Birds from Ashes: Birdlife at Flyash Ponds of NTPS, Nashik, Maharashtra, India

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Abstract

Flyash is a waste product generated from coal based thermal power plants. Globally, disposal of fly ash is a great challenge for the planners. Dumping the ash in nearby wastelands is most preferred disposal method adopted by the agencies. In India, such depositions are often transformed in to varying sizes of ponds that are known as fly ash ponds. Out of the 8 major thermal power plants of Maharashtra, fly ash ponds associated with Nashik Thermal Power Station were explored as habitats for the faunal diversity. Despite the toxic nature of flyash, these sites harbour significant avian diversity (128 species). Interestingly, these ponds are situated in close proximity with Nandur-Madhyameshwar Bird Sanctuary along the Nandur-Madhyameshwar dam. This in fact encouraged a comparative study of avian diversity of both these man-made wetlands. The analysis based on field observations made during 2007-2011, shows high similarity value (0.75) between these habitats. Present study signifies the association of avifauna with these industrial habitats that can be converted into eco parks.

Keywords: Flyash, Thermal Power Station, Foraging ground, Eco-park, Migration

Introduction:

Every activity of human development demands huge amount of energy in some or the other form. In the traditional methods that cater this need of our country, coal fired thermal power stations, till date, occupies topmost position. Flyash (FA) is a waste product generated out of such coal based power generation process. Around 68% of power generation in Maharashtra is through coal based power plants of Chandrapur, Nashik, Koradi, Khaparkheda, Paras, Parali-vaijanath, Bhusaval, Dahanu and TATA (Dhadase *et al.*, 2008). Flyash, basically comprises of various silicates (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO) and traces of heavy elements (Hg, I, Cd, Ga, Sb, Se, Ti, V, As, Cr, La, Mo, Ni, Pb, Th, U, Zn, B, Ba, Cu, Mn, Sr) (Amuthasheel and Manoharan 2003, Murthy and Ambalavana 2003, Naik 2006, Donaldson and Born 1998, Mckerall *et al.* 1982). These components have been proven toxic to various species of plants and animals (Murugappan *et al.* 2004, Mehra *et al.* 1998, Singh and Kumari 1999, Bryan *et al.* 2003, 2012). Although FA can be used by plants as a source of nutrient (Jala and Goyal 2006) when disposed in environment, it is toxic at higher amounts (Adriano et al. 1979). Being non biodegradable, deposition of FA remained always controversial and sensitive to environmental concerns at these sites. Coincidently, most of the thermal power stations are situated nearby protected areas (eg. Chandrapur near Tadoba-Andhari Tiger Project).

Nashik Thermal Power Station (NTPS) is one of the largest coal fired power station of the Maharashtra state that caters nearly 25% of the state's electricity requirement (http://www.nashik.com/corporate/thermal.html). Although the total installed capacity of NTPS is 910 MW (3 x 210 MW and 2 x 140 MW sets), on an average it generates around 600 Megawatts of energy (http://www.mahagencontps.com/). Subsequently, net annual deposition of FA from this station is considerably high that remains un-utilized despite series of initiatives by the Government. It has been estimated that for a normal rated generation, NTPS produces 3000 to 3500 tons of FA per day i.e. 12 million tons per annum (http://www.nashik.com/corporate/thermal.html). As a result, large amount of FA is dumped in the surrounding wastelands. FA is generally transferred in the form of slurry (mixed with water) from the source to these sites. Series of such deposition that are enacted by the weather and geographical processes convert these sites into several smaller flyash ponds (FAP). According to the Ramsar convention 1971, FAPs represent a unique example of near natural wetland type (group A, criterion 1) and support endangered species such as leopard (group B, criterion 2) (http://www.ramsar.org). Despite the fact that FA as an isolated entity toxic in nature, FAPs support significant avian diversity. Interestingly, Nandur-Madhyameshwar Bird Sanctuary (NMBS) along the Nandur-Madhyameshwar dam on Godavari River is located around 41 km from FAPs of NTPS. These manmade wetlands are studied in order to understand the pattern of association of avian species.

Methodology:

FAPs of NTPS (lies between 19°57'50.95"N to 19°58'41.19"N and 73°53'36.80"E to 73°54'43.93"E) are located ~9 km from one of the developing metropolitan city (Nashik) of Maharashtra and ~1 km from the main power plant (near Eklahare village). The study site 1 comprises FAPs and area surrounding them which includes scrubland and agricultural patches (Figure 1A). NMBS (lies between 20°00'11.82"N to 20°01'35.66"N and 74°05'53.08"E to 74°07'56.68"E) is located around 40 km from Nashik. It's a famous bird sanctuary founded by Dr. Salim Ali. The study site lies in and around backwater of Nandur-Madhyameshwar dam, situated on the Godavari and Kadwa rivers (Figure 1B). Line transects (variable width, time and length) and point census methods were adopted for bird surveys. Unidentified birds were photographed and/or videographed using Sony cybershot DSC H50. Online forums (http://www.indianaturewatch.net/) and field guides (Grimette et al. 2011, Rasmussen and Anderton 2005) were used to confirm identification. Birds were recorded as observed, heard and through secondary data obtained from amateur birdwatchers, photographers and villagers.

To understand similarity in species composition, both the ecosystems viz. FAPs and NMBS were compared using Sorensen index.

$$S = 2C / (A+B)$$

Where, S = Sorensen index value; C = number of shared species within two ecosystems (123); A: number of species in ecosystem A (FAPs) (128); B: number of species in ecosystem B (NMBS) (199).

Results:

Avian Species Diversity at FAPs and NMBS: FAPs support 128 bird species belonging to 101 genera (Figure 2); NMBS, on the other hand, supports 199 species belonging to 133 genera (Table 1 & 2). According to IUCN redlist of endangered species (http://www.iucnredlist.org/), FAPs show presence of 3 endangered species, whereas NMBS shows presence of 4 endangered species. Endangered species recorded at FAPs include Black headed ibis, Painted stork and Long billed vulture. Some notable sightings at FAPs are that of Greater flamingos and Bar headed geese (Anil Mali,

Fig. 1: Satellite Map of study sites (Google maps). 1A: Satellite map of FAPs. White patch shows dried FAP, green patch shows Ipomoea sp. Growth over FAPs. 1B: Satellite map of NMBS. Dull black color shows backwater of the dam and green patches show small islands formed in the backwater. 1C: FAP Landscape when it dries up.

pers. Observation), Comb duck and Greylag goose. During the surveys, we encountered many instances wherein we could watch courtship and nesting behavior of several bird species (Figure 3). We were able to locate nesting of Wire tailed swallows, Coots, Spotbills, Baya weaver birds and White breasted waterhen. It is evident from these sightings that FAPs act as a breeding ground for many resident as well as few of the migratory birds.

Comparison of FAPs and NMBS: The Sorensen index value calculated for FAP and NMBS is 0.75, which suggests that there is moderately high similarity in species composition across both the systems. 5 species are unique to FAPs which were never seen at NMBS. These include Desert wheatear (Figure 3), Plain prinia, Blyth's reed warbler, Common greenshank and Rosy starling. 76 species are found to be unique to NMBS which are not shared with FAPs.

Diversity of other taxa at FAPs: A number of taxa other than avian taxa can be observed at FAPs (Table 3). We listed some of the mammalian, reptilian and Odonata species during bird surveys. At least 9 mammalian, 9 reptilian and 23 Odonata species were recorded through direct and indirect observations and through villagers' interviews. This data shows that large mammals such as wild boar, leopard etc. (Figure 3) forage in and around FAPs. FAPs are rich in Odonata diversity. The group Odonata being completely dependent on water for their breeding (Subramanian K.A. 2009) suggests that FAPs act as a breeding ground for several Odonata species.

Hunting Pressure on FAPs: FAPs are not legally protected. There is high hunting pressure on these sites. During some instances we observed hunters killing Brahminy shelducks, Lesser whistling ducks (Figure 3), Spotbills etc. Fish nets and ground traps are used to capture ducks when they come out of the pond to rest at the shore.

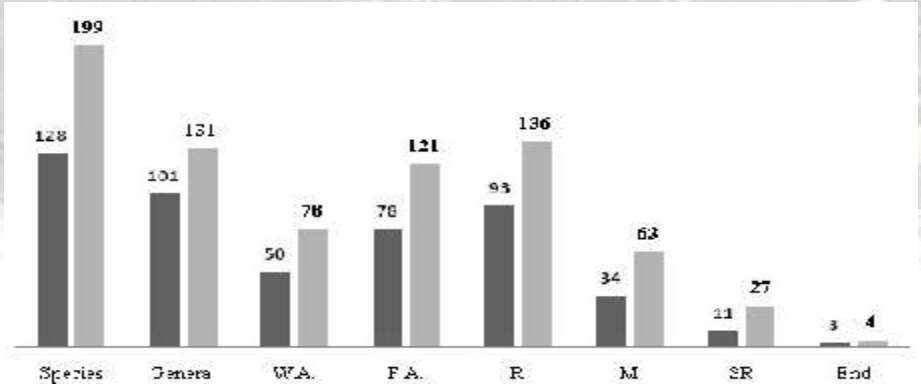

Fig. 2. Residential Status of FAP and NMBS Birds. W.A.: Wetland Associated; F.A.: Scrubland/Agricultural Land Associated; R: Resident; M: Winter Migratory; SR: Scarce Records in and around Nashik (less frequent sightings); End: Endangered Species (According to IUCN 2011 status)

Discussion:

The FAP of NTPS can be divided into three major landscape elements (LSE): wetland, scrubland and agricultural land. Despite the fact that species dependent on scrubland are more in number in the total list (Table 2), the wetland might be acting as a good foraging site for scrubland birds. Many of the forest associated birds (Baya weaver bird, Prinias etc.) were found nesting on Acacia sp. inside FAPs. High diversity at FAPs can be thought to be a function of habitat heterogeneity and net food resource availability. The study site of NMBS can be divided into five major LSEs: wetland, scrubland, agricultural land, grassland/reedbeds, Nilgiri plantation. Although NMBS has greater habitat heterogeneity as compared to FAPs most of the area of NMBS is under wetland which directly reflects in its total number of wetland associated species.

NMBS is an ideal habitat for some of the winter migratory birds and it is an obvious choice as a breeding ground for some. We were able to observe nesting of Streak throated swallows (approx. 50 nests) at NMBS. We suspect that high avian species diversity at FAPs might be contributed by NMBS to some extent. The thought behind this idea can be easily ascertained if one observes the aerial distance between these two sites. Although it takes 41 kms. to travel to NMBS from FAPs via road, by air (Crow flight distance) it is 21 kms. We suspect that birds of NMBS come foraging to FAPs and breed at NMBS. Even if this scenario proves to be true, it does not decrease the value of FAPs as a high avian species diversity wetland.

FA has always been the centre of controversy for many of the power generation stations. FA frequently percolates and contaminates groundwater. During rainy seasons, when FAPs are flooded, agriculture at foothills of FAPs gets adversely affected by deposition of FA. During summer season, FAPs become dried and FA disperses in the agricultural fields via wind. A recent study based on the environmental magnetic analysis of the soil revealed that the FA particles may get dispersed up to a radius of 6 km from FAPs (Basavaiah et al., 2012). Villagers residing near FAPs are badly affected by these problems. The land prizes around FAPs have decreased drastically. FAPs are not legally protected hence; hunting of water birds is frequent at FAPs. From our experience of our study we have developed a strategy (Figure 4), wherein flyash ponds can be converted into eco parks which in turn will protect these sites; at the same time it will provide alternate employment option for those affected by the

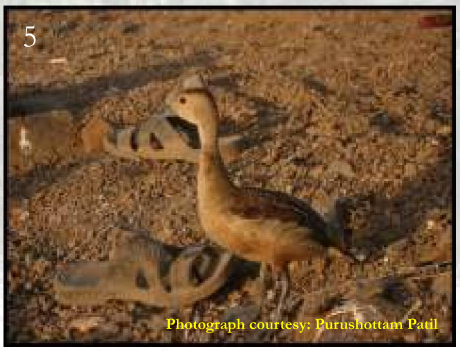

Fig. 3: Fauna observed at the fly ash pond. 1- Leopard pugmark at the dried FAP; 2- Black Winged Stilts, Garganey and Wood Sandpipers Feeding at FAP; 3- Banded Kukari snake at FAPs; 4- Senegal golden dartlets mating at FAPs.; 5- Lesser Whistling Duck captured by hunters

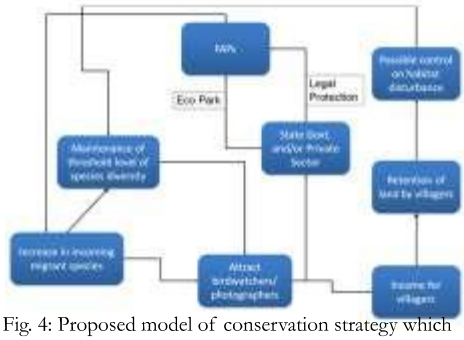

Fig. 4: Proposed model of conservation strategy which can be applied at FAPs

ill effects of flyash.

According to the latest studies on wetlands of India, the Maharashtra state occupies approximately 1 m ha area of inland and/or coastal wetlands (Panigrahy *et al.,* 2012). This is of utmost importance to understand and prioritize the need for conservation of such habitats. Unique new landscapes like flyash ponds are not well studied. Such sites can act as good resource centers for nature education and scientific research.

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Table 1. Comparative Avian Species Account of two Ecosystems: FAPs and NMBS

Species Distribution	**FAPs**	**NMBS**
Species	128	199
Genera	101	131
Wetland Associated	50	78
Forest Associated (Other than Wetland)	78	121
Resident	93	136
Migratory	35	63
Scarce Records in and around Nashik	4	23
Endangered (as listed by IUCN 2011)	3	8
Unique Species	5	76

Table 2: Avian Species Account for Flyash Ponds

No.	Scientific Name	Common Name	R/M	IUCN	WA	No.	Scientific Name	Common Name	R/M	IUCN	WA
1	*Accipitar badius*	Shikra	R	LC	0	65	*Ixobrychus cinnamomeus*	Cinnamon Bittern	R	LC	1
2	*Acridotheres tristis*	Common Myna	R	LC	0	66	*Lanius vittatus*	Bay backed shrike	R	LC	0
3	*Acridotheres fuscus*	Jungle Myna	R	LC	0	67	*Lanius schach*	Long Tailed Shrike	R	LC	0
4	*Acrocephalus dumetorum*	Blyth's Reed Warbler	PV; SR	LC	0	68	*Lonchura malacca*	Black Headed Munia	R	LC	0
5	*Actitis hypoleucos*	Common Sandpiper	R	LC	1	69	*Lonchura malabarica*	Indian Silverbill	R	LC	0
6	*Aegithina tiphia*	Common Iora	R	LC	0	70	*Lonchura punctulata*	Scaly Breasted Munia	R	LC	0
7	*Alcedo atthis*	Common Kingfisher	R	LC	1	71	*Luscinia svecica*	Bluethroat*	R	LC	0
8	*Amandava amandava*	Red Adavat	R	LC	0	72	*Megalaima haemacephala*	Coppersmith Barbet	R	LC	0
9	*Amaurornis phoenicurus*	White Breasted Waterhen	R	LC	1	73	*Merpos orientlis*	Green Bee eater	R	LC	0
10	*Ammomanes phoenicura*	Rufous Tailed Lark	R	LC	0	74	*Mesophoyx intermedia*	Intermediate Egret	R	LC	1
11	*Anas strepera*	Gadwall	M	LC	1	75	*Milvus migrans*	Black Kite	R	LC	0
12	*Anas querquedula*	Garganey	M	LC	1	76	*Mirafra erythroptera*	Indian Bush Lark	R	LC	0
13	*Anas clypeata*	Northern Shoveller	M	LC	1	77	*Motacilla cinerea*	Grey Wagtail	M	LC	1
14	*Anas crecca*	Common Teal	M	LC	1	78	*Motacilla madaraspatensis*	White Browed Wagtail	R	LC	1
15	*Anastomus oscitans*	Asian Openbill	M	LC	1	79	*Motacilla flava*	Yellow Wagtail	M	DD	1
16	*Anser indicus*	Bar Headed Geese*	M	LC	1	80	*Motacilla citreola*	Citrine Wagtail	M	LC	1
17	*Anser anser*	Greylag Goose*	M	LC	1	81	*Mycteria leucocephala*	Painted Stork	M	NT	1
18	*Anthus rufulus*	Paddyfield Pipit	R	LC	0	82	*Nectarinia zeylonica*	Purple Rumped Sunbird	R	LC	0
19	*Apus nipalensis*	House Swift	R	LC	0	83	*Nectarinia asiatica*	Purple Sunbird	R	LC	0
20	*Aquila rapax*	Tawny Eagle	R	LC	0	84	*Nycticorax nycticorax*	Black Crowned Night Heron	R	LC	1
21	*Ardea cinerea*	Grey Heron	M	LC	1	85	*Ocyceros birostris*	Indian Grey Hornbill	R	LC	0
22	*Ardea purpurea*	Purple Heron	M	LC	1	86	*Oenanthe deserti*	Desert Wheatear	M; SR	LC	0
23	*Ardeola grayii*	Indian Pond Heron	R	LC	1	87	*Orhotomus sutorius*	Common Tailorbird	R	LC	0
24	*Athene brama*	Spotted Owlet	R	LC	0	88	*Parus major*	Great Tit	R	LC	0
25	*Bubulcus ibis*	Cattle Egret	R	LC	1	89	*Passer domesticus*	House sparrow	R	LC	0
26	*Burhinus oedicnemus*	Eurasian Thick Knee	R	LC	0	90	*Pavo cristatus*	Indian Peafowl	R	LC	0
27	*Caprimulgus asiaticus*	Indian Nightjar	R	LC	0	91	*Pericrocotus cinnamomeus*	Small Minivet	R	LC	0
28	*Carpodacus erythrinus*	Common Rosefinch	M	LC	0	92	*Phalacrocorax niger*	Little Cormorant	R	LC	1
29	*Centropus sinensis*	Southern Coucal	R	LC	0	93	*Phoenicopterus ruber*	Greater Flamingos*	M	LC	1
30	*Cercomela Fusca*	Brown Rockchat	R	LC	0	94	*Phoenicurus ochruros*	Black Redstart	M	LC	0
31	*Ceryl rudis*	Pied Kingfisher	R	LC	1	95	*Platalea leucorodia*	Eurasian Spoonbill	M	LC	1
32	*Charadrius dubius*	Little Ringed Plover	R	LC	1	96	*Platalea leucorodia*	Eurasian Spotbill	R	LC	1
33	*Chrysomma sinense*	Yellow Eyed Babbler	R	LC	0	97	*Plegadis falcinellus*	Glossy Ibis	M	LC	1
34	*Ciconia episcopus*	Wooly Necked Stork	M	LC	1	98	*Ploceus philippinus*	Baya weaver bird	R	LC	0
35	*Circus aeruginosus*	Eurasian Marsh Harrier	M	LC	1	99	*Porphyrio porphyrio*	Purple Swamphen	R	LC	1
36	*Cisticola juncidis*	Zitting Cisticola	M	LC	0	100	*Prinia socialis*	Ashy Prinia	R	LC	0
37	*Columba livia*	Rock Pigeon	R	LC	0	101	*Prinia inornata*	Plain Prinia	R	LC	0
38	*Copsychus saularis*	Magpie Robin	R	LC	0	102	*Pseudibis papillosa*	Black Ibis	R	LC	1
39	*Coracious benghalensis*	Indian Roller	R	LC	0	103	*Psittacula krameri*	Rose Ringed parakeet	R	LC	0
40	*Corvus splendens*	House Crow	R	LC	0	104	*Pycnonotus cafer*	Red vented Bulbul	R	LC	0
41	*Corvus macrorlynchos*	Large Billed Crow	R	LC	0	105	*Rhipidura albigularis*	White Spotted Fantail	R	LC	0
42	*Coturnix coromandelica*	Rain Quail	R	LC	0	106	*Sarkidiornis melanotus*	Comb Duck	M	DD	1
43	*Dendrocygna javanica*	Lesser whistling duck	R	LC	1	107	*Saxicola torquata*	Common Stonechat	M	LC	0
44	*Dicaeum erythrorlynchos*	Pale-billed Flowerpecker	R	LC	0	108	*Saxicola caprata*	Pied Bushchat	R	LC	0
45	*Dicrurus leucophaeus*	Ashy Drongo	M	LC	0	109	*Saxicoloides fulicata*	Indian Robin	R	LC	0
46	*Dicrurus macrocercus*	Black Drongo	R	LC	0	110	*Steptopelia chinensis*	Spotted Dove	R	LC	0
47	*Egretta garzetta*	Little Egret	R	LC	1	111	*Sterna aurantia*	River Tern	R	LC	1
48	*Elanus caeruleus*	Black shouldered Kite	R	LC	0	112	*Streptopelia decaocto*	Eurasian Collared Dove	R	LC	0
49	*Erempotera grisea*	Ashy Crowned Sparrow Lark	R	LC	0	113	*Streptopelia senegalensis*	Laughing Dove	R	LC	0
50	*Eudynamys scolopacea*	Asian Koel	R	LC	0	114	*Sturnus pagodarum*	Brahminy Starling	R	LC	0
51	*Falco tinnunculus*	Common Kestrel	M	LC	0	115	*Sturnus roseus*	Rosy starling	M; SR	LC	0
52	*Falco peregrines*	Peregrine Falcon	R; SR	LC	0	116	*Tachybaptus ruficollis*	Little Grebe	R	LC	1
53	*Fulica atra*	Common Coot	R	LC	1	117	*Tadorna ferruginea*	Brahminy ducks	M	LC	1
54	*Gallinago gallinago*	Common Snipe	M	LC	1	118	*Threskiornis melanocephalus*	Black Headed Ibis	R	NT	1
55	*Gallinula chloropus*	Common Moorhen	R	LC	1	119	*Tringa ochrpous*	Green Sandpiper	M	LC	1
56	*Gyps indicus*	Long-billed Vulture	R; SR	CE	0	120	*Tringa glareola*	Wood Sandpiper	M	LC	1
57	*Halcyon smyrnensis*	White breasted Kingfisher	R	LC	1	121	*Tringa nebularia*	Common Greenshank	M	LC	1
58	*Haliastur indus*	Brahminy Kite	R	LC	0	122	*Turdoides caudatus*	Common Babbler	R	LC	0
59	*Himantopus himantopus*	Black winged stilt	M	LC	1	123	*Turdoides striatus*	Jungle Babbler	R	LC	0
60	*Hirundo rustica*	Barn Swallow	M	LC	0	124	*Turdoides malcolmi*	Large Grey Babbler	R	LC	0
61	*Hirundo concolor*	Dusky Crag Martin	R	LC	0	125	*Upupa epops*	Common Hoopoe	R	LC	0
62	*Hirundo daurica*	Red Rumped Swallow	R	LC	0	126	*Vanellus atrounchalis*	Red Wattled Lapwing	R	LC	1
63	*Hirundo smithii*	Wire Tailed Swallow	R	LC	0	127	*Zoonavena sylvatica*	White Rumped Needletail	R;SR	LC	0
64	*Hydrophasianus chirungus*	Pheasant Tailed Jacana	R	LC	1	128	*Zosterops palpebrosus*	Oriental White Eye	R	LC	0

*: As told by Birdwatchers/Photographers/Local Villagers/Hunters; Bold letters refers to birds which are unique to FAPs; R: Resident; M: Migratory; PV: Passage Visitor; SR: Scarse Records in and around Nashik; LC: Least Concern; NT: Near Threatened; CE: Critically Endangered; DD: Data Deficient; WA: Wetland Associated

Table 3: Mammalian, Reptilian and Odonata Fauna of FAPs

I. Mammalian Data

Common Name of Mammals	Scientific Name	IUCN	Status Remarks
Indian Grey Mongoose	*Herpestes edwardsii*	LC	
Indian Palm squirrel	*Funambulus palmarum*	LC	
Indian Hare	*Lepus nigricollis*	LC	
Indian Wild Boar	*Sus scrofa*	LC	
Small Indian Civet	*Viverricula indica*	LC	dead individuals
Leopard	*Panthera pardus*	NT	Pugmarks, local news
Indian Fox	*Vulpes bengalensis*	LC;	decreasing as told by local villagers

II. Reptilian Data

Common Name of Reptiles	Scientific Name	IUCN Status
Oriental Garden Lizard	*Calotes versicolor*	DD
Spectacled Cobra	*Naja naja*	DD
Striped Keelback	*Amphiesma stolatum*	DD
Checkered Keelback	*Xenopus picsator*	DD
Common Kukri Snake	*Oligodon arnensis*	DD
Green Keelback	*Macropisthodon plumbicolor*	DD
Oriental Rat Snake	*Ptyas mucosus*	DD
Indian Skink	*Sphenomorphus indicus*	DD
Common Indian Monitor Lizard	*Varanus bengalensis*	LC, decreasing

III. Odonata Data

No.	Common Name of Odonates	Scientific Name
Dragonfly		
1	Blue Tailed Green Darner	*Anax guttatus*
2	Common Clubtail	*Ictinogomphus rapax*
3	Common Hooktail	*Paragomphus lineatus*
4	Trumpet Tail	*Acisoma panorpoides*
5	Ditch Jewel	*Brachythemis contaminate*
6	Granite Ghost	*Bradinopyga geminata*
7	Ruddy Marsh Skimmer	*Crocothemis servilia*
8	Ground Skimmer	*Diplacodes trivialis*
9	Pied Paddy Skimmer	*Neurothemis tullia*
10	Blue Marsh Hawk	*Orthetrum glaucum*
11	Crimson Tailed Marsh Hawk	*Orthetrum pruinosum*
12	Green Marsh Hawk	*Orthetrum sabina*
13	Wandering Glider	*Pantala flavescens*
14	Yellow Tailed Ashy Skimmer	*Potamarcha congener*
15	Red Marsh Trotter	*Tramea basilaris*
16	Long Legged Marsh Glider	*Trithemis pallidinervis*
17	Pygmy Dartlet	*Agriocnemis pygmaea*
Damselfly		
18	Coromandel Marsh Dart	*Ceriagrion coromandelianum*
19	Golden Dartlet	*Ischnura aurora*
20	Senegal Golden Dartlet	*Ischnura senegalensis*
21	Blue Grass Dartlet	*Pseudagrion microcephalum*
22	Saffron Faced Blue Dart	*Pseudagrion rubriceps*
23	Emerald spreadwing	*Lestes elatus* Hagen