

FAUNAL EXPLORATION OF KUMBHALGRAH WILDLIFE SANCTUARY RAJASTHAN





Conservation Area Series, 47

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Kumbhalgarh Wildlife Sanctuary
Rajasthan**

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Sanctuary, Rajasthan
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KUMBHALGARH WILDLIFE SANCTUARY : AN OVERVIEW

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INTRODUCTION

Kumbhalgarh Wildlife Sanctuary (KWLS) was once the famous hunting ground of the world famous warrior Maharana Pratap. It envelops the Kumbhalgarh Fort constructed by Rana Kumbha, father of Maharana Pratap in 1448 A.D. at a height of 3600 ft on top of a hill. Kumbhalgarh was once the private hunting grounds of the Maharana Mewar and its royal past manifests itself in the magnificent fort of rulers of Mewar dating back to the 15th century.

STUDY AREA

Kumbhalgarh Wildlife Sanctuary spreads over an area of 610.528 sq.kms. This includes 224.890 sq.km core zone and 385.638 sq.km area as buffer zone (Fig. 1 & 2). The Core Zone is further divided into four ranges *i.e.*, Kumbhalgarh range; Sadri range; Desuri range and Bokhada range (Fig. 3). KWLS makes an ecotone between the hilly forests of Aravallis and the Thar Desert. Kumbhalgarh hills act like a barrier, checking the eastward extension of desert.

RIVERS

Kumbhalgarh hills form the catchment of many rivers and nallahs. Run off of the Kumbhalgarh catchment is drained out by 78 nallahs and ultimately these nallahs join 16 rivers, mainly Kot, Sumer, Sukri, Maghai, Lunawa, Mithadi, Jawai, Bhatund, Sai, Satpalia etc. As many as 23 dams including Latada, Sadra, Sonwa, Jawai, Prithvisagar, Sai Mithli, Nalwania, Seli, Rajpura, Hariomsagar, Hemawas, Mandigarh etc. have been constructed on these rivers, originating from Kumbhalgarh hills. These dams not only provides drinking water to human and bovine population of Pali, Jalore and Jodhpur districts but also irrigates 80,000 hectares of agricultural land present in these districts.

HUMAN SETTLEMENT

As many as 22 villages are situated inside the sanctuary whereas 138 villages are on the periphery. Inhabitants of these villages collect multiple forest products from sanctuary area to sustain their livelihood.

FOREST AREA

There are 35 forest blocks in this notified sanctuary with a total area of 610.528 sq. km. The district wise forest area under the Sanctuary is given in the **Table 1**.

Table 1. District wise forest area under the Sanctuary

Name of District	Area under Sanctuary (in sq.km.)
Pali	344.63
Udaipur	120.78
Rajsamand	145.118
Total	610.528

ECOLOGY, ROCK AND SOIL

KWLS lies in the Aravalli ranges, which is one of the oldest formations in the world. The sanctuary area lies an Archean formation. The soil depth is poor, mainly sandy and sandy loam with poor moisture retention capacity. However, the moisture retention capacity is fairly good in the hills covered with vegetation. The soil resulting from the disintegration of rocks is sandy, particularly where Schist's and quartzite predominate.

TERRAIN

The forest tract of the sanctuary is highly undulating with broken ranges of hills of height ranging from 300 to 4000 ft. above Mean Sea Level (MSL). The highest point of this range is near Ranakpur rest house, which rises to a height of 4020 ft. above the MSL. The slopes are gentle at the outer boundary and sometimes becomes precipitous at the top. Most of the hilly tract is highly slopy with almost 70 to 100% slopes at places. The hills and hillocks forming a network leading to the nallahs, entering the plains and draining into the bigger nallahas, which leads in many rivers and ultimately join the River Luni. The topography of the area can be divided into hills, piedmont zone and plains. The plains down the hills are mostly of agricultural fields. Areas in Rajsamand and Udaipur Districts are more hilly having steep slopes while the area in Pali district is less hilly.

CLIMATE

The climate is subtropical with extremely hot summer and relatively moderate winter. The three main seasons are, Summer: March to June, Rainy: July to September and Winter: November to February. Rainfall in the area is very erratic and unevenly distributed and drought conditions prevail even during the rainy season. Rains generally start in the last week of June and intermittently continue up to September end. Highest intensity of rain is generally observed in the month of July. The average annual rainfall is about 725 mm. The number of rainy days is 20 to 25, on an average.

A wide variation in temperature is observed round the year. Summers are very hot. The temperature increases rapidly after mid March. May and June are the hottest months when temperature reaches up to 44°C. Temperature starts declining in the month of October, after the withdrawal of monsoon. January is the coldest month with mean daily minimum temperature of 5°C. Humidity in the air is generally low and rarely exceeds 30-35% except in the rainy season when it ranges between 60-80 percent.

Winds blow from southwest to North-east during summer and direction is reversed during winter seasons. Winds generally blow with moderate speed and rarely, at a speed of 40-60 km per hour. During the summer the dust storms are sometimes observed. Periodic and frequent droughts are observed in the area. The sanctuary area mainly falls in the Aravalli hill ranges. Because of the shallow soil and its geo-morphological conditions, percolation of the rain water is considerably low. Most of the nallahs dry up during the pinch period and water available only at few points in the nallahs due to ground water seepage depending upon the recharge during the rains. Frequent droughts in the region worsen the conditions for wildlife and local population.

Dams and anicuts constructed prove good water source to wild animals. As many as 42 wells and 37 anicuts are there inside the Sanctuary. Twelve small and medium dams are present in and around the Sanctuary, which provide water supply almost throughout the year. There are 28 spots where natural water remains available either throughout the year, or till late summers.

FLORA

The floral constituents of the KWLS are mostly edaphic-climate climax type forests. As per the Champion & Seth's (1968) classification the forests of this sanctuary fall under the II category of Tropical Dry Deciduous forests, which can be sub-classified as Group 5 Tropical Dry Deciduous forests, Group 5 B-Northern Tropical Dry deciduous forest. Pandey & Singh (2000) described *Anogeissus pendula* forest of northern tropical dry deciduous forest type. Its composition resembles the vegetation of the entire region and can be classified into top of the Aravalli hills, middle and foot of the hills. There is a clear cut altitudinal zonation in the vegetation. The *Anogeissus pendula* is the main dominant tree of the sanctuary, particularly between base of hills to middle. The other common tree species associated with it are: *Acacia chundra*, *A. leucophloea*, *A. senegal*, *Albizia odoratissima*, *Anogeissus latifolia*, *Baushima racemosa*, *Bridelia retusa*, *Butea monosperma*, *Capparis grandis*, *Cassia fistula*, *Dalbergia lanceolaria*, *Ehretia aspera*, *E. laevis*, *Ficus racemosa*, *Haldina cordifolia*, *Holarrhena pubescens*, *Lannea coromandelica*, *Ziziphus mauritiana*, etc. Excepting a pond near Kelwara, there are no perennial rivers, tanks or lakes in the area, hence hydrophytes are very poorly represented. The aquatic species in the area are: *Azolla pinnata*, *Chara* spp., *Hydrilla verticillata* like some more aquatic species.

There are about 50 taxa of angiosperms and one species of gymnosperm which are considered to be rare and threatened in Rajasthan (Pandey & Shetty, 1981; Pandey, Shetty & Malhotra, 1981; Singh, 1985; Singh & Pandey, 1997) of these 21 taxa are endemic to Western Rajasthan and 4 to Mount Abu. Among the endemic representatives of Rajasthan

taxa viz., *Alysicarpus monilifer* var. *venosa*, *Barleria prionitis* var. *dicantha*, *Melhania futteyporensis* var. *major* and *Ziziphus trurcata* also occur in KWLS.

FAUNA

The leopard is the top carnivore in KWLS. This sanctuary is also famous for frequent wolf sightings (Singh, 2002). Other fauna are jackal, fox, wildboar, bear, neelgai, hare, mangoose. Some of the avifauna sighted are, the Jungle Babbler, Green Bee Eater, Blue Jay, Greater Coucal or Crow Pheasant, Jungle Fowl, Hoopoe, Grey Hornbill, Scarlet Minivet, Golden Oriole, Grey and painted Partridges. Raptors include the Serpent Eagle, Tawny Eagle, White-eyed Buzzard, Shikra, King and White-backed vultures. About 240 avian species have been recorded (Singh, 2002).

Five surveys have been conducted by DRC survey parties in KWLS sanctuary from 2006-2009. In all, about 526 lots comprising 2,212 examples of fauna were collected. The present document deals with 128 species of invertebrates and 184 species of vertebrates (total: 312 species) from the KWLS (Table 2). Nine species of different groups not included in this book as separate chapters are as *i.e.* Four species of ants belongs to family Formicidae of order Hymenoptera *i.e.* *Dorylus labiatus* Shuckard; *Leptogenys (Lobopelta) processionalis* Jerdon; *Messor barbarus himalayana* Forel and *Cataglyphis bicolor setipes* Emery; two species of bees belongs to family Apidae of order Hymenoptera *i.e.* *Apis dorsata* Fabricius and *Apis florea* Fabricius; two species belongs to two families of order Mantodea *i.e.* *Mantis religiosa* Linnaeus (Family Mantidae) and *Gongylus gongylodes* (Linnaeus) (Family Empusidae) and one species belongs to family Cyprinidae of class Pisces *i.e.* *Rasbora daniconius* (Hamilton).

Table 2. Summary of Faunal species recorded from Kumbhalgarh Wildlife Sanctuary

(A) Invertebrates	No. of species	(B) Vertebrates	No. of species
Plant and Soil Nematodes	50	Pisces	01
Odonata	17	Amphibia	03
Lepidoptera	19	Reptilia	14
Mantodea	02	Aves	143
Coleoptera	34	Mammals	23
Hymenoptera	06	-	-
Total (A)	128	Total (B)	184
		Grand Total (A+B)	312

THREATS

- A major problem faced in the Sanctuary is the cattle grazing practiced by the villagers within and on the periphery of the Sanctuary. Domestic cattle compete with wild ungulates for fodder. Unrestricted grazing has destroyed the surrounding natural

vegetation and caused unpalatable weed such as *Argemone mexicana* to replace fodder grasses in areas around the Sanctuary. Grazing goes on throughout the year and peaks in the monsoon.

- Other threats are: Wood collection and felling around the periphery of the Sanctuary, especially in villages such as Desuri, Ghanerao, Bijapur and other forest hamlets.
- Poor availability of water, frequent droughts, fire hazards.
- Invasion of obnoxious weeds like *Lantana canara*.
- Anthropogenic pressure due to human settlement inside the Sanctuary.

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PLANT AND SOIL NEMATODES

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INTRODUCTION

The soil samples collected from Kumbhalgarh Wildlife Sanctuary, Udaipur during 2006-2009 yielded wide variety of plant and soil nematodes. The present paper report 50 species belonging to 32 genera of 21 families of orders Tylenchida (18 spp.); Aphelenchida (1 sp.); Dorylaimida (18 spp.); Mononchida (7 spp.); Rhabditida (5 spp.) and Araeolaimida (1 sp.). These include two species as new records from India and 14 new records from the state.

MATERIAL AND METHOD

Nematodes were killed and fixed in hot 4% formalin and mounted on glass slides in anhydrous glycerine. Body measurements of species were taken with the help of Nikon E-600 trinocular microscope fitting with drawing tube.

SYSTEMATIC ACCOUNTS

Order TYLENCHIDA Thorne, 1949

Superfamily TYLENCHOIDEA Örley, 1880

Family TYLENCHIDAE Örley, 1880

1. *Tylenchus ritai* Siddiqi, 1963

1963. *Tylenchus ritai*, Siddiqi; Z. ParasitKde **23**, 170-180.

Material examined: 3 females, 2males.

Measurements: Females: L= 0.66-0.82mm; a= 27-34; b= 5.3-7.4; c= 5.1-6.6; c¹= 8-11; V= 50-61; Males: L= 0.69-0.81mm; a= 28-33; b= 5.6-7.1; c= 5.2-6.2; c¹= 8-9.

Description: Female: Body ventrally arcuate. Lip region continuous with body. Lateral fields marked by four incisures. Stylet 14-15 µm long. Pharynx typical tylenchid type. Female reproductive system monodelphic-prodelphic. Tail 112-146 µm long, strongly ventrally arcuate.

Male: Spicules 21-24 µm long arcuate, cephalated. Gubernaculum 5-6 µm long. Bursa 44-49 µm long.

Habitat and locality: Soil around roots of bean (*Phaseolus sp.*), Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Remark: First report from the state.

2. *Sakia alii* Suryawanshi, 1971

1971. *Sakia alii*, Suryawanshi. *Nematologica*, 17: 399-406.

Material examined: 2 females, 2 males

Measurements: Females: L= 0.54-0.58mm; a= 46.2-47.1; b=5.3-5.4; c=17.9-18.4; V= 70-73.

Males: L =0.56-0.59mm; a =47.2-47.8; b =5.5-5.6; c =18.4-18.9.

Description: *Female*: Body almost straight upon fixation. Cuticle finely striated. Lateral fields marked by four incisures. Lip region rounded, continuous with adjacent body contour. Stylet 5-8 μ m long, knobs weakly developed. Excretory pore in isthmus region, duct slightly sclerotized. Female reproductive system monodelphic-prodelphic. Postvulval uterine sac less than one body width long. Tail elongate.

Male: Spicules 17-20 μ m and gubernaculum 5-8 μ m long.

Habitat and locality: Soil around roots of cabbage (*Brassica oleracea*) at Kumbhalgarh Wildlife Sanctuary, Rajasmand.

Distribution: Maharashtra.

Remark: This species is being recorded for the first time from the state.

3. *Neothada tetra* (Thorne & Malek, 1968) Khan, 1973

1968. *Thada tetra*, Thorne & Malek. *Tech. Bull. S. Dak. Agric. Exp. Stn.* 31, 1-111.

1973. *Thada tetra*, Khan. *Sec. Biol. Sci. Proc. Nat. Acad. Sci., India*, pp. 17-18.

Material examined: 3 females.

Measurements: Females: L= 0.37-0.44mm; a= 30.3-31.2; b= 3.8-4.7; c= 18.7-22.2; V= 77-83.

Description: *Female*: Cuticle tessellated marked by prominent coarse and longitudinal striae. Lateral fields broads, marked by four incisures. Lip region continuous, striated. Stylet 5-8 μ m long. Postvulval uterine sac less than one body width long. Tail elongate, conoid, 19-20 μ m long, tip rounded or pointed.

Male: Not found.

Habitat and locality: Soil around roots of unidentified grass from Mahadev forest area, at Desuri, Ki Naal, Kumbhalgarh Wildlife Sanctuary.

Remark: This species is being recorded for the first time from the Country.

4. *Malenchus (M.) holochmatus* (Singh, 1971) Siddiqi, 1986

1971. *Ottolenchus holochmatus* Singh. *J. Helminth*, 45: 353-369.

1986. *Ottolenchus holochmatus* Siddiqi, *Com. Agric. Bure., Farn. Royal, Slough, UK*, ix+645pp

Material examined: 2 females.

Measurements: Females: L =0.37-0.39mm; a =36.5-39.5; b = 3.7-4.5; c = 27.5-28.2; V =61-62.

Description: Female: Body strong, tapering regularly more posterior to vulva. Lateral fields marked with two incisures. Lip region elevated, with four to six fine annules. Stylet 12-13 μm long with distinct basal knobs. Female reproductive system mono-prodelphic. Spermatheca elongate. Vulva located in a depression. Tail elongate-conoid, 12-14 μm long. Phasmids located at 1-3 annules anterior to anus.

Male: Not known.

Habitat and locality: Around roots of Banana (*Musa paradisiaca*), Ranakpur at Kumbhalgarh Wildlife Sanctuary.

Remark: First time reported from the state.

Suborder HOPLOLAIMINA Chizhov & Berezina, 1988
Superfamily HOPLOLAIMOIDEA Filipjev, 1934 (Paramonov, 1967)
Family HOPLOLAIMIDAE Filipjev, 1934 (Wieser, 1953)

5. *Hoplolaimus indicus* Sher, 1963

1979. *Basirolaimus indicus* (Sher, 1963) Shamsi, *Nematol. Medit.*, 7: 15-19.

1982. *Hoplolaimus arachidis* Maharaja & Das, *Proc. Indian Acad. Parasitol.*, 3: 30-32.

1963 *Hoplolaimus indicus* Sher, *Nematologica*, 12: 1-56.

Material examined: 4 females, 6 males.

Measurement: Females: L= 1.-1.3 mm; a= 21-34; b= 7.3-9.8; c= 40-63; c= 0.61-0.65; V= 53-57.

Males: L= 0.94-1.30 mm; a= 26-36; b= 7.9-10.1; c= 31-38; T= 50-55.

Description: Female: Body straight upon fixation. Lip region hemispheroid, marked by 3-4 annules. Stylet robust, 31-34 μm long; basal knobs tulip- shaped. Female reproductive system amphidelphic. Epiptygma single or double. Spermatheca filled with sperms. Tail with 7-12 annules.

Male: Spicules arcuate and cephalated, 36-49 μm long. Gubernaculum 11-20 μm long. Tail conoid. Bursa terminal.

Habitat and locality: Soil around roots of bean (*Phaseolus sp.*), Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: Rajasthan, West Bengal, Delhi, Himachal Pradesh, Bihar, Punjab, Haryana, U.P., Sikkim, etc.

Remark: It is a widely distributed species.

6. *Helicotylenchus erytherinae* (Zimmerman, 1904) Golden, 1956

1956. *Helicotylenchus erytherinae* Golden. *Maryland Ag. Exp. Stn Bull.* A-85, 28pp.

Material examined: 3 females.

Measurements: Females: L =0.69-0.86mm; a =24-26; b = 6.5-7.6; c = 28-31; V =57-62.

Description: Female: Body spirally curved. Lip region hemispherical, marked by 4-5 striae. Stylet 31-32 μm long, basal knobs slightly anteriorly directed. Female reproductive system amphidelphic. Spermatheca functional. Tail 24-25 μm long, tapering into a pronounced ventral projection. Phasmids located at 1-3 annules anterior to anus.

Male: Not found.

Habitat and locality: Soil around roots of onion (*Allium cepa*) Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Distribution: Rajasthan, Gujarat, Maharashtra.

Family PRATYLENCHIDAE Thorne, 1949 (Siddiqi, 1963)

7. *Pratylenchus goodeyi* Sher & Allen, 1953

1953. *Pratylenchus goodeyi* Sher & Allan, 1953.

Material examined: 6 females.

Measurements: Females: L= 0.59-0.60mm; a= 35-38; b= 3.5-4.2; c= 7.7-8.7; V= 71-73.

Description: Female: Body slightly curved ventrally. Cuticle with transverse and longitudinal striations. Lip region continuous, marked by three to four annules; labial sclerotization extending backwards on two or three body annules. Stylet 15-16 μm long. Spermatheca without sperms. Tail 4.9-5.5 anal body width long, with 27-28 annules, tip broadly rounded to truncate.

Male: Not found

Habitat and Locality: Soil around roots of maize (*Zea mays*), Jhalawar, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: Gujarat, Haryana, Punjab, Rajasthan.

8. *Pratylenchus thornei* Sher & Allen, 1953

1953. *Pratylenchus thornei* Sher & Allen. *Univ. Calif. Publ. Zool.*, **57**: 441-470.

Material examined: 6 females.

Measurements: Females: L= 0.43-0.51mm; a= 24-26; b= 4.5-4.7; c= 16-22; V= 75-79.

Description: Female: Cuticle with transverse striations. Lip region continuous, marked by three annules; labial sclerotization extending backwards on two or three body annules. Stylet 18-20 μm long. Spermatheca without sperms. Tail tip broadly rounded to truncate, smooth.

Male: Not found

Habitat and Locality: Soil around roots of maize (*Zea mays*), Jhalawar, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: Gujarat, Haryana, Punjab, Rajasthan.

9. *Hirschmanniella caudacrena* Sher, 1968

1968. *Hirschmanniella caudacrena* Sher. *Nematologica* , 14: 243-275

Material examined: 4 females.

Measurements: Females: L = 1.19-1.20mm; a =46.9-48.6; b =5.3-5.9; c =29.8-30.4; V =49-50.

Description: Female: Body slightly curved ventrally. Lip region continuous with body, flattened, marked by four to five annules. Stylet robust, 19-20 μ m long, with rounded basal knobs. Female reproductive system amphidelphic. Spermatheca filled with sperms. Intestine not overlapping rectum. Tail elongate conoid, 1.9-2.2 anal body width long, with mucronate terminus. Phasmids located in the posterior half of tail.

Male: Not found.

Habitat and locality: Soil around roots of Chilli (*Capsium annuum*), Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

10. *Hirschmanniella oryzae* (Van Breda de Haan, 1902) Luc & Goodey, 1963

1902. *Hirschmanniella oryzae* Van Breda de Haan.

Material examined: 3 females, 2males.

Measurements: Females: L= 1.11-1.64mm; a= 51-66; b= 8.6-12.0; c= 16-20; V= 51-54

Males: L= 1.11-1.41mm; a= 50-59; b= 9.0-11.2; c= 15-17; T=50-52.

Description: Female: Body straight or slightly curved ventrally. Lip region continuous with body, low, flattened with rounded apex, marked by three to four annules. Stylet robust, 15-19 μ m long, with rounded basal knobs. Spermatheca with sperms. Intestine not overlapping rectum. Tail elongate conoid 4.1-6.3 anal body width long, with mucronate terminus. Phasmids located in the posterior half of tail.

Male: Similar to female in general morphology except reproductive system. Spicules cephalated, slightly arcuate, 17-27 μ m long. Gubernaculum 8-9 μ m long. Bursa subterminal. Tail with a pointed ventral mucro.

Habitat and locality: Soil around roots of unidentified grass from Mahadev forest area at Desuri Ki Naal, Kumbhalgarh Wildlife Sanctuary, Udaipur.

Distribution: Rajasthan, Gujarat and West Bengal.

Remark: *H. oryzae* is widely distributed and considered a key pest of rice in Far East and tropical countries (including India).

Superfamily DOLYCHODOROIDEA Chitwood in Chitwood & Chitwood, 1950
(Siddiqi, 1986)

Family TELOTYLENCHIDAE Siddiqi, 1960

11. *Tylenchorhynchus delhiensis* Chawla, Bhamburkar, Khan & Prasad, 1968

1968. *Tylenchorhynchus delhiensis* Chawla, Bhamburkar, Khan & Prasad

Material examined: 3 females.

Measurements: Females: L = 0.6-0.7mm; a = 27-33; b = 6-7; c = 14-17; V = 46-57.

Description: Female: Body slightly ventrally arcuate upon fixation, tapering gradually at both extremities. Lip region rounded, slightly setoff from adjacent body. Lateral fields marked by four incisures. Stylet 13-15 μ m long, with rounded basal knobs. Excretory pore located in region of pharyngeal bulb. Female reproductive system amphidelphic. Tail sub cylindrical, about four anal body-diameter long, marked by 28-30 striae, with rounded terminus. Phasmids located in the anterior half of tail.

Male: Not found.

Habitat and locality: Soil around roots of unidentified grass, Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

12. *Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959

1959. *Tylenchorhynchus mashhoodi* Siddiqi & Basir., *Proc. 46th Indian Sci. Cong. IV:* 35.

1960. *Tylenchorhynchus dactylurus* Das, *Z. Parasitenk.* **19:** 553-605.

1968. *Tylenchorhynchus zae* Sethi & Swarup, *Bull. Ent.* **9:** 76-80

Material examined: 5 females, 3 males.

Measurements: Females: L = 0.53-0.71mm; a = 27-38; b = 4.2-5.6; c = 14-17; V = 52-56.

Males: L = 0.56-0.68mm; a = 28-34; b = 4.3-5.4; c = 13-16; T = 37-51

Description: Female: Body ventrally curved in posterior half of its length. Lip region continuous with body, marked by 3-4 annules. Labial frame work slightly sclerotized. Stylet 15-18 μ m long, with rounded basal knobs which may be slightly flattened anteriorly. Female reproductive system amphidelphic. Spermatheca with sperms. Tail cylindrical to subcylindrical in shape, slightly narrowing behind anus. Phasmids in anterior half of tail.

Male: Spicules 17-19 μ m long medially. Gubernaculum 11-15 μ m long. Tail elongate-conoid, with subacute terminus, 2.4-3.1 anal body-width long. Phasmids in the anterior half of tail.

Habitat and locality: Soil around roots of maize (*Zae mays*), Jhalawar, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

13. *Tylenchorhynchus triglyphus* Seinhorst, 1963

1963. *Tylenchorhynchus triglyphus* Seinhorst

Material examined: 5 females.

Measurements: Females: L= 0.61-0.73mm; a= 24-26; b= 3.9-4.1; c= 15-18; V= 48-50.

Description: Female: Body almost straight upon fixation. Cuticle marked by coarse striae, about 2 µm apart in mid body. Lip region continuous with body, marked by 4-5 annules. Labial frame work slightly sclerotized. Stylet 13-16 µm long, with rounded basal knobs which may be slightly flattened anteriorly. Spermatheca with sperms. Tail conoid, 2.5-3.1 anal body width long. Phasmids in anterior half of tail.

Male: Not found.

Habitat and locality: Soil around roots of maize (*Zea mays*) Desuri, at Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

14. *Bitylenchus brevilineatus* (Williams, 1960) Jairajpuri, 1982

1960. *Tylenchorhynchus brevilineatus* Williams.

Material examined: 4 females, 2males.

Measurements: Females: L= 0.54-0.70mm; a= 34-42; b= 4.2-5.9; c= 13-17; V= 52-58.

Males : L= 0.53-0.62mm; a= 34-37; b= 4.3-6.2; c= 12-18.

Description: Female: Body ventrally curved upon fixation. Lip region set off from adjacent body contour, annules 5-6. Labial sclerotization present. Cuticle marked with both longitudinal and transverse striae. Longitudinal lines only confined to pharyngeal region. Stylet 12-18 µm long. Basal knobs indented posteriorly. Tail 41-45 µm bearing 41-43 tail annules, hemispheroid tail, terminus smooth, 2.3-2.7 anal body width long.

Male: Spicules 20-26 µm long. Gubernaculum 10-14 µm long. Tail 43-45 µm long, tip pointed.

Habitat and Locality: Soil around roots of bean (*Phaseolus sp.*), Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: Rajasthan, Uttar Pradesh, West Bengal, Delhi.

15. *Bitylenchus goffarti* (Sturhan, 1966)

1966. *Tylenchorhynchus goffarti* Sturhan. Appl. Nematol; 19: 185-188.

1986. *Bitylenchus goffarti* (Sturhan,) Siddiqi. CAB Agri. Bureax, Farnham royal, Slough, UK, ix + 645 pp.

1982. *Bitylenchus goffarti* (Sturhan, 1966) Jairajpuri. Meded. Fac. Landbou Wetem. Rijkuniv., Gent., 47: 765-770.

Material examined: 3 females, 2 males.

Measurements: Females: L= 0.53-0.74mm; a= 24-41; b= 4.8-6.3; c= 11-15; V= 51-56.

Males: L= 0.52-0.67mm; a= 35-43; b= 5.0-5.8; c= 12-15; T= 41-51

Description: Female: Lip region set off from body by depression. Labial sclerotization moderate. Stylet 14-17µm long. Median oesophageal bulb oval. Vulva transverse. Post anal intestinal sac present. Tail 35-42µm long conoid with smooth terminus.

Male: Spicules 23-25µm long. Gubernaculum 10-11µm long. Bursa enveloping entire tail length. Tail tip pointed.

Habitat and Locality: Soil around roots of maize (*Zea mays*), Jhalawar, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: West Bengal, Rajasthan, Gujarat.

16. *Uliginotylenchus rhopalocercus* (Seinhorst, 1963) Siddiqi, 1971

1963. *Tylenchorhynchus shopalocerus* Seinhorst. *Nematologia*, 9: 173-180.

Material examined: 3 females.

Measurements: Female: L =0.6-0.7mm; a =27-33; b = 6-7; c = 14-17; V =46-57.

Description: Female: Body ventrally arcuate upon fixation, tapering gradually at both extremities. Lip region rounded, slightly setoff from adjacent body. Lateral fields marked by three incisures, areolated. Stylet 17-18 µm long, with rounded, small basal knobs. Female reproductive system amphidelphic. Vulva in depression. Tail elongate to cylindrical, five to six anal body-diameter long, marked by 26-35 striae, with rounded terminus. Phasmids located in the anterior half of tail.

Male: Not found.

Habitat and locality: Soil around roots of Cabbage (*Brassica oleracea*), Ranakpur, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from state.

17. *Scutylenechus mammilatus* (Tobar-Jimenez, 1966) Jairajpuri, 1971

1966. *Tylenchorhynchus mammilatus* Tobar-Jimenez.

Material examined: 3 females.

Measurements: Females: L =0.54-0.67mm; a =31-33; b =4.2-5.2; c =11-13; V =52-58.

Description: Female: Body arcuate upon fixation. Lip region continuous marked by 5-6 annules. Lateral fields marked by six incisures. Labial framework moderately sclerotized. Stylet with posteriorly directed basal knobs. Vulva in a cavity or depression, with epiptygma. Female tail conoid to subcylindrical with rounded tip.

Male: Not found.

Habitat and locality: Soil around roots of maize (*Zea mays*), Jhalawar, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: Uttar Pradesh.

Remark: First time reported from state.

18. *Scutylenechus stegus* (Thorne & Malek, 1968) Siddiqi, 1979

1968. *Scutylenechus stegus* Thorne & Malek, *Agricultural Exp. Station South Dokala. Tech. Bullt*; 1-110.

Material examined: 4 females, 2males.

Measurements: Females: L =.72-0.75mm; a 25-26; b =4.9-5.1; c =16-17; V =54-55.

Male: L =0.72mm; a =26; b =5.5; c =14.

Description: Female: Body cylindroids, tapering towards extremities. Cuticle marked by 24 longitudinal striae. Lateral fields marked by six incisures. Stylet 21-22 μm long. Lip region setoff by constriction with 3 or 4 annules. Post rectal blind sac extending half way or more into tail.

Male: Male with broad, finely create bursa. Spicules cephalated, 52 μm long.

Habitat and locality: Soil around roots of bean (*Phaseolus sp.*), Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: North Dakota.

Remark: First time reported from the State.

Order APHELENCHIDA Siddiqi, 1980

Family APHELENCHIDAE Fuchs, 1937

19. *Aphelenchus avenae* Bastian, 1865

1865. *Aphelenchus avenae* Bastian. *Tran.Linn. Soc. Lon.*, **25**: 73-184.

Material examined: 4 females.

Measurements: Females: L =0.54-0.78; a =24-37; b =4.7-6.4; c =26-32; V =73-77.

Description: Female: Body almost straight. Lip region flattened, with 3-4 very faint annules. Lateral field marked with 10-14 incisures. Stylet 10-12 μm long, slightly thickened at base. Female reproductive system mono-prodelphic. Post uterine sac reaching about half way from vulva to anus. Tail bluntly rounded, 16-30 μm long, less than one anal body diameter long.

Male: Not found.

Habitat and locality: Soil around roots of maize (*Zea mays*) at Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Remark: It has a cosmopolitan distribution.

Order DORYLAIMIDA Pearse, 1942

Superfamily DORYLAIMOIDEA De Man, 1876

Family DORYLAIMIDAE De Man, 1876

20. *Laimydorus siddiqii* Baqri & Jana, 1982

1982. *Laimydorus siddiqii* Baqri & Jana. *Nematologica*, **28**: 192-205.

Material examined: 2 females.

Measurements: Females: L =2.3-2.5mm; a =47-49; b =4.4-4.7; c =7.9-8.1; V =46-48.

Males: L=2.5-2.6mm; a =44-46; b =4.1-4.2; c =93-102.

Description: Female: Lip region continuous with body contour. Odontostyle 27-30 μm long, aperture 38-43% of odontostyle length. Guiding ring 1.0-1.1 lip region-width from anterior end. Odontophore 30-36 μm long. Basal expanded part of pharynx occupies 52-

60% of the pharyngeal length. Female reproductive system amphidelphic. Prerectum 31-34 μm long. Rectum 32-35 μm or 1.1-1.3 anal body width long. Tail filiform, 12-13 anal body width long.

Male: Sperms spindle shape. Spicules 52-56 μm long. Lateral guiding pieces 10-13 μm long. Tail bluntly rounded.

Habitat and locality: Soil around roots of bean (*Phaseolus sp.*), Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

21. *Thornenema mauritianum* (Williams, 1959) Baqri & Jairajpuri, 1967

1958. *Thornenema viriosum* Williams, *Maurit. Sug. Ind. Res. Inst. Occ. Paper*, 2: 9.

1965. *Thornnema africanum* Andrassy, *Opusc. Zool. Budapest*, 5: 9-23.

Material examined: 12 females.

Measurements: Females: L= 1.02-1.65mm; a= 26-36; b= 5.2-6.0; c= 6.3-7.1; V= 32-43.

Description: Female: Lip region rounded, narrower than body, marked by a slight depression, moderately sclerotized. Odontostyle 13-16 μm long, its aperture 4-5 μm . Odontophore 22-25 μm long. Basal expanded part of pharynx occupies 38-46% of pharyngeal length. Female reproductive system mono-opisthodelphic. Tail filiform with smooth rounded terminus, 143-260 μm or 8-10 anal body-width long.

Male: Not found.

Habitat and locality: Soil around roots of unidentified grasses from Mahadev forest area, Desuri, Ki Naal, Kumbhalgarh Wildlife Sanctuary.

Distribution: Delhi, Rajasthan, West Bengal, Uttar Pradesh, Gujarat.

Family APORCELAIMIDAE Heyns, 1965

22. *Tubixiba parva* Pretorius, Kruger & Heyns, 1987

1987. *Tubixiba parva* Kruger & Heyns. *Koedoe*, 30: 41-47.

Material examined: 4 females.

Measurements: Females: L = 3.12-3.78 mm; a = 45-52; b= 4.0-4.6; c= 89-96; V= ⁷⁻⁸54-55⁷⁻⁸

Description: Female: Lip region distinctly set off by deep constriction. Lips twice as wide as high; separated. Odontostyle 15-17 μm long; its aperture 5-6 μm . Odontophore 26-30 μm long. Guiding ring 9-10 μm from anterior end. Basal expanded part of pharynx occupies 51-54% of neck region. Tail bluntly conoid; 32-34 μm or 0.7-1.1 anal body- widths long.

Male: Not found

Habitat and Locality: Soil around roots of maize (*Zea mays*), Jhalawar, Rajasmand.

Distribution: Gujarat, Rajasthan.

Remark: Widely distributed species in Rajasthan and Gujarat state.

Family QUDSISNEMATIDAE Jairajpuri, 1965

23. *Labronema confusum* (Jana & Baqri, 1983) Andrassy, 1991

1983. *Thonus confusum* Jana & Baqri., *Bull. Zool. Surv. India*; 6: 75-79.

Material examined: 10 females.

Measurements: Females: L= 0.94-1.18mm; a= 29-37; b= 4.1-4.5; c= 43-54; V= 48-54

Description: Female: Lip region setoff by constriction. Odontostyle 13-15 μ m long; its aperture 5-6 μ m. Odontophore, 19-22 μ m long. Guiding ring double. Basal expanded part of oesophagus occupies 37-39% of neck region. Female reproductive system amphidelphic. Tail 23-24 μ m long, obtusely rounded, about 0.8 anal body-width long.

Male: Not found.

Habitat and locality: Soil around roots of bean (*Phaseolus sp.*), Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: West Bengal, Rajasthan, Gujarat.

24. *Labronema digiturum* Vinciguerra, 1984

1984. *Labronema digiturum*, Vinciguerra

Material examined: 2 females.

Measurements: Females: L=1.21-1.31mm; a = 33-34; b =3.7-3.8; c =80.8-81.0; V =56-57.

Description: Female: Lip region setoff from body. Odontostyle 11-12 μ m long; with aperture 30% of odontostyle length. Guiding ring double. Odontophore, rod-like 21-22 μ m long. Basal expanded part of pharynx occupies 40-41% of pharyngeal length. Vulva post equatorial. Reproductive system amphidelphic. Prerectum 30-35 μ m long, 1.4-1.6 anal body-width long. Rectum 1.6-1.7 anal body-width long. Tail 15-17 μ m long or 0.6-0.7 anal body-width long, tail digitate or dome-shaped.

Male: Not found.

Habitat and locality: Soil around roots of maize (*Zea mays*) at Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from India.

Superfamily ACTINOLAIMOIDEA Thorne, 1939

Family ACTINOLAIMIDAE Thorne, 1939

25. *Noactinolaimus attenuates* Khan, Ahmad & Jairajpuri, 1994

1994. *Noactinolaimus attenuates* Khan, Ahmad & Jairajpuri

Material Examined. 4 females.

Measurements: Females: L =2.66-2.81mm; a =59.0-59.1; b = 5.0-5.3; c = 19.6-20.4; c' = 6.0-6.1; V = 47-50.

Description: Female: Lip region rounded, expanded, setoff by a deep constriction. Vestibular ring corrugated. Pharynx armed with four large onchia, each onchium provided

with secondary tooth. Odontostyle 21-22 μm long, with aperture about two fifth of its length. Guiding ring double, located at 15-16 μm from anterior end. Odontophore, rod-like 18-20 μm long. Basal expanded part occupies 37-39% of total pharyngeal length. Reproductive system amphidelphic. Prerectum 68-72 μm long or 4.8-5.1 anal body -width. Tail 130-143 μm long or 6.1-6.5 anal body width, elongate conoid with uniform conoid terminus.

Male: Not found.

Habitat and locality: Soil around roots of maize (*Zea mays*) at Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: Gujarat.

Family CARCHAROLAIMIDAE Thorne, 1967

26. *Carcharolaimus masoodi* Jairajpuri, 1968

1968. *Carcharolaimus masoodi* Jairajpuri., *Proc. Helminth. Soc. Wash*; 35: 96-102.

Material examined: 4 females.

Measurements: Females: L= 1.59-1.60mm; a= 48-49; b= 4.2-4.5; c= 64-72; V= 50-51

Description: Female: Lips large, angular, labial papillae visible, 21-22 μm wide or as wide as about 2/3rd of body-width at the base of oesophagus. Amphids cup-shaped, situated 7-9 μm from anterior end, 6-7 μm wide. Odontostyle 11-13 μm long; aperture 5-6 μm or 45-46% of odontostyle length. Guiding ring 9-11 μm from anterior end. Odontophore 20-24 μm long. Basal expanded part of oesophagus occupies 55-60% of total neck region. Prerectum 35-50 μm long or 1.5-1.6 anal body-width long. Both genital branches are equally developed. Tail rounded conoid, 22-25 μm long or 1.1-1.2 anal body-width long, with two caudal pores on each side.

Male: Not found.

Habitat and Locality: Soil around roots of bean (*Phaseolus sp.*), at Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: Rajasthan, Gujarat, Uttar Pradesh.

Remark: New record from state.

Superfamily LONGIDOROIDEA Thorne, 1935

Family LONGIDORIDAE Thorne, 1935

27. *Paralongidorus major* Verma, 1973

1973. *Paralongidorus major*, Verma. *Zoologischer Anzeiger*, 190: 170-174

Material examined: Females (3)

Measurements: Females: L =5.71-6.35mm; a =114-236; b =9.9-12.3; c =189-204; V =41-43.

Description: Female: Body ventrally arcuate upon fixation. Lip region broadly rounded, setoff from body by a constriction. Amphidial pouch short, cup-like. Odontostyle 119-120

μm long. Odontophore, 62-64 μm long. Guiding ring 31-33mm from anterior end. Female reproductive system amphidelphic. Prerectum 162-169 μm long. Tail 31 μm , with convex-conoid terminus, less than one anal body diameter long.

Male: Not found.

Habitat and locality: Soil around roots of Onion (*Allium cepa*), at Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

Family XIPHINEMATIDAE Dalmasso, 1969

28. *Xiphinema coxi* Tarjan, 1964

1964. *Xiphinema coxi*, Tarjan. *Proc. Helminth. Soc. Wash.*, **31**: 65-76

Material examined: 2 females.

Measurements: Females: L =2.0-2.1mm; a =52.2-53.0; b =6.0-6.2; c =41.7-41.9; V =43-44.

Description: Female: Lip region almost flat at apex or rounded at apex. Odontostyle 100-103 μm long. Fixed guiding ring 81-83 μm from anterior end. Odontophore, 63-65 μm long. Basal expanded part of pharynx 23-27% of pharyngeal length. Vulva transverse. Female reproductive system amphidelphic. Prerectum 52-72 μm or 2-3 anal body -width long. Tail 45-56 μm or about 2.0-2.1 anal body- width long, elongate conoid with subdigitate terminus.

Male: Not found.

Habitat and locality: Soil around roots of bean (*Phaseolus sp.*), at Desuri, Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

29. *Xiphinema raditicola* Goodey, 1936

1936. *Xiphinema raditicola*, Goodey. *J. Helminth*, **14**: 69-72

Material examined: 2 females.

Measurements: Females: L =2.22-2.26mm; a =54.0-54.9; b =5.1-5.4; c =46.3-46.8; V = 40-42

Description: Female: Body 'C' shaped upon fixation. Lip region set off. Odontostyle 102-108 μm long. Fixed guiding ring at 85-89 μm long from anterior end. Basal expanded part of pharynx 25-29% of pharyngeal length. Female reproductive system amphidelphic. Prerectum 62-70 μm long or 2.5-2.8 anal body-width long. Tail 48-52 μm long or 1.8-2.2 anal body-width long with mammillated terminus.

Male: Not found

Habitat and locality: Soil around roots of grass from Mahadev forest area, Desuri Ki Naal, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

Superfamily BELONDOROIDEA Thorne, 1939

Family BELONDIRIDAE Thorne, 1939

30. *Dorylaimellus (Belondorylaimellus) discocephalus* Siddiqi, 1964

1964. *Dorylaimellus discocephalus* Siddiqi. *Labdev. J. Sci. Tech.*, 2: 37-41

Material examined: 10 females.

Measurements: Females: L= 1.03-1.31mm; a= 37-38; b= 4.2-4.5; c= 39-46; V=7⁸50-52⁷⁻⁸

Description: Female: Lip region well set-off Lateral glandular organs conspicuous, 70-72 in number, variable in size and irregular in arrangements. Odontostyle 6-7µm, its aperture 2-3µm; odontophore ,9-11µm long; with typical flanges. Basal expanded part of oesophagus occupies 55-57% of neck region. Female reproductive system amphidelphic. Prerectum 50-60µm or 2-3 anal body width long. Tail 26-28µm, cylindrical with bluntly rounded terminus, about 1.4 anal body -width long.

Male: Not found.

Habitat and Locality: Soil around roots of cotton (*Gossypium* spp.) Mahadev forest area, Kumbhalgarh Wildlife Sanctuary.

Distribution: Rajasthan, Gujarat, West Bengal, Uttar Pradesh etc.

31. *Dorylaimellus (Axodorylaimellus) parvulus* Thorne, 1939

1939. *Dorylaimellus (A.) parvulus* Thorne. *Capita Zool.*, 8: 1-261.

Material examined: 3 females.

Measurements: Females: L = 0.42-0.51mm; a = 23-30; b =2.5-2.6; c = 27-32, V = 56-59.

Description: Female: Lip region set off from adjacent body. Odontostyle 5-6 µm long. Odontophore ,8- 9µm long with flanges. Female reproductive system amphidelphic. Prerectum about 4 anal body -width long. Tail 15-20 µm or 1-1.5 anal body-diameter long.

Male: Not found.

Habitat and locality: Soil around roots of grass from Mahadev forest area at Desuri, Pali, Kumbhalgarh Wildlife Sanctuary.

Superfamily TYLENCHOLAIMOIDEA Filipjev, 1934

Family TYLENCHOLAIMIDAE Filipjev, 1934

32. *Tylencholaimus constrictus* Vinciguerra, 1986

1986. *Tylencholaimus constrictus* Vinciguerra. *Nematol. Medit.*, 14: 107-116.

Material examined: 3 females.

Measurements: Females: L= 0.86-0.90mm; a= 30-31; b= 4.2.-4.5; c= 34-36;V= 62-68.

Description: Female: Body cylindrical tapering gradually towards both extremities. Lip region setoff by a slight constriction, disc-like. Odontostyle 8-9µm long. Odontophore ,10-11µm long. Basal expanded part of oesophagus occupies 47-50% of neck length. Vulva

transverse. Reproductive system prodelphic. Posterior uterine sac present 23-25µm long. Prerectum 2-3 anal body -width long. Tail 24-25µm, hemispherical or rounded about one anal body -width long.

Male: Not found

Habitat and Locality: Soil around roots of Brinjal (*Solanum melongona*) at Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Distribution: Rajasthan, Gujarat.

33. *Tylencholaimus gertii* Kruger, 1965

1965. *Tylencholaimus gertii* Kruger. *Proc. Helm. Soc. Wash.*, **32**: 1.

Material examined: 3 females.

Measurements: Females: L= 0.61-0.62mm; a= 17-21; b= 3.6; c= 22-24; V= 46-47.

Description: Female: Body almost straight upon fixation. Lip region setoff by a deep constriction. Odontostyle 7-8µm long; its aperture one fourth of its length. Odontophore 9-10µm long. Basal expanded part of oesophagus occupies 49-50% of neck length. Female reproductive system opisthodelphic. Anterior uterine sac absent or very small. Prerectum 5-6 anal body -width long. Tail 16-18µm, bluntly convex-conoid with characteristic bowl shaped terminal core about less than one anal body- width long.

Male: Not found

Habitat and Locality: Soil around roots of Onion (*Allium cepa*), Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Distribution: Rajasthan, Gujarat.

Family MYDONOMIDAE Thorne, 1964

34. *Dorylaimoides (Tarjania) longiurus* Siddiqi, 1965

1965. *Dorylaimoides (Tarjania) longiurus* Siddiqi. *Nematologica*, **11**: 100-108.

Material examined: 2 females.

Measurements: Females: L =1.15-1.17mm; a = 64.0-64.1; b = 7.6-7.8; c = 15-16; V =37-39

Description: Female: Body slender tapering toward both extremities. Lip region, continuous, labial papillae indistinct. Odontostyle asymmetrical short, ventral side 5.0-6.0 µm long; odontophore arcuate, 11-12 µm long, slightly sclerotized. Pharyngeal bulb cylindrical about 37-38 µm of pharyngeal length. Vulva transverse; vagina distally sclerotized. Anterior gonad 24 µm long. Posterior gonad normal. Prerectum distinct 56 µm or 6.1 anal body width long. Tail 178-180 µm long, elongate, filiform, about 16.0-16.4 anal body- width long.

Male: Not found.

Habitat and locality: Soil around roots of Brinjal (*Solanum melongona*), Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Distribution: Uttaranchal, Uttar Pradesh.

Remark: New record from the state.

35. *Dorylaimoides (Tarjania) constrictoides* Goesco, Ferris & Ferris, 1976

1976. *Dorylaimoides (Tarjania) constrictoides* Goesco, Ferris & Ferris. *Res. Bull. Agric. Expt.*, **941**: 46pp.

Material examined: 2 females

Measurements: Females: L = 1.10-1.12mm; a = 39.0-39.5; b = 7.5-7.6; c = 8.2-8.5; V = 35-37.

Description: Female: Lip region narrow, slightly set off; lip papillae indistinct. Odontostyle assymetrical, short, ventral side 5-6 μ m long. Odontophore heavily sclerotized, arcuate, 11-12 μ m long. Basal expanded part of pharynx cylindrical 36-37% of pharyngeal length. Vulva transverse. Anterior uterine branch 24 μ m long. Posterior gonad normal. Prerectum distinct 56 μ m or 6.1 anal- body width long. Tail 95-102 μ m long, conoid, terminus rounded, about 7-8 anal body -width long.

Male: Not found.

Habitat and locality: Soil around roots of bean (*Phaseolus sp.*), Thandi Beri at Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

Superfamily NYGOLAIMOIDEA Thorne, 1935

Family NYGOLAIMIDAE Thorne, 1935

36. *Nygolaimus anneckei* Heyns, 1968

1967. *Nygolaimus (Nygolaimus) anneckei* Heyns. *Entomology Memoirs.*, **19**: 1-144.

Material examined: 3 females.

Measurements: Females: L = 1.25-1.34mm; a = 43-44; b = 4.3-4.5; c = 67-69; V = ⁶⁻⁸43-44⁶⁻⁸

Description: Female: Body almost straight upon fixation. Lip region set off by constriction. Tooth deltoid 7-8 μ m somewhat dorsally curved. Basal expanded part of pharynx occupies 48-50% of neck length. Cardiac glands present. Both genital branches equally developed. Prerectum 1.8-1.9 anal body width. Rectum 0.8-0.9 anal body width long. Tail 18-19 μ m dorsally convex-conoid terminus.

Male: Not found

Habitat and locality: Around roots of maize (*Zea mays*), Jhalawar at Rajasmand.

Distribution: Rajasthan, Gujarat, Andaman and Nicobar.

37. *Nygolaimus harishi* Ahmad and Jairajpuri, 1988

1980. *Nygolaimus harishi* Ahmad & Jairajpuri. *Revue Nematol.*, **3**: 41-50

Material examined: 2 females.

Measurements: Females: L = 1.07-1.17 mm; a = 40-42; b = 3.7-3.9; c = 61-66; V = ⁷⁻⁸41-43⁸⁻¹⁰

Description: Female: Body almost straight upon fixation. Cuticle transversely striated, 2-3 μ m thick (thickest at tail). Lip region distinctly setoff from body. Tooth deltoid, 6-7 μ m long. Basal expanded part of pharynx occupies 50-52% of neck length. Cardiac glands rounded. Vulva transverse. Female reproductive system amphidelphic. Anterior genital

branch reduced. Prerectum 1.5-1.6 anal body width. Tail 16-18 μ m straight-conoid with rounded terminus, about anal body width long.

Male: Not found.

Habitat and locality: Soil around roots of Onion (*Allium cepa*), Thandi Beri at Kumbhalgarh Wildlife Sanctuary.

Distribution: Rajasthan, Haryana, Punjab, Gujarat, Himachal Pradesh.

ORDER MONONCHIDA JAIRAJPURI, 1969
Superfamily MONONCHOIDEA Chitwood, 1937
Family MONOCHIDAE Filipjev, 1934

38. *Coomansus icarus* Jairajpuri & Khan, 1981

1981. *Coomansus icarus*, Jairajpuri & Khan. *Predatory nematodes (Monochida)*. New Delhi, India, Associate Publishing, 131pp.

Material examined: 2 females.

Measurements: Females: L =2.41-2.48mm; a =31-33; b =3.9-4.1; c =15-17; V =60-62.

Description: Female: Body slightly ventrally arcuate upon fixation. Lip region slightly expanded from body adjacent body contour. Amphidial apertures 3-4 μ m wide located at 14-16 μ m from anterior end. Dorsal tooth medium sized, situated in anterior half of buccal cavity. Buccal cavity 21-32/10-16 μ m tapering at base. Subventral walls without denticles. Female reproductive system amphidelphic. Tail conoid, rounded at tip, 3-4 anal body diameter long. Caudal glands rudimentary.

Male: Not found.

Habitat and locality: Soil around roots of Brinjal (*Solanum melongona*) at Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

Family MYLONCHULIDAE Jairajpuri, 1969
39. *Mylonchulus amurus* Khan & Jairajpuri, 1979

1979. *Mylonchulus amurus* Khan & Jairajpuri. *Nematologica*, **25**: 406-418

Material examined: 2 females.

Measurements: Females: L =0.82-1.12mm; a =16-22; b =2.6-3.1; c =27-40; V =57-62.

Description: Female: Body robust, ventrally arcuate upon fixation. Lip region 26-30 μ m wide. Amphidial apertures 3-4 μ m wide, located at 9-12 μ m from anterior end. Buccal cavity 22-25 μ m long, 11-15 μ m wide. Dorsal tooth of medium sized, located at 70-78% of the length of buccal cavity from base. Submedian teeth absent. Subventral walls bearing 5 transverse rows of denticles. Female reproductive system amphidelphic. Uterus with eggs. Tail conoid with clavate terminus, 1.2-1.4 anal body diameter long. Caudal glands grouped. Spinneret terminal.

Male: Not found.

Habitat and locality: Soil around roots of millet (*Pennisetum americanum*) at Ranakpur, Kumbhalgarh Wildlife Sanctuary.

Remark: New record from the state.

40. *Mylonchulus brachyuris* (Bütschli, 1873) Altherr, 1953

1873. *Mylonchulus brachyuris*, Bütschli. *Novo Acta Acad. Nat. Curiso.*, **36**: 1-124

1953. *Mylonchulus brachyuris* Altherr. *Bull. Soc. Vaudoise Sc. Nat.*, **65**: 429-460

Material examined: 2 females.

Measurements: Females: L =0.82-1.21mm; a =23-27; b =2.8-3.5; c =30-45; V =59-67.

Description: Female: Body ventrally arcuate upon fixation. Lip region 23-24 µm wide. Amphidial apertures 3-4µm wide, located at 8-9 µm from anterior end and 22-24 µm from base of buccal cavity. Buccal cavity 21-25µm long, 12-14µm wide. Dorsal tooth massive, 70-75% of the length of buccal cavity from base. Subventral walls bearing 6 transverse rows of denticles. Submedian teeth present. Female reproductive system amphidelphic. Uterus filled with eggs. Tail conoid with blunt terminus. Caudal glands grouped. Spinneret subterminal.

Male: Not found.

Habitat and locality: Soil around roots of bean (*Phaseolus* sp.) at Malgad, Kumbhalgarh Wildlife Sanctuary.

41. *Mylonchulus dentatus* Jairajpuri, 1970

1970. *Mylonchulus dentatus* Jairajpuri. *Nematologica*, **16**: 434-456.

Material examined: 2 females.

Measurements: Females: L =1.5-1.8mm; a =29-41; b =3.5-4.1; c =30-42; V =61-67.

Description: Female: Body ventrally arcuate upon fixation. Lip region 27-32 µm wide. Amphidial apertures 5-6µm wide, located at 8-12 µm from anterior end and 20-23 µm from base of buccal cavity. Buccal cavity 23-25 µm long, 14-20µm wide. Dorsal tooth massive, 78-80% of the length of buccal cavity from base. Subventral walls bearing multiple transverse rows of denticles, not arranged in definite rows. Submedian teeth prominent. Female reproductive system amphidelphic. Tail conoid with blunt terminus. Caudal glands grouped. Spinneret terminal.

Male: Not found.

Habitat and locality: Soil around roots of Onion (*Allium cepa*) at Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

42. *Mylonchulus hawaiiensis* (Cassidy, 1931) Andrassy, 1958

1931. *Mylonchulus hawaiiensis* Cassidy. *Hawaii Planter's Rec.*, **35**: 305-339.

1958. *Mylonchulus hawaiiensis* Andrassy. *Ann. Hist. Nat. Mus. Nat. Hungar.*, **50**: 151-171.

Material examined: 2 females.

Measurements: Females: L =0.81-1.02mm; a =21-28; b =2.9-3.8; c =26-34; V =53-58.

Description: Female: Body ventrally arcuate upon fixation. Lip region 21-24 μ m wide. Amphidial apertures 3-4 μ m wide, located at 13-14 μ m from anterior end. Buccal cavity 17-26 μ m/10-15 μ m. Dorsal tooth large, located in anterior half of buccal cavity. Subventral walls bearing 6-7 transverse rows of denticles. Submedian teeth present. Female reproductive system amphidelphic. Tail tip slightly clavate, about one anal body diameter long. Caudal glands tandem. Spinneret terminal.

Male: Not found.

Habitat and locality: Soil around roots of Brinjal (*Solanum melongona*), Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Distribution: Gujarat.

43. *Mylonchulus lacustris* (N.A. Cobb in M.V. Cobb, 1915) Andr ssy, 1958

1958. *Mylonchulus lacustris* Andr ssy. *Ann. Hist. Nat. Mus. Nat. Hungar.* **50**: 151-171

Material examined: 1 female.

Measurements: Females: L =1.09mm; a =28; b =3.8; c =26; V =59.

Description: Female: Body robust, ventrally arcuate upon fixation. Lip region 26 μ m wide. Amphidial aperture 5 μ m wide, located at 12 μ m from anterior end. Buccal cavity 25 μ m long, 15 μ m wide. Dorsal tooth of medium size, located at 73% of the length of buccal cavity from base. Subventral walls bearing 7 transverse rows of denticles. Excretory system not present. Female reproductive system amphidelphic. Tail conoid, arcuate or more than one anal body diameter long. Caudal glands tandem. Spinneret terminal.

Male: Not found.

Habitat and locality: Around roots of unidentified grasses at Ranakpur, Kumbhalgarh Wildlife Sanctuary.

44. *Mylonchulus minor* (Cobb, 1893) Andr ssy, 1958

1958. *Mylonchulus minor* Andr ssy. *Ann. Hist. Nat. Mus. Nat. Hungar.* **50**: 151-171

Material examined: 3 females.

Measurements: Females: L =0.93-1.1mm; a =17-28; b =3.1-3.6; c =31-46; V =53-66.

Description: Female: Body robust, ventrally arcuate upon fixation. Lip region expanded from adjacent body contour. Amphidial apertures 2-3 μ m wide, located at 8-10 μ m from anterior end. Buccal cavity 25-27 μ m long, 15-17 μ m wide. Dorsal tooth of medium size, located at 69-72% of the length of buccal cavity from base. Subventral walls bearing 6 transverse rows of denticles. Female reproductive system amphidelphic. Tail arcuate, conoid. Caudal glands tandem. Spinneret terminal.

Male: Not found.

Habitat and locality: Soil around roots of Banana (*Musa paradisiaca*) at Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Order RHABDITIDA Örley, 1880 (Chitwood, 1933)

Family RHABDITIDAE Örley, 1880

45. *Mesorhabditis miotki* (Sudhaus, 1978) Andrassy, 1983

1978. *Mesorhabditis miotki* Sudhaus, *Zool. Jahrb. Syst.*, **105**: 399-461

1983. *Mesorhabditis miotki* Andrassy,

Material examined: 5 females.

Measurements: Females: L =0.51-0.72mm; a =14-20; b = 4.3-5.7; c =6.0-8.3; V = 72-78.

Description: Females: Body medium-sized; almost straight upon fixation. Cuticle 1.0-1.5 µm thick, finely annulated. Lip region set off from body contour. Lips six, globular, separate, each with setose papilla. Cheilostom rounded. Stoma prismatic, cuticularised, 18-23 µm long. Metastegostomal swelling with denticles. Body at posterior end of pharynx about 2.5 times broader than lip diameter. Excretory pore located at 70-91% of pharyngeal length. Females mostly with eggs of 34-52 x 15-19 µm dimension. Tail 1.2-1.6 times longer than vulva to anus distance.

Male: Not found.

Habitat and locality: Moist soil from bank of pond at Kumbhalgarh Wildlife Sanctuary.

Distribution: Delhi, Uttar Pradesh.

Family CEPHALOBIDAE Filipjev, 1934

46. *Acrobeles dimorphus* Heyns & Hogewind, 1969

1969. *Acrobeles dimorphus* Heyns & Hogewind, *Phytophylactica*, **1**: 19-22.

Material examined: 3 females.

Measurements: Females: L =0.79-0.89mm; a =16-24; b =3.7-4.3; c =7.9-9.0; V =52-56.

Description: Females: Body medium sized, tapering towards both extremities, ventrally curved upon fixation. Cuticle double, thick, annulated, annuli 3.0-4.0 µm. Lip region continuous to body contour. Labial probolae long, bifurcated. Labial and cephalic probolae each with 6-7 times. Stoma cephaloboid. Pharyngeal corpus 3 times longer than isthmus length. Female reproductive system cephaloboid. Ovary reflexed, sometime show double flexure posterior to vulva. Post uterine sac 1.5-2.0 corresponding body diameters long. Phasmids located in middle of tail. Tail 5-6 anal body diameter long.

Male: Not found.

Habitat and locality: Soil around roots of grasses at Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Distribution: Uttar Pradesh, Uttranchal.

47. *Chiloplacus scelerovaginatus* Heyns & Hogewind, 1969

1969. *Chiloplacus scelerovaginatus* Heyns & Hogewind, *Phytophylactica*, **1**: 19-22.

Material examined: 3 females & 2 males.

Measurements: Females: L =0.53-0.71mm; a =15.8-22; b =3.3-4.5; c =14-20; V =59-67.

Males: L =0.49-0.68mm; a =15-20; b = 3.1-4.3; c =14-19

Description: Females: Body ventrally curved upon fixation. Cuticle annulated, annuli 1.0-1.5 μ m. Lip region continuous to body contour. Labial probolae slightly concave 3-4 μ m long. Stoma cephaloboid, with distinct rhabdions. Pharynx cylindrical, with basal bulb. Nerve ring encircles base of corpus. Female reproductive system cephaloboid. Ovary reflexed. Spermatheca distinct. Vagina , anteriorly directed. Tail 1.7-2.0 anal body diameter long, with 12-16 ventral annuli.

Male: Similar to female in general morphology, except reproductive system and more ventrally curved body. Testis single. Spicules cephalated, 30-37 μ m long, ventrally curved. Gubernaculum 2-23 μ m long.

Habitat and locality: Around the roots of Onion (*Allium cepa*) at Thandi beri, Kumbhalgarh Wildlife Sanctuary.

48. *Chiloplacus quadricarinatus* (Thorne, 1925) Thorne, 1937

1925. *Chiloplacus quadricarinatus* Thorne. *Trans. Amer. Microsc. Soc.*, **44**: 172-210

1937. *Chiloplacus quadricarinatus* Thorne. *Proc. Helminthol. Soc. Wash.*, **4**: 1-16

Material examined: 2 females.

Measurements: Females: L =0.78-0.95mm; a =21-23; b =4.2-4.5; c =18-20; V =65-67.

Description: Female: Body, ventrally curved upon fixation. Cuticle annulated, annuli 2 μ m apart. Lateral fields marked with four lateral lines. Lip region continuous to body contour. Labial probolae slightly concave 2-3 μ m long. Stoma cephaloboid, with distinct rhabdions. Pharynx cylindrical, with basal bulb. Nerve ring encircles mid isthmus. Female reproductive system cephaloboid. Ovary reflexed. Spermatheca distinct. Vagina one third of corresponding body diameter long, anteriorly directed. Body posterior to vulva markedly narrow. Tail 2 anal body diameter long.

Male: Not found.

Habitat and locality: Soil around roots of bean (*Phaseolus sp.*) at Rajasmand, Kumbhalgarh Wildlife Sanctuary.

Distribution: Uttar Pradesh.

49. *Zeldia punctata* (Thorne, 1925) Thorne, 1937

1925. *Zeldia punctata* Thorne. *Trans. Amer. Microsc. Soc.*, **44**: 172-210

1937. *Zeldia punctata* Thorne. *Proc. Helminthol. Soc. Wash.*, **4**: 1-16

Material examined: 3 females, 3males.

Measurements: Females: L= 0.68-0.89mm; a= 15-26; b= 3.2-4.7; c= 13-22; V = 63-67.

Males: L =.86-0.88mm; a =22-30; b =3.8-4.3; c =15-18.

Description: Female: Body straight upon fixation. Cuticle annulated. Lip region continuous with body contour. Labial probolae slightly concave. Cephalic probolae flap-like. Cephalic axils narrow, dentate, W-shape. Stoma with distinct rhabdions. Pharynx cylindrical with ovoid basal bulb. Nerve ring encircles isthmus. Cardia small, 3 μ m long. Intestine with wide lumen. Female reproductive system typical cephaloboid. Tail 1.9-3.0 anal body diameter long. Phasmid in anterior half of tail.

Male: Similar to female in morphology except reproductive system. Spicules 28-33 μ m and gubernaculums 12-19 μ m long.

Habitat and locality: Soil around roots of various grasses at Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Distribution: Uttranchal, Uttar Pradesh.

Order ARAEOLAIMIDA De Coninck & Schuurmans Stekhoven, 1933

Family RHABDOLAIMIDAE Chitwood, 1951

50. *Rhabdolaimus terrestris* De Man, 1880

1880. *Rhabdolaimus terrestris* De Man. *Tijdschr. Nederl. Dierk. Ver.*, 5: 1-104.

Material examined: 3 females, 2 males.

Measurements: Females: L= 0.46-0.51mm; a= 26-28; b= 4.4-5.3; c= 3.4-4.6; V= 42-47.

Description: Female: Body straight to slightly curved ventrally upon fixation. Cuticle thin, finely striated. Lip region anteriorly flatten, continuous with body contour. Anterior stoma with a small dorsal tooth. Stoma 26-30 μ m long. Pharynx a muscular tube, with rounded basal bulb. Cardia small. Intestine with wide lumen. Female reproductive system amphidelphic. Ovaries reflexed. Tail gradually narrowing, about 10 anal body diameter long, with spinneret.

Male: Not found.

Habitat and locality: Soil around roots of Onion (*Allium cepa*), Thandi Beri, Kumbhalgarh Wildlife Sanctuary.

Distribution: Uttar Pradesh.

SUMMARY

Altogether 50 species are being reported from Kumbhalgarh wildlife Sanctuary. Out of these two species are new records from India i.e *Neothada tatra* and *Labronema digiturum*, where as 14 species as new records from the state.

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INSECTA : ODONATA

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INTRODUCTION

Odonata (Damsel & Dragonflies) includes some of the most ancient and beautiful insects ever roamed the earth, as well as some of the largest flying invertebrates ever to have lived. For some 270 million years, odonates with their four long independent membranous wings and long bodies have remained unchanged in their essential form and are dominant invertebrate predators in ecosystem. They were the first creatures to truly command the air of this earth. They are amphibious hemi-metabolous insects having the aquatic egg and larval (nymph) stages, while the adults are terrestrial, both larvae and adults are predator. They are some of the best hunters in the insect world. Their powerful acrobatic flight enables them to catch many small organisms. Now a days they are extensively used in controlling causative agents of malaria and filarial, and of insect pests in different ecosystems on the global basis (Kumar, 2002).

Approximately 6,000 species and subspecies belonging to 630 genera in 28 families of Odonata are known from all over the world (Tsuda, 1991), out of which 499 species and subspecies of Odonata under 139 genera belonging to 17 families are reported from India (Prasad and Varshney, 1995). They are among the dominant invertebrate predators in ecosystems. Being predators both at larval and adult stages, they play a significant role in the food chain of forest ecosystem (Vashishth *et al.*, 2002). In addition to this, their value as indicators of quality of the biotope is being increasingly recognized (Subramanian, 2002). The Perusal of literature reveals that no consolidated account is available on the Odonata fauna of Rajasthan, though a few workers contributed *i.e.* Agarwal (1957) recorded 15 species from Pilani, Rajasthan, Bose and Mitra (1976) recorded 13 species from Rajasthan, Prasad and Thakur (1981), Thakur (1985) and Tyagi and Miller (1991) recorded 23 species from Rajasthan, Prasad (1996) recorded 31 species from Thar Desert of Gujarat and Rajasthan and Prasad (2004) recorded 11 species from Desert National Park, Rajasthan.

The present study is based on the collection of Odonata collected from Kumbhalgarh Wildlife Sanctuary, Rajasthan by the survey parties of Desert Regional Centre, Zoological Survey of India, Jodhpur. Altogether 17 species belonging to 13 genera under 4 families and 2 suborders of order Odonata reported from Kumbhalgarh Wildlife Sanctuary, Rajasthan.

MATERIALS AND METHODS

A detailed study and extensive collection of odonates were made by using aerial sweep net in Kumbhalgarh Wildlife Sanctuary, Rajasthan during 2008. The collected individuals

in the field were transferred into insect collection paper packs and were brought to the Desert Regional Centre, Zoological Survey of India, Jodhpur laboratory, where these were properly stretched, pinned, oven dried for 72 hours at 60°C and preserved in collection boxes. In the field observations and in the laboratory, specimens were photographed prior to studies, by using a Nikon D70s and Sony-D300-SLR digital cameras. Identification of adult individuals was carried out using identification keys provided by Fraser (1933, 1934 & 1936).

SYSTEMATIC ACCOUNT

Order ODONATA

Sub order ZYGOPTERA

Family COENAGRIONIDAE

1. *Ceriagrion coromandelianum* (Fabricius)

1934. *Ictinus rapax*: Fraser, *Fauna Brit. India Odon.*, 2: 373-376.

1798. *Agrion coromandelianum* Fabricius, *Ent. Syst. (suppl.)*: 287.

1876. *Ceriagrion coromandelianum*: Selys, *Bull. Acad. Belg.*, 42(2): 528.

1933. *Ceriagrion coromandelianum*: Fraser, *Fauna Brit. India Odon.*, 1: 315-316.

1967. *Ceriagrion coromandelianum*: Asahina, *Jap. J. Zool.*, 15: 279.

Material examined: 2 males, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 28-30 mm; Hindwing 18-20 mm. *Head*: Labium pale yellow; labrum, clypeus, genae, bases of mandibles and frons bright citron-yellow; basal three joints of antennae pale yellow. *Prothorax* and *thorax* uniformly olive-green; laterally citron yellow. *Legs* citron-yellow, with short black spines. *Wings* hyaline, pterostigma golden yellow, framed in brown nervures covering one cell; 11 to 12 postnodal nervures in forewings, 10 to 11 in the hind. *Abdomen* uniformly citron-yellow. *Anal appendages* citron-yellow, the inferiors tipped with black; superiors about half the length of segment 10.

Distribution: *India*: Throughout India. *Elsewhere*: Sri Lanka, Myanmar, Malaysia and China.

2. *Pseudagrion rubriceps* Selys

1876. *Pseudagrion rubriceps* Selys, *Bull. Acad. Belg.*, 42(2): 510.

1933. *Pseudagrion rubriceps*: Fraser, *Fauna Brit. India Odon.*, 1: 296-299.

1954. *Pseudagrion rubriceps*: Lieftinck, , *Treubia*, 22 (suppl.): 60.

1983. *Pseudagrion rubriceps*: Mitra, *Ent.mon. Mag.*, 119: 29.

Material examined: 1 male, Thandi Beri, 23.xii.2008, Reg. No. VI/4360, Coll. G. Sharma & party.

Diagnostic characters: Male– Abdomen 29 mm; Hindwing 18-20 mm. *Head:* Labium citron-yellow; labrum, bases of mandibles, genae, clypeus, and frons bright orange; eyes olivaceous green above, changing rapidly to bright rich orange and then golden yellow, and faintly bluish beneath. *Prothorax* black, having pale blue markings. *Thorax* olivaceous green, with a golden tinge as far back as the first lateral suture, the sides azure blue. *Legs* yellow, femora black on the outer and posterior surface; spines 4 or 5 on femora, short, black. *Wings* hyaline; pterostigma strongly braced, covering less than one cell, reddish brown, diamond-shaped; 10 postnodal nervures in forewings, 9 in the hind. *Abdomen* marked broadly with black on dorsum; segments 1 and 2 olivaceous green above, azure blue laterally; segment 2 with a goblet-shaped marking on dorsum; segments 3 to 7 black, bronzed green on dorsum, pale greenish laterally; segments 9 and 10 azure blue, unmarked. *Anal appendages* black, inferiors one-fourth shorter than superiors.

Distribution: *India:* Throughout India. *Elsewhere:* Myanmar, Malaysia, China and Formosa.

3. *Ischnura aurora aurora* (Brauer)

1858. *Agrion delicatum* Hagen, *Verh. zool. bot. Ges. Wien.*, **8**: 479.

1933. *Ischnura delicata* Fraser, *Fauna Brit. India Odon.*, **1**: 360-362.

1991. *Ischnura aurora aurora*: Tsuda, *A distributional list of World Odonata*, p. 34.

Material examined: 1 male, Rankpur, 25.xii.2008, Reg. No. VI/4375, Coll. G. Sharma & party.

Diagnostic characters: Male– Abdomen 16-20 mm; Hindwing 10-12 mm. *Head:* Labium white; labrum citron-yellow, with the base narrowly bordered with black; anteclypeus pale olive-green; postclypeus bronzed black; bases of mandibles, genae, frons, and the three basal joints of antennae pale grass-green; vertex bronzed black; eyes a beautiful olive-green, dark olive above. *Prothorax* bronzed black on dorsum, the sides and anterior lobe blue. *Thorax* bronzed black on dorsum, marked with narrow grass-green antehumeral strips. *Legs* pale citron-yellow; anterior and middle pairs of femora with a short black strip on the outer side of the distal half. *Wings* hyaline; pterostigma differing in the fore and hindwings, that of forewings slightly broader than long, kite-shaped, rose-red for its proximal half, hyaline for the distal, inner and posterior borders thick, black; in the hindwing much smaller, about half the size, uniform pale grey. *Abdomen* citron-yellow, except segments 8 to 10, which are azure blue. *Anal appendages* pale ochreous, tipped with black; superiors about as long as segment 10, triangular as seen both from above and the side; inferiors broad at extreme base, the apex turned slightly up and tipped with black; of almost equal length to the superiors.

Distribution: *India:* Throughout India. *Elsewhere:* Afghanistan, Bangladesh, China, Iran, Japan, Micronesia, Pakistan, Thailand, Taiwan, Sri Lanka, Myanmar, Malaysia, Indonesia (Borneo), New Guinea, Australia, Philippines and Samoa.

Sub order ANISOPTERA

Family GOMPHIDAE

4. *Ictinogomphus rapax* (Rambur)

1842. *Diastatomma rapax* Rambur, *Ins. Neurop.*: 169.

1854. *Ictinus rapax*: Selys, *Bull. Acad. Belg.*, **21**(2): 90.

1983. *Ictinogomphus rapax*: Mitra, *Ent. Mon. Mag.*, **119**: 30.

Material examined: 3 males, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male– Abdomen 52 mm; Hindwing 40 mm. *Head*: Eyes bluish-grey; labium yellow, bordered with brownish; labrum yellow, with a heavy black border and a median prolongation of black from the base which may or may not meet the black anterior border; face and frons greenish-yellow. *Prothorax* black, marked with yellow. *Thorax* black, marked with yellow or greenish-yellow. *Wings* clear or when fully mature, slightly enfumed. Pterostigma black, braced, long, covering 5 to 6 cells; discoidal cell of forewings with 4 cells, of hindwings with 3 cells; subtrigone of forewing with 2 cells, of hindwing with 1 cell; membrane whitish; 3 cubital cells in forewing, 2 in a hindwing; 5 cells in anal triangle. *Legs* black, coxae and trochanters yellow; hind femora extending just beyond hind margin of thorax, furnished with an inner and outer row of spines. *Abdomen* black, marked with bright yellow. *Anal appendages* black, as long as the two last segments, cylindrical and tapering. Inferior much shorter, deeply bifid, black.

Distribution: *India*: Throughout India. *Elsewhere*: Sri Lanka, Myanmar and Malaysia.

Family : AESHNIDAE

5. *Anax parthenope parthenope* (Selys)

1839. *Aeshna* (*Anax*) *parthenope* Selys, *Bull. Acad. Belg.*, **6**(2): 389.

1991. *Anax parthenope parthenope*: Tsuda, *A distributional list of World Odonata*. p. 120.

Material examined: 1 male, Thandi Beri, 23.xii.2008, Reg. No. VI/4360, Coll. G. Sharma & party.

Diagnostic characters: Male– Abdomen 47-49mm; Anal appendages 5 mm; Hindwing 46-50 mm. *Head*: Labium and labrum golden-yellow; face and frons pale olivaceous to greenish-yellow; eyes bluish; occipit black, with a point of yellow posteriorly bordered with black behind. *Prothorax* blackish-brown, yellow laterally; *thorax* pale olivaceous-brown with sutures finely dark brown. *Legs* black, femora reddish-brown. *Wings* hyaline, enfumed with brown or yellowish brown from apices nearly to discoidal triangles; pterostigma reddish-brown, long and narrow, covering 3 cells; membrane blackish; discoidal triangle of forewing longer and narrower than that of hind, made up of 6 cells, but only 5 in the hind; 4 or 5 cubital nervures in all wings; 13 or 14 cells in anal loop. *Abdomen*: Segment 1 olivaceous-brown, with a small dark brown spot on each

side; segment 2 turquoise-blue; segments 4 to 9 with jugal and accessory lateral sutures or ridges finely black; segment 10 black, with its sides and apical border narrowly bluish-grey. *Anal appendages*: inferior appendages very short, very broad, less than one-fourth the length of superiors, paler than superiors, which are reddish-brown; about 12 robust spines at each outer corner of inferior.

Distribution: India: Chandigarh, Himachal Pradesh, Jammu & Kashmir, Uttar Pradesh and Western Ghats. *Elsewhere*: South Europe and North Africa.

Family LIBELLULIDAE

6. *Acisoma panorpoides panorpoides* Rambur

1842. *Acisoma panorpoides* Rambur, *Ins. Neurop.* p. 28.

1936. *Acisoma panorpoides panorpoides*: Fraser, *Fauna Brit. India Odon.*, 3: 330-331.

Material examined: 2 males, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 15-18 mm; Hindwing 16-21 mm. *Head*: Labium creamy-white; labrum pale yellow; face and frons palest azure-blue; eyes blue, behind glossy black spotted with yellow. *Prothorax* black, with the anterior border of anterior lobe, mid-dorsum of middle lobe, and posterior border and mid-dorsum of posterior lobe pale yellow. *Thorax* azure-blue marbled with black; sutures all narrowly black. *Legs* black, femora striped with yellow. *Wings* hyaline; distal antenodal complete; discoidal field with 2 rows of cells; pterostigma pale yellow between black nervures, covering rather more than 1 cell; membrane brownish. *Abdomen* azure-blue, marked with black. *Anal appendages*: superiors very long, nearly straight, acute at apex and spined beneath nearly to base, white or yellow above, black beneath; inferior very broadly triangular, white at middle, bordered with black.

Distribution: India: Arunachal Pradesh, Assam, Bihar, Chandigarh, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, South India, Uttar Pradesh and west Bengal. *Elsewhere*: Sri Lanka to Philippines and China, Indonesia (Java and Sumatra) and the Celebes.

7. *Brachythemis contaminata* (Fabricius)

1793. *Libellula contaminata* Fabricius, *Ent. Syst.*, 2: 382.

1868. *Brachythemis contaminata*: Brauer, *Verh. Zool.-bot. Ges. Wien.*, 18: 736.

1936. *Brachythemis contaminata*: Fraser, *Fauna Brit. India Odon.*, 3: 365-366.

Material examined: 4 males, Rankpur, 25.xii.2008, Reg. No. VI/4375, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 18-21 mm; Hindwing 20-23 mm. *Head*: Labium pale ochreous; labrum reddish-ochreous; eyes violaceous-brown above, pale olivaceous laterally and beneath; occipit brown. *Prothorax* ochreous, with dark reddish-brown strips traversing anterior and posterior borders of middle lobe; *thorax* olivaceous-brown,

ferruginous, dorsally marked with an obscure reddish-brown humeral strip and two obscure brownish strips on each side. *Legs* ochreous, femora dark brown or blackish on extensor surface. *Wings* hyaline, reticulation reddish, with a broad bright orange fascia extending from base to within 2 to 3 cells of pterostigma in forewing and as far as that organ in the hind; pterostigma rust-red, posterior border brown; membrane pale reddish-brown or carneous. *Abdomen* reddish-ochreous, marked with obscure dorsal and subdorsal brown strips; segments 8 and 9 often black on mid-dorsum. *Anal appendages* ferruginous.

Distribution: India: Throughout India. *Elsewhere:* Bangladesh, Hong Kong, Japan, Malaysia, Nepal, Singapore, Taiwan, Thailand, Sri Lanka, Myanmar, China, Philippines and Indonesia (Java and Sumatra).

8. *Bradinopyga geminata* (Rambur)

1842. *Libellula geminata* Rambur, *Ins. Nevrop.* p. 90.

1936. *Bradinopyga geminata*: Fraser, *Fauna Brit. India Odon.*, 3: 349-350.

Material examined: 1 male, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 26-29 mm; Hindwing 33-36 mm. *Head:* Labium pale yellowish-white; labrum palest yellow or dark brown; eyes brown above, pale greyish beneath; occipit brown. *Prothorax* and *thorax* dirty pale yellow. *Legs* greyish. *Wings* hyaline, pterostigma black at centre, pure white at distal and proximal ends. *Abdomen* black marbled with yellow. *Anal appendages* pale creamy white.

Distribution: India: Bihar, Central India, Haryana, Orissa, Peninsular India, Rajasthan, Uttar Pradesh and West Bengal.

9. *Crocothemis servilia servilia* (Drury)

1770. *Libellula servilia* Drury, *Ill. Ex. Ins.*, 1: 112.

1936. *Crocothemis servilia servilia*: Fraser, *Fauna Brit. India Odon.*, 3: 345-347.

Material examined: 3 males, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 24-35 mm; Hindwing 27-38 mm. *Head:* Labium ferruginous; labrum blood-red bordered diffusely with darker red; anteclypeus pale red, rest of face and frons bright blood-red; occipit bright orange; eyes blood-red above, purple laterally, paler below. *Prothorax.* ferruginous, with a spot on middle of anterior lobe and borders of posterior lobe brighter rust-red; middle lobe ridged transversely, this ridge bearing a ruff of stiff reddish hairs. *Thorax* bright ferruginous, often blood-red on dorsum. *Legs* ochreous. *Wings* hyaline, bases of all marked with rich amber-yellow to as far distal as the cubital nervure in forewing and to first antenodal nervure nearly to *arc* and including the tornal angle in hindwing; apices of wings lined narrowly with pale brown in old specimens; pterostigma dark ochreous between blackish nervures; membrane dark reddish-brown. *Abdomen* blood-red, segments 8 and 9 with mid-dorsal carina blackish. *Anal appendages* blood-red.

Distribution: India: Throughout India. *Elsewhere*: Mesopotamia, Sri Lanka, Myanmar, South Asia to Japan, Philippines, Australia and Sundaic Archipelago.

10. *Diplacodes trivialis* (Rambur)

1842. *Libellula trivialis* Rambur, *Ins. Neurop.* p. 115.

1911. *Diplacodes trivialis*: Ris, *Cat. Coll. Selys Lib.*, 12: 462.

1936. *Diplacodes trivialis*: Fraser, *Fauna Brit. India Odon.*, 3: 336-338.

Material examined: 1 male, Rankpur, 25.xii.2008, Reg. No. VI/4375, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 19-22 mm; Hindwing 22-23 mm. *Head*: Labium, labrum and bases of mandibles creamy-yellow; face, frons and vesicle palest azure-blue; eyes reddish-brown above, pale bluish or yellowish below. *Prothorax* pale yellow to black; *thorax* greenish yellow. *Legs* greenish yellow or black. *Wings* hyaline, minute yellow point in cubital space of hindwing. *Abdomen* with segments 1 to 3 greenish yellow. *Anal appendages* bright yellow.

Distribution: India: Throughout India. *Elsewhere*: Sri Lanka, Myanmar and South Asia to Formosa and the Philippines.

11. *Orthetrum glaucum* (Brauer)

1865. *Libellula glauca* Brauer, *Verh. zool.-bot. Ges. Wien.*, 15: 1012.

1890. *Orthetrum glaucum*: Kirby, *Syn. Cat. Neur. Odon.* p. 39.

1936. *Orthetrum glaucum*: Fraser, *Fauna Brit. India Odon.*, 3: 307-309.

Material examined: 1 male, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 29-35 mm; Hindwing 33-40 mm. *Head*: Labium, labrum and face, including whole of frons, uniform glossy black; eyes dark green; capped with reddish-brown. *Prothorax* bright yellow to dark brown marked with yellow; *thorax* pruinose dark dull blue or black with a very thin pruinescence. *Legs* black, femora paler on extensor surface. *Wings* hyaline, with extreme base tinted with dark amber-yellow; pterostigma dark ochreous between thick black nervures; covering 2 cells; membrane black. *Abdomen* ventro-dorsally dilated at segments 1 to 3, then very slim and of even width to the end, pruinose pale dirty blue from segment 1 to apical end of segment 8, black for the remainder. *Anal appendages* black.

Distribution: India: Throughout India. *Elsewhere*: Afghanistan, Annam, Bangladesh, Hong Kong, Indo-China, Japan, Laos, Myanmar, Malaysia, Nepal, Singapore, Sri Lanka, Taiwan, Thailand, Tibet, Vietnam, Yunnan and Philippines.

12. *Orthetrum pruinoseum neglectum* (Rambur)

1842. *Libellula neglecta* Rambur, *Ins. Neurop.*: 86.

1909. *Orthetrum pruinoseum neglectum*: Ris, *Cat. Coll. Selys fasc.*, 9: 181.

1936. *Orthetrum pruinosum neglectum*: Fraser, *Fauna Brit. India Odon.*, **3**: 311-312.

Material examined: 2 males, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male– Abdomen 28-31 mm; Hindwing 32-36 mm. *Head*: Labium, labrum, and face ochreous to pale reddish-brown; frons anteriorly and above dark brown; vesicle and occipit dark reddish-brown; eyes blue-black above, bluish-grey below. *Prothorax* and *thorax* reddish-brown to dull purple according to amount of pruinescence present. *Legs* black, reddish-brown at base of femora. *Wings* hyaline, enfumed pale brown especially towards apices in old adults, and with a reddish-brown basal marking extending distalwards in hindwing to first antenodal nervure; only a vestige of this in forewing; pterostigma reddish-brown to black, covering 2 cells; membrane black. *Abdomen* bright vermilion-red in subadults, purplish-red in adults, due to pruinescence. *Anal appendages* red.

Distribution: India: Throughout India. *Elsewhere*: Sri Lanka, Myanmar, Tibet and China.

13. *Orthetrum sabina sabina* (Drury)

1770. *Libellula sabina* Drury, *Ill, Exot. Ins.*, **1**: 114-115.

1889. *Orthetrum sabina*: Kirby, *Trans. Zool. Soc. Lond.*, **12**: 302.

1936. *Orthetrum sabina sabina*: Fraser, *Fauna Brit. India Odon.*, **3**: 300-302.

Material examined: 3 males, Rankpur, 25.xii.2008, Reg. No. VI/4375, Coll. G. Sharma & party.

Diagnostic characters: Male– Abdomen 30-36 mm; Hindwing 30-36 mm. *Head*: Labium yellow, middle lobe brownish to black; labrum, face, and frons yellowish; frons very deeply notched so as to form two triangular facets in front; vesicles black tipped with yellow; eyes greenish. *Prothorax* bright yellow, with anterior and middle lobes blackish brown posteriorly; *thorax* greenish-yellow, marked with black as follows: sutures all finely black; an antehumeral strip narrow and is outlined in black. *Legs* black, anterior femora yellow on inner surface. *Wings* hyaline; only slightly enfumed at apices and borders of wings; pterostigma black with middle ochreous, covering 2 cells; membrane dark brown; are situated opposite the second antenodal nervure or between the first and second. *Abdomen* greenish-yellow, marked with black as follows: Apical borders and jugal sutures of segments 1 to 3 all finely black; segments 4 to 6 with a broad oval dorsal black spot on basal third of segments which is continued finely along mid-dorsal carina to become confluent with very broad apical black rings on 4 and 5 and a narrow one on segment 6; segments 7 to 9 black; 10 with base broadly, apical border finely black and with two small black baso-dorsal points. *Anal appendages* as long as segment 9, creamy-white in colour, with a row of very small black teeth or spines below superiors.

Distribution: India: Throughout India. *Elsewhere*: Somaliland, Mesopotamia, Persia to Samoa and Australia.

14. *Othertrum triangulare triangulare* (Selys)

1878. *Libellula triangularis* Selys, *Mitt. Mus. Dresden*. p. 314.

1909. *Orthetrum triangulare triangulare*: Ris, *Cat. Coll. Selys fasc.*, 9: 181.

1936. *Orthetrum triangulare triangulare*: Fraser, *Fauna Brit. India Odon.*, 3: 305-307.

Material examined: 1 male, Rankpur, 25.xii.2008, Reg. No. VI/4375, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 29-33 mm; Hindwing 37-41 mm. *Head*: Labium dark blackish-brown, paler towards borders of lateral lobes; labrum, face, frons, vesicle and occipit glossy black; behind head black with single yellow spot; eyes dark blue. *Prothorax* and *thorax* velvety black. *Legs* black. *Wings* hyaline, with a broad triangular blackish-brown spot at base of hindwing which extends irregularly to the third antenodal nervure; a vestige of same in forewings extending to the first antenodal nervure; pterostigma black, covering 2 cells; membrane black. 2 rows of cells between *IRiii* and *Rspl*; *Cu* arising from the posterior angle of discoidal cell in hindwing; discoidal cell of forewing 3-celled, 2-celled in the hind; 4 cells in subtrigone of forewing. *Abdomen* broad at base, then tapered gradually to the anal end, strongly carinated from segments 3 to 9; pruinose palest azure-blue except segment 1, sides of segment 2, and whole of segments 8 to 10. *Anal appendages* black.

Distribution: India: Throughout India. *Elsewhere*: Somaliland, Mesopotamia, Persia to Samoa and Australia.

15. *Trithemis aurora* (Burmeister)

1839. *Libellula aurora* Burmeister, *II & b, Ent.*, 2: 859.

1868. *Trithemis aurora*: Brauer, *Verh. zool. bot. Ges. Wien.*, 18: 177.

1936. *Trithemis aurora*: Fraser, *Fauna Brit. India Odon.*, 3: 383-385.

Material examined: 2 males, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 21-29 mm; Hindwing 24-34 mm. *Head*: Labium dark ochreous; labrum dark brown; face and front of frons ochreous, changing to reddish above; vesicle and upper surface of frons metallic violaceous; occipit brown; eyes crimson above, brown laterally changing to liaceous beneath. *Prothorax* reddish-brown, anterior lobe pale brown, anterior half of middle lobe and base of posterior lobe black. *Thorax* dull purple due to a thin pruinescence overlaying a reddish ground-colour; an obscure superior humeral brown strip and a narrow black strip on postero-lateral suture with an angular black line crossing it. *Legs* black, tibiae and tarsi ferruginous on flexor surface. *Wings* hyaline, with crimson reticulation and a broad amber-yellow fascia at base of wings, with darker brown rays in subcostal and cubital spaces. *Abdomen* swollen dorso-ventrally at base, then slightly constricted at segment 3 and again dilated fusiformly, depressed and rather broad; violaceous throughout, segment 9 laterally at ventral border and segment 10 at base marked with black. *Anal appendages* red.

Distribution: India: Throughout India. *Elsewhere:* Sri Lanka, Myanmar, Philippines and Java.

16. *Trithemis festiva* (Rambur)

1842. *Libellula festiva* Rambur, *Ins. Neurop.*: 92.

1868. *Trithemis festiva*: Brauer, *Verh. zool. bot. Ges. Wien.*, **18**: 736.

1936. *Trithemis festiva*: Fraser, *Fauna Brit. India Odon.*, **3**: 387-389.

Material examined: 2 males, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 22-28 mm; Hindwing 26-32 mm. *Head:* Labium blackish-brown; labrum dark olivaceous-brown or black with base brown; anteclypeus black; postclypeus dark olivaceous-brown; frons dark brown in front, metallic violet above, as well as vesicle; occipit dark brown; eyes dark brown above with purple reflex, bluish-grey laterally and beneath. *Prothorax* dark blue; *thorax* black, coated with a thin purplish pruinescence. *Legs* black. *Wings* hyaline, with a dark opaque brown mark at base of hindwing, dark rays in subcostal and cubital spaces as far as cubital nervure and extending in a curve posteriorly as far as the limit of membrane, which is dark with paler attached border; pterostigma black. *Abdomen* black, segments 1 to 3 with a thin bluish pruinescence. *Anal appendages* black.

Distribution: India: Throughout India. *Elsewhere:* Sri Lanka, Myanmar, Bhamo, Celebes, China, Hong Kong, Indonesia, Japan, Kampuchea, Laos, Malaysia, Nepal, Pakistan, Philippines, Singapore, Taiwan, Thailand, Tibet, Timor and Vietnam.

17. *Pantala flavescens* (Fabricius)

1798. *Libellula flavescens* Fabricius, *Ent. Syst. Suppl.*, : 285.

1861. *Pantala flavescens*: Hagen, *Syn. Neur. N. Amer.*, : 142.

1936. *Pantala flavescens*: Fraser, *Fauna Brit. India Odon.*, **3**: 414-416

Material examined: 2 males, Rankpur, 24.xii.2008, Reg. No. VI/4372, Coll. G. Sharma & party.

Diagnostic characters: Male— Abdomen 29-35 mm; Hindwing 38-40 mm. *Head:* Labium variably pale brown or yellowish, with middle lobe and borders of lateral lobes dark brown; labrum bright ochreous broadly bordered with black; anteclypeus pale olivaceous-yellow; postclypeus and frons bright golden-yellow or orange; vesicle bright ochreous; eyes reddish-brown above, bluish laterally and beneath. *Prothorax* rich ochreous, with a transverse belt of dark reddish-brown between anterior and middle lobes; *thorax* olivaceous or ferruginous, coated thickly with yellowish hairs, paler laterally. *Legs* black, bases and extensor surface of all femora yellowish. *Wings* hyaline, with base of hindwing pale golden-yellow as far distal as anal loop and with a narrow apical brown spot limited to posterior border of wing; pterostigma bright ochreous or reddish-brown. *Abdomen* bright ochreous, dorsum tinted with bright brick red, sides

of segments 1 to 4 pale yellow; segments 8 to 10 with sharply-defined black mid-dorsal pyriform spots. *Anal appendages* ochreous, changing to black towards apex; superiors about as long as segments 9 and 10 taken together, slim, but dilated at apical half and acuminate at apex.

Distribution: India: Throughout India. *Elsewhere:* Cosmopolitan.

SUMMARY

A total of 17 species belonging to 13 genera under 4 families and 2 suborders of order Odonata are first time reported from Kumbhalgarh Wildlife Sanctuary, Rajasthan.

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INSECTA: LEPIDOPTERA: RHOPALOCERA

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INTRODUCTION

Approximately 17,200 species of butterflies are known globally, of which 1,501 species are known from India (Kunte, 2000). The present study is based on a collection of butterflies netted from Kumbhalgarh Wildlife Sanctuary, Rajasthan from 2006-08 by the survey parties of the Desert Regional Centre, Zoological Survey of India, Jodhpur. Altogether 19 species belonging to 13 genera under 3 families of order Lepidoptera are reported here from the Kumbhalgarh Wildlife Sanctuary, Rajasthan. The common butterfly species were identified in the field and representative collection of species that could not be identified in the field for further taxonomic studies were collected.

SYSTEMATIC ACCOUNT

Family NYMPHALIDAE

1. *Ariadne merione* Cramer

1777. *Papilio merione* Cramer, *Pap. Exot.*, 2: 76.

1994. *Ariadne merione*: Varshney, *Oriental Ins.*, 28: 167.

Material examined: 3 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside reddish brown with transverse black wavy lines. Wavy lines broader in the form of distinct bands in female. Forewing with small, white subapical costal spot and a series of obscure spots within the submarginal markings. Underside often pale and duller in colour, black wavy lines replaced by denser and diffuse brown bands. Wingspan 52-62 mm.

Distribution: *India*: Throughout India. *Elsewhere*: Sri Lanka, Pakistan, Bhutan, Bangladesh, Myanmar, Malaysia, and Indonesia.

2. *Danaus chrysippus* (Linnaeus)

1758. *Papilio chrysippus* Linnaeus, *Syst. Nat.*, (ed.x) 1: 471.

1947. *Danaus chrysippus chrysippus*: Talbot, *The Fauna of British India, Butterflies*, 2: 20.

Material examined: 2 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside reddish brown with black borders in both wings and black apex in Forewing. Forewing with variable number of white spots in the costa and apex. Hindwing with four small black spots around the cell in male and three in female and a pouch in male. Underside dull orange. Forewing dark brown in the upper half with white spots in the black area and Hindwing with six black spots. Wingspan 70-80 mm.

Distribution: *India:* Throughout India. *Elsewhere:* Afghanistan, Africa, Australia, Iran, Turkey, Syria, South-eastern Europe, Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, Singapore, Indonesia, Madagascar, Mauritius, Fiji, Japan, New Guinea and China.

3. *Danaus genutia* (Cramer)

1779. *Papilio genutia* Cramer, *Pap. Exot.*, 3: 23.

1987. *Danaus genutia*: Gupta & Shukla, *Rec. zool. Surv. India, Occ. Pap. No. 106*: 17.

Material examined: 2 examples, Joba forest, 26.xii.2008, Reg. No. VI/4377, Coll. G. Sharma & party.

Diagnostic characters: Adult orange-brown with bold black veins, black and white apical and marginal bands. Underside pale with more prominent black lines along the veins. Wingspan 75-95 mm.

Distribution: *India:* Throughout India. *Elsewhere:* Entire Oriental region, the Americas, Australia, the Canary Islands and the Mediterranean countries.

4. *Hypolimnas misippus* (Linnaeus)

1764. *Papilio misippus* Linnaeus, *Mus. Ulr.*: 264.

1987. *Hypolimnas misippus*: Gupta & Shukla, *Rec. zool. Surv. India, Occ. Pap. No. 106*: 17.

Material examined: 2 example, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult male upperside black with dark iridescent blue or violet-ringed white, oval discal patch on both wings. Forewing with a small oval spot in the apex. Underside oval spot prominent which in the hindwing occupy the entire discal area and a prominent black costal spot. Adult female upperside orange or orange-brown, mimics the *Danaus chrysippus*. Forewing with white-spotted, black apex and costa. Hindwing with a prominent black costal spot and more wavy margin. Wingspan 70-85 mm.

Distribution: *India:* Throughout India. *Elsewhere:* Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, Indonesia, Africa, Japan, Australia, Thailand, Taiwan, Hongkong, the Carribean Islands, parts of Latin America and China.

5. *Junonia almana* (Linnaeus)

1758. *Papilio almana* Linnaeus, *Syst. Nat.*, (ed.x) 1: 472.

1994. *Junonia almana*: Varshney, *Oriental Ins.*, 28: 176.

Material examined: 2 examples, Rankpur, 25.xii.2008, Reg. No. VI/4374, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside light yellowish brown with two ocelli each in both wings; that near apex of Hindwing large, having two whit spots in peacock background and surrounded by yellow and black rings. Forewing with dark costal bars and both wings with brown wavy margins. Underside leaflike, brownish in male and yellowish in female. Wingspan 60-65 mm.

Distribution: *India:* Throughout India. *Elsewhere:* Afghanistan, Iran, Turkey, Syria, south-eastern Europe, Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, Singapore, Indonesia, Thailand, Philippines, Hongkong, Taiwan, the lesser Sunda Islands and China.

6. *Junonia hierta* (Fabricius)

1798. *Papilio hierta* Fabricius, *Ent. Syst. (suppl.)* 4: 424.

1994. *Junonia hierta*: Varshney, *Oriental Ins.*, 28: 176.

Material examined: 3 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult male upperside forewing bright yellow. Forewing black bordered with two yellowish white elongated markings in the apex and two ocelli in the discal area. Hindwing with broad black costa and base, the latter with a brilliant blue oval patch and no spots in the yellow area. Female larger but pale. Forewing with narrow costal border having four bands extending inwards. Hindwing with costal and basal areas more black or brownish; oval blue patch small and two spots in the yellow border. Underside straw yellow. Forewing more yellowish with distinct ocelli. Hindwing greyish basally with brown wavy lines. Spots and lines more pronounced in female. Wingspan 45-60 mm.

Distribution: *India:* Himalayas as far as west of Kashmir, Assam, Bengal, South and Central India, Saurashtra. *Elsewhere:* Sri Lanka, Pakistan, Afghanistan, Arabia, Bangladesh, Myanmar, Thailand, China and Hongkong.

7. *Junonia lemonias* (Linnaeus)

1912. *Precis vaisya* Fruhstorfer, In Seitz, *The Macrolepidoptera of the World*, 9: 424.

1994. *Junonia lemonias*: Varshney, *Oriental Ins.*, 28: 176.

Material examined: 4 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside dark brown or greyish brown. Forewing with black lines, yellowish brown spots and 2 red ocelli, the lower one larger and prominent. Hindwing with a large apical red ocellus enclosing two minute white spots and smaller lower black spot. Underside yellowish brown in male, pinkish brown in female with several wavy lines and the lower ocellus in the forewing alone visible mostly. Wingspan 45-60 mm.

Distribution: *India:* Himalayas as far west as Kashmir, Assam, West Bengal, South and Central India. *Elsewhere:* Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, Indonesia, China, Hongkong, Taiwan and the Philippines.

8. *Junonia orithyia* (Linnaeus)

1885. *Junonia swinhoi* Butler, *Ann. Mag. Nat. Hist.*, 16(5): 309.

1994. *Junonia orithyia*: Varshney, *Oriental Ins.*, 28: 176.

Material examined: 2 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult male upperside forewing basal two-thirds black and apex pale brown with white transverse bands. Hindwing predominantly bright blue. Both wings with two orange-ringed ocelli each. Female larger, pale almost light brown. Blue markings in the hindwing slight and orange-ringed spots bigger than in female. Underside greyish brown with white markings and wavy lines. Ocelli visible in forewing only. Wingspan 40-60 mm.

Distribution: *India*: Throughout India. *Elsewhere*: Arabia, Africa, Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, China, Hongkong, Taiwan, Japan and Australia.

9. *Neptis hylas* Moore

1872. *Neptis astola* Moore, *Proc. Zool. Soc. Lond.*: 560.

1987. *Neptis hylas astola*: Gupta & Shukla, *Rec. zool. Surv. India, Occ. Pap. No. 106*: 36.

Material examined: 2 examples, Joba forest, 26.xii.2008, Reg. No. VI/4377, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside black with white markings. Forewing with white streaks, triangular spot and a series of spots. Hindwing with a basal broad white band and an outer series of squarish white spots. Underside golden brown with white markings as above, but sharply edged with black lines. Wingspan 50-60 mm.

Distribution: *India*: Throughout India. *Elsewhere*: Most of the Oriental region except the Philippines and Sulawesi.

10. *Phalanta phalantha* (Drury)

1770. *Papilio phalantha* Drury, *Exot. Inst.*, 1: 41.

1987. *Phalanta phalantha phalantha*: Gupta & Shukla, *Rec. zool. Surv. India, Occ. Pap. No. 106*: 30.

Material examined: 1 example, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside bright yellowish brown with rows of black spots and wavy lines. Markings slightly larger in female. Underside very pale brownish. Markings as above but indistinct. Hindwing with a pinkish tinge. Wingspan 50-60 mm.

Distribution: *India*: Throughout India. *Elsewhere*: Sri Lanka, Pakistan, South-Western Arabia, Africa, Bangladesh, Myanmar, Malaysia, Indonesia, Japan and Hongkong.

Family PAPILIONIDAE

11. *Pachliopta aristolochiae* (Fabricius)

Material examined: Observed in Rankpur, 24.xii.2008, Identified. G. Sharma.

Diagnostic characters: Adult upperside black. Forewing discal area paler with black fold stripes and well marked pale vein-stripes. Hindwing with a prominent tail, five elongate white discal spots and red submarginal spots. Female paler with broader wings. Underside discal spot in the anal area red. Wingspan 80-100 mm.

Distribution: India: Throughout India. *Elsewhere:* Sri Lanka, Bangladesh, Malaysia, Singapore, Thailand, Indonesia, Philippines, Sunda Islands and China.

12. *Papilio demoleus* Linnaeus

1758. *Papilio demoleus* Linnaeus, *Syst. Nat.*, (ed.x): 464.

1939. *Papilio demoleus demoleus* Talbot, *The Fauna of British India, Butterflies*, 1: 189.

Material examined: 1 example, Joba forest, 26.xii.2008, Reg. No. VI/4377, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside black with yellow spots. Hindwing without a tail and with a brick red oval spot anteriorly bordered with blue lunule at the inner margin and a bluish spot near the costal margin. Yellow wavy markings at the base of both wings. Underside forewing almost black with seven yellow streaks at the base and a few orange spots. Hindwing with blue-bordered orange spots in the middle. Wingspan 80-100 mm.

Distribution: India: Throughout India. *Elsewhere:* Afghanistan, Iran, Iraq, Arabia, Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, Indonesia, Thailand, Philippines, Taiwan, Papua New Guinea, Northern Australia and South China.

13. *Papilio polytes* Linnaeus

1939. *Papilio polytes* Talbot, *The Fauna of British India, Butterflies*, 1: 178.

Material examined: 1 example, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside black. Forewing with terminal series of white or yellow spots, decreasing in size towards the apex. Hindwing with complete discal band of elongate white spots, more prominent in female, ending in a red lunule in the tornal region and submarginal series of crimson lunules in female. Wingspan 90-100 mm.

Distribution: India: Throughout India. *Elsewhere:* Sri Lanka, Nepal, Bhutan, Bangladesh, Myanmar, Malaysia, Japan, Philippines, the Moluccas and China.

Family PIERIDAE

14. *Anaphaeis aurota* (Fabricius)

1793. *Papilio aurota* Fabricius, *Syst. Ent.*, 3: 197.

1939. *Anapheis aurota aurota*: Talbot, *The Fauna of British India, Butterflies*, 1: 380.

Material examined: 2 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside male pure white with black apex in the forewing and black outer margins in both wings. Black area with white spots, elongated in the

forewing and rounded in the hindwing. Female similar to male, but with thicker and broader veins, apex and outer margins. A characteristic hockey stick like spot in the middle of forewing. Underside male spots in the apex, yellowish in the forewing and yellow with black veins in hindwing. Wingspan 50-60 mm.

Distribution: India: Throughout India except Assam. *Elsewhere:* Afghanistan, Africa, a few Mediterranean countries, Bhutan, Pakistan, Saudi Arabia, Iran, Asia Minor, Madagascar, Myanmar and Australia.

15. *Catopsilia pyranthe* (Linnaeus)

1758. *Papilio pyranthe* Linnaeus, *Syst. Nat.*, (ed.x) 1: 469.

1939. *Catopsilia pyranthe pyranthe*: Talbot, *The Fauna of British India, Butterflies*, 1: 497.

Material examined: 1 example, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside dull white or greenish. Male forewing with a narrow black border at the apex and termen and a small cell spots. Hindwing mostly without markings. Female similar to male but forewing with larger cell spots, broader black border and black costal border. Underside closely mottled with fine brown or green lines in both sexes and with or without red-ringed silver spots in female. Wingspan 50-70 mm.

Distribution: India: Throughout India. *Elsewhere:* The entire Oriental region, tropical Africa, Southern Arabia, New Guinea and parts of Australia.

16. *Delias eucharis* Drury

1773. *Papilio eucharis* Drury, *Illustr. Nat. Hist.*, 2: pl. x, figs. 5,6.

1939. *Delias eucharis*: Talbot, *The Fauna of British India, Butterflies*, 1: 352.

Material examined: 2 observed in Rankpur, 24.xii.2008, Identified: G. Sharma.

Diagnostic characters: Adult upperside male white or bluish white with prominent black veins and black outer discal band in both wings. Marginal black band with a row of white spots in forewing and light pink spots in the hindwing. Female dull white yellow and pink tinge. Veins and spots heavily marked in the forewing. Underside hindwing pale yellow (rarely dark) with black veins and a row of white-ringed red or pink marginal spots, bordered black on both sides in both the sexes. Wingspan 66-83 mm.

Distribution: India: Throughout India except the desert tracts. *Elsewhere:* Sri Lanka and Nepal.

17. *Eurema hecabe* Linnaeus

1939. *Eurema hecabe simulata*: Talbot, *The Fauna of British India, Butterflies*, 1: 530-531.

Material examined: 4 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside bright yellow. Forewing with broadly black excavated border in the apex and termen. Hindwing with narrow irregular border. The

borders broader in female. Underside both wings yellow. Forewing with two cell black spots and the border not or less excavated in dry season form. Irregular ring spots outside the cell in both wings. Wingspan 40-50 mm.

Distribution: India: Throughout India. *Elsewhere:* Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, Thailand, Indonesia, Africa, Madagascar, Mauritius, Fiji, Japan, Tonga, New Guinea, Korea, Australia and South Eastern China.

18. *Ixias marianne* (Cramer)

1779. *Papilio marianne* Cramer, *Pap. Exot.*, 3: 41.

1939. *Ixias marianne*: Talbot, *The Fauna of British India, Butterflies*, 1: 440.

Material examined: 2 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside white. Male forewing with grey base and black apical half enclosing a large, broad orange patch. Hindwing with a broad black terminal border. Female forewing with black base and narrow orange patch containing four black spots. Underside rich sulphur-yellow with minute spots. Orange patch of upperside slightly visible in the disc. Both wings with a large black-white centered disco-cellular spot and a broad purple-brown band composed of conical, white pointed spots. Wingspan 50-55 mm.

Distribution: India: Peninsular India to Saurashtra, Punjab and West Bengal. *Elsewhere:* Entire Oriental region and Papua New Guinea.

19. *Ixias pyrene* (Linnaeus)

1777. *Papilio sesia* Fabricius, *Gen. Ins.*, 41.

1939. *Ixias pyrene sesia*: Talbot, *The Fauna of British India, Butterflies*, 1: 445.

Material examined: 1 examples, Rankpur, 24.xii.2008, Reg. No. VI/4371, Coll. G. Sharma & party.

Diagnostic characters: Adult upperside yellow. Male forewing with costal area and apex black having a large orange band. Hindwing with black outer border. Underside pale yellow with brown blotches and ocellus like blackish brown spots in both sexes. Wingspan 50-70 mm.

Distribution: India: Peninsular India to Saurashtra, North-West Himalayas to Assam and West Bengal. *Elsewhere:* Sri Lanka, Pakistan, Bangladesh, Myanmar, Malaysia, Taiwan, Japan and China.

SUMMARY

During present study 19 species belonging to 13 genera under 3 families of order Lepidoptera are reported from Kumbhalgarh Wildlife Sanctuary, Rajasthan.

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INSECTA: COLEOPTERA : SCARABAEIDAE: COPRINAE (DUNG BEETLES)

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INTRODUCTION

The Coleoptera is one of the largest and predominant order of class Insecta in the animal kingdom and they greatly differ in size, structure, habit and adaptability and play very important role in national economy and found through out the world. The beetles belonging to sub family of the family Scarabaeidae are commonly known as "dung Beetle" and largely depends for their food on the dung of herbivorous mammals, and are abundantly found in rainy season. The dung beetles as a whole can be pronounced as useful to mankind as Coprinae because not a single species is known to feed upon living matter or any substances of commercial value. The various species of Coprinae serve as intermediate hosts for parasitic worms of domestic animal, which causes diseases. They also break down tones of animal excrement (dung) and remove from the soil surface to make clean and healthy environment and at the same time much of it incorporate into the soil to increase the soil fertility. The present study is based on the collection of dung beetles collected from "Kumbhalgarh Wild Life Sanctuary, Rajasthan" by the parties of Desert Regional Centre, Zoological Survey of India, Jodhpur during 2006 to 2008. Total 34 species belonging to 8 genera have been recorded for the first time.

SYSTEMATIC ACCOUNT

Order COLEOPTERA

Suborder POLYPHAGA

Superfamily SCARABAEIOIDEA

Family SCARABAEIDAE

Subfamily COPRINAE

1. *Catharsius platypus* Sharp

1875. *Catharsius platypus* Sharp, *Col. Hefte.*, 13: 42.

1931. *Catharsius platypu*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae)., 3: 93-94, pl. VIII, fig. 1 & 2.

1963. *Catharsius platypus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 313-314.

Material examined: 1 exs. , 24-09-2006, coll. R. Sewak.

Diagnostic Characters: Very massive, short broad and parallel sided. Head broad and semicircular, transversely strigose in front and closely granular behind. Prothorax closely granular and front angles broadly rounded and hind angle obtuse, and lateral margins bisinuate and base margined. Elytra broadly rounded but rather elevate at sutures and intervals flat. Pygidium shining and punctured. Metasternum closely punctured and hairy, with narrow smooth medium groove. hind tarsi long. Head of male has cephalic horn and erect transverse carina. Prothorax with irregular shaped shining area and hind tibial spurs broad, obliquely truncate at end. Middle and hind tarsus broad short and flat.

Distribution: India: Rajasthan and Uttar Pradesh. *Elsewhere:* Pakistan.

2. *Catharsius sagax* Quenstedt

1806. *Copris sagax* Quenstedt, *Schönh. Syn. Insect.*, 1: 43.

1931. *Catharsius sagax*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 96, pl. VIII, fig. 3.

1963. *Catharsius sagax*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 309-310.

Material examined: 3 exs., 27-09-2006, coll. R. Sewak.

Diagnostic Characters: Closely similar to *Catharsius mollosus* but smaller in size. Elytra less dull and sooty. Head has smooth shining area adjoining eyes on each side. Cephalic horn less erect and situated forward. Thoracic declivity straight and front angles sharp but not all produced.

Distribution: India: Bihar, Haryana, Punjab, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* Bhutan.

3. *Catharsius birmanensis* Lansberg

1874. *Catharsius birmanensis* Lansberg, *Col. Hefte.*, 12:11.

1931. *Catharsius birmanensis*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 97-98, pl. VIII, fig. 4, 5.

1963. *Catharsius (s.str.) birmanensis*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 311, pl. XV, fig. 1.

Material examined: 2 exs., 28-09-2006, coll. R. Sewak.

Diagnostic Characters: Broadly oval and convex. Head broad and semicircular, clypeus finely rugose, its front margin eflexed and not perceptibly excised in middle. Prothorax partly or entirely covered with closely set minute granule. Front angles obtuse and hind angles completely obliterated and base gently rounded and margined. Elytra finely but distinctly striate, stria with scarcely perceptibly punctured, intervals smooth except near base and scarcely punctured. Pygidium lightly punctured. Metasternal shield smooth, bluntly angular in front, with a longitudinal groove and has a deep pit at base. Middle and hind tarsi broad. Male differentiate from female by presence of erect slender horn, arises just in front of eyes and slight short sharp conical prothoracic protuberance in male.

Distribution: India: Rajasthan and Sikkim. *Elsewhere:* Bhutan and Myanmar.

4. *Catharsius pithecius* Fabricius

1775. *Scarabaeus pithecius* Fabricius, *Syst. Ent.*, 21.

1931. *Catharsius pithecius*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 100-101, pl. VII, fig. 1&2.

1963. *Catharsius pithecius*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 312-313, pl. XV, fig. 2.

Material examined: 2 exs., 28-09-2006, coll. R. Sewak.

Diagnostic Characters: Short, oval and very convex. Head nearly semicircular, clypeus feebly excised in middle and having nearly straight slendered horn, arising just in front of eyes. Male and female having slightly acuminate transverse elevation. Prothorax has a slight, sharp, conical protuberance on each side of median groove in male. Metasternal shield acutely angular in front and very smoothly shining along with median groove.

Distribution: India: Arunachal Pradesh, Bihar, Karnataka, Kerala, Maharastra, Rajasthan, Tamil Nadu and Uttar Pradesh. *Elsewhere*: Sri Lanka.

5. *Copris sacontala* Redenbacher

1910. *Copris sacontala* Redtenbacher, *Hugel's Kaschmir*, 4 (2): 519.

1931. *Copris sacontala*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 104-105, pl. IX, fig. 16.

1963. *Copris* (s. str.) *sacontala*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 339, pl. XVIII, fig.1.

Material examined: 3 exs., 12-03-2007, coll. R. Sewak.

Diagnostic Characters: Broadly oval and very convex. Head short and broad and clypeus notched in middle. Prothorax with feeble median longitudinal groove posteriorly and sides strongly rounded, front angles truncate and hind angles entirely obsolete. Elytra obsoletely striate and some stria with traces of minute punctures. Front tibia broad and armed with three external teeth. Male with a curved tapering sharp pointed cephalic horn, which quadrangular at base and prothorax with a vertical anterior declivity and two blunt prominences along with sharp lateral tooth on each side. Female bears a slight transverse cephalic carina.

Distribution: India: Rajasthan, Utrakhand and Uttar Pradesh.

6. *Copris indicus* Gillet

1910. *Copris indicus* Gillet, *Notes Leyed. Mus.*, 32: 5.

1931. *Copris indicus*: Arrow: *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 106-107, pl. X, fig. 6.

Material examined: 4 exs., 18-03-2007, coll. R. Sewak.

Diagnostic Characters: Broadly oval and highly convex. Head semicircular and front margin feebly bilobed in middle. Sides of prothorax nearly straight in front and strongly

rounded behind. Front angles broadly truncate and hind angles very obtuse. Front tibia broad, armed with four blunt external teeth, and terminal spur has bented tip at right angles. Male with a short erect and flattened median cephalic horn, which slightly dilated and feebly bicuspid at extremity, and prothorax with dorsal straight prominence along with lateral tubercle on each side. Female bears a slight transverse cephalic elevation.

Distribution: India: Arunachal Pradesh, Gujarat, Karnataka, Kerala, Rajasthan and Tamil Nadu.

Elsewhere: Sri Lanka.

7. *Copris iris* Sharp

1881. *Copris iris* Sharp, *Mitth. Munch. Ent., Ver.*, 5: 88.

1931. *Copris iris*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 124-125.

1963. *Copris (s. str.) iris*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 350-351.

Material examined: 2 exs., 27-09-2006, coll. R. Sewak.

Diagnostic Characters: Moderately elongate and very convex. Head rounded in front, rather strongly and unevenly punctured. Clypeal margin strongly reflected and scarcely notched in middle. Prothorax very unevenly punctured and without median groove. Front angles obtuse and sides strongly rounded and reflexed. Elytra deeply striate, stria minutely punctured and intervals flat, sparsely and minutely punctured. Pygidium shining sparsely punctured. Metasternal shield entirely smooth and sides strongly punctured. Male having a long recurved pointed cephalic horn and very short but pointed in female.

Distribution: India: Arunachal Pradesh, Assam, Meghalaya, Manipur, Rajasthan and Sikkim. *Elsewhere:* China, Laos, Siam, Tonkin and Yuman.

8. *Copris magicus* Harold

1881. *Copris magicus* Harold, *Mitth. Munch. Ent. Ver.*, 5: 88.

1931. *Copris magicus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae). 3: 112-113, pl. IX, fig. 11 & 12.

1963. *Copris (s. str.) magicus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 350-351, pl. XX, fig. 1.

Material examined: 9 exs., 25-09-2007, 26-09-2007 and 27-09-2007, coll. R. Sewak.

Diagnostic Characters: Broadly oval and very convex. Head semicircular, clypeal sharply notched at front margin in middle. Prothorax very shining and has a strong median longitudinal groove. Front angles broadly truncate and hind angles obsolete. Elytra deeply sulcate and intervals convex and punctured. Front tibia broad, armed with four external teeth, and terminal spur feebly curved. Male with a slender backwardly curved median cephalic horn, along with a minute posterior tooth on each side at a short distance and prothorax nearly vertical in front. Female bears an erect quadrate cephalic carina and prothoracic parallel carina.

Distribution: India: Rajasthan. *Elsewhere:* China and Myanmar.

9. *Copris repertus* Walker

1858. *Copris repertus* Walker, *Ann. Mag. Nat. Hist.*, **3**(2): 208.

1931. *Copris repertus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), **3**: 126-127, pl. X, figs. 8 & 9.

1963. *Copris* (s. str.) *repertus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), **1**: 351-352, pl. XX, fig. 2.

Material examined: 2 exs. , 22-09-2006 and 26- 09- 2006, coll. R. Sewak.

Diagnostic Characters: Broadly oval and highly convex and covered with reddish bristles beneath. Head semicircular and clypeus deeply notched in middle. Prothorax strongly grooved longitudinally in middle, front angles truncate and hind angles almost obsolete. Front tibia broad, armed with four external teeth and nearly straight. Male bears a slendered slightly compressed erect cephalic horn and with a minute tooth near base on each side and female with short transverse elevated cephalic carina.

Distribution: India: Arunachal pradesh, Bihar, Gujarat, Karnataka, Maharastra, Madhya Pradesh, Pondicherry, Rajasthan, Tamilnadu and Uttar Pradesh. *Elsewhere:* China, Myanmar and Srilanka.

10. *Copris corpulentus* Gillet

1910. *Copris corpulentus* Gillet, *Notes. Leyden Mus.*, **32**: 118.

1931. *Copris corpulentus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), **3**: 118-119.

1963. *Copris* (s. str.) *corpulentus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), **1**: 363-364.

Material examined: 4 exs., 18-03-2007, coll. R. Sewak.

Diagnostic characters: Elongate-oval, moderately convex, covered with reddish bristles beneath. Clypeal margin notched in middle, feebly bilobed, with a sharp pointed backwardly curved cephalic horn in middle. Prothorax has a median groove and front angles obtuse. In male, thoracic prominences simple, conical, but flattened dilated laterally in female.

Distribution: India: Arunachal Pradesh, Assam, Gujarat, Manipur, Meghalaya, Rajasthan and Uttar Pradesh. *Elsewhere:* Laos, Myanmar and Tonkin.

11. *Copris numa* Lansberge

1986. *Copris numa* Lansberge, *Tizds. Ent.*, **29**: 19.

1931. *Copris numa* Arrow: *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), **3**: 121-122, pl. X, fig. 14.

1963. *Copris* (s. str.) *numa*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), **1**: 364-365.

Material examined: 6 exs., 25-09-2006 and 26-09-2006, coll. R. Sewak.

Diagnostic Characters: Narrowly oval and moderately convex, covered with reddish bristles beneath. Clypeus feebly excised in middle at front margin and with a very short conical cephalic process just in front of eyes. Median prothoracic groove extended from basal groove to in front of middle, front angles truncate and hind angles obsolete. Middle and hind tibiae trilobed at extremity. In male, front tibial spurs blunt and pointed in female.

Distribution: India: Arunachal Pradesh, Assam, Gujarat, Rajasthan and Uttar Pradesh. *Elsewhere:* Borneo, Malaya Peninsula, Myanmar, Sumatra and Tenassrim.

12. *Copris imitans* Felsche

1910. *Copris imitans* Felsche, *Deutsche, Ent. Zeits.*, p. 47.

1931. *Copris imitans:* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 124-125, pl. X, fig. 3.

1963. *Copris (Paracopris) imitans:* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 367-368.

Material examined: 6 exs. , 27-09-2006, coll. R. Sewak.

Diagnostic Characters: Broadly oval and convex. Head smooth and shining, with few punctures on ocular lobes and vertex. Clypeus reflect and little immarginate in front. Prothorax finely evenly closely punctured. Front angles very obtuse and hind angles obsolete, and lateral margins strongly margined. Elytra deeply striate, stria closely punctured and intervals convex and with few minute scattered punctures. Pygidium strongly punctured. Metasternal shield very smooth, shining and with fine scattered punctured. In male clypeal process flat and prothorax very convex while carinate in female.

Distribution: India: Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan.

13. *Copris cribratus* Gillet

1927. *Copris cribratus* Gillet, *Ann. Soc. Ent. Belg.*, 67: 253.

1931. *Copris cribratus:* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 129.

1963. *Copris (Paracopris) cribratus:* Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 1: 373-374.

Material examined: 5 exs., 27-09-2006 and 12-03-2007, coll. R. Sewak.

Diagnostic Characters: Chocolate brown and more reddish beneath, bristles only present on sides and punctures with pale minute setae. Front clypeal margin strongly bidentated at middle. Front angle of prothorax broadly rounded and hind angles almost obsolete. Front tibia broad and armed with four sharp external teeth.

Distribution: India: Arunachal Pradesh, Gujarat, Kerala, Meghalaya, Rajasthan and Uttar Pradesh.

14. *Copris signatus* Walker

1858. *Copris signatus* Walker, *Ann. Mag.Nat.Hist.*, 3:208

1931. *Copris signatus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 131., pl. X, figs. 10 & 11.

Material examined: 3 exs., 28-09-2006, coll. R. Sewak.

Diagnostic Characters: Oval and not very convex. Clypeus not very smooth, frons and ocular lobes strongly punctured. Prothorax densely punctured, front angles entirely rounded and hind angles obsolete, and lateral margins strongly rounded. Elytra strongly striate and intervals convex and closely punctured. Metasternal shield very smooth shining and with few scattered punctures. In male, clypeus has a pair of narrow erect processes, nearly parallel and scattered hairs while strongly bilobed and a slight conical projection in front of eyes in female.

Distribution: India: Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu.

15. *Caccobius torticornis* Arrow

1931. *Caccobius torticornis* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 144-145.

1963. *Caccobius torticornis*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 135-136.

Material examined: 3 exs., 09-03-2007, coll. R. Sewak.

Diagnostic Characters: Black and shining, with deep red spot on each shoulder and red marginal patch at extremity. Body broadly oval, compact and convex. Head broad and bluntly angular in front of eyes. Clypeus sharply bidentate and sides straightly convergent. Prothorax moderately strongly but not closely punctured, front angles fairly sharp and base gently rounded. Elytra striate, intervals flat and has minutely sparsely aciculate-punctate. Pygidium strongly and not closely punctured. Metasternum bearing few large punctures. In male, posterior margin of head produced as flat plate and its angles produced into a short sharp horn, but clypeus and frons separated by strong carina in female.

Distribution: India: Rajasthan and Uttarakhand.

16. *Caccobius meridionalis* Boucomont

1914. *Caccobius meridionalis* Boucomont, *Ann. Mus. Civ.*, Geneva, 47: 239.

1931. *Caccobius meridionalis*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 148-150, fig. 10.

1963. *Caccobius (Caccophilus) meridionalis*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 138.

Material examined: 2 exs., 12-03-2007, coll. R. Sewak.

Diagnostic Characters: Small, oval and very convex. Clypeus bilobed, separated from frons by a curved carina. Prothorax has well mark posterior longitudinal groove. Front angles rather blunt and base rounded. Front tibia very short and broad. Terminal tooth very blunt and set obliquely in male and long sharp in female.

Distribution: India: Gujarat, Karnataka, Kerala, Maharashtra, Rajasthan and Tamil Nadu.

17. *Onthophagus spinifex* Fabricius

1781. *Scarabaeus spinifex* Fabricius, *Spec. Ins.*, 1: 29.

1931. *Onthophagus spinifex*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 200-201.

1963. *Onthophagus* (s. str.) *orientalis*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 535.

Material examined: 15 exs., 24-09-2006, coll. R. Sewak.

Diagnostic Characters: Broadly oval and very convex. Head nearly semicircular and clypeus separated from frons by an arcuate carina. Prothorax with small granules and front angles produced, lateral margin straight in front and sinuate behind, and hind angles obsolete. Elytra striate, intervals flat and irregularly granular. Pygidium strongly closely punctured and clothed with decumbent hairs. Male has a pair of long slender backwardly curving cephalic horns, arising between eyes and female having two strongly elevated carina.

Distribution: India: Bihar, Karnataka, Maharashtra, Orrisa, Rajasthan and Tamil Nadu. *Elsewhere:* Sri Lanka.

18. *Onthophagus pygmaeus* (Schaller)

1783. *Scarabaeus pygmaeus* Schaller, *Abh. Nat. Gus. Halle.*, 1: 239.

1931. *Onthophagus pygmaeus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 210-211, pl. I, fig. 12.

1963. *Onthophagus* (s. str.) *pygmaeus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 491-492.

Material examined: 2 exs., 27-09-2006, coll. R. Sewak.

Diagnostic Characters: Oval and convex. Head not broad and clypeus bilobed in front. Prothorax strongly closely punctured in basal part and granulated anteriorly. Front angles sharp, lateral margin straight in front and sinuate behind, and base rounded. Elytra striate, intervals flat and strongly punctured. Pygidium very strongly and closely punctured, clothed with long hairs. In male, front legs very long, tibia feebly curved, and terminal spur long and curved but front broad in female.

Distribution: India: Rajasthan. *Elsewhere:* Afghanistan, Sri Lanka and Turkestan.

19. *Onthophagus orientalis* Harold

1968. *Onthophagus orientalis* Harold, *Col. Hefte.*, 4: 83.

1931. *Onthophagus orientalis*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 213-214.

1963. *Onthophagus* (s. str.) *orientalis*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 463-464.

Material examined: 25 exs., 26-09- 2006, coll. R. Sewak.

Diagnostic Characters: Oval and very convex. Head not broad and clypeal margin strongly rounded. Prothorax convex, very deeply and closely punctured except near front margin, and also with deep median longitudinal basal groove. Front angles blunt, lateral margins feebly curved in front, strongly bisinuate behind and hind angles distinct but obtuse. Elytra striate and having a little rounded irregular intervals. Pygidium strongly closely punctured and clothed with moderately long recumbent hairs. Male has a pair of backwardly upward curving parallel horns behind eyes and carina in female.

Distribution: India: Arunachal Pradesh, Andaman Island, Assam, Bihar, Manipur, Meghalaya, Rajasthan, Sikkim, Uttrakhand and Uttar Pradesh. *Elsewhere*: Bangladesh, Malay Peninsula, Myanmar, Siam and South China.

20. *Onthophagus catta* (Fabricius)

1787. *Scarabaeus catta* Fabricius, *Mant. Inst.*, 1: 12.

1931. *Onthophagus catta*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 230-231.

Material examined: 87 exs., 22-10-2006, 23-10-2006, 24-10-2006, 25-10-2006, 26-10-2006, 27-2006, 28-10-2006 and 14-03-2007, coll. R. Sewak.

Diagnostic Characters: Broadly oval and convex, smooth and moderately shining. Head semicircular, clypeus strongly reflexed anteriorly and separated from frons by a strong feebly curved carina. Prothorax bearing granules in middle part and scattered punctures behind. Elytra striate and with flat intervals. Pygidium has an angulate basal carina and a few scattered punctures. Vertex of male bears a pair of slendered horns and prothorax has two-minute prominence, which separated by a slight groove.

Distribution: India: Anrunachal Pradesh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Maharastra, Punjab, Rajasthan, Uttranchal, Uttar Pradesh and Tamil Nadu. *Elsewhere*: Africa, Arabia, Pakistan, Combodia, Myanmar, Madagascar and Srilanka.

21. *Onthophagus bonasus* Fabricius

1775. *Scarabaeus bonasus* Fabricius, *Syst. Ent.*, p. 23.

1931. *Onthophagus bonasus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 231-232, pl. XIII, fig. 5 & 6.

1963. *Onthophagus* (*Digitonthophagus*) *bonasus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 296-297, pl. XII, fig. 5.

Material examined: 11 exs., 13-03-2007, coll. R. Sewak.

Diagnostic Characters: Very broadly oval and convex. Legs and sides clothed with yellow setae beneath. Head semi-circular with strongly reflexed front margin. Clypeus separated from frons by a strong curved carina. Vertex has a pair of back wardly directed horns and a short acute horn in middle. Prothorax having a slight median groove, front angles acutely produced, sides feebly sinuate, and hind angles and base angulate in middle. Front tibia of male elongated, slendered and having feebly curved external teeth and its inner extremity produced as a long slender tooth.

Distribution: India: Arunachal Pradesh, Himachal Pradesh, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. *Elsewhere:* Afghanistan, Combodia Pakistan, Myanmar, Siam and Tonkin.

22. *Onthophagus seniculus* (Fabricius)

1781. *Scarabaeus seniculus* Fabricius, *Spec. Ins.*, 1: 23.

1931. *Onthophagus seniculus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 235-236.

Material examined: 142 exs., 22-10-2006, 23-10-2006, 24-10-2006, 25-10-2006, 26-10-2006, 27-10-2006, 28-10-2006 and 14-03-2007, coll. R. Sewak.

Diagnostic Characters: Broadly oval, moderately compact smooth and not very shining above. Head having a straight, parallel carina and basal joint of antenna has serrate anterior edge. Prothorax has smooth shining excavation just behind front margin and horizontal prominence behind each excavation. Clypeus of male curved upward a little in front and sides nearly straight Front tibia little elongate with rather small teeth while head of female almost semicircular in out line and dorsal prothoracic prominence slightly rounded.

Distribution: India: Arunachal Pradesh, Gujarat, Rajasthan and Uttar Pradesh. *Elsewhere:* Indo-China, China, Malay Peninsula and Myanmar.

23. *Onthophagus amplexus* Sharp

1875. *Onthophagus amplexus* Sharp, *Col. Hefte.*, 14: 53.

1931. *Onthophagus amplexus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 238-239, pl. III, fig. 14, 5 & 16.

1963. *Onthophagus (Proagoderus) amplexus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 271-297, pl. XII, fig. 5.

Material Examined: 2 exs., 26-09-2006, coll. R. Sewak.

Diagnostic Characters: Oval and compact. Head semicircular, rugoely granular, covered with recumbent short hairs and bears a strong anterior carina and a pair of posterior horns, united at base in male and carina in female. Prothorax long and rugosely granular, front angles bluntly produced and base strongly rounded, obtusely angular in middle. Elytra indefinitely striate with slightly convex deeply punctured intervals. Pygidium opaque and moderately punctured.

Distribution: India: Punjab, Rajasthan and Uttrakhand.

24. *Onthophagus ensifer* Boucomont

1914. *Onthophagus ensifer* Boucomont, *Ann. Mus. Civ. Genova*, **46**: 220.

1931. *Onthophagus ensifer*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), **3**: 334- 335, fig. 41.

1963. *Onthophagu (s.str.) ensifer*: Balthasar. *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), **2**: 342.

Material Examined: 45 exs., 26-09-2006, 9-3-2007, 13-03-2007 and 14-03-2007, coll. R. Sewak.

Diagnostic Characters: Oval and moderately convex. Head not very broad. Clypeus and ocular lobes rounded. Front angles of prothorax a little produced and fairly sharp and lateral margins straight in front and sinuate behind. Male having a very long slendered, slightly flattened, backwardly directed curved cephalic horn, arises from middle of frons and extending upto middle of body. Female has a curved carina in place of horn.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Gujarat, Kerala, Rajsthan and Uttar Pradesh.

25. *Onthophagus frugivorus* Arrow

1931. *Onthophagus frugivorus* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), **3**: 336-337.

1963. *Onthophagus (Paraphanaeomorphus) frugivorus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), **2**: 356.

Material Examined: 4 exs., 24-09-2006, coll. Sewak.

Diagnostic Characters: Black or very dark chocolate brown, oval and highly convex rather deeply waisted. Head not very broad, rather closely moderately punctured. Clypeal margins strongly rounded and ocular lobes prominent. Prothorax strongly evenly punctured, front angles prominent, lateral margins straight in front and sinuate behind and base strongly rounded. Elytra shallowly striate, intervals flat and bearing fine scattered punctures. Frons of the male has a long backwardly directed slender horn, arising between eyes, and prothorax flat and also sloping on each side of longitudinal median ridge. Female having a distinct curved clypeo-frontal carina and a short straight more distinct another one between eyes.

Distribution: India: Assam, Rajasthan and Uttar Pradesh.

26. *Oniticellus pallipes* (Fabricius)

1781. *Scarabaeus pallipes* Fabricius, *Spec. Ins.*, **1**: 33.

1931. *Oniticellus pallipes*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), **3**: 375-376, fig. 52.

1963. *Oniticellus (Euoniticellus) pallipes*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), **2**: 74, pl. X. , fig. 3.

Material Examined: 6 exs., 25-09-2006, 26-09-2006, 9-03-2007, 10-03-2007, 11-03-2007, 12-03-2007 and 13-03-2007, coll. R. Sewak.

Diagnostic Characters: Narrowly elongate. Head short and broad, clypeal margin straight in front and vertex hollowed. Prothorax having slight posterior median groove and with almost rectangular front angle, sides strongly rounded and base angulate in middle. Prothorax also having a spot a little behind front margin in middle, a similar one on each side of last, one on each side of middle and another one in same line near outer margin, a pair near middle of base and one on middle of pygidium. Male having a strong curved carina between clypeus and frons, another carina just behind it. Front tibia less broad and having four sharp short external teeth.

Distribution: India: Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Maharashtra, Rajasthan, Tamil Nadu and West Bengal. *Elsewhere:* Bangladesh.

27. *Oniticellus cinctus* (Fabricius)

1775. *Scarabaeus cinctus* Fabricius, *Syst. Ent.*, 30.

1931. *Oniticellus cinctus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 379-380.

1963. *Oniticellus* (s. str.) *cinctus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 77.

Material Examined: 4 exs., 27-09-2006 and 12-03-2007, coll. R. Sewak.

Diagnostic Characters: Smooth and shining black, with a slight greenish lusture, oblong-oval and not very convex. Clypeus rounded and gently excised in middle and has a slight depression just behind middle of front margin. Prothorax very smooth unpunctured and with deeply impressed median longitudinal line, sides nearly straight in front and rounded behind. Front angles rounded and hind angles obsolete. Elytra deeply striate, striae feebly closely punctured, intervals convex and very minutely and sparingly punctured. Pygidium opaque and rugose. Front tibia of male produced at extremity into a broad, blunt and slightly hooked processes, but not in female and external teeth longer stouter than male and terminal one distinctly oblique.

Distribution: India: Arunachal Pradesh, Assam, Gujarat, Haryana, Himachal Pradesh, Karnataka,

Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Uttranchand, Uttar Pradesh and West Bengal. *Elsewhere:* Annam, Bangladesh, Malaya Peninsula, Myanmar, Siam and South China.

28. *Drepanocerus setosus* Wiedemann

1823. *Copris setosus* Wiedemann, *Zool. Mag.*, 2:19.

1931. *Drepanocerus setosus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 381-382, fig. 53.

1963. *Drepanocerus sinicus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 68-69, fig. 40.

Material Examined: 51 exs. , 9-03-2007, 10-03-2007, 12-03-2007, 13-03-2007 and 14-03-2007, coll. R. Sewak.

Diagnostic Characters: Elongate oval and a little depressed. Head rather narrow, unevenly and unequally punctured, sides nearly straight and clypeus bidentate. Prothorax closely covered with large shallow pits, sides rounded in front and nearly straight behind, and base obtusely angulate in middle. Front angles blunt and hind angles obsolete. Elytra opaque, broadly and shallowly striate, with straight setose ridge upon anterior half of 3rd and entire bisinuate setose ridge upon 5th and one interrupted upon 7th interval behind shoulder. Pygidium opaque and setose. Front tibia broad, bears three short blunt lateral teeth and a sharper one upon straight front margin. Prothorax of male has small anterior lateral depression on each side and a large posterior depression and has a slender dorsal horn, directed obliquely forward and little bifurcated at its extremity arising from middle of base, but in female, prothorax has a large median posterior depression along with smaller one in front of it and anterior lateral depression on each side.

Distribution: India: Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Uttarakhand. *Elsewhere*: Sri Lanka.

29. *Drepanocerus exsul* (Sharp)

1875. *Oniticellus exsul* Sharp, *Col. Hefte.*, 13: 53.

1931. *Drepanocerus exsul*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 385-386, Fig. 55.

Material Examined: 51 exs., 9-03-2007, 10-03-2007, 12-03-2007 and 14-03-2007, coll. R. Sewak.

Diagnostic Characters: Elongate, oval and a little depressed. Head rather narrow, unevenly and unequally punctured, sides straight and clypeus bidentate. Prothorax closely covered with large shallow pits, sides rounded in front and straight behind and base obtusely angulate in middle. Front angles blunt and hind angles obsolete. Elytra opaque, broadly striate and with straight setose ridge upon anterior half of 3rd and bisinuate setose ridge upon 5th and 7th intervals. Pygidium opaque and setose. Front tibia broad, bears three short blunt lateral teeth and a sharp upon front margin. Prothorax of male has small anterior lateral depression on each side and a large posterior depression and has a slender horn, directed obliquely forward from its extremity, and bifurcated tips scarcely diverging.

Distribution: India: Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Uttarakhand. *Elsewhere*: Sri Lanka.

30. *Onitis lama* Lansberge

1875. *Onitis lama* Lansberge, *Ann. Soc. Ent.*, Belgium, 18: 123.

1931. *Onitis lama*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae). 3: 389-390, pl. XI, fig. 11 & 12.

1963. *Onitis lama*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaearktischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 44- 45.

Material Examined: 11 exs., 10-03-2007, 12-03-2007 and 14-03-2007, coll. R. Sewak.

Diagnostic Characters: Rather narrowly oval and very convex. Head has a strongly elevated, slightly acute frontal carina, a short straight another transverse carina and a trisinate vertex carina, extended from eye to eye. Front angles of prothorax blunt, sides strongly rounded and base almost rounded. Front femur of mle having a very sharp oblique tooth beyond middle of its lower edge and hind femur with a tooth near end of its lower edge. Front tibia broad and armed with four external teeth and a small articulate terminal spur.

Distribution: India: Gujarat, Haryana, Punjab, Rajasthan, Uttaranchal and Uttar Pradesh

31. *Onitis falcatus* (Wulfen)

1786. *Scarabaeus falcatus* Wulfen, *Descr. Cap. Ins.* p. 14, pl. 2, fig. 17.

1931. *Onitis falcatus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 392-393, pl. XI, figs. 9, 10.

1963. *Onitis falcatus*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaeark-tischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 33-34, pl. IV, fig. 1.

Material Examined: 57 exs., 23-09- 2006, 25-09- 2006 and 27-09- 2006, coll. R. Sewak.

Diagnostic Characters: Rather narrowly oval and convex. Clypeus elliptical, clypeo-frontal carina widely interrupted in middle and with a short frontal tubercle behind it. Prothorax without a well-marked median groove and base strongly rounded and has basal foveae. Front tibia of male elongate, armed with four short external teeth, two or three minute teeth before middle of lower surface and a sharp incurved terminal process. Middle femur has a minute tooth near end of lower edge. Front tibia of female rather uniformly curved and armed at tip with an articulated terminal spur.

Distribution: India: Arunachal Pradesh, Assam, Gujarat, Haryana, Karnataka, Meghalaya, Manipur, Rajasthan, Tamil Nadu, Tripura, Uttranchal, Uttar Pradesh and West Bengal. *Elsewhere:* Bangladesh, Malaya Peninsula, Philipine Island and South- China.

32. *Onitis philemon* Fabricius

1801. *Onitis philemon* Fabricius, *Syst. Eleut.*, 1: 30.

1931. *Onitis philemon* Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 393-394, pl. XI, figs. 3, 4.

1963. *Onitis philemon*: Balthasar, *Monographie der Scarabaeidae und Aphodiidae der Palaeark-tischen und Orientalischen Region* (Coleoptera: Lamellicornia), 2: 41, pl. V, fig. 2.

Material Examined: 49 exs., 23-09-2006, 24-09-2006, 25-09-2006, 26-09-2006, 27-09-2006 and 28-09-2006, coll. R. Sewak.

Diagnostic Characters: Oval, not very elongate and convex. Clypeus parabolic and with a feeble emargination in middle, separated from frons by interrupted carina, and with a short transverse carina just before along with a conical tubercle just behind it. Prothorax without well marked median line, front angles rectangular and hind angles obsolete, sides

straight in front and strongly rounded in middle, and base obtusely angulate in middle. Middle femur of male has a sharp tooth near end of lower edge and hind trochanter little toothed beneath. Front tibia of female broad, armed with four strong external teeth and an articulated terminal spur.

Distribution: India: Arunachal Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Srilanka.

33. *Onitis brahma* Lansberge

1875. *Onitis brahma* Lansberge, *Ann. Soc. Ent.*, Belgium, 142.

1931. *Onitis brahma*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 399- 4003, pl. XI, fig. 7 & 8.

Material Examined: 2 exs., 13-03-2007, coll. R. Sewak.

Diagnostic Characters: Rather elongate and parallel sided. Clypeal margin strongly reflexed and a little excised in middle, forming two obtuse angles and separated by an interrupted carina from frons, and having a sharply elevated transverse carina a little in front of it along with a truncate tubercle a little behind of it. Prothorax has a posterior median groove, uniting behind with a basal fovea. Front angles at right angles and hind angles almost obsolete. Front leg of male elongate, femur with a blunt process a little before extremity, tibia slendered, strongly curved in its interior half and armed with four sharp external teeth. Middle femur has a sharp tooth near middle of its lower edge and hind femur also having a sharp outwardly directed tooth at its upper edge near base.

Distribution: India: Gujarat, Karnataka, Maharashtra, Rajasthan and Tamilnadu
Elsewhere: Pakistan.

34. *Chironitis indicus* Lansberge

1875. *Chironitis indicus* Lansberge, *Ann. Soc. Ent.*, Belgium, 18: 45.

1931. *Chironitis indicus*: Arrow, *Fauna of British India including Ceylon and Burma* (Coleoptera: Lamellicornia: Coprinae), 3: 402-403, pl. XII, fig. 15 & 16.

Material Examined: 14 exs., 3-09-2006, 25-09-2006, 26-09-2006 and 27-09-2006, coll. R. Sewak.

Diagnostic Characters: Oblong and rather depressed. Front margin of clypeus strongly depressed and having a short transverse posterior carina and separated from frons by another carina which bears short erect setae. Prothorax broader than elytra, lateral margins strongly dilated in middle, convergent and nearly straight from there to front. Front angles slightly and hind angles strongly obtuse and basal foveae narrow. Front femur having a sharp strong tooth near end of its anterior edge, tibia long slender strongly curved and armed with four external teeth. Clypeo-frontal carina of female having a sharp tubercle in middle.

Distribution: India: Guajrat, Karnataka, Maharashtra, Rajasthan and Tamil Nadu.
Elsewhere: Pakistan.

SUMMARY

Total 34 species belonging to 8 genera of sub family Coprinae under the family Scarabaeidae were recorded from "Kumbhalgarh Wild Life Sanctuary", Rajasthan. All these species *Catharsius platypus* Sharp, *Catharsius sagax* Quenstedt, *Catharsus birmanensis* Lansberge, *Catharsius pithecius* Fabricius, *Copris sacontala* Weidemann, *Copris indicus* Gillet, *Copris iris* Gillet, *Copris magicus* Harold, *Copris repertus* Walker, *Copris corpulentus* Gillet, *Copris imitans* Felsche, *Copris numa* Lansberge, *Copris cribratus* Gillet, *Copris signatus* Walker, *Caccobius torticornis* Arrow, *Caccobius meridionalis* Boucomont, *Onthophagus spinifex* Fabricius, *Onthophagus pygmaeus* (Schaller), *Onthophagus orientalis* Harold, *Onthophagus catta* (Fabricius), *Onthophagus bonasus* Fabricius, *Onthophagus seniculus* (Fabricius), *Onthophagus amplexus* Sharp, *Onthophagus ensifer* Boucomont, *Onthophagus frugivorus* Arrow, *Oniticellus pallipes* (Fabricius), *Oniticellus cinctus* (Fabricius), *Drepanocerus setosus* Wiedemann, *Drepanocerus exsul* (Sharp), *Onitis lama* Lansberge, *Onitis falcatus* (Wulfen), *Onitis philemon* Fabricius, *Onitis brahma* Lansberge and *Chironitis indicus* Lansberge have been recorded for the first time from "Kumbhalgarh Wildlife Sanctuary" and are belonging to tribe Coprini.

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HERPETOFAUNA

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INTRODUCTION

The present study is based on the observations and collection of Herpetofauna collected from Kumbhalgarh Wildlife Sanctuary (KWLS), Rajasthan by the survey parties of Desert Regional Center, Zoological Survey of India, Jodhpur. Identification of the material collected resulted in 3 species of Amphibians and 14 species of Reptiles on which the present paper is based. The concerning literature Chanda (2002) and Smith (1931, 1935) for Amphibians and Reptiles respectively has been consulted.

SYSTEMATIC ACCOUNT

Class AMPHIBIA

Order ANURA

Family RANIDAE

1. *Hoplobatrachus tigerinus* (Daudin)

1802. *Rana tigrina* Daudin, *Hist. Nat.*, 42

Material Examined: Rajsamand: Mahakaleshwer Temple, 1ex., 19.iii.2008, S.Kumar & Party, Reg No. V/2697; Pali: Sumer, 3ex., 13.iii.2008, S. Kumar, Reg No. V/700; Ranakpur, 1ex., 18.iii.2008, P. Bohra & Party, Reg No. V/2696; 1ex., 24.Xii.2008, S. Kumar & Party, Reg No. V/2699; Thandi Beri, 1ex., 23.xii.2008, P. Bohra & Party, Reg No. V/2698.

Diagnosis: In colour it is usually olive brown above but often greenish marked with characteristic black spots. A strong glandular fold extending from the eye to the shoulder present. Snout more or less pointed. First finger is longer than the second.

Distribution: *India:* Throughout India except Meghalaya. *Elsewhere:* Nepal, Pakistan and Bangladesh.

2. *Euphlyctis cyanophlyctis* (Schneider)

1799. *Euphlyctis cyanophlyctis* Schneider, *Hist. Amph.*, 1; 222

Material examined: Udaipur: Manga Village: 2ex., 7.xii.2007, Reg No. V/2694; Pali: Rajpur Dam and around, 6ex., 9.iii.07, R. Sewak & party, Reg No. V/2687; Sumer and around, 2ex., 11.iii.07, R. Sewak & party, Reg No. V/2688; Rajsamand: Ranakpur and around 2ex., 11.iii.07, R. Sewak & party, Reg No. V/2691.

Diagnosis: A medium sized frog with a length of about 65 cm from snout to vent. A more or less distinct, dark, light edged band present above each flank and also on the

upper and lower margins of thigh. Lower surface of thigh with two dark streaks. Limbs spotted with dark. Dorsum with rows of pores while its under side is nearly smooth.

Distribution: India: Throughout India except Meghalaya. *Elsewhere:* Nepal, Pakistan, Sri Lanka, Thailand and Bangladesh.

Family BUFONIDAE

3. *Bufo stomaticus* Lutken

1862. *Bufo stomaticus* Lutken, *vindensk, Medd, Dansk, Naturalist, Foren:* 305.

Material Examined: Pali: Desuri Forest area 1ex., 24.ix.01, Reg. No. V/2689; Sumer and around, 5ex., 14.ix.2006, Reg. No. V/2686.

Diagnosis: Body tuberculated dorsally and the underside with granules. Tympanum distinct.

Distribution: India: Rajasthan, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Bihar. *Elsewhere:* Sri Lanka, Pakistan.

Class REPTILIA
Order SQUAMATA
Suborder SAURIA
Family GEKKONIDAE

1. *Hemidactylus brookii* Gray

1845. *Hemidactylus brookii* Gray, *cat, Liz. Brit. Mus.*, p. 153.

Material Examined: Thandi Beri, 1ex., 23.xii.2008, P. Bohra & Party, Reg. No. V/2693.

Diagnosis: Recognised easily by the presence of black spots on the overall brown-coloured dorsum.

Distribution: A widely distributed Gecko of India.

Family AGAMIDAE

2. *Sitana ponticeriana* Cuvier

1829. *Sitana* Cuvier, *Regene Anim.* ed. 2: p.43.

Species observed: Thandi Beri, 23.xii.2008, P. Bohra & Party

Diagnosis: Identified easily by the diamond shaped spots on the Dorsum.

Distribution: India: Widely distributed in India both in the plains and hills.

Elsewhere: Sri Lanka.

3. *Calotes versicolor* (Daudin)

1802. *Agama versicolor* Daudin *Hist. Nat. Rept.*, 3: 395. pl. 44.

Species observed: Thandi Deri, 23.xii.2008, Idf. G. Sharma.

Diagnosis: A medium sized free living lizard characterised by an oval head, laterally compressed body and a long tail. Usually brownish with a pattern of spots and bars.

Distribution: India: The common garden lizard of India. *Elsewhere:* Pakistan, Afganistan, South of China.

Family SCINCIDAE

4. *Mabuya carinata* Schneider

1801. *Scincus carinatus* Schneider, *Hist. Amphib*, 2: 183

Species observed: Ranakpur, 24.xii.2008, Idf. G. Sharma.

Diagnosis: Olive brown and bronzy above with two prominent dorso-lateral stripes.

Distribution: India: Assam, Bangal, Rajasthan. *Elsewhere:* Nepal.

Family LACERTIDAE

5. *Ophisops jerdoni* Blyth

1853. *Ophisops jerdoni* Blyth. *J. Asiat. Soc. Beng.*, 22: 653

Material Examined: Pali; Sumer and around, 2ex., 23.ix.2006, R. Sewak Reg. No. V/2684.

Diagnosis: Dorsum olive brown with a golden tinge, marked with 2 golden lateral stripes. Upper head shields are strongly striated and keeled. Nostril in large anterior nasal scale.

Distribution: India: Rajasthan Andhra Pradesh, Kutch, Maharasthra, Madhya Pradesh, Tamil nadu.

Elsewhere: Pakistan

Family VARANIDAE

6. *Varanus bengalensis* (Linnaeus)

1758. *Lacerta monitor* Linnaeus, *Syst. Nat.*, ed. 10: 201.

Species observed: Ranakpur, 24.xii. 2008, Idf. G. Sharma.

Diagnosis: Usually olive or brownish above, with dark spots and yellowish below.

Distribution: India: The common Indian Monitor Lizards.

Elsewhere: Sri Lanka, Pakistan and Nepal.

Suborder SERPENTES

Family TYPHLOPIDAE

7. *Ramphotyphlops braminus* (Daudin)

1803. *Eryx braminus* Daudin, *Ind Serp.*, 1: 48.

Species observed: Thandi Beri, 23. xii. 2008, Idf. G. Sharma.

Diagnosis: A small worm-like with closely fitting polished scales, speck-like eyes and a spiny tail.

Distribution: India: Throughout India. *Elsewhere:* Pakistan, Sri Lanka, Bangladesh.

Family BOIDAE

8. *Eryx conicus* (Schneider)

1801. *Boa conicus* Schneider, *Hist. Amphib.* II. p. 268.

Species observed: Ranakpur, 24.xii.2008, Idf. G. Sharma.

Diagnosis: A stout-bodied burrowing snake with a tail that is blunt and conical in shape.

Distribution: India: Throughout India.

Elsewhere: Pakistan, Sri Lanka, Afghanistan.

9. *Eryx johnii* (Russell)

1801. *Boa johnii* Russell, *Ind. Serp.* II. pp. 18-20.

Species observed: Thandi Beri, 23. xii. 2008, Idf. G. Sharma.

Diagnosis: A heavy bodied snake with a markedly blunt tail that almost looks like another head; body light buff to reddish in colour with dark cross bands in the young.

Distribution: India: Rajasthan, Gujarat, Andhra Pradesh, Maharashtra, Uttar Pradesh, Punjab, Tamil Nadu.

Elsewhere: Sri Lanka, Afganistan, South China, Malaysia.

Family COLUBRIDAE

10. *Ptyas mucosus* (Linnaeus)

1758. *Coluber mucosus* Linnaeus. *Mus. Ad. Frid.*, i. p. 37.

Species observed: Ranakpur, 24.xii.2008, Idf. G. Sharma.

Diagnosis: A long and robust snake with a thin neck and a long slender tail.

Distribution: India: Throughout India including the Andaman Islands.

Elsewhere: Sri Lanka, Pakistan.

11. *Elaphe helena* (Daudin)

1803. *Coluber helena* Daudin. *Hist. Nat. Rept.* vi. p. 277.

Species observed: Ranakpur, 24.xii.2008, Idf. G. Sharma.

Diagnosis: Body with whitish transverse lines anteriorly and pale vertebral stripes posteriorly.

Distribution: India: Rajasthan, Gujarat, Almora, Assam and Nagaland.

Elsewhere: Sri Lanka, Pakistan.

12. *Xenochrophis piscator* (Schneider)

1796. *Natrix piscator* Russell, *Ind. Serp.* i. p. 25.

Species observed: Ranakpur, 26.xii.2008, Idf. G. Sharma.

Diagnosis: An olive, yellow or brown snake with a distinct pattern of numerous black and white spots arranged like a chessboard.

Distribution: India: Throughout India.

Elsewhere: Sri Lanka, Pakistan, Bangladesh and Malaysia.

13. *Macropisthodon plumbicolor* (Cantor)

1839. *Tropidonotus plumbicolor* Cantor *p.z.s.* p. 54

Species observed: Ranakpur, 26.xii.2008, Idf. G. Sharma.

Diagnosis: Dorsally grass-green with regular transverse dark spots that may form crossbars on the back and Tail.

Distribution: India: Peninsular India, Gujarat and Rajasthan.

Elsewhere: Sri Lanka.

Family VIPERIDAE

14. *Trimeresurus gramineus* (Shaw)

1802. *Coluber gramineus*, Shaw, *Gen. zool.* iii. p. 420.

Species observed: Joba forest area, 26.xii.2008, Idf. G. Sharma.

Diagnosis: Distinguished by the triangular head, narrow neck and characteristically a pit between the eye and nose on each side of the face. Overall colouration is grass green above and yellow or greenish below.

Distribution: India: Rajasthan and Gujarat.

Elsewhere: Sri Lanka, Bangladesh, Pakistan, Malaysia.

SUMMARY

The paper reports 3 species of Amphibians and 14 species of Reptiles recorded from the Kumbhalgarh Wildlife Sanctuary, Rajasthan.

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AVES

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INTRODUCTION

Kumbhalgarh Wildlife Sanctuary is an important bird area (IN-RJ-09) in India with an area of 610.528 sq. kms. in the winding valleys of Aravalli hill ranges. Geographically the area of this sanctuary falls within the limits of Udaipur, Rajsamand & Pali districts of the state of Rajasthan forming a dividing line between the erstwhile states of Mewar and Marwar. Biogeographically the forest of the sanctuary fall under the II category of Tropical dry deciduous forests with highly undulating terrain and broken hill ranges. Kumbhalgarh sanctuary makes an ecotone between hilly forests of Aravallis and the Thar Desert situated in the west. Kumbhalgarh hills not only acts like a barrier, checking eastward extension of desert but also forms catchment of many rivers and nallahs drained out by as many as 78 nallahs finally joining 16 rivers. There are many spots within the sanctuary where natural water is available throughout the year supporting major avian diversity in this region.

The Kumbhalgarh wildlife sanctuary supports very rich avian diversity in the region. Large number of both resident and migrant birds can be sighted throughout the year. It holds significance in terms of rich diversity as well as high population of species distributed among the various habitats available within the protected area.

MATERIAL AND METHODS

A total of 12 major localities were surveyed in the PA. The avian diversity was recorded using random method, line transect and point count method. Birds were identified based on physical features with the help of field guides and reference books (Ali and Ripley, 1989; Grimmett *et al.*, 2001). Specific details were observed with the help of Nikon Travelite IV 10 x 40 and Nikon-Pentavision 7x-15 x 35 zoom (291 ft/1000 yds at 7x or 97 M/1000M at 7 x) field binoculars. Field data was recorded pertaining to habitat, type of ecology, vegetation, topographical features, point and area coordinates, species diversity and population, threats and disturbances etc. The thick forest areas and high elevation sites were approached during day time to observe the avian fauna. Observation sites were selected with the help of Forest department consultation to observe maximum diversity zones. Besides, birds were also recorded in major vegetation types and at different water bodies.

Photographs were taken wherever possible on digital format using Nikon D70s SLR camera with the help of DX SWM ED IF Aspherical ϕ 67 Nikon AF S Nikkor lens 18-70 mm zoom 1:3.5-4.5 G ED; ϕ 62 " - 1.5m Nikon AF Nikkor lens 70-300 mm zoom 1:4-5.6 G and Analogue Canon EOS 300 camera with the help of ϕ 58mm Macro lens EF 100mm 1:2.8 USM. Video photography was also made on VHS movie format using NV-M3500 Panasonic camera of Wide X140 digital zoom lens. Garmin (*etrex*) made navigational Global Positioning System (GPS) handset was used to record the coordinates (WGS 84 format) of different study sites (Table 1). The main areas of the sanctuary were approached by Jeep: Armada wherever Tar/Gravel motorable tracks were available. Photographs of animals and different habitats of the sanctuary are given at the end.

Table 1. List of Major Avian Congregation Sites with GPS data

Locality No.	Bird Congregation Site (s)	WGS 84 GPS	Coordinates
Kumbhalgarh Wildlife Sanctuary (KWLS)			
1.	Sumer Forest area	N25°18.960′	E73°38.753′
2.	Thandiberi Forest area	N25°11.809′	E73°35.131′
3.	Mahori Khet to Aret	N25°11.809′	E73°34.630′
4.	Desuri Nal Forest area	N25°15.957′	E73°35.610′
5.	Rankakar Forest area	N25°07.794′	E73°31.621′
6.	Kalthee Khet Forest area	N25°07.218′	E73°30.684′
7.	Kumbhalagrh Fort Forest area	N25°09.293′	E73°34.734′
8.	Ranakpur Forest area (Teerthankar Nature Trail & Magai river bed)	N25°07.001′	E73°28.041′
9.	Saira Forest area	N.A.	
10.	Mallpura Forest area	N25°04.413′	E73°26.949′
11.	Banya Ghati & Palar block	N25°11.780′	E73°35.115′
12.	Parashram Mahadev Forest area	N25°07.301′	E73°28.277′

RESULT AND DISCUSSION

Kumbhalgarh wildlife sanctuary lies in the west Aravalli hills of Rajasthan with an altitude as high as 4000 ft. AMSL. The forest is broadly dry deciduous dominated by *dhok, salar, godal, semal, Moringa, kherni, umb, khair, ber, bel patra, siris, sitaphal, aritha, khakhro, kadaya, jhinjha, kemda, ronjh, timru, kumtha, papal, bargad, neem, churael, kalia, jamun, sawn, rohini, dhak, ardu, gular, imli, khajur, agnia, vilayati babul, tambolia, bahera, barna, dhaman, ghittor, gugal, kolai, jharber, ardusa, adhasisi, dasan, dhaori, dholekan, kadda, gagan, frangen, kanter, maror, phalli, negad, subpan, sitraival, thor, murali, awal, dhaman, dub, gokharu, aak,*

ker, *amar bel* and *morpankhi*, etc. The sanctuary with perennial water bodies and streams supports dense forest cover. The density and diversity of woodland vegetation serves as micro-niches and provide food to the vast assemblage of avian diversity surviving in the sanctuary.

A total of 143 species of avifauna belonging to forty-nine families under 17 orders have been observed and recorded from 12 main localities in different habitat of Kumbhalgarh wildlife sanctuary in the recent survey conducted during March, 2008 (Table 1). Review of literature reveals that the species number varies from year to year. 123 species were reported by SFD in their management plan from 1996-97 to 2000-01 (Anon, 2001). More than 200 bird species were reported by Sharma (2002) and 201 species of birds belonging to 61 families and subfamilies have been reported by Chhangani (2002) from the studies made during 1994 to 2000. Thus recording a drastic increase in species diversity holds significance. Whereas, State Forest Department, Rajasthan again recorded 131 species (Anon 2003). But in 2008, only 143 birds were recorded from Kumbhalgarh wildlife sanctuary under the present study. The list of birds recorded is listed systematically along with status in Table 2. Species distribution under each family in different sub-localities of Kumbhalgarh Wildlife Sanctuary is given in Table 3.

Table 2. List of Bird species recorded from KWLS during March 2008.

ORDER/ FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS
PODICIPEDIFORMES			
Podicipedidae	Little Grebe	<i>Tachybaptus ruficollis</i> (Pallas)	C
PELECANIFORMES			
Phalacrocoracidae	Little Cormorant	<i>Phalacrocorax x niger</i> (Vieillot)	C
	Indian Shag	<i>Phalacrocorax x fuscicollis</i> Stephens	C
	Great Cormorant	<i>Phalacrocorax x carbo</i> (Linnaeus)	R
Anhingidae	Darters	<i>Anhinga melanogaster</i> Pennant	UC
CICONIIFORMES			
Ardeidae	Little Egret	<i>Egretta garzetta</i> (Linnaeus)	C
	Cattle Egret	<i>Bubulcus ibis</i> (Linnaeus)	VC
	Black-crowned	<i>Nycticorax x nycticorax</i> (Linnaeus)	C
	Night Heron		
Ciconiidae	Painted Stork	<i>Mycteria leucocephala</i> (Pennant)	UC
	White-necked Stork	<i>Ciconia episcopus</i> (Boddaert)	UC
Threskiornithidae	Oriental White Ibis	<i>Threskiornis melanocephalus</i> (Latham)	C
	Black Ibis	<i>Pseudibis papillosa</i> (Temminck)	R
	Eurasian Spoonbill	<i>Platalea leucorodia</i> Linnaeus	C

ORDER/ FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS
ANSERIFORMES			
Anatidae	Brahminy Shelduck	<i>Tadorna ferruginea</i> (Pallas)	UC
	Nakta or Comb Duck	<i>Sarkidiornis melanotos</i> (Pennant)	R
	Cotton Teal	<i>Nettapus coromandelianus</i> (Gmelin)	UC
	Spot-billed Duck	<i>Anas poecilorhyncha</i> J. R. Forester	C
	Northern Shoveller	<i>Anas clypeata</i> Linnaeus	VC
	Common Pochard	<i>Aythya ferina</i> (Linnaeus)	UC
FALCONIFORMES			
Accipitridae	Black-shouldered Kite	<i>Elanus caeruleus</i> (Desfontaines)	UC
	Black Kite	<i>Milvus migrans</i> (Boddaert)	C
	Egyptian Vulture	<i>Neophron percnopterus</i> (Linnaeus)	C
	Indian White-backed Vulture	<i>Gypus bengalensis</i> (Gmelin)	UC
	Long-billed Vulture	<i>Gypus indicus</i> Scopoli	UC
	Red-headed Vulture	<i>Sarcogyps calvus</i> (Scopoli)	R
	Crested Serpent-Eagle	<i>Spilornis cheela</i> (Latham)	UC
	Shikra	<i>Accipiter badius</i> (Gmelin)	UC
	Eurasian Sparrowhawk	<i>Accipiter nisus</i> (Linnaeus)	C
	Falconidae	Common Kestrel	<i>Falco tinnunculus</i> Linnaeus
GALLIFORMES			
Phasianidae	Grey Francolin	<i>Francolinus pondicerianus</i> (Gmelin)	VC
	Common Quail	<i>Coturnix coturnix</i> (Linnaeus)	UC
	Grey Junglefowl	<i>Gallus sonneratii</i> Temminck	VC
	Indian Peafowl	<i>Pavo cristatus</i> (Linnaeus)	VC
GRUIFORMES			
Rallidae	White-breasted Waterhen	<i>Amaurornis phoenicurus</i> (Pennant)	C
	Common Moorhen	<i>Gallinula chloropus</i> (Linnaeus)	VC
	Common Coot	<i>Fulica atra</i> Linnaeus	VC
	CHARADRIIFORMES		
Charadriidae	Little Ringed Plover	<i>Charadrius dubius</i> Scopoli	R
	Red-wattled Lapwing	<i>Vanellus indicus</i> (Boddaert)	VC

ORDER/ FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS
Scolopacidae	Black-tailed Godwit	<i>Limosa limosa</i> (Linnaeus)	UC
	Common Redshank	<i>Tringa totanus</i> (Linnaeus)	VC
	Common Greenshank	<i>Tringa nebularia</i> (Gunner)	C
	Wood Sandpiper	<i>Tringa glareola</i> Linnaeus	C
Recurvirostridae	Black-winged Stilt	<i>Himantopus himantopus</i> (Linnaeus)	C
Burhinidae	Stone-Curlew	<i>Burhinus oedicnemus</i> (Linnaeus)	C
Laridae	River Tern	<i>Sterna aurantia</i> J. E. Gray	C
COLUMBIFORMES			
Columbidae	Blue Rock Pigeon	<i>Columba livia</i> Gmelin	A
	Little Brown Dove	<i>Streptopelia senegalensis</i> (Linnaeus)	A
	Spotted Dove	<i>Streptopelia chinensis</i> (Scopoli)	A
	Red Collared-Dove	<i>Streptopelia tranquebarica</i> (Hermann)	A
	Eurasian Collared-Dove	<i>Streptopelia decaocto</i> (Frisvaldszky)	A
	Yellow-legged Green-Pigeon	<i>Treron phoenicoptera</i> (Latham)	C
PSITTACIFORMES			
Psittacidae	Alexandrine Parakeet	<i>Psittacula eupatria</i> (Linnaeus)	C
	Rose-ringed Parakeet	<i>Psittacula krameri</i> (Scopoli)	A
	Plum-headed Parakeet	<i>Psittacula cyanocephala</i> (Linnaeus)	C
CUCULIFORMES			
Cuculidae	Pied Crested Cuckoo	<i>Clamator jacobinus</i> (Boddaert)	C
	Indian Cuckoo	<i>Cuculus micropterus</i> Gould	C
	Indian Plaintive Cuckoo	<i>Cacomantis passerines</i> (Vahl)	C
	Asian Koel	<i>Eudynamis scolopacea</i> (Linnaeus)	A
	Sirkeer Malkoha	<i>Phaenico.phaeus leschenaultii</i> (Lesson)	C
	Greater Coucal	<i>Centropus sinensis</i> (Stephens)	VC
STRIGIFORMES			
Tytonidae	Barn Owl	<i>Tyto alba</i> (Scopoli)	R
Strigidae	Eurasian Scops Owl	<i>Otus scops</i> (Linnaeus)	R
	Spotted Owlet	<i>Athene brama</i> (Temminck)	C

ORDER/ FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS
CAPRIMULGIFORMES			
Caprimulgidae	Common Indian Nightjar	<i>Caprimulgus asiaticus</i> Latham	C
APODIFORMES			
Apodidae	Asian Palm-Swift	<i>Cypsiurus balasiensis</i> (J. E. Gray)	C
	House Swift	<i>Apus affinis</i> (J. E. Gray)	C
CORACIIFORMES			
Alcedinidae	Small Blue Kingfisher	<i>Alcedo atthis</i> (Linnaeus)	C
	White-breasted Kingfisher	<i>Halcyon smyrnensis</i> (Linnaeus)	VC
	Lesser Pied Kingfisher	<i>Ceryle rudis</i> (Linnaeus)	VC
Meropidae	Small Bee-eater	<i>Merops orientalis</i> Latham	VC
	Blue-tailed Bee-eater	<i>Merops philippinus</i> Linnaeus	C
Coraciidae	Indian Roller	<i>Coracias benghalensis</i> (Linnaeus)	VC
Upupidae	Common Hoopoe	<i>Upupa epops</i> Linnaeus	C
Bucerotidae	Indian Grey Hornbill	<i>Ocyrceros birostris</i> (Scopoli)	C
PICIFORMES			
Capitonidae	Brown-headed Barbet	<i>Megalaima zeylanica</i> (Gmelin)	UC
	Coppersmith Barbet	<i>Megalaima haemacephala</i> (P. L. S. Muller)	UC
Picidae	Grey-capped Pygmy Woodpecker	<i>Dendrocopos canicapillus</i> (Blyth)	C
	Yellow-fronted Pied Woodpecker	<i>Dendrocopos mahrattensis</i> (Latham)	C
	Rufous Woodpecker	<i>Celeus brachyurus</i> (Vieillot)	C
	Little Scaly-bellied	<i>Picus xanthopygaeus</i>	R
	Green Woodpecker	(J. E. Gray & G. R. Gray)	
	Lesser Golden-backed Woodpecker	<i>Dinopium benghalense</i> (Linnaeus)	C
PASSERIFORMES			
Pittidae	Indian Pitta	<i>Pitta brachyura</i> Linnaeus	UC
Alaudidae	Red-winged Bush Lark	<i>Mirafra erythroptera</i> Blyth	C
	Ashy-crowned Sparrow-Lark	<i>Eremopterix grisea</i> (Scopoli)	VC

ORDER/ FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS
	Rufous-tailed Finch-Lark	<i>Ammomanes phoenicurus</i> (Franklin)	VC
Hirundinidae	Common Crested Lark	<i>Galerida cristata</i> (Linnaeus)	C
	Dusky Crag-Martin	<i>Hirundo concolor</i> Sykes	C
	Common Swallow	<i>Hirundo rustica</i> Linnaeus	VC
	Red-rumped Swallow	<i>Hirundo daurica</i> Linnaeus	C
Motacillidae	White wagtail	<i>Motacilla alba</i> Linnaeus	C
	Citrine wagtail	<i>Motacilla citreola</i> Pallas	C
	Grey Wag tail	<i>Motacilla cinerea</i> Tunstall	C
	Tawny Pipit	<i>Anthus campestris</i> (Linnaeus)	UC
Campephagidae	Scarlet Minivet	<i>Pericrocotus flammeus</i> (Forster)	C
	Common Wood shrike	<i>Tephrodornis pondicerianus</i> (Gmelin)	C
Pycnonotidae	Red-vented Bulbul	<i>Pycnonotus cafer</i> (Linnaeus)	VC
Irenidae	Common Iora	<i>Aegithina tiphia</i> (Linnaeus)	C
Laniidae	Bay-backed Shrike	<i>Lanius vittatus</i> Valenciennes	C
	Rufous-backed Shrike	<i>Lanius schach</i> Linnaeus	C
	Great Grey Shrike	<i>Lanius excubitor</i> Linnaeus	VC
Muscicapidae	Blue Rock Thrush	<i>Monticola solitarius</i> (Linnaeus)	C
Turdinae			
	Oriental Magpie-Robin	<i>Copsychus saularis</i> (Linnaeus)	UC
	Indian Robin	<i>Saxicoloides fulicata</i> (Linnaeus)	VC
	Black Redstart	<i>Phoenicurus ochruros</i> (Gmelin)	C
	Pied Bushchat	<i>Saxicola caprata</i> (Linnaeus)	C
	Grey Bushchat	<i>Saxicola ferrea</i> Gray	R
	Desert Wheatear	<i>Oenanthe deserti</i> (Temminck)	C
	Indian Chat	<i>Cercomela fusca</i> (Blyth)	VC
Timaliinae	Yellow-eyed Babbler	<i>Chrysomma sinense</i> (Gmelin)	C
	Large Grey Babbler	<i>Turdoides malcolmi</i> (Sykes)	VC
	Jungle Babbler	<i>Turdoides striatus</i> (Dumont)	VC
Sylviinae	Indian Great Reed-Warbler	<i>Acrocephalus stentoreus</i> (Hem. & Ehren.)	C
	Common Tailorbird	<i>Orthotomus sutorius</i> (Pennant)	C
	Common Chiffchaff	<i>Phylloscopus collybita</i> (Vieillot)	UC
	Greater Whitethroat	<i>Sylvia communis</i> (Latham)	C

ORDER/ FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS
Muscicapinae	Red-throated Flycatcher	<i>Ficedula parva</i> (Bechstein)	UC
	Tickell's Blue-Flycatcher	<i>Cyornis tickelliae</i> Blyth	UC
Rhipidurinae	White-throated Fantail-Flycatcher	<i>Rhipidura albicollis</i> (Vieillot)	R
	White-browed Fantail-Flycatcher	<i>Rhipidura aureola</i> Lesson	C
	Great Tit	<i>Parus major</i> Linnaeus	C
Paridae	Pied Tit	<i>Parus nuchalis</i> Jerdon	R
	Purple Sunbird	<i>Nectarinia asiatica</i> (Latham)	VC
Zosteropidae	Oriental White-eye	<i>Zosterops palpebrosus</i> (Temminck)	C
Emberizidae: Emberizinae	Grey-necked Bunting	<i>Emberiza buchanani</i> Blyth	UC
Estrildidae	Red Munia	<i>Amandava amandava</i> (Linnaeus)	R
	White-throated Munia	<i>Lonchura malabarica</i> (Linnaeus)	C
	Spotted Munia	<i>Lonchura punctulata</i> (Linnaeus)	UC
Passeridae: Passerinae	House Sparrow	<i>Passer domesticus</i> (Linnaeus)	A
	Yellow-throated Sparrow	<i>Petronia xanthocollis</i> (Burton)	C
Ploceinae	Black-breasted Weaver	<i>Ploceus benghalensis</i> (Linnaeus)	R
	Baya Weaver	<i>Ploceus philippinus</i> (Linnaeus)	UC
Sturnidae	Brahminy Starling	<i>Sturnus pagodarum</i> (Gmelin)	C
	Rosy Starling	<i>Sturnus roseus</i> (Linnaeus)	C
	Common Starling	<i>Sturnus vulgaris</i> Linnaeus	C
	Asian Pied Starling	<i>Sturnus contra</i> Linnaeus	C
	Common Myna	<i>Acridotheres tristis</i> (Linnaeus)	VC
	Bank Myna	<i>Acridotheres ginginianus</i> (Latham)	VC
	Eurasian Golden Oriole	<i>Oriolus oriolus</i> (Linnaeus)	C
Dicruridae	Black Drongo	<i>Dicrurus macrocercus</i> Vieillot	VC
	White-bellied Drongo	<i>Dicrurus caerulescens</i> (Linnaeus)	C
Corvidae	Indian Treepie	<i>Dendrocitta vagabunda</i> (Latham)	C
	House Crow	<i>Corvus splendens</i> Vieillot	VC
	Jungle Crow	<i>Corvus macrorhynchos</i> Wagler	C
Where: A=Abundant, C=Common; R=Rare; UC=Uncommon; VC=Very Common			

Table 3. Number of avian species shown locality-wise in KWLS (Survey, 2008)

Localities	Sumer Forest area	Thandiberi Forest area	Mahori Khet to Aret	Desuri Nal Forest area	Rankakar Forest area	Kalthee Khet Forest area	Kumbhal garh Fort Forest area	Ranakpur Forest area	Saira Forest area	Mallpura Forest area	Banya Ghati & Palar block	Parashram Mahadev Forest area
Families												
Podicipedidae		1							1			
Phalacrocoracidae		3		1				2	1			
Anhingidae		1										
Ardeidae	2	3		1				2	2			
Ciconiidae		1						1				
Threskiornithidae	1	2		1				2	2			
Anatidae		5						2	2			
Accipitridae	2	4	1	2	2	1	2	1		1	1	2
Falconidae		1			1							
Phasianidae	2	2	3	2	1	2	1	3	2	1	1	1
Rallidae	1	3		1	1			2	2	1		
Charadriidae	1	1	1	1	1	1		1	1	1		1
Scolopacidae	2	3	1	2				2	2		1	1
Burhinidae	1		1	1	1			1				
Laridae	1	1						1	1			
Columbidae	4	4	3	4	3	2	3	4	2	2	4	3
Psittacidae	1	2	1	2	2	2	1	2	1	1	2	1
Cuculidae	3	4	4	3	3	3	4	3	2	2	2	2
Tytonidae		1			1						1	
Strigidae		1			1			1			1	1
Caprimulgidae	1		1		1		1	1				1
Apodidae	2	2			1		2		2		1	2
Alcedinidae	2	2	1	1	1		1	2	2	1		2
Meropidae	1	1	2	1	2	1		1		1	1	1
Coraciidae			1	1	1		1	1	1			
Upupidae	1				1	1			1	1		

Localities	Sumer Forest area	Thandiberi Forest area	Mahori Khet to Aret	Desuri Nal Forest area	Rankakar Forest area	Kalthee Khet Forest area	Kumbhal garh Fort Forest area	Ranakpur Forest area	Saira Forest area	Mallpura Forest area	Banya Ghati & Palar block	Parashram Mahadev Forest area
	Number of Species											
Bucerotidae	1		1	1				1			1	
Capitonidae	1	1					1	1			1	
Picidae	2	2	3	1	1		2	1		1	3	1
Pittidae	1	1	1	1	1	1	1	1	1	1	1	1
Alaudidae	1	2	2	2	1	1		3	1	2	2	1
Hirundinidae	3	2	1		2	1	3	2			3	1
Motacillidae	2	1	2	1	1	1		1	1	2	1	2
Campephagidae	1		1		1		1		1		1	
Pycnonotidae	2	2	1	1			1	1	1			
Laniidae								1			1	
Muscicapidae												
<i>Turdinae</i>	5	3	3	4	3	2	3	4	2	1	3	2
<i>Timaliinae</i>	2	1	1	2	1	1		2	1		2	1
<i>Sylviinae</i>	2	2	2	1	2	2	1		2	1	1	
<i>Muscicapinae</i>	1	1			1	1		1			1	
<i>Monarchinae</i>	1		1					1			1	
<i>Rhipidurinae</i>	1	1		1	1	1		1			1	
Nectariniidae		1	1		1	1	1	1	1		1	
Zosteropidae	1	1	1	1	1			1			1	1
Estrildidae	1	2	1		1	1		1			2	1
Passeridae												
<i>Passerinae</i>	1	1	1	1	1	2	1	2	1	1	2	1
Sturnidae	4	4	3	2	3	4	2	4	2	1	3	2
Oriolidae	1	1			1	1		1				
Dicruridae	2	2	1	1	2	2	1	2	1	1	2	2
Corvidae	2	2	2	1	2	3	2	3	1	1	3	2

Appendix-I

Indo-Malayan Tropical Dry Zone Birds found in KWLS

Family/Subfamily	Scientific Name
Phasianidae	<i>Francolinus pictus</i>
	<i>Coturnix coromandelica</i>
	<i>Perdicula argoondah</i>
	<i>Pavo cristatus</i>
Charadriidae	<i>Vanellus malabaricus</i>
Columbidae	<i>Treron phoenicoptera</i>
Psittacidae	<i>Psittacula cyanocephala</i>
Strigidae	<i>Bubo coromandus</i>
Caprimulgidae	<i>Caprimulgus asiaticus</i>
Bucerotidae	<i>Ocyrceros birostris</i>
Capitonidae	<i>Megalaima zeylanica</i>
Picidae	<i>Dendrocopos mahrattensis</i>
	<i>Dinopium benghalense</i>
Alaudidae	<i>Mirafra erythroptera</i>
	<i>Eremopterix grisea</i>
Campephagidae	<i>Pericrocotus cinnamomeus</i>
	<i>Tephrodornis pondicerianus</i>
Muscicapidae	
Timaliinae	<i>Turdoides malcolmi</i>
	<i>Turdoides striatus</i>
Sylviniinae	<i>Prinia sylvatica</i>
	<i>Prinia socialis</i>
Rhipidurinae	<i>Rhipidura aureola</i>
Paridae	<i>Parus nuchalis</i>
Estrildidae	<i>Amandava formosa</i>
Sturnidae	<i>Sturnus pagodarum</i>
	<i>Acridotheres ginginianus</i>
Dicruridae	<i>Dicrurus caerulescens</i>

Appendix-II

Birds Listed in IUCN and ZSI Red Data Book and Bird Life International

Common Name	Latin Name	Category	Red Data Book
White Bellied Minivet	<i>Pericrocotus erythropygus</i>	Near Threatened	IUCN
Indian Black Ibis*	<i>Pseudibis papillosa</i>	Near Threatened	IUCN
Painted Stork*	<i>Myeteria leucocephala</i>	Vulnerable, Near Threatened	IUCN, Bird Life International
Pied Tit/White-winged Black Tit*	<i>Parus nuchalis</i>	Vulnerable, Near Threatened	IUCN, Bird Life International
Asian Openbill	<i>Anastomus oscitans</i>	Vulnerable	IUCN
Sarus Crane	<i>Grus antigone</i>	Vulnerable	Bird Life International
Indian Skimmer	<i>Rynchops albicollis</i>	Vulnerable	Bird Life International
Green Munia*	<i>Amandava formosa</i>	Vulnerable	Bird Life International
Indian White-backed Vulture*	<i>Gyps bengalensis</i>	Vulnerable, Critically endangered	IUCN, Bird Life International
Red-headed Vulture*	<i>Sarcogyps calvus</i>	Vulnerable, Near Threatened	IUCN, Bird Life International
Long-billed Vulture*	<i>Gyps indicus</i>	Critically endangered	Bird Life International
Eurasian Spoonbill*	<i>Platalea leucorodia</i>	Threatened	ZSI
Common Peafowl*	<i>Pavo cristatus</i>	Threatened	ZSI

The perusal of the tables cited above reveals that large number of passeriformes and non-passeriformes are found in the Kumbhalgarh wildlife sanctuary. Kumbhalgarh is an excellent representative of the natural vegetation and avifauna of the Aravalli. Twenty seven bird species of Biome-11 (Indo-Malayan Tropical Dry Zone) are found here (Appendix-I). Thirteen bird species found in Kumbhalgarh wildlife sanctuary also an important IBA site are under the category of threatened, vulnerable and near threatened as listed by IUCN and ZSI Red Data Book and Bird Life International (Appendix-II). Out of these 13 species, 9 marked with asterisk were recorded during the present survey. *Parus nuchalis* an endemic species is found in KWLS. It becomes obvious that Kumbhalgarh is a bird's paradise indicating still less polluted or a healthy environment with rich floral and faunal diversity. During monsoon months the whole area becomes lush green with overflowing water bodies supporting thick luxurious vegetation serving as food for herbivore avian species and thriving of other invertebrates which in turn are food of insectivorous and predatory birds. The thick forest with natural catchment areas, hilly terrain offers good food for flourishing of many more avian species.

These avian species diversity in the protected forest areas are under various biotic and abiotic pressures. Such pressures are mainly due to tree cutting, overgrazing, forest fires, floods, spread of exotic weed species (*Lantana camara* & *Prosopis juliflora*), spread of diseases, soil erosion, mining, human habitation, trespass due to pilgrimage points, road accidents of animals due to trespass on motorable tracks, poaching of wild species etc. The conservation of avian fauna in the sanctuary can be done if it is made free from above threats. Regular training to the existing forest field staff and supplement of better equipments can also effectively provide better management to the sanctuary. Birds are indicator of global climate change and hence their seasonal population fluctuation and abundance needs to be studied and co-related with abiotic factors along with regular monitoring and documentation of species arrival and departure to evolve better management strategies for species conservation.

SUMMARY

A total of 143 species of avifauna belonging to forty-nine families under 17 orders have been recorded in the present study from Kumbhalgarh Wild Life Sanctuary. Out of 143 species recorded 41 are water dependant, 23 aquatic and rest are forest dwellers or found near human habitations. Nine threatened and vulnerable species were also recorded during the present survey along with documentation of the endemic species *Parus nuchalis*.

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MAMMALS

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INTRODUCTION

Kumbhalgarh Wildlife Sanctuary was once the famous hunting ground of world famous warrior Maharana Pratap now it protects the rare species of mammals struggling for their survival. The natural vista in the backdrop of hills provides an ideal habitat paradise for diverse mammalian species. A total of 33 species of mammals have been recorded earlier (Anon., 2003 and Chhangani, 2001 & 2004) including six species of mammals viz. *Rhinopoma hardwickei* Gray, 1831, *Rhinopoma microphyllum* (Brünnich, 1782), *Megaderma lyra* Geoffroy, 1810, *Pipistrellus* sp., *Mellivora capensis* (Schreber, 1776), *Tatera indica* (Hardwicke, 1807) (Anon., 2010). The present study enlists 23 mammalian species mainly observed during March 2008 while undertaking the faunal survey of the Kumbhalgarh Wildlife Sanctuary.

MATERIAL AND METHODS

A total of 12 major localities were surveyed of the PA in the month of March, 2008 for 10 days. Joba wolf point at Sadri, Choti Odhi, Sumer, Ranakpur, Rootada Odhi and Tani area were the main localities for sighting of mammals. Major vertebrate groups were observed and recorded in the field using 10 x 50 field monocular with the help of field guides and reference books (Alfred *et al.*, 2006; Roberts, 1977 & Prater, 1971). Apart from direct sightings, the sanctuary was also surveyed to find out burrows of the animals, scats, leftover of any dead specimens, skeleton or skull etc. The dead body and skeletal parts were also carefully observed and the measurements were taken. The thick forest areas and high elevation sites were approached during day time to observe the mammalian fauna/ maximum diversity zones. Besides, mammals were also recorded in major vegetation types and at different water bodies.

The classification and conservation status is followed after Ellerman and Morrison-Scott (1951), Honaki *et al.* (1982), Alfred, *et al.* (2006 a and 2006 b). Abbreviations used in the text: Lrnt=Lower Risk Near Threatened; LRLc=Lower Risk Least Concern; VU=Vulnerable, EN=Endangered; CR=Critically Endangered; DD=Data Deficient; IWPA=Indian Wildlife Protection Act, 1972; CITES=Convention on International Trade in Endangered Species of Wild Fauna and Flora; CAMP= Conservation Assessment and Management Plan of Biodiversity Conservation Prioritization Project; IUCN=International Union for Conservation of Nature and Natural Resources; RDB= Red Data Book.

Field data was recorded pertaining to habitat, type of ecology, vegetation, topographical features, point and area coordinates, species diversity and population, threats and

disturbances etc. Photographs were taken wherever possible on digital format using Nikon D70s SLR camera with the help of DX SWM ED IF Aspherical ϕ 67 Nikon AF S Nikkor lens 18-70 mm zoom 1:3.5-4.5 G ED; ϕ 62 " - 1.5m Nikon AF Nikkor lens 70-300 mm zoom 1:4-5.6 G and Analogue Canon EOS 300 camera with the help of ϕ 58mm Macro lens EF 100mm 1:2.8 USM. Video photography was also made on VHS movie format using NV-M3500 Panasonic camera of Wide X140 digital zoom lens. Garmin (*etrex*) made navigational Global Positioning System (GPS) handset was used to record the coordinates (WGS 84 format) of different study sites (Table 1). The main areas of the sanctuary were approached by Jeep: Armada wherever Tar/Gravel motorable tracks were available. Photographs of animals and different habitats of the sanctuary are given at the end.

Table 1. List of major mammalian observation sites at Kumbhalgarh Wildlife Sanctuary (KWLS) with GPS data

Locality No.	Mammals observation site (s)	WGS 84	GPS Coordinates
1.	Sumer Forest area	N25°18.960′	E73°38.753′
2.	Desuri Ki Nal Forest area	N25°15.957′	E73°35.610′
3.	Joba wolf point at Sadri	N25°11. 942′	E73°35.162′
4.	Mahori Khet to Aret point	N25°11.809′	E73°34.630′
5.	Thandiberi Forest area	N25°11.809′	E73°35.131′
6.	Banya Ghati & Palar block	N25°11.780′	E73°35.115′
7.	Kumbhalagrh Fort Forest area	N25°09.293′	E73°34.734′
8.	Rankakar Forest area	N25°07.794′	E73°31.621′
9.	Kalthee Khet Forest area	N25°07.218′	E73°30.684′
10.	Ranakpur Forest area	N25°07.001′	E73°28.041′
11.	Parashram Mahadev Forest area	N25°07.301′	E73°28.277′
12.	Mallpura Forest area	N25°04.413′	E73°26.949′

SYSTEMATIC ACCOUNT

Order INSECTIVORA

Family SORICIDAE

Subfamily CROCIDURINAE

Genus *Suncus* Ehrenberg, 1832

1. *Suncus murinus* (Linnaeus, 1766) House Shrew

1766. *Sorex murinus* Linnaeus, *Syst. Nat.* 12th ed. 1: 74, Type locality: Java, Indonesia.

Diagnostic characters: Greyish dark brown, emits strong musk odour, make squeaking sound, nocturnal in habit.

Distribution: India: Throughout the country. *Elsewhere:* S. E. Asia, Continental & peninsular Indo-malayan region, Costal Africa, Madagascar, Comores, Mauritius and into costal Arabia.

Remarks: The species was mostly found near the forest chawki's within the core and buffer areas of the National Park.

Status: CAMP: LR1c (Nationally); DD (Globally).

Order CHIROPTERA
Suborder MEGACHIROPTERA
Family PTEROPODIDAE
Subfamily PTEROPODINAE
Genus *Pteropus* Erxleben, 1777

2. *Pteropus giganteus* (Brünnich, 1782) Indian Flying Fox

1782. *Vespertilio gigantea* Brünnich, *Dyrenes Historie*, 1: 45 (Bengal = West Bengal, India).

Diagnostic characters: Very Large size, brown with ears black, head long with dog like muzzle, extremely gregarious, tail absent, roosts on tree forming a colony of few hundred individuals.

Distribution: India: Widely distributed throughout India including Andamans. *Elsewhere:* China, Thailand, Pakistan, Sri Lanka, Nepal, Bangladesh, Maldiv Islands and Myanmar.

Remarks: Seen in flight during dawn behind the Khumbhalgarh Fort and Tandi beri area, though no roosting colonies were located within the sanctuary area.

Status: CAMP: LRnt, CITES: Appendix II.

Order PRIMATES
Family CERCOPITHECIDAE
Subfamily COLOBINAE
Genus *Semnopithecus* Desmarest, 1822

3. *Semnopithecus entellus* (Dufresne, 1797) Hanuman Langur

1797. *Simia entellus* Dufresne, *Bull. Soc. Philom Paris, ser. 1:* 7: 49 (W. Bengal).

Diagnostic characters: Black face monkey with long limbs and tail, diurnal, terrestrial and arboreal.

Distribution: India: Throughout the country except NE India and Western part of Gujarat. Bihar, Delhi, Haryana, Madhya Pradesh, Orissa, Punjab, Rajasthan (except extreme west), Uttar Pradesh, West Bengal. *Elsewhere:* China, Nepal, Pakistan, Bangladesh and Sri Lanka.

Remarks: Large in population, commonly seen throughout the forested area of the sanctuary and vigilant to mark the presence of panther.

Status: IWPA: Schedule II; CAMP: LR1c (Nationally); DD (Globally); CITES: Appendix I and IUCN: LRnt.

Order CARNIVORA
Family CANIDAE
Genus *Canis* Linnaeus, 1758

4. *Canis aureus* Linnaeus, 1758 Asiatic Jackal

1758. *Canis aureus* Linnaeus. *Syst., Nat.*, 10th ed., 1: 40.

Diagnostic characters: Smaller than wolf, without elevated forehead and arching brows; coat colour variable with mixture of black and white, buff around the shoulder, ears and legs. Diurnal and nocturnal species.

Distribution: India: Almost throughout the country. *Elsewhere:* Afghanistan, central South western and South Asia, North and East Africa, Southeastern Europe, Iran, Nigeria, Tangania, Thailand, Transcaucasus, Sri Lanka.

Remarks: Often seen across the sanctuary especially at dawn and dusky.

Status: IWPA: Schedule II, Part II; CAMP: LRlc (Nationally); CITES: Appendix III.

5. *Canis lupus* Linnaeus, 1758 Wolf

1758. *Canis lupus* Linnaeus, *Syst. Nat.*, 10th Ed., 1: 39.

Diagnostic characters: Larger than Asiatic jackal and looks like Alsatian dog distinguished by powerful jaws, arching brows and elevated forehead; coat colour variable from sandy fawn to stippled with black. Both diurnal and nocturnal species.

Distribution: India: Throughout India except extreme south. *Elsewhere:* Throughout the northern hemisphere, North America south to 20° N in Oaxaca (Mexico), Europe, Asia including the Arabian peninsula and Japan excluding Indo-China.

Remarks: Sighted in the Joba village area which is an ideal wolf sighting point within the sanctuary. At the foothills near Muchala Mahaveer are thick forest area with hillocks and natural caves an ideal habitat for wolf.

Status: IWPA: Schedule I, Part I; RDB; VU; CITES: Appendix I; CAMP: LRnt (Nationally); DD (Globally).

Genus *Vulpes* Frisch, 1775

6. *Vulpes bengalensis* (Shaw, 1800) Indian Fox

1800. *Canis bengalensis* Shaw, *Gen. Zool. Syst. Nat. Hist.*, 1(2), Mammalia p. 330.

Diagnostic characters: Slender limped grey coloured species with back of ears grey and tail tip black.

Distribution: India: Throughout India. *Elsewhere:* Nepal and Pakistan.

Remarks: Commonly seen.

Status: IUCN: DD; IWPA: Schedule II, Part II; CITES: Appendix III.; CAMP: LRnt (Nationally); DD (Globally).

Family HYAENIDAE
Subfamily HYAENINAE
Genus *Hyaena* Brunnich, 1771

7. *Hyaena hyaena* (Linnaeus, 1758) Striped Hyaena

1758. *Hyaena* Brunnich, *Zool. Fundamenta*, pp. 34, 42, 43.

Diagnostic characters: Coat dark grayish to creamish buff in colour with blackish transverse stripes on body and limbs.

Distribution: *India:* South to the Nilgiri Hills, west to Gujarat, north to lowland of Jammu and Kashmir and Kumaon, east to west Bengal. *Elsewhere:* Afghanistan, Algeria, CIS Countries, Egypt, Ethiopia, Iran, Iraq, Israel, Kenya, Libya, Mali, Morocco, Nepal, Nigeria, Pakistan, Saudi Arabia, Sierra Leone, Somalia, South Africa, Sudan and Tanzania.

Remarks: Commonly seen during night survey especially when light trap collection was made by the survey party at different localities of the sanctuary.

Status: IWPA: Schedule III; CAMP: LRnt (Nationally); DD (Globally).

Family FELIDAE
Subfamily FELINAE
Genus *Felis* Linnaeus, 1758

8. *Felis chaus* Schreber, 1777 Jungle Cat

1777. *Felis chaus* Schreber, *Die Säugethiere*, 2 (13): pl. 1101B (1777): text, 3(24): 414 (1777).

1832. *Felis kutas* Pearson, *J. Asiat. Soc. Bengl.*, 1: 75 (Medinapur, West Bengal, India).

Diagnostic characters: Unspotted dorsal coat varying in colour from yellowish grey to tawny rufous; black horizontal stripes present on the inner side of front legs; tail short with black tip. Both diurnal and nocturnal.

Distribution: *India:* South of Krishna river in South India, Bihar, Gujarat, Madhya Pradesh, Orissa, Rajasthan, Jammu & Kashmir, Sikkim, Uttar Pradesh and West Bengal. *Elsewhere:* Afghanistan, Algeria, Arabia, Benin, China, Egypt, Iran, Iraq, Israel, Kenya, Malawi, Morocco, Mozambique, Myanmar, Nepal, Pakistan, Sri Lanka, Syria, Thailand, Vietnam, Yemen, Zambia, Zimbabwe and CIS countries.

Remarks: Occasionally observed in the core area of the sanctuary.

Status: IWPA: Schedule II, Part II; CITES: Appendix II; CAMP: LRnt (Nationally); DD (Globally).

Subfamily PANTHERINAE
Genus *Panthera* Oken, 1816

9. *Panthera pardus* (Linnaeus, 1758) Leopard

1758. *Felis pardus* Linnaeus, *Syst. Nat.* 10th ed., 1: 41.

Diagnostic characters: Comparatively smaller than tiger; coat sleek and short-haired with colour varying from pale yellow to warm grey, rich tawny to rufous fawn and marked with close set black rosettes, all over the sides of body and tail except ringed tail tip. Spots down the middle of the back and on head, limbs and belly solid black (not rosettes). Mainly nocturnal in habit.

Distribution: India: Throughout India. *Elsewhere:* Afghanistan, Algeria, Angola, Arabia, Botswana, Cameroon, Central African Republic, Congo, Chad, China, Egypt, Ethiopia, Gabon, Guinea-bissau, Indonesia, Iran, Iraq, Kenya, Korea, Liberia, Laos, Malawi, Malaysia, Mauritania, Morocco, Mozambique, Myanmar, Namibia, Nepal, Niger, Nigeria, Pakistan, Senegal, Sierra Leone, Somalia, south Africa, Sri Lanka, Sudan, Tanzania, Thailand, Tunisia, Turkey, Uganda, CIS Countries, Vietnam, Zaire, Zambia, Zimbabwe.

Remarks: Rarely seen as sighted at only four localities viz. Choti Odhi, Sumer, Rootada Odhi and Tani area within the Kumbalgarh Sanctuary.

Status: IWPA: Schedule I, Part I; RDB; VU; CITES: Appendix I.; CAMP: VU (Nationally); DD (Globally).

Family HERPESTIDAE
Subfamily HERPESTINAE
Genus *Herpestes* Illiger, 1811

10. *Herpestes edwardsii* (E. Geoffrey Saint-Hilaire, 1818) Indian Gray Mongoose
1818. *Ichneumon edwardsii* E. Geoffroy Saint-Hilaire. *Descrip de L'Egypte*, 2 : 139.

1874. *Herpestes ferrugineus* Blanford, *Proc. Zool. Soc. Lond.*, pp. 661 (Larkhana, Sind, Pakistan).

Diagnostic characters: Pale gray grizzled body with reddish brown speckling, face sharply conical with small ears concealed beneath the body, hind foot distinctly reddish.

Distribution: India: Throughout India. Gujarat, Rajasthan, Himachal Pradesh. *Elsewhere:* Afganistan, Bahrain, Indonesia, Pakistan, Iraq, Iran, Japan, Kuwait, Malaysia, Nepal, Saudi Arabia and Sri Lanka.

Remarks: Commonly seen throughout the sanctuary.

Status: IWPA: Schedule IV; CITES: Appendix III; CAMP: LR1c (Nationally); DD (Globally).

11. *Herpestes javanicus* (E. Geoffrey Saint-Hilaire, 1818)
auropunctatus Small Indian Mongoose

1818. *Ichneumon javanicus* E. Geoffroy Saint-Hilaire, *Descrip. De L'Egypte*, 2 : 138.

Diagnostic characters: Small in size, tail shorter than body, fur brownish soft and silky.

Distribution: India: Jammu and Kashmir in the north, Gujarat in the west, Andhra Pradesh in the south to north eastern states in the east. *Elsewhere:* Afghanistan, Bangladesh, Bhutan, Cambodia, China, Indonesia, Malaysia, Myanmar, Nepal, Pakistan, Thailand, Vietnam, Introduced to Cuba, Dominican Republic, Fiji Isls., Hawaiian Isls., Jamaica, Japan, Puerto Rico, Surinam Indies and many other tropical regions.

Remarks: It was observed regularly at various places in the Sanctuary.

Status: IWPA: Schedule IV; CAMP: LR1c (Nationally); DD (Globally).

Family URSIDAE
Subfamily URSINAE
Genus *Melursus* Meyer, 1793

12. *Melursus ursinus* (Shaw, 1791) Sloth Bear

1791. *Bradypus ursinus* Shaw, *Nat. Misc.*, 2 (unpaged), pl. 18.

Diagnostic characters: Instantly recognized by its long, coarse, shaggy black hair, elongated grey snout; white or cream coloured V-shaped mark over its chest and ivory claw. Both diurnal and nocturnal.

Distribution: India: Throughout in suitable localities. *Elsewhere:* Sri Lanka.

Remarks: Regular visitor to the sugarcane fields near Aret point, Tandi beri area and was encountered during day in the Palar block some 4 kms from Tandi beri. Also seen around Choti Odhi, Sumer and Tani area.

Status: IUCN: VU; IWPA: Schedule I, Part I; CITES: Appendix I.; CAMP: VU (Nationally); DD (Globally).

Family VIVERRIDAE
Subfamily PARADOXURINAE
Genus *Paradoxurus* Cuvier, 1821

13. *Paradoxurus hermaphrodites* (Pallas, 1777) Toddy Cat

1777. *Viverra hermaphrodites* Pallas, In Schreber, *Die Säugethiere*, 3 (25): 426.

Diagnostic characters: Black or blackish brown in colour with coarse hair, under wool whitish, buff or rich yellow, a white patch below the eye. Nocturnal.

Distribution: India: Almost throughout the country except desert part of Rajasthan and Gujarat. *Elsewhere:* Bhutan, Cambodia, China, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Singapore, Sri Lanka, Thailand, Vietnam, Sulawesi, Moluccas, Aru Islands.

Remarks: Recorded from Mahori Khet area towards the Aret village.

Status: IWPA: Schedule II; Part II; CAMP: LR1c (Nationally); DD (Globally).

Subfamily Genus VIVERRINAE *Viverricula* Hodgson, 1838

14. *Viverricula indica* (Desmarest, 1804) Small Indian Civet

1804. *Viverra indica* Desmarest, *Tabl. Meth. Hist. Nat., In. Nouv. Diet. Hist. Nat.*, 24: 9, 17.

Diagnostic characters: Greyish brown with black spots almost in rows on the flank. Neck bars also present. Dorsal crest absent. Nocturnal.

Distribution: India: Throughout the country *Elsewhere:* Bangladesh, Cambodia, China, Hong Kong, Indonesia, Laos, Malaysia, Myanmar, Pakistan, Sri Lanka, Taiwan, Thailand and Vietnam.

Remarks: Recorded from Mahori Khet area towards the Aret village.

Status: IWPA: Schedule II; Part II; CITES: Appendix III; CAMP: LRnt (Nationally); DD (Globally).

Order ARTIODACTYLA

Family SUIDAE

Subfamily SUINAE

Genus *Sus* Linnaeus, 1758

15. *Sus scrofa* Linnaeus, 1758 Indian Wild Boar

1839. *Sus cristatus* Wagner, *Munch. Gelehrt. Anaz.*, 9: 35 (probably Malabar Coast, India).

Diagnostic characters: Females smaller than males. Body with short thick neck and slender legs. Head with sloping muzzle, large ears and small eyes. Body colour varies from dark gray to pinkish brown with coarse black and brown bristles. Tusk like canine developed in adult males.

Distribution: India: Throughout forested or semi-forested tracts of whole of India. *Elsewhere:* Australia, China, U.S.A, Central and South America, Europe, Norway, Sweden, South Russia to middle east, Pakistan, South Africa, Sri Lanka, Nepal, Bangladesh, Fiji Islands, Galapagos, Hawain Islands, Myanmar, Indonesia, Lesser Sunde Islands, Solomon Islands, Mauritius, Molucca Islands, Malaysia West Indies and Vietnam.

Remarks: Large population dwells in the sanctuary and commonly seen on the margins of the wetlands or swampy portion surrounded by forest. They can be abundantly seen in Sumer and almost all other water bodies having swampy-vegetation margins throughout the protected area.

Status: IWPA: Schedule I as *S. s. andamanensis*, others Schedule III; RDB: IK. As *S.s. andamanensis*; CAMP: LR1c (Nationally); DD (Globally).

Family CERVIDAE

Subfamily CERVINAE

Genus *Cervus* Linnaeus, 1758

16. *Cervus unicolor* Kerr, 1792 Sambar

1792. *Cervus unicolor* Kerr., In. Linnaeus, *Anim. Kingdom*, p. 300.

Diagnostic characters: Largest of ungulates with elegant horns. Coat colour brown with yellowish or grayish tinge.

Distribution: India: Tamil Nadu, northwards to Uttar Pradesh, east to Northeastern States. *Elsewhere:* Australia, China, Indonesia, Malaysia, Myanmar, Taiwan and Sri Lanka.

Remarks: Commonly seen throughout the sanctuary especially exploring wetlands, near Choti Odhi.

Status: IWPA: Schedule III; CAMP: LR1c (Nationally); DD (Globally).

Family BOVIDAE
Subfamily ANTILOPINAE
Genus *Gazella* Blainville, 1816

17. *Gazella bennettii* (Sykes, 1831) Indian Gazella

1831. *Antilope bennetti* Sykes, *Proc. Zool. Soc. Lond.*, 1830-31: 104 (Deccan, India).

Diagnostic characters: Medium sized, slender, body colour sandy brown to light chestnut with white underparts, tuft of long hairs on each knee and short black tail; horns slightly curved, closely ringed and relatively long in male; in female when horns present are shorter and smooth. Diurnal.

Distribution: *India:* Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh and Rajasthan. *Elsewhere:* E. Iran to Pakistan.

Remarks: Occasionally seen near the water points of the sanctuary especially in Sumer area.

Status: IUCN: LRcd; IWPA: Schedule II; Part I; RDB: VU; CAMP: LR1c (Nationally); DD (Globally).

Subfamily BOVINAE
Genus *Boselaphus* Blainville, 1816

18. *Boselaphus tragocamelus* (Pallas 1766) Blue Bull

1766. *Antilope tragocamelus* Pallas, *Misc. Zool.*, p. 5.

Diagnostic characters: Male iron-grey with a white ring below each fetlock and two white spots on its cheek; horns not ringed but distinctly keeled in front; females and young males sandy brown. Both diurnal and nocturnal.

Distribution: *India:* From base of Himalayas to Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan and Uttar Pradesh. *Elsewhere:* Nepal and Pakistan. Introduced into Texas (U.S.A.).

Remarks: Commonly seen throughout the sanctuary. Large population were seen in Sumer.

Status: IUCN: LRcd; IWPA: Schedule III; CAMP: LR1c (Nationally); DD (Globally).

Genus *Tetracerus* Leach, 1825

19. *Tetracerus quadricornis* (Blainville, 1816) Four-horned Antelope

1816. *Cerophorus quadricornis* Blainville, *Bull. Sci. Soc. Philom. Paris*. P. 75

Diagnostic characters: Male with two pairs of unringed but keeled horns hence also popularly called as chowsingha. Females without horns. A dark stripe present on front of each legs.

Distribution: India: Peninsula, south to Tamil Nadu, Eastern Ghats, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan and Uttar Pradesh. *Elsewhere:* Nepal

Remarks: Was sighted near the slopes behind the Kumbhalgarh Fort and one herd of seven was seen in the Palar block.

Status: IUCN: VU; IWPA: Schedule I, Part I; RDB: VU; CAMP: LRnt (Nationally); DD (Globally).

Order RODENTIA
Suborder SCIUROGNATHI
Family SCIURIDAE
Subfamily SCIURINAE
Genus *Funambulus* Lesson, 1835

20. *Funambulus pennantii* Wroughton, 1905 Northern Palm Squirrel

1905. *Funambulus pennantii* Wroughton, *J. Bombay nat. Hist. Soc.*, **16**: 411 (Mandvi Taluka, Surat, Gujarat, India).

Diagnostic characters: Small in size, ears rounded, and muzzle pointed. Dorsum grey and divided by three cream coloured stripes and distinctly separated from belly by indistinct creamy buff longitudinal strip. Tail bushy with whitish or creamy tip.

Distribution: India: Andaman Islands, Assam, Bihar, Delhi, Gujarat, Haryana, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Sikkim, Uttar Pradesh and West Bengal. *Elsewhere:* Afghanistan, Pakistan, Iran, Nepal and Bangladesh.

Remarks: Most commonly found around abandoned buildings inside forested zone and human habitation in and around the sanctuary.

Status: IWPA: Schedule IV; CAMP: LR1c (Nationally); DD (Globally).

1807. *Dipus indicus* Hardwicke, *Trans. Linn. Soc. London*, **8**: 279.

Family MURIDAE
Subfamily MURINAE
Genus *Rattus* Fischer, 1803

21. *Rattus rattus* (Linnaeus, 1758) House Rat

1758. *Mus rattus* Linnaeus, *Syst. Nat.*, 10th, **1**: 61. From Uppsala, Sweden.

Diagnostic characters: Medium size, belly white in outdoor forms and grayish buff in indoor; tails dark in colour and longer than head and body.

Distribution: India: Throughout Indian Territory including Andaman Islands. *Elsewhere:* Introduced worldwide in the tropics and temperate zones.

Remarks: The species was frequently encountered in good numbers around abundant buildings and dwellings in the sanctuary especially near the forest chowki's.

Status: IWPA: Schedule V; CAMP: LR1c (Nationally); DD (Globally).

Suborder HYSTRICOGNATHI

Family HYSTRICIDAE

Genus *Hystrix* Linnaeus, 1758

22. *Hystrix indica* Kerr, 1792 Indian Crested Porcupine

1792. *Hystrix indica* Kerr, In: Linnaeus, *Anim. Kingdom*, p. 213.

Diagnostic characters: Brown crest of bristles on head and neck; coarse bristles cover shoulder and belly; back with long quills bearing alternative bands of brown and white. Nocturnal and fossorial.

Distribution: Throughout India. *Elsewhere:* Israel, Nepal, Pakistan, Russian Turkestan and Sri Lanka.

Remarks: The Kumbhalgarh Wildlife Sanctuary holds sizeable population of this species and can be seen in the night on the margins of pathways of Ranakpur to Kumbhalgarh.

Status: IWPA: Schedule IV; CAMP: LR1c (Nationally); DD (Globally).

Order LAGOMORPHA

Family LEPORIDAE Fischer, 1817

Genus *Lepus* Linnaeus, 1758

23. *Lepus nigricollis* Cuvier, 1823 Indian Hare or Black-napped Hare

1874. *Lepus dayanus* Blanford, *Proc. Zool. Soc.*, 663 (Sukkur, Sind, Pakistan).

Diagnostic characters: Dark brown or black patch on its neck from ears to shoulders and upper surface of tail black distinguishes it from other species.

Distribution: India: Throughout India. *Elsewhere:* Bangladesh, Bhutan, Indonesia, Pakistan and Sri Lanka.

Remarks: Commonly found throughout the sanctuary. Variation in their length and shade of the coat was noticed may be due to age and moulting process.

Status: IWPA: Schedule IV; CAMP: LR1c (Nationally); DD (Globally).

RESULTS AND DISCUSSION

Kumbhalgarh wildlife sanctuary has a varied habitat with diversified fauna and flora. The tropical dry deciduous forest of *Anogeissus pendula*, *Boswellia*, *Butea*, dry bamboo brakes with other mixed varied vegetation supports large number of mammalian elements. It is home to a very large variety of wildlife, some of which are highly endangered species.

Review of literature reveals that 33 species of mammals have been recorded earlier (Anon., 2003 and Chhangani, 2001 & 2004) including six species of mammals viz. *Rhinopoma hardwickei* Gray, 1831, *Rhinopoma microphyllum* (Brünnich, 1782), *Megaderma lyra* Geoffroy, 1810, *Pipistrellus* sp., *Mellivora capensis* (Schreber, 1776), *Tatera indica* (Hardwicke, 1807) (Anon., 2010). A total of 23 species of mammals have been reported during the present survey of the KWS in March 2008 (Table 2; Fig 1). Some of the important wild mammals in the sanctuary are Panther, Wolf, Jungle cat, Striped Hyaena, Wild Boar, Toddy cat, Mongoose, Indian Fox, Jackal, Sloth Bear, Sambar, Nilgai, Four-horned Antelope, Hanuman Langur, Chinkara, Five striped palm squirrel, Rats, Hedgehog, Indian Pangolin, Bats, Porcupine and Hare. It is estimated that more than forty wolves inhabit the Joba area of the sanctuary. During summer wolves roam around water holes and wolf's activities can be seen easily. In the present survey a herd of 8-14 wolves were seen at a time in the Joba area of the sanctuary.

Amongst the area surveyed, the richest faunal diversity spots were Thandiberi, Banya Ghati including the Palar block area, the forest area under Teerthankar Nature Trail in the Ranakpur range and the forest area on the back side of the Kumbalgarh Fort down below the range at Mahori Khet etc. The carnivore population of the cat family is represented by the frequent calls of their presence in most parts of the sanctuary.

Tetracerus quadricornis, *Cervus unicolor* and *Boselaphus tragocamelus* were observed in large numbers just below the Kumbhalgarh Fort wall towards Mahori Khet forest. *Melursus ursinus* was found to be a regular visitor of the sugarcane fields at Aret point towards village side. Sloth bear was also observed in the Thandiberi area upto Banya Ghati forest area. Though *Pteropus giganteus* species was found flying in large numbers inside the sanctuary area but no roosting site was found within the territory of the sanctuary. Some of the important wildlife sights within the sanctuary are Choti Odhi near Kharni Takri, Rootada Odhi, Tani area, Watch Tower at Kalthee Khet, Dhola, Tari ki Nal and Amali Ghati. It is found that the mammalian diversity thrives well across the sanctuary except toward the peripheral zone on the Marwar side. The sanctuary encompasses combination of freshwater manmade wetlands and natural nallahs/river ecosystem.

There are some 160 villages (22 inside and 138 outside) with about 1,75,000 human and more than 1,90,000 livestock population depend directly or indirectly on the resources of the sanctuary. Local people living on the border of KWLS cut trees mainly for construction, agricultural implements and fodder. Pressure of livestock due to overgrazing is quite evident in many parts of the sanctuary especially areas adjacent to human habitations. Exotic weed species e.g. *Lantana camara* and *Prosopis juliflora* are thriving well inside the sanctuary and occupied large tracts in the vicinity of the protected forest of Kumbhalgarh sanctuary. The highways and state roads which pass through the sanctuary and man and wildlife conflict are the major threats to the existing wildlife, animals being killed in large numbers. Forest fires, floods and road accidents are some other additional threats to biodiversity of the sanctuary.

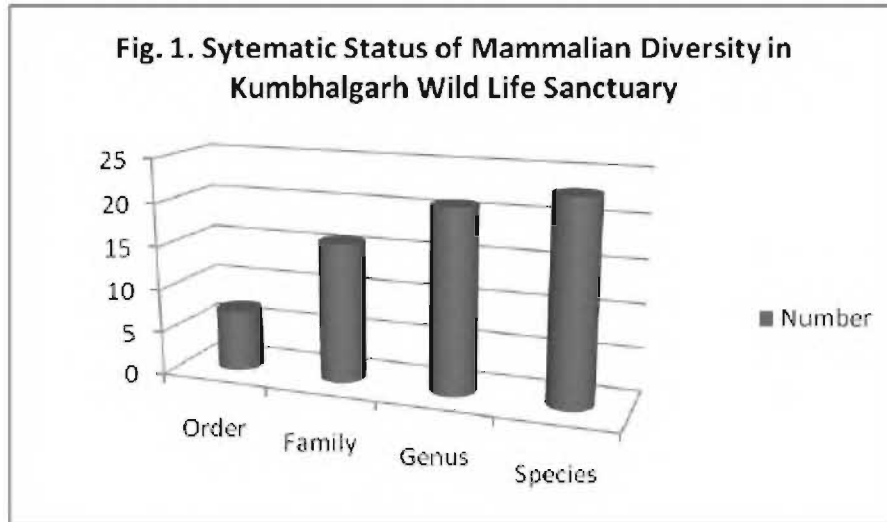
Due to village settlements in adjacent areas, activities such as collection of firewood, illegal felling of trees and poaching are known to occur inside the sanctuary area. Strict patrolling is needed to prevent such activities. Awareness campaigns are required to control

poaching and killing of animals. The Muchalla Maharaj Temple Trust is helping the Forest Department to look after the injured animals inside the sanctuary, as well as the other wild fauna. The trust has opened a small hospital to provide medical aid to the animals in and around the sanctuary. The site has very rich faunal biodiversity with dense cover in the core area, which has not yet been studied due to its remote undulating landscape. This area needs field surveys to document the fauna and flora. Rodgers and Panwar (1988) have strongly recommended establishment of at least a 20,000 ha national park as core area to prevent biotic pressures and also have important water conservation benefits locally.

The conservation of fauna in the sanctuary can be done if it is made free from threats such as poor availability of water, frequent draught, low number of herbivores, fire hazard, invasion of obnoxious weeds like *Lantana camara* anthropogenic pressure, human settlement inside the sanctuary, unscientific lopping of trees, encroachment on forest land, lack of trained staff, etc.

Table 2. Systematic List of Mammals recorded from KWLS in March, 2008

Order	Family	Subfamily	Genus	Species
Insectivora	Soricidae	Crocidurinae	<i>Suncus</i>	<i>murinus</i>
Chiroptera	Pteropodidae	Pteropodinae	<i>Pteropus</i>	<i>giganteus</i>
Primates	Cercopithecidae	Colobinae	<i>Semnopithecus</i>	<i>entellus</i>
Carnivora	Canidae		<i>Canis</i>	<i>aureus</i>
			<i>Canis</i>	<i>lupus</i>
			<i>Vulpes</i>	<i>bengalensis</i>
			<i>Hyaena</i>	<i>hyaena</i>
			<i>Felis</i>	<i>chaus</i>
	Herpestidae	Herpestinae	<i>Panthera</i>	<i>pardus</i>
			<i>Herpestes</i>	<i>edwardsii</i>
			<i>Herpestes</i>	<i>javanicus</i>
	Ursidae	Ursinae	<i>Melursus</i>	<i>ursinus</i>
	Viverridae	Paradoxurinae	<i>Paradoxurus</i>	<i>hermaphroditus</i>
<i>Viverricula</i>			<i>indica</i>	
Suidae		Suinae	<i>Sus</i>	<i>scrofa</i>
		Cervidae	Cervinae	<i>Cervus</i>
Bovidae	Antilopinae		<i>Gazella</i>	<i>bennettii</i>
	Bovinae	<i>Boselaphus</i>	<i>tragocamelus</i>	
		<i>Tetracerus</i>	<i>quadricornis</i>	
Rodentia	Sciuridae	Sciurinae	<i>Funambulus</i>	<i>pennantii</i>
	Muridae	Murinae	<i>Rattus</i>	<i>rattus</i>
	Hystricidae		<i>Hystrix</i>	<i>indica</i>
Lagomorpha	Leporidae		<i>Lepus</i>	<i>nigricollis</i>



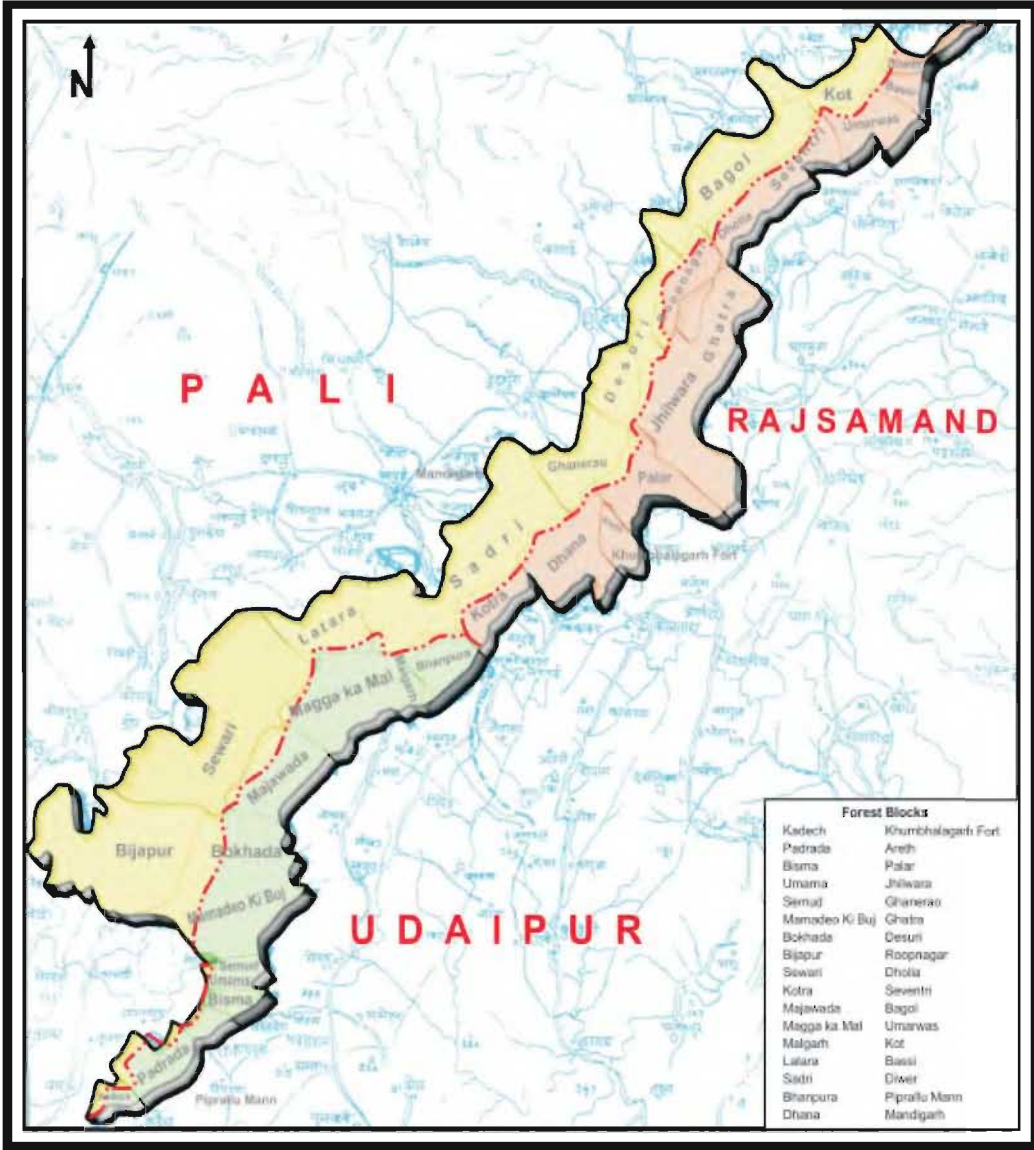
SUMMARY

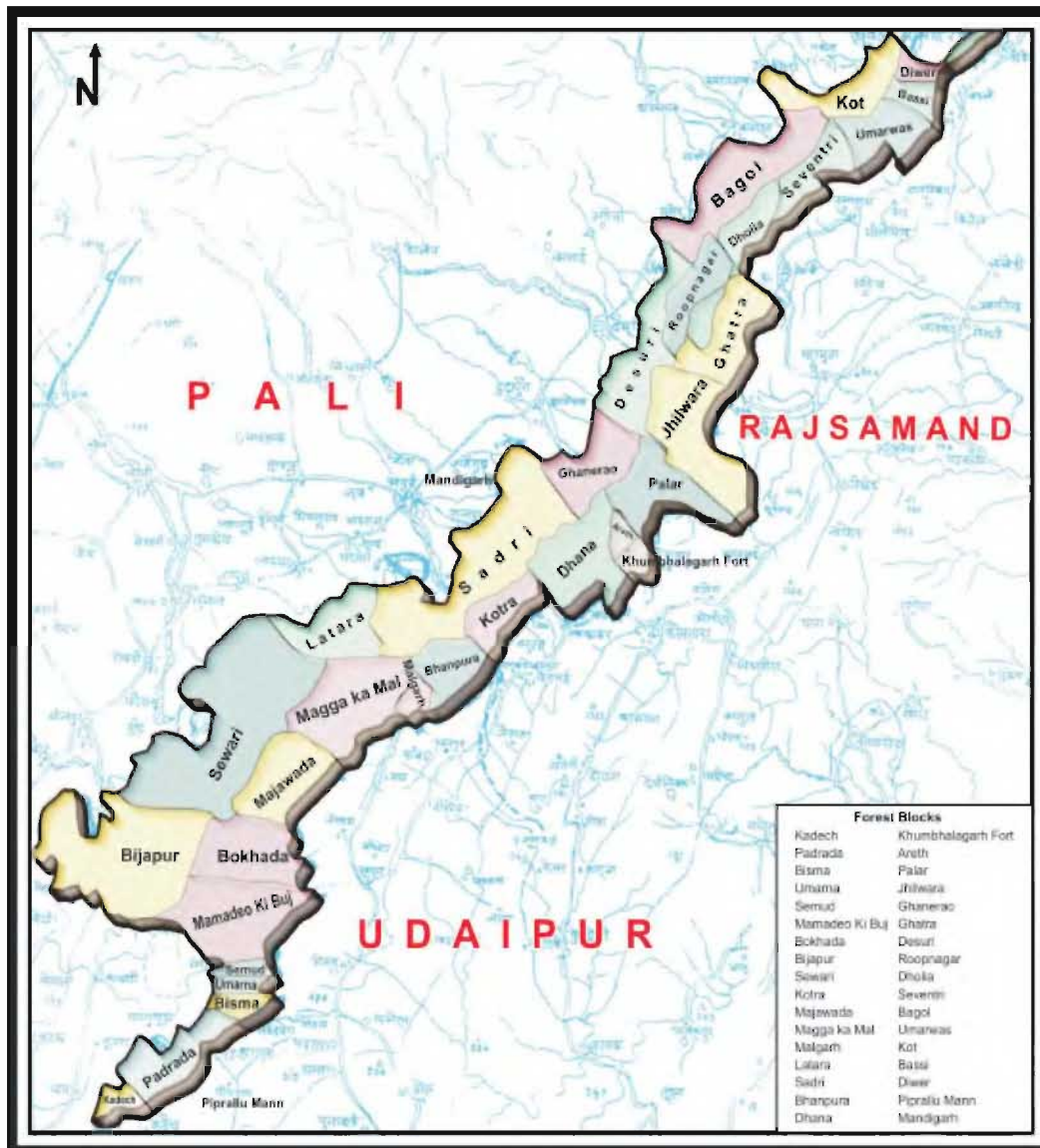
The paper records the sighting of twenty-three species of mammals belonging to seven orders under sixteen families and twenty-one genera. The mammalian species reported are abundantly found in the core and buffer zone of the sanctuary. These animals are partially or substantially depended on water bodies within the protected area for various needs and remain closely associated with the wetlands. The Kumbhalgarh Wildlife Sanctuary has rich habitat ecology and abundance of mammalian diversity. This protected area has potential to conserve vast biological diversity to remain intact for future. Efforts can be made to protect rare and endangered faunal taxas especially higher mammals in this region.

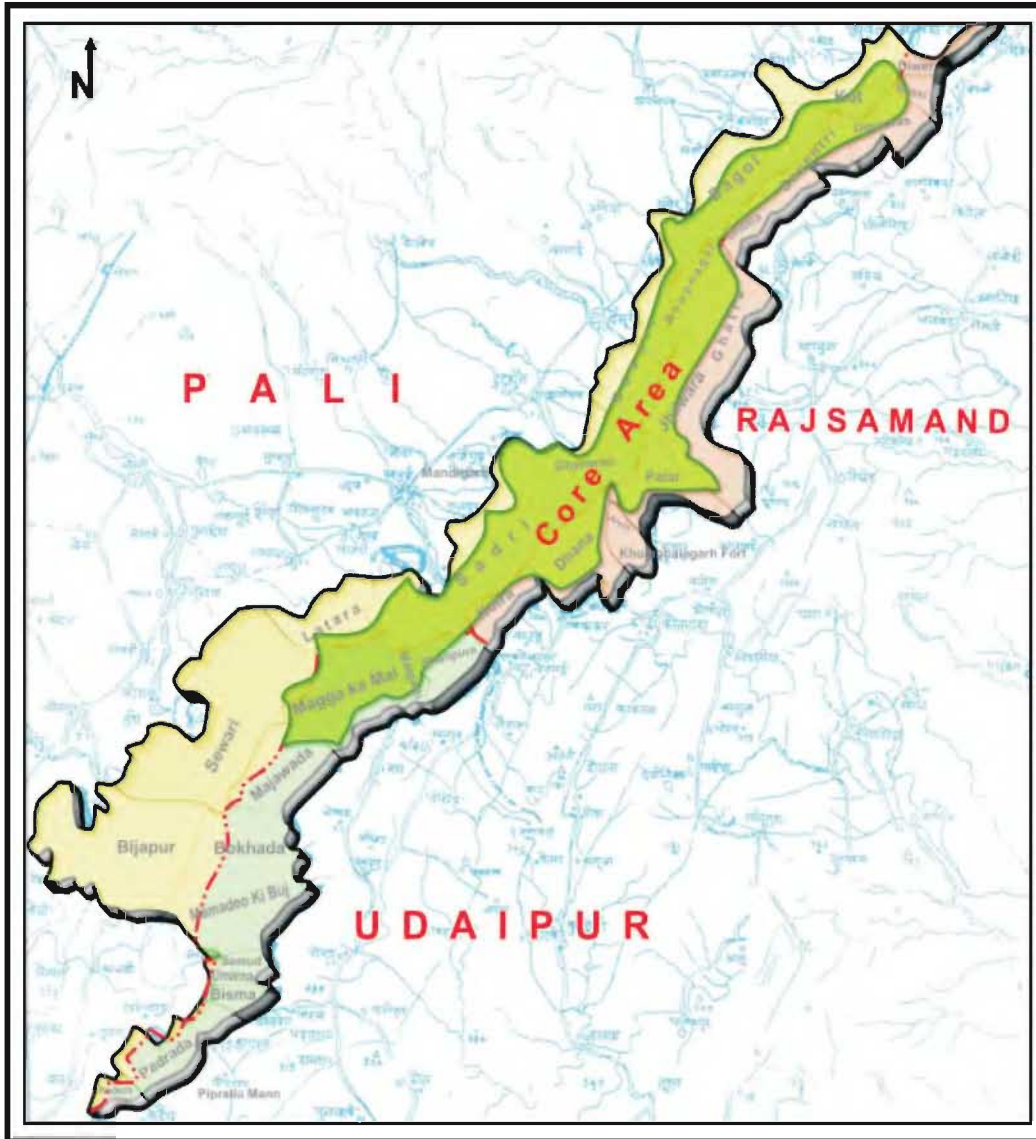
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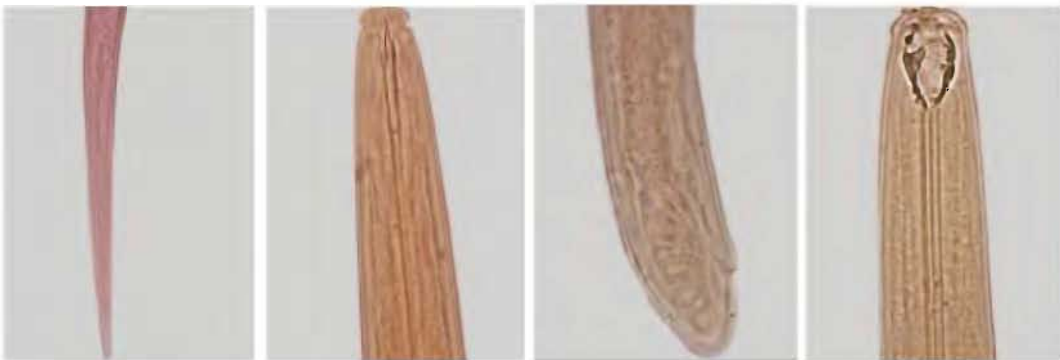
















Avian Species at Kumbhalgarh Wildlife Sanctuary, Rajasthan



Acridotheres ginginianus



Tachybaptus ruficoilis



Motacilla maderaspatensis



Ceryle rudis



Ocyeros birostris



Nectarinia asiatica



Passer domesticus



Deridrocitta vagabunda

Avian Species at Kumbhalgarh Wildlife Sanctuary, Rajasthan*Megalaima zeyfanica**Columba livia**Ardeola grayii**Turdoides striatus**Dinopium benghalense**Cantopus bengalensis**Platalea leucorodia**Streptopelia chinensis*

Avian Species at Kumbhalgarh Wildlife Sanctuary, Rajasthan



Psittacula krameri



Upupa epops



Motacilla cinerea



Petronia xanthocoltis (Male)



Dendrocopos mahrattensis



Pavo cristatus



Gallus sonneratii



Psittacuta cyanocephala

Avian Species at Kumbhalgarh Wildlife Sanctuary, Rajasthan*Tephrodon pondicerianus**Corvus macrorhynchos**Gyps indicus**Petronia xanthocollis female**Vancellus indicus**Threskiomis melanocephalus**Haicyon smymensis**Parus major*

Avian Species at Kumbhalgarh Wildlife Sanctuary, Rajasthan



Ciconia episcopus



Himantopus himantopus



Mesophoyx intermedia



Phalacrocorax niger



Stumus pagodarum



Picus squamatus



Pycnonotus cafer



Lonchura malabarica



