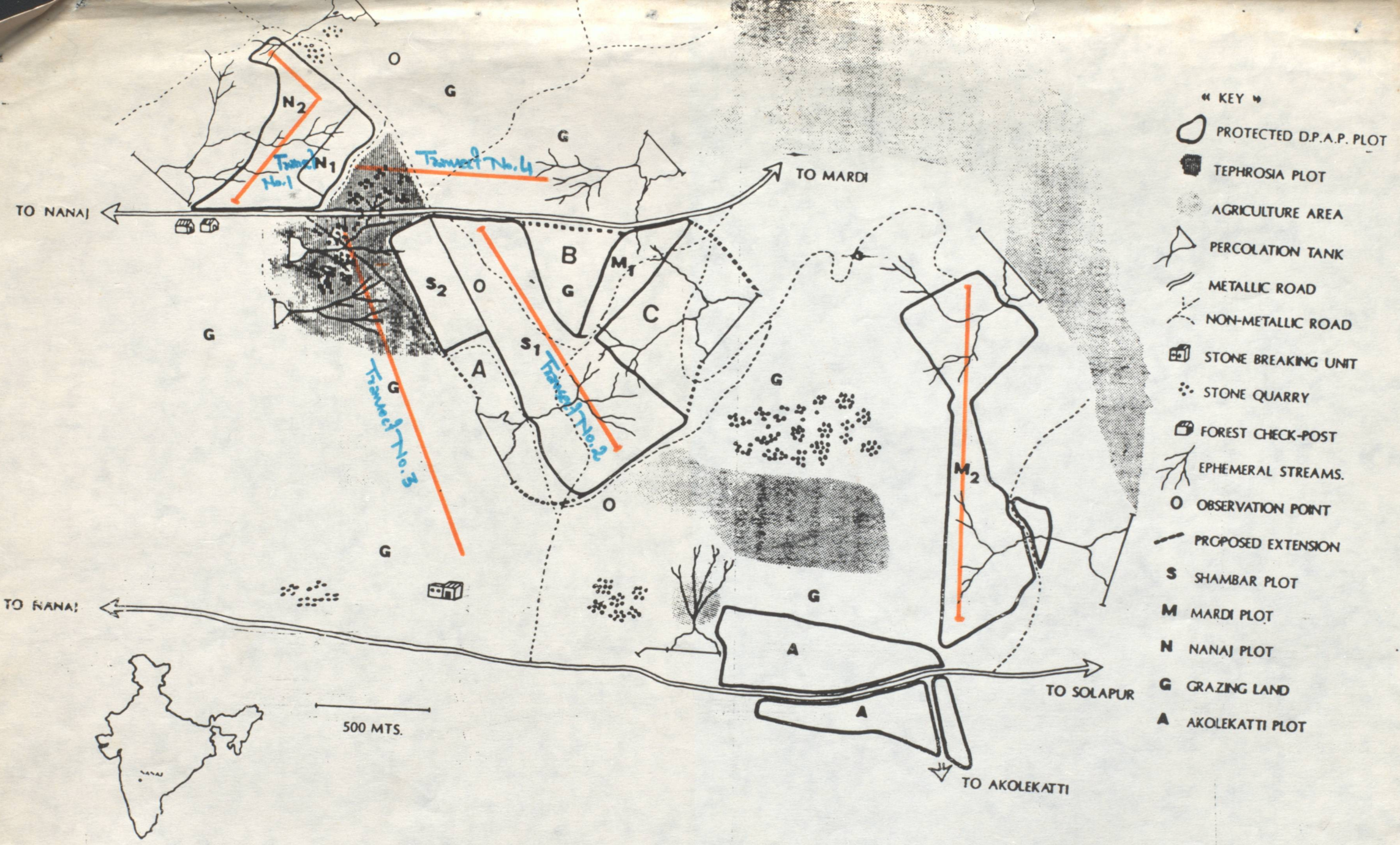


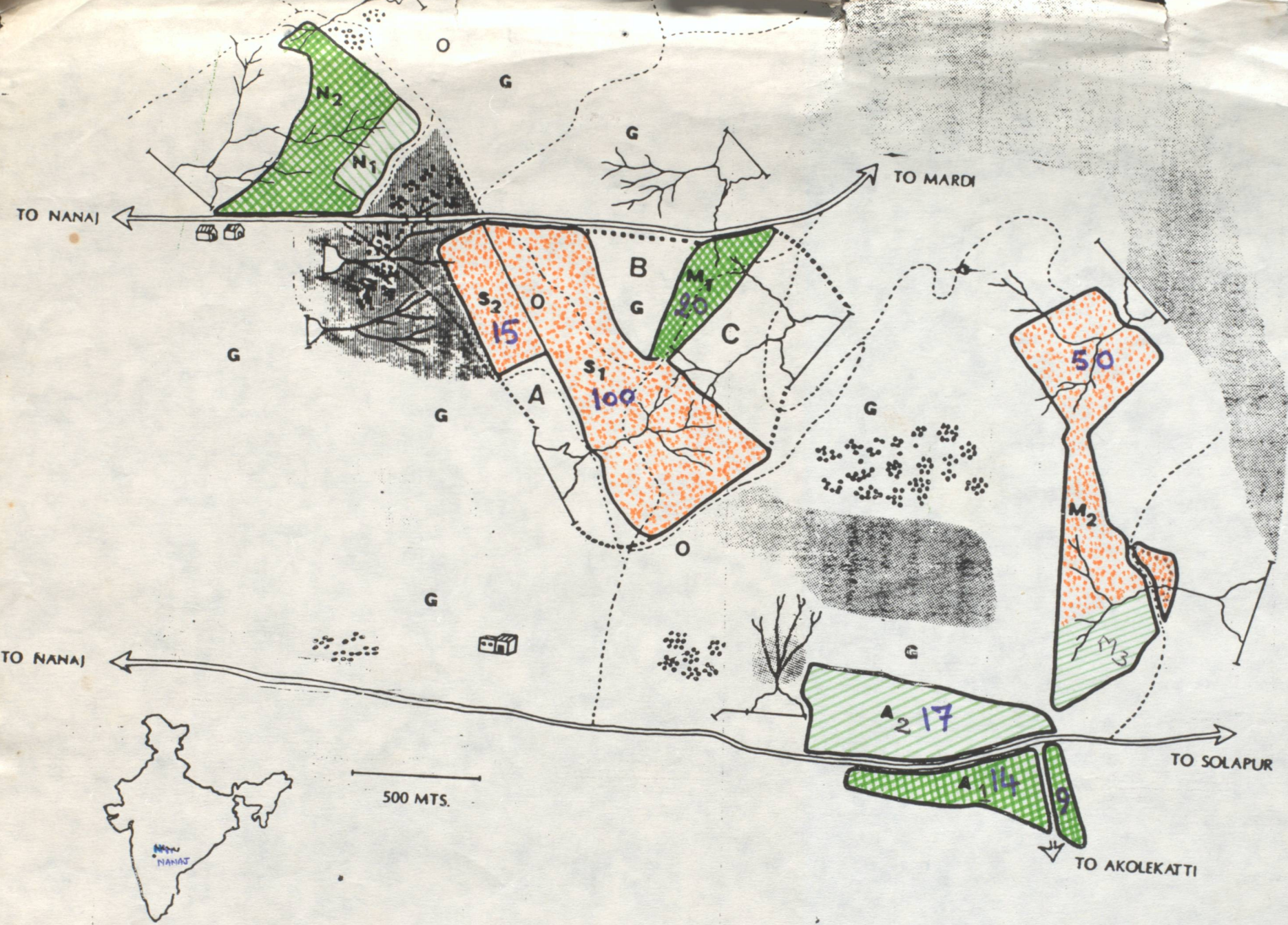
- « KEY »
- PROTECTED D.P.A.P. PLOT
  - TEPHROSIA PLOT
  - AGRICULTURE AREA
  - PERCOLATION TANK
  - METALLIC ROAD
  - NON-METALLIC ROAD
  - STONE BREAKING UNIT
  - STONE QUARRY
  - FOREST CHECK-POST
  - EPHEMERAL STREAMS.
  - OBSERVATION POINT
  - PROPOSED EXTENSION
  - S** SHAMBAR PLOT
  - M** MARDI PLOT
  - N** NANAJ PLOT
  - G** GRAZING LAND
  - A** AKOLEKATTI PLOT

- Nests (Great Indian Bustard)
- Deserted (sighted on July 19<sup>th</sup>, 1991)
  - } Unsuccessful (sighted on July 21<sup>st</sup>, 1991)
  - }
  - Successful (sighted on 2<sup>nd</sup> Aug., 1991 & hatched on 19<sup>th</sup> Aug.)

*Nesting sites of the Great Indian Bustard (1991)*



Orange-lines depicting transects for Bird-census in Protected Plots & Revenue Land



- « KEY »
- PROTECTED D.P.A.P. PLOT
  - TEPHROSIA PLOT
  - AGRICULTURE AREA
  - PERCOLATION TANK
  - METALLIC ROAD
  - NON-METALLIC ROAD
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  - S** SHAMBAR PLOT
  - M** MARDI PLOT
  - N** NANAJ PLOT
  - G** GRAZING LAND
  - A** AKOLEKATTI PLOT

- Thick Plantation
- Sparse Plantation
- Grassland (Protected)

MAP OF STUDY AREA AT NANNAJ (SOLAPUR)

1645.4 mm  
 Total Rain 1645.4 mm  
 No of dry days 48

Immigration 1986

⑤

Date	Rain	Js												
22/6	34	2-	18/7	16.2	12+19	13/8	3.9	-	8/9		8	4/10		
23/6	8.	1	19/7	.7	2 <sup>5</sup>	14/8	110.6	-	9/9		8	5/10		
24/6	20	1	20/7	0	2 <sup>5</sup>	15/8	200	-	10/9		8	6/10		
25/6	1.5	1	21/7	0	2 <sup>5</sup> +19	16/8	28.8	-	11/9		8	7/10		
26/6	3	0	22/7	34.7	-	17/8	17.7	9 <sup>2</sup>	12/9		8	8/10		
27/6	2	1	23/7	98.4	-	18/8	<del>19.7</del> 9 <sup>2</sup>		13/9		8	9/10		
28/6	5	1	24/7	342.2	-	19/8	12.7	10 <sup>2</sup>	14/9		8	10/10		
29/6	0	0	25/7	110.6	3 <sup>5</sup> +19	20/8	<del>3.9</del> 8 <sup>2</sup>	-	15/9		7	11/10		
30/6	0	0	26/7	102.6	2 <sup>5</sup>	21/8	-		16/9		7			
31/7	24.5	2	27/7	46.1	2 <sup>5</sup>	22/8		11 <sup>2</sup>	17/9		7			
2/7	4.5	0	28/7	43.3	1 <sup>5</sup>	23/8		11 <sup>2</sup>	18/9	6.5	6			
3/7	0	-	29/7	34.6	3 <sup>5</sup>	24/8		11 <sup>2</sup>	19/9	3.4	6			
4/7	0	28+19	30/7	6.7	3 <sup>5</sup> +29	25/8		10	20/9		4			
5/7	0	28+19	31/7	11.7	5 <sup>5</sup> +29	26/8		10	21/9		2			
6/7	12.0	4 <sup>5</sup>	7/8	0	4 <sup>5</sup>	27/8		10	22/9		1			
7/7	3.4	38+19	2/8	0	4 <sup>5</sup>	28/8		10	23/9		0			
8/7	0	28+19	3/8	11	7 <sup>5</sup>	29/8		10	24/9		0			
9/7	0	3 <sup>5</sup>	4/8	0	-	30/8		10	25/9		1			
10/7	0	1 <sup>5</sup>	5/8	0	-	31/8		10	26/9	6.7	0			
11/7	0	1 <sup>5</sup>	6/8	48.8	<del>8<sup>5</sup></del>	1/9		10	27/9		1			
12/7	0	0	7/8	0	7 <sup>5</sup>	2/9		10	28/9		0			
13/7	0	0	8/8	4.8	7 <sup>5</sup>	3/9		9	29/9		0			
14/7	64.5	28+19	9/8	3.5	-	4/9		8	30/9		0			
15/7	3.1	2 <sup>5</sup>	10/8	0	<del>8<sup>5</sup></del>	5/9		8	1/10		1			
16/7	44	0	11/8	4.1	8 <sup>5</sup>	6/9		8	2/10	9.4	0			
17/7	3.2	0	12/8	0	9 <sup>5</sup>	7/9		8	3/10		0			

Keoladeo National Park in Bharatpur was selected for the study on its own merit as one of the best waterfowl reserves and consequently, of avian predators in the world. Moreover, the study fits into or is an essential part of an indepth system analysis of the ecosystem of the park where raptors are the major predators in the higher trophic level.

The field study was conducted from September 1984 to February 1988 and intensively from September 1985 to August 1986.

The population was estimated by transects on foot and on cycle along the bunds and the roads criss-crossing the park. The highest population was recorded in December in all the years, 95,100 & 94, respectively in 1984-85, 1985-86 and 1987-88. The Shannon-Weiner species diversity index was consistently higher during the winters, whereas equitability was the lowest during this season.

To study the predator-prey relationship the population of the prey species, mainly waterfowl was also estimated every month. A significant positive correlation was seen between raptors and waterfowl population. ( $r=.99$ ,  $.86$  and  $.89$  during 1984-85, 1985-86 and 1987-88 respectively).

The distribution of raptors was studied by marking each sighting on a map. The migrants depend largely on the marshes and surrounding forest, whereas the residents prefer the terrestrial area, thereby indicating niche partition between them. The migrants appear to have site fidelity as they occupy almost the same territories in subsequent years.

Total Rainfall = 1269.9  
 Rain days = 48

Immigration 1988

Date	Rain	Root Flow											
25/6		0	23/7	2.7	2♂+1♀	70/8	↑	↑ 1♂	17/9				
26/6	5.4	0	24/7	4.6		21/8		↓ Data	18/9				
27/6		0	25/7	2.4	4♂+1♀	22/8	↓ 1165	2♂	19/9			3♂	
28/6	13.3	0	26/7	7.0	1♂	23/8	18.5	2♂ No	20/9				
29/6	4.1	0	27/7		1♂	24/8	48.2	Data 2♂	20/9				
30/6		0	28/7		0	25/8	11.5	2♂	22/9	15.1			
1/7		0	29/7		0	26/8		2♂	23/9	47.8			
2/7		0	30/7		1♂	27/8		2♂	24/9	39.2			
3/7	1	0	31/7	38.4	1♂	28/8		2♂	25/9			2♂	
4/7	1.2	0	1/8	10.7		29/8		2♂	26/9			2♂	
5/7		0	2/8	6.2	2♂	30/8		2♂	27/9			2♂	
6/7	31.2	1♀	3/8	15.2	3♂	31/8		2♂	28/9			2♂	
7/7	38.4	0	4/8	187.5	2♂	1/9		2♂	29/9	54.3		2♂	
8/7		0	5/8	49.0	2♂	2/9		2♂	30/9				
9/7		0	6/8	5.2	1♂+1♀	3/9		2♂	1/10			1♂	
10/7		0	7/8	14.2	2♂	4/9		2♂	2/10	15.8		0	
11/7		0	8/8			5/9		-	3/10				
12/7		0	9/8			6/9		-	4/10				
13/7		0	10/8			7/9			5/10				
14/7	61.5	1♂	11/8			8/9							
15/7	5.2	1♂	12/8			9/9		2♂					
16/7	5.9	2♂	13/8	31.4		10/9	45.2						
17/7		2♂	14/8			11/8							
18/7		3♂	15/8			12/9							
19/7		3♂	16/8			13/9							
20/7		2♂	17/8			14/9							
21/7		1♂	18/8			15/9	11.5						
22/7	188.5	0	19/8			16/9	12.4						

The habitat preference of raptors was studied by recording the species of tree where the bird was sighted, height at which the sightings were made and activity at the time of observation. According to the phenological condition of the perch and the whole tree, the perching trees were divided into three classes, namely, dry, top-dry and green.

The habitat preference of six dominant species namely Imperial Eagle (Aquila heliaca), Steppe Eagle (Aquila rapax nipalensis), Greater Spotted Eagle (Aquila clanga), Lesser Spotted Eagle (Aquila pomarina) Pallas's Fishing Eagle (Haliaeetus leucoryphus) and Marsh Harrier (Circus aeruginosus), was studied in detail. A very significant difference in the preference of tree species by all the raptors was noticed. Sympatric marsh loving Aquila species although utilising almost similar habitats, were segregated by their choice of different tree classes as well as different heights. The habitat preference index showed that Aquila heliaca and Aquila clanga prefer green Mitragyna parvifolia, whereas Haliaeetus leucoryphus and Aquila pomarina, prefer dry Mitragyna parvifolia, Aquila rapax nipalensis had high preference for top-dry Acacia nilotica while Circus aeruginosus preferred dry Zizyphus jujuba.

Aquila clanga had the highest habitat niche breadth ( $B=.309$ ) probably owing to the even utilization of tree classes. Aquila heliaca and Aquila rapax nipalensis shared similar tree classes resulting in high niche overlap ( $\alpha=.71$ ).

The food and feeding habits were studied by standard field methods. The food species diversity index, one dimensional niche breadth and niche overlap based on food items were calculated. The three marsh loving Aquila species preferred avian prey, while Haliaeetus leucoryphus and Circus aeruginosus

rainy days.  
 29 Total 1224.5

Date	Rain	No. of birds	Immigration	1987.
7/6	28.8		7/7 2.5	1 6/8 5 19 5/9 1♂
8/6			8/7	2 7/8 6.1 1♂ 6/9 2♂
9/6			9/7	0 8/8 7/9 2♂
10/6			10/7	0 9/8 2.5 1♂ 8/9 1♂
11/6			11/7	18+19 10/8 1♂ 9/9 1♂
12/6			12/7	0 11/8 0 10/9 0
13/6	14.6		13/7 0.5	0 12/8 0 11/9 1♂
14/6			14/7 <del>19/8</del> 1♂	1♂ 13/8 1♂ 12/9 1♂
15/6			15/7 1.8	1♂ 14/8 1♂ 13/9 1♂
16/6	0.8		16/7	0 15/8 1♂ 14/9 1♂
17/6	2.8		17/7	2♂+2♀ 16/8 1♂ 15/9 2♂
18/6			18/7	0 17/8 100.6 2♂ 6/9 1♂
19/6			19/7	2♂+2♀ 18/8 1♂ 17/9 1♂
20/6			20/7	1♂ 19/8 0 18/9 1♂
21/6			21/7	1♂ 20/8 60.7 0 19/9 1♂
22/6			22/7	0 21/8 2♂ 20/9 0
23/6			23/7	0 22/8 34 1♂ 21/9 0
24/6	4.4		24/7 1.5	0 23/8 90.6 2♂ 22/9 0
25/6	18.4		25/7	1♂ 24/8 206.6 1♂ 23/9 7.2 1♂
26/6	16.4	0	26/7	0 25/8 211.7 0 24/9 0
27/6	4.5	0	27/7	0 26/8 86.7 0 25/9 0
28/6	44.5	0	28/7	1♀ 27/8 1♂ 26/9 0
29/6		0	29/7	18+19 28/8 1♂ 27/9 0
30/6		1♂	30/7	0 29/8 65 1♂ 28/9 0
1/7		0	31/7	1♀ 30/8 69.8 1 29/9 0
2/7		0	1/8	0 31/8 13.5 0 30/9 0
3/7		0	2/8	1♀+1♂ 1/9 1♂ 11/10 0
4/7		0	3/8	18+19 2/9 0.5 0 2/10 0
5/7		0	4/8	1♀ 3/9 0 3/10 0
6/6	3	0	5/8 21	18+19 4/9 0 4/10 0

R. 15

SYNOPSIS  
OF  
A THESIS ON

The General Ecology of Raptors (Families, Accipitridae and Strigidae, class Aves) in Keoladeo National Park, Bharatpur.

*Submitted to the University of Bombay for the degree of Doctor of Philosophy in Zoology by Vibhu Prakash, under the guidance of Mr. J.C. Daniel, Department of Field Ornithology, Bombay Natural History Society, Bombay.*

Raptors are a group of apex species and are considered to be the indicators of the health of an ecosystem in which they occur. They feed on a variety of animals and sometimes they subsist entirely on rodents and other vermin, of importance in the agricultural economy as well as in maintaining an ecosystem in dynamic equilibrium. Attempts have already been made, mostly in Europe and North America to evaluate the status of raptors in the dynamics of an ecosystem, however in India, till to date, studies on raptors have not received much attention.

The present study is the first attempt to gather simultaneously, information on the basic ecology of all the raptors that are found in an ecosystem. Data on the population and distribution; number of breeding and non-breeding species; habitat utilization; activity pattern and time budgeting; nesting density and distribution; nest site selection and building; clutch size and share of the sexes in incubation, nestling and fledgling periods; and hatching; nestling and nesting success of some species in detail and of others in general has been collected.

(As of 10/9/1991)

One R.F.O.  
One Forester

Banmer Range.

S.No	Chowki/Area	Type	No. guards	No cattle guards	No of forester	No of camels
(1)	Bandtha 'A'	enclosure				
(2)	Bandtha 'B'	"		one at Bandtha		
(3)	Manihari 'A'	"	2 guards only based at Bandtha	one Manihari		3 camels 1 young 2 old - one blind in one eye good condition.
(4)	Manihari 'B'	"				
(5)	Piparli	"		one Piparli		
(6)	Sundra clow	"		one Piparli		
(7)	Kudal	"		one Sihadar - near clowre		
(8)	Khabdala 'A'	"	one	one		0
(9)	Khabdala 'B'	"		one		
(10)	Dogari	"		one		
Protection forces						
(1)	Bandtha	as above	as above			
(2)	Girab	Protection Chowki; RH	one	-	-	0
(3)	Gadhra (road) (Gadhra road)	"	two	-	-	0
(4)	Sundra <del>clow</del> village	"	one	-	-	0
(5)	Dorimanha	outside D.M.P Closed area Bishnoi Area	Three	-	-	0
(6)		No chowki Rented acc. at Dorimanha				

Area of Gujarat = 196084  
 " " Madh = 59222 8 dist  
 Raj = 87218 10 dist.  


---

 342524 sq. km = 34252400 ha.

Area of Samnagar 14125  
 Sunaghad 10607  
 Rajkot 11203  


---

 35935 = 35935 ha.

1982. 3 districts Samn. Sun. Raj.

Total grasslands surveyed = 78.  
 Area given for = 69

areas

S.R.V. Surveyed Reserved vides = 38  
 S.N.V. Surveyed Non Res vides = 30  
 S.P.V. " Private = 20

Ha. AREAS :-

S.R.V = 17317 (38)  
 S.N.V = 1670 (9)  
 S.P.V = 2512 (22)

Total Nos. of grasslands in 3 areas  
 R N P  
 71 : 198 : 70\*



S.No.	Enclosure	Year of Const.	Type wire fence Clover	Area (ha)	No. Gans	No. C. Gans	No. bulls	No. calves
SAINACHER RANGE - ① R.F.O. ① Forester H.P. Jawalher fowls								
1	Sudasari 'A'	80-81	"	700	1	1	1	1
2	Sudasari 'B'	87-88	"	350	2	1	0	1
3	Sudasari 'C'	88-89	"	350	1	1	1	1
4	Sam 'A'	81-82	"		2	2	0	1 yang 1 old
5	Sam 'B'	81-82	"		1	1	1	1 old and 1 lame total 3
6	RAMDEVRA 'A'	(86-87?) 87-88	"		3	1	0	0
7	RAMDEVRA 'B'	87-88	"		1	1	1	1
8	RASLA 'A'	88-89	"	500	2	1	1	1
9	RASLA 'B'	90-91	"	100	1	1	1	1
10	USACA	88	"	250	2	0	0	0

BARMER RANGE; ONE RANGER; ONE FORESTER H.P. Barmer fowls								
1	Banddha 'A'	81-82	"	235	1	1	1	1
2	Banddha 'B'	81-82	"	422	1	1	1	1
3	SUMDRA	81-82	"	700	1	1	1	1
4	PIPARCI	83-84	"	260	2	1	1	2 (1 old 1 young) one old 210 are kept 1483
5	Manihari 'A'	86-87	"	40	1	1	1	1
6	Manihari 'B'	87-88	"	70	1	1	1	1
7	KUNDAC	83-84	"	250	1	1	1	1
8	Khabdala 'A'	88-89	"	450	1	1	1	1
9	Khabdala 'B'	89-90	"	300	1	1	1	1 Young
10	Dagari	86-87	"	400	1	1	1	1

S.No.	Enclosure	Type	Year	Area	No. of gawals	No. of C-gawals	No. of fester	No. Cakets
Miyajlar	Range - ①	R.F.O.	H.9		Miyajlar.			
1	Miyajlar	close	80-81	(530) 500	2	2	1	5
2	Phwila	"	81-82	400	1	1	1	1
3	Dab	"	88-89	500				
4	Bersiala	"	1988-89	400	1	0	0	0
5	Koriya	"	89-90	375	1	0	0	0
6	Dabdi	"	89-90	450	1	0	0	0

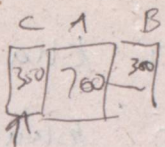
Protection Posts.

Barmer Range

(1)	Girab	P.C.	-	-	one	-	0	0
2	Gadhra Rd	"	-	-	2	-	0	0
3	Sundra village	"	-	-	1	-	0	0
4	Dorimanka	No. chowki; rent acc. outside D.N.P., Bakhniara	-	-	3	-	0	0

Miyajlar Range

1)	Satto	P.C.	-	-	1	-	0	0
2)	khuri	"	-	-	1	-	0	0



BARMER RANGE

SAISALMER RANGE

1980-81	SUDASARI 'A'	700 ha.
87-88	SUDASARI 'B'	350 ha.
<del>86-87</del>	-	-
<del>88-89</del>	SUDASARI 'C'	350 ha.
1980-82	SAM 'A' & 'B'	1100 ha.
1987-88	RAMDEVRA A & B	640 ha.
88-89	RASCA 'A'	500 ha.
90-91	RASCA 'B'	100 ha. - 120?
1988	USACA	250 ha.

BARMER RANGE

81-82	BANDDHA 'A'	235	✓
<del>82-83</del>		<del>600</del> ha.	
81-82	SUNDRA	700 ha.	✓
81-82	BANDDHA 'B'	422 ha.	✓
83-84	Piparli	260 ha.	✓
<del>86-87</del>	Manihani <del>A &amp; B</del> A	<del>110</del> ha.	40 ✓
<del>87-88</del>	Manihani 'B'	70 ha.	✓
83-84	Kundal	250 ha.	✓

D.D.P. COMPLEX

D.F.O. OFFICE.

CICA DIHORA.

Saisakher Pol

12 km

Hausani - Phata

Hausani - Girals - Bandidha

checklist of birds.

D.M.P.

10/7/1991 - 17/7/1991

	inside	outside	
Black crowned finch lark	✓	✓	
laggar falcon	✓	✓	
white backed vulture	✓	✓	
Egyptian vulture	✓	✓	
king vulture.	✓	✓	
Raven	✓	✓	
white checked bulbul	✓	✓	
Home crow	✓	✓	
House sparrow	✓	✓	
Ring dove	✓	✓	
blue rock pigeon	✓	✓	
Hoopoe lark		✓	
Common babbler	✓	✓	
Large grey shrike	✓	✓	
Indian Sandpiper	✓	✓	
Rosy pastor	✓	✓	
yellow throated sparrow	✓	✓	
Great Indian bustard	✓	✓	
Redvented bulbul	✓		
Bush lark (?)	✓		
Tawny eagle			✓ (outside jaisalmer)
+ Yellow (?) wattled lapwing			✓
Spotted owl	✓	✓	
Plain wren warbler	✓		
White throated Munia	✓	✓	
Black headed bunting	✓	✓	
Red wattled lapwing	Sam	✓	Just before Saisalmer (Sam)
Great Horned owl	✓	✓	
Pied wheatear	✓	✓	8/8/91
Puffin chat	✓	✓	Aug 1st week
Purple supbird	✓		11/8/91 Sam.
Red backed shrike	✓	✓	
Montagu's harrier	✓	✓	
Houbara		✓	reported 2nd or 3rd September
Rock Bunting - party of 5	✓ Dagan v. Dagan	✓ Boothal ridge	on 11/9/91

Grey necked bunting 27/9/91 Maqra opp. 99196 hi  
nati

Lesser shorttoed lark early september

Pied Bush chat Rasfa / Sudan

Desert wheatear 2<sup>nd</sup> week september

Desert Cream colored courser "

Red winged Bush lark ? Rasfa

Little Brown dove Banddha.

Hoopoe

Short toed eagle

blue cheeked bee-eater

Little green bee-eater.

Bittern sp ————— Mohanyad canal

Spoonbill " oct 1<sup>st</sup> week

w. Breasted kingfisher " sam !! twice

white breasted waterhen "

Bay backed shrike ————— Banddha

Houbara

10/4/91

Sudan K

tracks on 2<sup>nd</sup> Oct. +

~~Pied Bush~~

Pied wheatear

Isabelline wheatear

~~Cream colored courser~~

Desert warbler (?)

Crested lark

Grey quail

Bank mynah

Mammals.

Chinkara

Gerbille sp.

long eared Hedgehog

Desert fox

Indian fox.

Foraging & walking  
 S+CA  
 maintenance

16

3

d 17  
 l 1  
 1

Year	Nos	Same district	Same vidi	Other area
1943	100	(1944) 1		(1944) 1
1944	99	0	0	0
1945	111 + 1	0	1	0
1946	100	(1946) 2		2
1947	67	(1947) 1	5	2
1949	11		4	1

Total 489  
 - 1 9

19 + 488 =

1.03% same vidi



DATE 1/8/91 LOCATION same as last Length 1.3  
 START TIME 8:45 END TIME Cloud cover - 1  
 START TEMP 32 END TEMP Sunrise.

Seq No.	Time	Species	No.	Direction	Substrate	General vegetation	Reaction
12	8:50	Agamid	1		Sandy	Sewan	Ran away
11	9:00	Skink	1		"	"	into burrow

Date: - 2/8/91  
loc. outside  
same as el.

Seq No.	Time	Species	Nos.	Direction	Substrate	General beheading	Reaction
13	8:25	Fox	1	L-R	Sandy	near lower brush.	
13	8:30	"	1	L-R	"	"	