



# JOURNAL OF ECOLOGICAL SOCIETY

Vol.s 13 and 14, 2000-2001

**Biodiversity Profile of an Urban Area  
Special Double Issue**

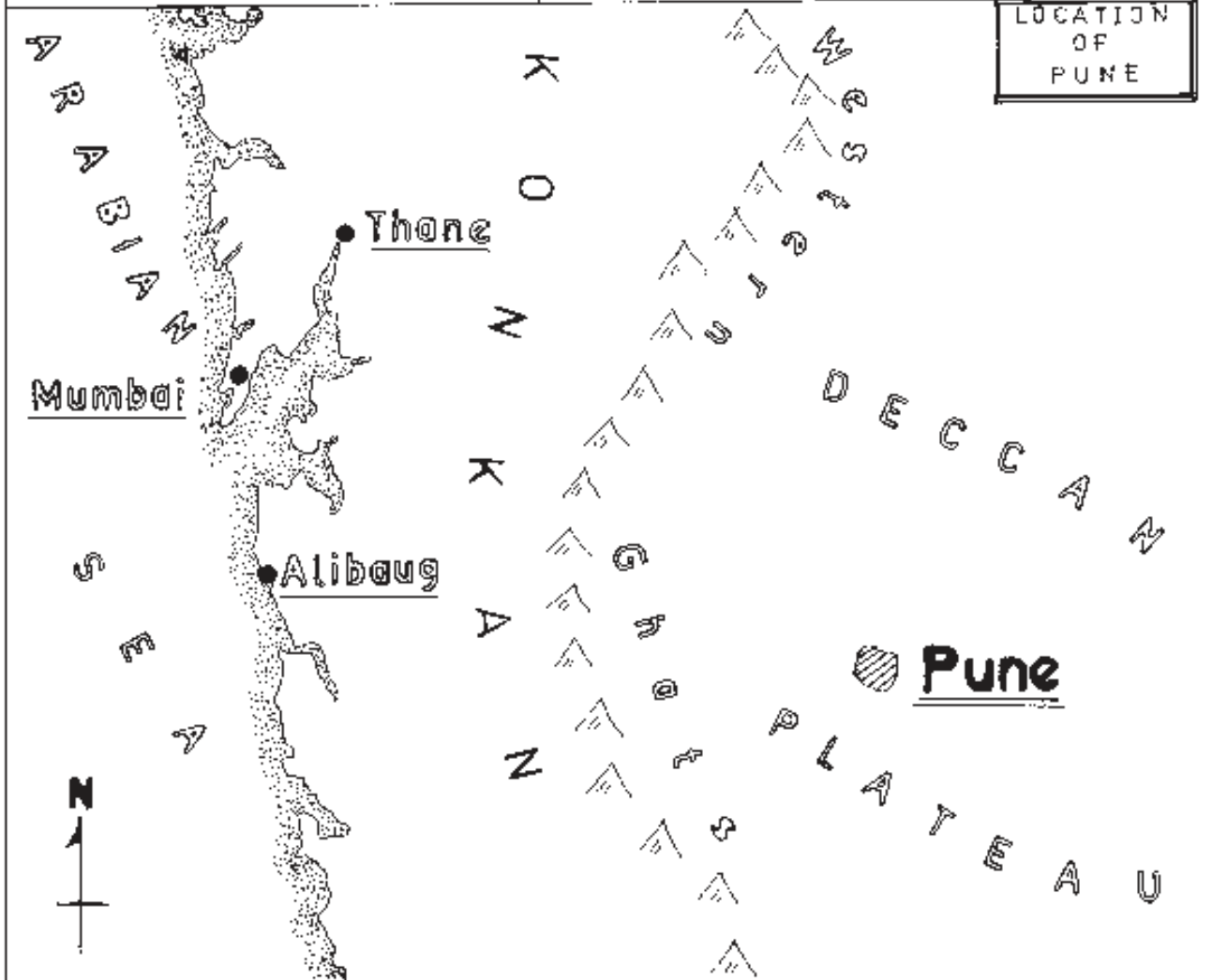
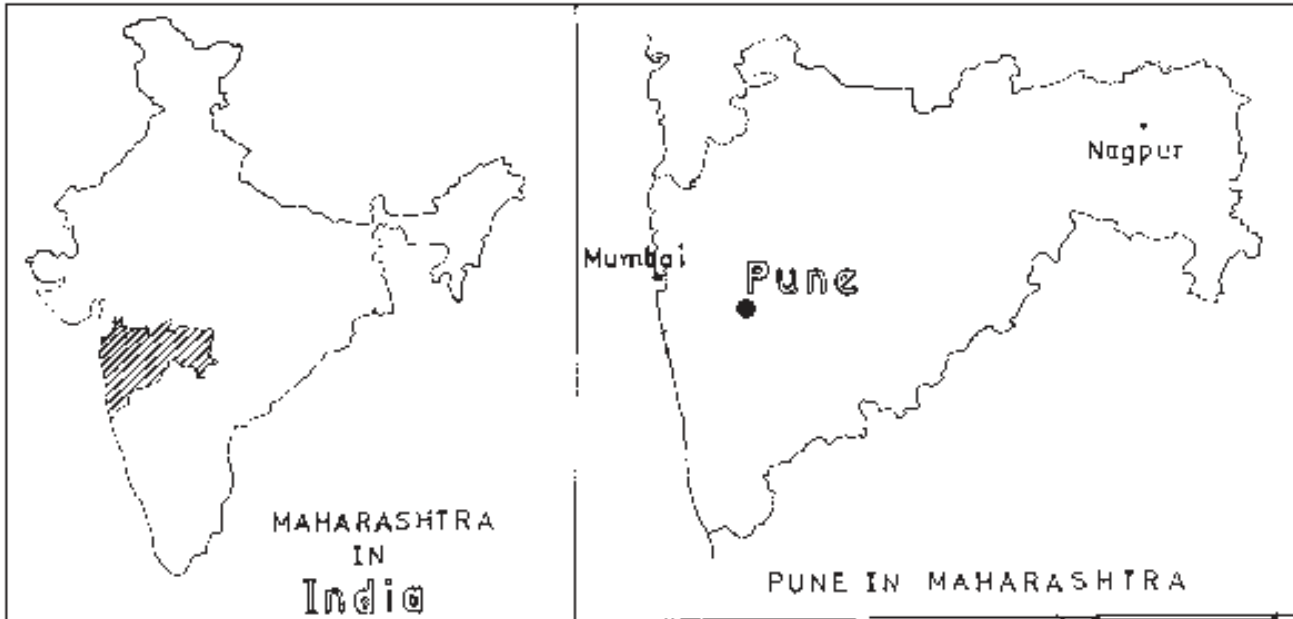


## Foreword

Urban biodiversity sounds like a misnomer! What diversity of (non-human) life a burgeoning city with three million plus human population is likely to retain? The proof of the pudding is in eating. Here is a gallant attempt to draw a picture of the extant biodiversity of the Pune urban area based on field-work. Enthusiastic collegians under the guidance of their teachers have probed various natural and urban habitats to complete this picture. The wherewithal was provided by 'Ranwa', a Pune-based NGO deeply interested in the study and conservation of nature. The guest editors for this volume, Prof. Sanjeev Nalavade and Utkarsh Ghate, themselves involved in inspiring this effort have painstakingly edited the available material to give a shape and form that is at once interesting and informative. Hopefully this effort will prove a bench-mark and a useful guide in formulating the future development policies and plans of the Pune urban area. This special double issue is grandly embellished by excellent photographs. Thanks to the contribution made by leading nature photographers of Pune.

The web of life that still permeates our urban setting proves the tenacity and adaptive capacities of natural beings in the face of insuperable odds. Notwithstanding the loss of invertebrates and fish species and some of the interesting birds, nature shows extraordinary capabilities to cling to whatever habitat traces that remain. We, the citizens of Pune, must remember that the biodiversity pictured here is not because of any conscious efforts on our part. On the contrary, in the name of development, our efforts are assiduously directed to change and destroy all kinds of natural habitats to be replaced by man-made ones. If only the individual citizen and his representatives, the policy-makers and bureaucrats could understand the necessity and importance of retaining natural habitats, the picture would have been different. Environmental protagonists are always accused of being sentimental and making claims without the foundation of a data base and scientists are accused of collecting and presenting data which have little relevance in making plans and policies. Increasingly however, both environmentalists and scientists are becoming conscious of their duties and responsibilities in setting up a sound data base and presenting it in a usable form. The present effort hopes to be a contribution in spirit and content in this right direction.

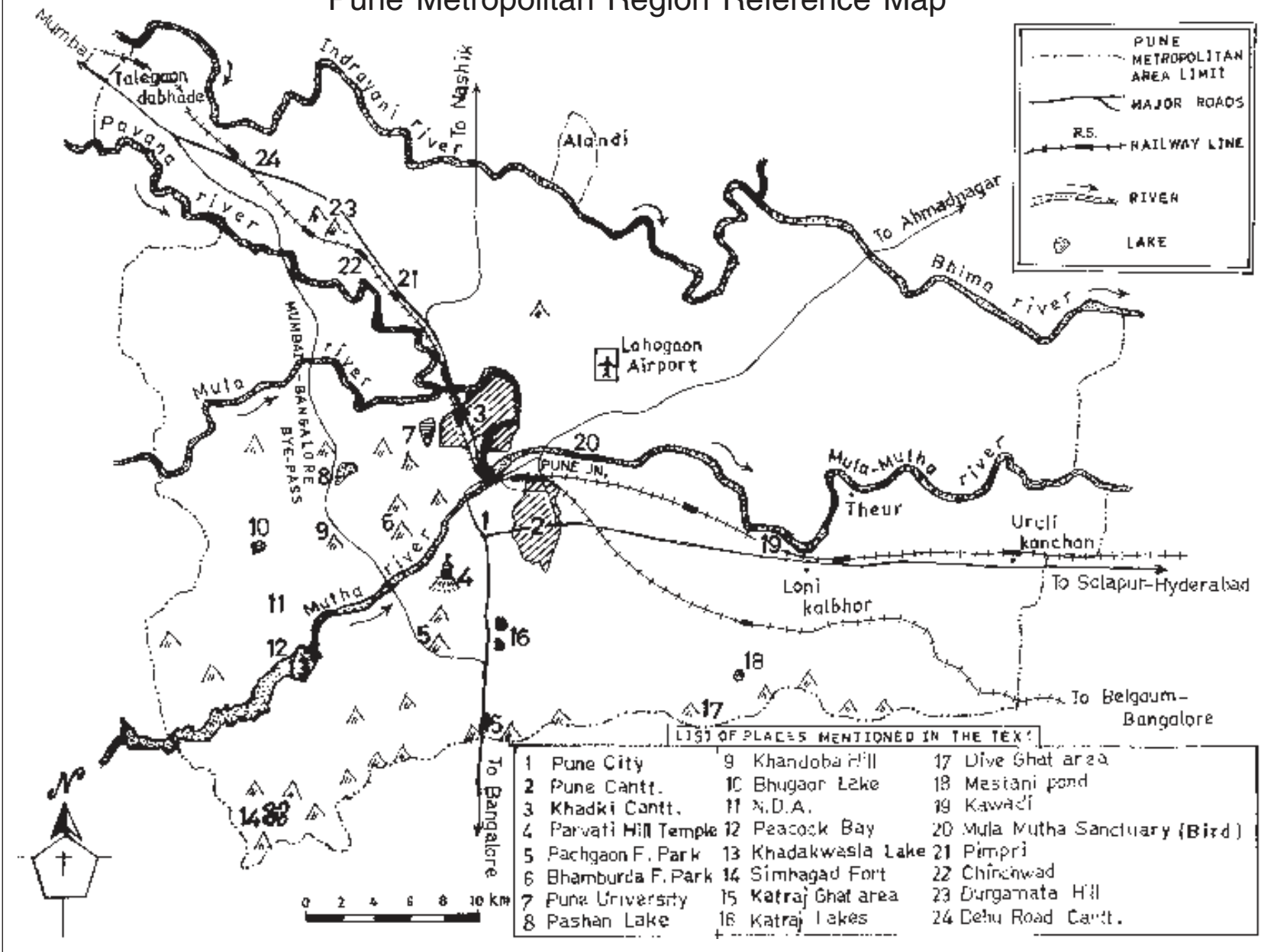
Prakash Gole



## Contents

Changing Geography of Pune Urban Area .....	5
<i>S. B Nalavade</i>	
Pune Urban Biodiversity : A Case of Millennium Ecosystem Assessment ....	8
<i>A. Dixit, S. Nalavade, G. Utkarsh</i>	
Fungal Genera Distribution Across Pune City .....	14
<i>P. Y Lamrood and J. G. Vaidya</i>	
Herb Diversity of Some Habitats of Pune City .....	18
<i>Anagha Ranade</i>	
Tree Diversity of Pune Urban Area : Cosmetic Increase? .....	21
<i>Ankur A. Patwardhan and R. V. Gandhe</i>	
Aquatic Insects and Molluscs of Pune City .....	34
<i>Rupesh N. Raut, Shruti Desai, Rohini Bapat and S. S. Kharat</i>	
Ant Genera Distribution Across Habitats of Pune City .....	37
<i>Tejaswini Pachpor, Yogita Ghodke, and Anand Padhye</i>	
Butterfly Diversity of Pune City along the Human Impact Gradient .....	40
<i>Krushnamegh Kunte</i>	
Decline of Fresh-Water Fish of Pune Urban Area .....	46
<i>S. S. Kharat, Neelesh Dahanukar and Rupesh Raut</i>	
Amphibian Species Decline in Pune City .....	52
<i>A. D. Padhye and Mukul Mahabaleshwarkar</i>	
Reptiles of Pune Urban Area : Increase or Decline? .....	55
<i>Sanjay Thakur and Vivek Gour-Broome</i>	
Bird Diversity Changes of Pune Urban Area .....	59
<i>S. Ingalthalikar, R. Purandare, S. Nalavade and S. Dhole</i>	
Bat Fauna of Pune City .....	71
<i>K. D. Yardi and V. S. Korad</i>	
Retreating Wild Mammals of Pune Urban Area .....	74
<i>Sanjeev B Nalavade</i>	

# Pune Metropolitan Region Reference Map



4

Prepared by Prof. S. B. Nalavade, Pune

## Changing Geography of Pune Urban Area

*S. B Nalavade*

Pune, formerly known as Poona is one of the most important cities of Western India, aptly called the 'Queen of the Deccan' after its elevated position atop the Deccan Plateau, its salubrious climate and surrounding hills. The city is nicknamed variously such as 'Pensioner's Paradise', the 'Oxford of East', 'Detroit of India', the 'cultural capital of Maharashtra', once the 'Cycle city' and now the 'Scooter city' of S. India and upcoming 'IT-BT' capital of India.

### **History**

From a tiny agricultural settlement called 'Punnaka' in the 8<sup>th</sup> century, the city has grown into a metropolis covering more than 700 sq. km. area and supporting about 4 million people. The tiny settlement of the 8<sup>th</sup> century developed into a small town - 'Kasbe Pune', during the 11<sup>th</sup> century under the Moghals. Since then till 1817, the city changed hands from one dynasty to the other, especially between the Moghals and the Marathas. During the mid-17<sup>th</sup> century, the city became the temporary residence of Shivaji. The city rose to prominence when the Peshwas established the 'Seat' of Marathas empire here (1749 A.D.). During the Peshwa's rule, the City expanded considerably. The 1761 defeat at Panipat affected the fate of the Maratha Empire and consequently that of the city. The Maratha rule came to an end at Khadki near Pune, in 1817 when the British defeated them and the city and the environs came under the British rule. Under the British, Pune became the 'Monsoon Capital' of the then Bombay Presidency. The Army bases established by the British on the city's outskirts, were later converted into the cantonments of Pune and Khadki. The Rail-

way rolled into Pune from Mumbai in 1856. Pune Municipality was established in 1858. A number of educational institutes also came up here: the Deccan College (one of the oldest in western India), Engineering College (second oldest in the Subcontinent), Fergusson College (amongst ten most reputed in India), Agricultural College (one of the earliest in the country) to name a few. Pune also houses many research institutes of national and international repute. Pune is also the Headquarters of the Southern Command and has many other defense establishments. The important events in the city's growth and development include the development of Deccan Gymkhana and other colonies across the river in 1920's, the establishment of Pune Municipal Co-operation in 1950, influx of refugees from Pakistan (1948-'50), the establishment of an industrial estate in Pimpri-Chinchwad (1960) and the Panshet deluge (1961).

### **Physical Settings and Climate**

Pune (18° 31' N, 73° 51' E) is a plateau city situated near the western margin of the Deccan plateau. It lies on the leeward side of the Sahyadri i.e. the Western Ghats and is hardly 50 km from the crest of the Ghat country. As the crow flies, it is 100 km east from the Konkan i.e. the west coast. It is almost 160 kms south-east of Mumbai, by road. It is situated at a height of 560m above the mean sea level, near the confluence of the Mula and Mutha rivers. Two more rivers, the Pavana and the Indrayani traverse the north-western outskirts of the urban area. The Mula-Mutha river later empties into the Bhima river. In a sense, the city is located in the upper Bhima basin. The city is sur-

**Table 1 Areal Expansion : Pune City and Pune Urban Areas**

Year	Area (sq.km)		Reason for expansion
	Pune City	Pune urban area	
1817	5.0	-	-
1860	7.6	34.71	Formation of Pune Municipality, establishment of Pune and Khadki cantonments.
1940	18.84	81.95	Establishment of Dehuroad cantonment
1950	125.75	188.86	Pune Municipal Corporation formed
1970	138.76	266.88	Pimpri-Chinchwad Municipal Council established
1982	146.00	314.11	Pimpri-Chinchwad Municipal Corporation formed
1997	440.00	700.00	Merging of 38 and 18 fringe villages in to Pune and Pimpri-Chinchwad Municipal Corporations respectively

rounded by hills on the west and the south. The Simhagad-Katraj-Dive ghat range is the southern boundary of the urban area. The highest point within the city is the Vetil hill (800 m) whereas the highest point of the urban area is the Simhagad fort (1400 m).

The climate is typical monsoonal, with three distinct seasons – summer, rains and winter, as elsewhere in India. The height above sea level and the leeward location with reference to the Western ghats have made the city climate moderate and salubrious. The mean daily maximum and the mean minimum for the hottest month – May – is 37<sup>o</sup> Celsius and 23<sup>o</sup> Celsius respectively. The evening sea breeze from west/north-west keeps the city summer nights at bearable levels. The same for the coldest month of December are 30<sup>o</sup> Celsius and 12<sup>o</sup> Celsius respectively. The relative humidity ranges from 36% in March to 81% in August. Three fourths of the annual rainfall of 70 cm occurs in just four months from June to September.

**The Growth in Population and Area**

When the British captured Pune by defeating the Marathas (1818), the city was hardly 5 sq. km. in extent. The city gradually expanded during the British rule with the formation of Pune Municipality and the establishment of Pune, Khadki and Dehuroad cantonments. The city expanded explosively in the post independence period. The physical growth of the city and of the urban area since 1818 and the reasons therein are shown in the table 1. During the 180 yr period (1817-1997), the Pune urban area has grown from a mere 5sq.km to 700sq.km which is 140 times the original area! Table 2 shows that between 1901 and 2001 (estimated) Pune’s urban population has grown

from 1.64 lakh to about 42 lakh (estimated figure for 2001) which is 25 times the original figure. The density of population of Pune city was 8672 persons per sq. km (1981), whereas it was about 5000 persons per sq. km for Pune urban area.

**Change in Landuse**

During the 1970’s the urban activities spilled beyond the erstwhile city limits and it was felt that for comprehensive and integrated planning, a metropolitan region converging on Pune be defined. Accordingly, Pune metropolitan region was established in July, 1967. Pune urban area or agglomeration as recognised by Central Govt. includes the areas under Pune and Pimpri-Chinchwad Municipal Corporations, Pune, Khadki and Dehu Road Cantonments, Talegaon

**Table 2 Population Growth of Pune Urban Area**

Year	Population (in lakh)
1901	1.64
1911	1.72
1921	1.98
1931	2.50
1941	3.24
1951	6.00
1961	7.37
1971	11.35
1981	16.86
1991	24.94
2001	42.00 (estimated)

**Table 3 Landuse change in Pune Metropolitan Region**

Landuse Category	Area Under Each Category (%)	
	1967*	1998+
Settlements	17.33	41.00
Agriculture	61.26	42.11
Watersheets	02.25	02.25
Hills and Forest	07.64	07.64
Grassland and scrub	11.52	07.00
Total	100.00	100.00

Source : \* Anon 1970, + Author

and a few semi-urbanised villages on the periphery. The total Pune urban area is about 700 sq. km. The total area of Pune metropolitan region is 1605 sq. km. The study area for the 'Pune alive project' described in this volume is by and large within 30 km of the city centre. The study area more or less coincides with the metropolitan area. Hence for comparative study, landuse figure for the metropolitan region has been taken into consideration (Table 3). Following changes appear striking between 1967 and 1998

- i) The area under settlement has increased 2.4 times during these 30 yrs.

- ii) The area under Agriculture and Grassland-Scrub has decreased by 31% and 39% respectively.
- iii) The area under 'Hills and Forests' and watersheets has remained apparently the same, though there are some encroachments over some hillslopes.

To conclude, the urban sprawl appears to be at the cost of Agriculture and especially Grassland-Scrub habitats.

### Bibliography

- Anon 1885 Poona District Gazetteer. Government Central Press, Bombay.
- Anon 1970. Summary of Regional Plan for Poona Metropolitan Region : 1970-1991. Government Press, Pune.
- Anon 1986. District Census Handbook, Government Press, Pune.
- Anon 1991. Census statistics- 1991. The Maharashtra Census Directorate, Bombay.
- Anon, 1998. IRS-1D : PAN+LISS 3 image of Pune urban area. National Remote Sensing Agency (NRSA), Hyderabad.
- Anon, 2000. 'India-2000 : Observer Statistical Handbook. Observer Research Foundation, Delhi.
- Diddee Jaymala and Gupta Samita. 2000. Pune - Queen of the Deccan. Elephant Design Pvt. Ltd. Pune.
- Mangudkar, M. P. 1960. Poona Municipal Body Centenary Volume. Poona Municipal Corporation, Poona.
- Sawant, P. B. 1978. The City of Poona. University of Pune, Pune.

□





## **Pune Urban Biodiversity : A Case of Millennium Ecosystem Assessment**

*A. Dixit<sup>1</sup>, S. Nalavade<sup>2</sup> and G. Utkarsh<sup>3</sup>*

### **Introduction**

Love for nature resides amongst all of us, goes the Biophilia hypothesis (Wilson, 1984). This often translates into curiosity and subsequently, careful observation of the environment. Few have both the inclination and the resources to pursue such studies. Such amateur naturalists frequent cities that are centres of education and wealth. Ironically, flourishing cities made up of manmade capital survive by eroding their natural capital. This prompts the naturalist to lament and protest in vain, the so-called development activities that only destroy nature. Lack of good, useful information is a major reason for such shortsighted, unsustainable development. Naturalists have important perceptions about changing environment of the city but rarely record and project those to generate sharp arguments. A strong scientific argument can help, if not guarantee environmental protection. Thus naturalists do not help nature if they fail to build substantive arguments. Some naturalists from Pune, decided to make a difference by overwhelmingly responding to a call by a city-bred NGO, RANWA (Research and Action in Natural Wealth Administration). Incidentally, 'ranwa' means 'wilderness' in vernacular and is a term coined by the editor of this journal Prakash Gole. The enthusiastic response to RANWA's appeal was spearheaded by the Abasaheb Garware College (AGC) faculty and students. This academic collaboration amongst naturalists together with academicians began earlier this year, strength-

ened and refined by about half a dozen meetings over the year, leading to this publication in the millennium year due to generous help from various quarters! In part, this study was triggered by the vision motivated by the local millennium ecosystem assessment exercise pioneered by Indian Institute of Science (IISc), Bangalore and coauthored by some of us (Gadgil *et al*, 2000).

### **Methodology**

Unlike the above assessment, we had neither financial nor human resources to investigate the non-living ecosystem components such as soil and water parameters or even air pollution. We attempted to make the best with available human resource, exposed to natural history through earlier efforts like the IISc's college network involving the AGC (Gadgil, 1996 b). Our approach stemmed from the belief that living organisms serve as reliable ecosystem indicators (Hawksworth, 1995). We began by standardising the methodology so that results across organismic groups become comparable and relate to levels and kinds of human impacts. Thus, a common definition of land and water habitats was arrived at through discussion and literature survey. These habitat types, specified in each organismic manuscript in this volume, are macrohabitats, ranging over the hectare scale (Gadgil, 1996 a). Information on microhabitat i.e. meter scale is also available but not analysed for this publication, which only aims to generate a preliminary, broad scale understanding. The land habitat types, roughly

1. President, RANWA and Reader, Physiology Dept., Dental College, Bharati Vidyapeeth, Pune 411043  
2. Head, Dept. of Geography, Ferguson College, Pune 411 004. Email : nalawade123@vsnl.net  
3. Secretary, RANWA, C-26/1 Ketan Heights, Kothrud, Pune 411 029. Email : utkarshg@hotmail.com

in the decreasing order of relative human influence include : forest (F), scrub (S), grasslands (G), plantations (P), agriculture (A) and habitations (H). The first three habitat types constitute the wilderness (W) zone while the latter three types constitute the impacted (I) zone. The aquatic ecosystem classification remained at a broad level – low (W) and high (I) impact zones.

After standardising the sampling strata, a qualitative sampling scale was designed to rank the abundance/frequency of encounter of species, as we had only a few systematic counts available and that too for a few groups. To cope with the considerable inter-observer variation, we used the ordinal ranking popular amongst naturalists, with qualitative categories like abundant, common, occasional and rare, besides stray. Preferred habitat type of each species around Pune city is indicated in each manuscript, except the stray species. As a matter of fact, aquatic insects could be identified only up to family level while ants and fungi up to genus level.

Sampling intensity varied across organismic groups. For instance, birds are the most intensively studied organisms with many birdwatchers pooling their observations for decades together. In contrast, aquatic invertebrates or ants were seldom studied here earlier, resulting in poor literature. There is no illusion that this volume is a complete and accurate inventory. We believe that this first comprehensive record will trigger debate, criticism, relevant observation and publications, even elsewhere. Further, while invertebrate records are mostly only recent, records of vertebrates or trees indicate species not recorded recently, but reported from literature. This has indeed made this effort a millennium assessment both symbolically and literally! The focus being diversity, no wonder that presentations in this volume have variously evolved. Thus, while Kharat *et al* carefully discriminate driving forces of decline in fish diversity, Patwardhan partitions reported increase in tree diversity to observer biases and errors. Yardi and Korad have shown now intensive and allout search can reveal many new bat species hither to unknown to the region. While habitat typology remains the focal theme of investigation for most groups, emphasis has been given on specific localities of occurrence in case of lower or sedentary groups like ants or fungi.

The study area has a radius of about 30 km from the City Post office. The study area is termed as 'Pune Urban Area' measuring about 700 sq. km and consists of Pune and Pimpri-Chinchwad Municipal Corporations besides cantonments at Pune, Khadki and Dehuroad. It also includes Talegaon and a few semi-

urban villages in the adjoining area including the Sinhagad fort, a favourite nature study spot. The area is situated on the Deccan plateau in the transition zone leading to Western Ghats mountains to the West.

## Results and Discussion

Table 1 depicts the citywise diversity levels for various organismic groups, with only ant diversity being considerably underestimated. Pune urban area appears to shelter between a third to over two thirds of the total taxic richness reported for vertebrate groups from the whole of the Deccan plateau (Nagalu *et al.* 2000). In part, this high diversity relative to a small expanse can be attributed to location of Pune city in the transitional zone between dryland plateau and moist mountains, connected to the city through hills. This largely explains the higher diversity of Pune urban area than the levels reported for most groups from Bangalore (Karthikeyan, 1999) and Delhi (Anon, 1997). Interesting biogeographic patterns include much lower fish and mammal diversity at Bangalore than Pune, the latter being much better connected to the Western Ghats through rivers and mountains. The Himalayan influence probably explains much higher diversity of birds and fish at Delhi, notwithstanding much lower levels for other groups. Some of these differences can be attributed to differing sampling intensity across cities and groups. To address this difficulty, Gadgil *et al* (2000) provide an interesting statistical technique to estimate total taxonomic richness from distinct subsamples, such as locality wise

**Table 1 Biodiversity of Some Indian Cities**

Group	Unit	Pune <sup>+</sup>	Bangalore*	Delhi <sup>†</sup>
Fungi	Genus	65		
Herbs	Species	600		
Trees	Species	350		
Aquatic insects	Family	13		
Snails	Species	15		23
Ants	Genus	12	73	
Butterflies	Species	105	130	50
Fishes	Species	70	40	87
Amphibians	Species	14	15	7
Reptiles	Species	50	37	25
Birds	Species	300	315	434
Mammals	Species	65	40	32

+ Present study, \* Karthikeyan (1999), † Anon (1997)

data on occurrence of ants. In any case, the comparison highlights that Indian cities also host phenomenal levels of biodiversity and a few, such as Mumbai or Chennai host even wildlife reserves alongside skyscrapers. This matches the trends elsewhere on the globe (Burton, 1977).

Table 2 indicates that various organismic groups differ considerably with respect to their diversity distribution across habitat types and human impact levels. Some groups such as butterflies, reptiles and mammals have almost all their species recorded from wilderness zone while nearly two thirds of them occur in forests. In contrast, diversity of fungi, herbs and trees seems to be as much or more in impacted habitats than in low impact zone. The biodiversity is lower in impacted habitat types in case of sensitive organisms like the fish (Kharat *et al*, this volume) or birds (Ingalhallikar *et al*, this volume) than the less sensitive organisms such as ants (Pachpore *et al*, this volume). Notwithstanding the maintenance of considerable species richness amidst urban habitats, some unique species are even wiped out under human impact, only to be replaced by more tolerant species owing to suitable life attributes like dispersal abilities. Such species substitution explains higher species richness in habitat types such as scrub (a result of moderate human impact), harbouring greater diversity than the most or least impacted habitats. While the habitat approach

adopted here highlights a broader picture, much remains to be projected in terms of finer impacts such as loss of squirrel or snake populations due to conversion of old houses in the city into skyscrapers.

The results confirm the widely known trends of an increase in species diversity with moderate disturbance, though severe human influence tends to erode the diversity, except a few stress tolerant species, often having cosmopolitan distribution and wide habitat choice (Daniels *et al*, 1990). Further, rather than the total species diversity, human impact critically affects the diversity of unique species like habitat specialists as also emphasised by Daniles *et al* (1990). Another notable trend is lack of tight correlation across organismic groups, in response to similar human influence as reported in the literature (Kunte *et al*, 1999). For instance, while fish species seem to be sensitive to levels of pollution, besides harvest or introduction of exotic species, aquatic invertebrates appear much less sensitive, notwithstanding the sensitivity mentioned in the literature (Raut *et al*, this volume). The higher diversity recorded in some moderate or high human impacted zones such as the city heart or home gardens must not mislead one to undervalue the less impacted zones like the hill forests surrounding the city. For, these continue to be the biodiversity source while most urban habitats serve merely as sinks, unable to sustain the diversity on their own. For instance, nearly

**Table 2 Habitat level covariation of diversity and exclusivity across organismic groups : Pune Urban Area**

Group	Unit	Total Urban	% OF TOTAL DIVERSITY								% UNIQUENESS <sup>#</sup>								
			*F	S	G	A	P	H	W	I	F	S	G	A	P	H	W	I	
Fungi	Genus	65	65					95	40	80	95	5				25	-	5	25
Herbs	Species	600	20	10	15	10	20	40	45	55									
Trees	Species	350	25	15			65	15	35	65	75	65			80	10	95	95	
Aquatic insects	Family	13							75	70								40	20
Snails	Species	15							60	70								50	40
Ants	Genus	12	45		35	35	65	35	50	70	20		-	-	-	20	25	15	
Butterflies	Species	105	70	75	40	70	55	35	95	70	15	3	-	-	-	-	25	3	
Fish	Species	70							100	50								30	10
Amphibians	Species	14							100	60								35	-
Reptiles	Species	50	60	40	40	45	50	15	80	55	25	5	-	-	-	10	25	5	
Birds	Species	300	35	50	15	30	25	10	95	35	35	5	5	-	-	-	60	5	
Mammals	Species	65	60	30	15	30	20	20	65	55	30	10	6	-	-	6	30	6	

\* F = Forest, S = Scrub, G = Grassland, A = Agriculture, P = Plantation, H = Habitation, W = Wilderness (F, S, G), I = Impacted (A, P, H)

# Uniqueness reflects the proportion of exclusive species to the total that inhabit a given habitat type / zone.

a fifth of the butterfly species emerge from their food plants confined to the hill forests (Kunte, this volume) which also exclusively host over a sixth of the bird species, seldom seen elsewhere in the city campus (Ingalhallikar *et al*, this volume). Thus, bird or butterfly richness in the city gardens is inconceivable without the hill forests.

Table 3 presents the past and present landscape composition and ongoing changes, based on perceptions, besides records (Nalavade, this volume). Pune urban area has been expanding at an average rate of about 500m per year for the last two decades or so. Human habitations are encroaching upon the farm land and orchards of the fringe villages. The most suffered habitat type has perhaps been riverine vegetation especially babul (*Acacia nilotica*) tree groves along the rivers Mula and Pawana. Grassland and scrub on the eastern outskirts have also been destroyed. There is heavy pressure on scrub and forest in the hills for fuel wood especially near the hutments e.g. Kelewadi slum adjoining Bhamburda forest park and Mutha canal slums near Parvati-Pachgaon. Bootleggers located in the hills are also responsible for tree cutting. Pune city hosts more than one million vehicles, over three-fourths being two-wheelers. Additional 10,000 vehicle pass through the city every day. The traffic on all the outgoing roads, particularly the high ways, is heavy and continuous, even during night hours. The Mumbai-Bangalore bypass constructed recently skirts the city along the western and southwestern margin and virtually cuts through the Parvati-Panchgaon forest park. This study brings out its impacts in terms of loss of amphibian (Padhye and Mahabaleshwarkar, this volume) and mammal (Nalavade, this volume) populations.

Though we do not have complementary data on

non-living ecosystem parameters like air, soil and water pollution loads, their monitoring may become gradually possible, through likely collaboration with the international ecosystem assessment (Ayensu *et al*, 1999), that encourages local assessments (Gadgil *et al*, 2000). In any case, the present millennium assessment of living components of an urban ecosystem would set the tone for their ongoing, periodic monitoring, regardless of physio-chemical studies; as already initiated by some authors of this volume (Kunte, 1997). But without eyeing for large, sponsored projects, environmental students from Pune University have voluntarily initiated chemical monitoring of various impact zones of waterbodies around Pune (Chole, V. S., Jagdale, R., *pers. comm.*), furthering the earlier research (Gunale, 1987).

Our efforts were inspired by the pioneering, amateur effort to compile checklists of urban fauna at Bangalore (Karthikeyan, 1999). Later, we chanced upon a more professional endeavour (Anon, 1997). However, the benchmark publication lacked the details of species habitat preference or relative abundance estimates, prompting us to provide those for the present monitoring around Pune city. Most phenomenal organismic monitoring in India is perhaps the nationwide waterfowl count. While this decade old decentralised effort has inspired thousands of birdwatchers to census bird populations on a predetermined day, every year, no results appear to be churned out or popularised, despite mere compilations since long (Joost, 1987). Unfortunately, the leading national and international agencies like Bombay Natural History Society (BNHS), Asian Wetland Bureau (AWB) appear silent on this count. Interestingly, smaller groups have triggered locality specific data literacy, as evident from the efforts of Prakriti Samsad, a birdwatcher's

**Table 3 Habitat Dynamics of Pune urban Area**

HABITAT TYPE	% AREA 1950	% AREA 2000	CONVERTED INTO	TYPICAL AREAS
Forest	7	6	Plantations	Katraj, NDA, Law college hill
Riparian forest	1	-	Agriculture	Aundh (Mula river)
Scrub/grassland	10	8	Habitation, Plantations	Malwadi, Nagar road
Wastelands	2	1	Habitation	Nagar road, Solapur road
Agriculture	60	40	Habitation	Manjari
Plantations	-	3	-	Pachgaon
Wetlands	3	2	Habitation	Pashan, Mula-Mutha
Habitation	15	40	-	All over

group at Calcutta that has published their data, if not the results or signals, that would gradually emerge (Mukherjee, 1999). Similarly, Kalpavriksh, an NGO is initiating data analysis and publication from monthly bird counts across Delhi over a decade (Kothari, A., *pers. comm.*), besides having recently published a fieldguide to promote monitoring (Smetacek, 2000). The college/NGO network initiated by the IISc, Bangalore, along the Western Ghats (Gadgil, 1996 a, Kunte *et al*, 1999) has also begun emphasising importance of building local assessments and awareness, besides developing the training material (Kunte, 2000). Colleges around Nasik (Acharya, S. *pers. comm.*) and Mangalore (Bhat, G. K., *pers. Comm.*) have already expressed interest in similar assessments and publications next year, besides parallel effort by NGOs in Nagpur city (Ladkhedkar, R. *pers.comm.*)

It is hoped that such studies would promote further scientific development such as a study of plant-butterfly (Kunte, 1997) or fig-bird relationships (Utkarsh and Almeida, 1999), eventually leading to careful ecological monitoring. Such monitoring can help better understanding of the ongoing process of ecorestoration around the Pune city, such as at Pachgaon, Bhamburda and Chandani chowk hills. Here, protection by Forest Department coupled with the vigil by nearby residents who regularly visit these areas for exercise or recreation has facilitated regeneration of natural plants and revival of native fauna. Temple trusts, educational institutions such as 'Dnyanprabodhini', NGOs such as 'Nisargasevak' have also helped this cause. The revival of natural trees or herbs amidst plantations, has triggered colonization of these new habitats by birds, butterflies etc. Notably, even seasonal puddles, formed in these areas now harbour moults of dragonfly nymphs etc. indicating ongoing colonization and establishment of organisms that are highly susceptible to seasonality. Recently increasing tree cover of suitable species in some areas such as the Osho Park has probably similarly helped predominantly Western Ghats dweller butterflies such as the Blue Mormon, seldom seen in the city earlier (Kunte, this volume). An understanding of eco-restoration process can help its manipulation and replication in neighbouring areas and even other cities (Jordan *et al.*, 1987). Besides, such ongoing monitoring can easily detect notable declines in certain species like the sparrows and vultures, being noticed and debated currently (Rahmani, A., *pers. comm.*). If such sudden population fluctuations are any signal of impending calamity, the purpose of monitoring is served much beyond academic interests. Such monitoring can even

become quite popular, yet cost effective through internet publicity such as the electronic discussion group of Asian naturalists having thousands of members worldwide (nathistory-india@lists.Princeton.EDU).

Notably, such publications based on long term observations might pre-empt the facile environmental impact assessments (EIAs) that are currently mushrooming like a fashion, such as those on the proposed dams on the river Narmada, where Puneites have made significant contributions either way. While upholding the cause of dam construction, the Supreme Court has often expressed dissatisfaction about superficial environmental assessments. Unfortunately, environmentalists are not equipped with much concrete, scientific data. That scientific data can at times lead to stringent legal action against environmental hazards is proven in case of pollution at Delhi and Agra. Unfortunately, much of the EIA activity is driven by the sponsor's interests in promoting development at the cost of environment. Since RANWA did not seek any targeted sponsorship, this effort lacks such directed loyalty. We hope that this initiative will kick off more such efforts, both locally and elsewhere. Such proactive, decentralised monitoring, especially by the students, is envisioned by the Project Lifescape launched by the Indian Academy of Sciences, Bangalore, to pay tribute to Dr. Salim Ali (Gadgil, 1996 b, Kunte, 2000). If the recent legal activism takes note of such serious publications, environmental care cannot be easily wished away by the shroudy EIAs. It is with this hope that we have uploaded this entire volume on internet (<http://www.ranwa.org/punealive>)

### Acknowledgements

Reviewers, often from amongst the authors of this volume, especially Anand Pathye, have enhanced the quality manifold. Dr. Hemant Ghate, foremost animal taxonomist and ecologist in the city needs a special mention for buttressing abilities of the group. Dr. Asad Rahmani, heading the prestigious BNHS gave an ear to these efforts and persuaded its easy, quick and compiled publication through the Ecological Society. He was more than complimented by the receptive, encouraging editor Prakash Gole. Prof. M. Gadgil and the IISc team, including WGBN members have variously motivated and buttressed these efforts. World Wide Fund for Nature-India (WWF-I), especially Shekhar Singh and A. R. K. Shastri, had earlier sponsored RANWA in executing part of the Biodiversity Conservation Prioritisation Project (BCPP). Our modest savings then helped us to trigger this endeavour.

We remain obliged to them all, besides our friends and families that gracefully bore the brunt of our ecological obsession!

### References

- Anon 1997. Fauna of Delhi. Zoological Survey of India. Calcutta.
- Ayensu *et al*, 1999. International Ecosystem Assessment. *Science*. 286 : 685-6.
- Burton J. A. 1977. Worlds Apart Vol. 1 – Nature in the city. Double day and Co. New York.
- Daniels, R.J.R., Hegde, M., and Gadgil, M., 1990. Birds of the manmade ecosystems : the plantations. *Proc.Ind.Acad.Sci. (Anim. Sci.)* 99 : 79-89.
- Gadgil, M. (1996 a) Documenting diversity : An experiment. *Current Science* 70 : 36-44.
- Gadgil, M., 1996 b. Deploying student power to monitor India's lifescape. *Current Science* 71 : 688-697.
- Gadgil *et al*, 2000. Participatory Local Level Assessment of Life Support Systems. Centre for Ecological Sciences, Indian Institute of Sciences, Bangalore, Technical Report no. 78. See also : <http://ces.iisc.ernet.in/hpg/cesmg>
- Gunale V. 1987. Algal communities as indicators of pollution. *Jr. Env. Biol.* 223-232.
- Hawksworth, D. L. (ed.) 1995. Biodiversity measurement and estimation. The Royal Society and Chapman and Hall, London.
- Jordan, W. R., Gilpin, M. E., Aber, J. D. (Eds.) 1987. Restoration Ecology : A Synthetic Approach to Ecological Research Cambridge University Press, Cambridge.
- Joost V. Ed. 1987. Asian waterfowl. International Wetland Research Bureau. Slimbridge.
- Karthikayan S. 1999. The vertebrate and butterfly fauna of Bangalore : A checklist. WWF-India, Karnataka State Office. Bangalore.
- Kunte,, K. 1997. Seasonal patterns in butterfly abundance and species diversity in four tropical habitats in northern Western Ghats. *Jr. Biosciences* : 22(5) : 593-603.
- Kunte K. (2000). The butterflies of Peninsular India. University Press, Hyderabad.
- Kunte, K., Joglekar, A., Utkarsh, G. And Pramod, P. 1999. Patterns of butterfly, bird and tree diversity in the Western Ghats. *Current Science* 77 (4) : 577-586.
- Mukherjii, K., 1999. Mid-winter waterfowl census in southern West Bengal 1990-7. Prakriti Samsad. Calcutta.
- Nagulu V., Rao V. V. and Shrinivasulu C. 2000. Wildlife Heritage of the Deccan in Gupta H., Parashar A., Sen M., Balsubramaniam D. (eds.) Deccan Heritage. University Press, Hyderabad.
- Smetacek, P. 2000. Butterflies Of Delhi. Kalpavriksh, Delhi.
- Utkarsh G. and Almeida M. R., 1999. Figs. *Resonance* 4(12) : 90-100.
- Wilson,E.O. 1984. Biophilia : The Human Bond With Other Species. Harvard University Press, Cambridge.

□



## Fungal Genera Distribution Across Pune City

P. Y Lamrood<sup>1</sup> and J. G. Vaidya<sup>2</sup>

### Introduction

Kingdom Fungi constitutes the most diverse group of organisms, that also exhibits myriad enigmatic shapes, caps and parasols, balls and crumples sheets, layered plats and overlapping shingles, muted and gaudy. These appear suddenly amongst the fallen leaves, on trees or encrusting dead wood, just after the first shower of the monsoon. Despite their popularity, not many people know mushrooms as being fruiting, rather spore producing bodies of some fungi. Mushrooms possess pigments of various colours viz. white, cream, red, yellow, lavender, blue, green, pink, orange, brown and even black. However, mushroom lack chlorophyll unlike plants and therefore cannot manufacture their own food from solar energy. They absorb their nourishment, primarily carbohydrates, directly from dead or live plants and animals and known as saprophytes. Fine cottony threads called hyphae that are networked into a cobweb, termed mycelium facilitate the absorption. This vegetative part of the fungus lies beneath the soil, lasting from months to millennia, depending on resource supply etc. Under suitable environment, mycelium produces mushrooms i.e. sporophores annually that shade the spores that are wind dispersed and ultimately generate mycelium. Due to good dispersal ability and durability, fungi inhabit soil, animals, leaves, tree trunks, symbiotically or as parasites.

Fungi are crucial in the terrestrial ecosystem, as dominant decomposers. Plant debris that is rich in lignin, that would not yield even to bacteria, is broken

down by fungal enzymes. They have application in paper and pulp industries, fruit juice industry, wastewater treatment, textile industry, bakery products, food and feed industry etc. Mushrooms are a delicacy worldwide, white button mushroom (WBM) being the commonest. Some mushrooms e.g. *shiitake*, *Pleurotus*, *Auricularia*, even serve as a medicine on several ailments to reduce blood pressure, on diabetes to reduce cholesterol etc. Mushrooms are also used for hallucination. About 10% of mushroom species are even poisonous. Unfortunately, little is studied about ecology of these interesting and useful creatures in India, prompting us to undertake this study.

### Methodology

Different localities in and around Pune were frequently visited, especially during the monsoon of 1999 and 2000. These included forested hills of Sinhagad, Law college and Chandani chowk; banks of Pashan lake, extensive tree plantations in and around University and habitations including small tree plantations around the Fergusson college. In each locality, fungi were collected opportunistically along random paths. The mushrooms were picked up with the help of a scalpel from the soil or the substrate. General habit and habitat, colour, smell (if any), host plant, surrounding vegetation etc. were noted in the field. Mushrooms were photographed prior to picking and then were kept in a paper bag carefully with a label showing the collection number, locality and date. Polypores were removed from the host with the help of hammer and a sharp knife and were kept on a clean

1. 500 Kasba Peth, Pune 411 011. Email : fifthkingdom@rediffmail.com

2. Department of Botany, Pune University, Pune 411 007.

polythene bag. Puffballs and especially damage-prone stink horns were both carefully preserved in a clean plastic bag. Few specimens of mushrooms and polypores from each collection were kept for sporeprint. Few of the specimens were oven dried at 60°C temperature. The puffballs were also dried and stinkhorns were wet preserved in 2-5% formaline solution. Thin sections of fresh specimens were observed under the microscope after staining with Phloxin and cotton blue stain and mounting in the lactophenol. The polypore sections were first treated with 5% KOH solution and then mounted in lactophenol on a clean glass slide with a cover glass after intensive teasing and staining with cotton blue. As for puffballs, the fruiting body was opened to view the number of peridium layers, presence or absence of mucilage sheath and colour of the gliba. Thin sections of gliba, peridium were mounted in lactophenol after staining the section in cotton blue. Various structures seen in the section were noted down systematically and were used along with the sporeprint for identification, using the standard keys (see bibliography).

### Results and Discussion

The sampling yielded 71 species belonging to 68 genera from 28 families (see annexure). Ascomycetes members were represented by 4 genera belonging to 4 families. The remaining 64 genera belonged to Basidiomycetes, with mushrooms constituting 38 of them from 12 families, Gastromycetes constituting 13 genera from 10 families and polypores constituting another 13 genera from 6 families. Table 1 illustrates that extensive tree growth, both wild and planted such as around University, harboured most of these while forests along hills harbored about three fourth. About a quarter taxa are recorded only from woodlands/ plantations, but not forests. Forests exclusively harbour just three genera. This can be in part attributed to more intensive studies around University campus.

**Table 1 Habitatwise Diversity and Exclusivity of Fungal Genera**

Habitat Type	No. of total Genera	No. of un-shared Genera
Forest (F)	52	3
Plantations (P)	64	15
Habitations (H)	27	0
Lakeside (L)	33	0

While these numbers might change after intensive sampling elsewhere, especially in hill forests, the importance of urban plantations in hosting significant fungal diversity will remain evident. Commonest genera include *Merasmius*, *Hygrocybe*, *Auricularia*, *Hexagonia*, etc.

This high fungal diversity around the University campus can also be attributed to old and extensive tree growth, which shares most taxa with forests, given wide dispersal ability of fungi. In addition, some fungi favour such plantations, such as *Itajahya* associated only with *Dalbergia melanoxylon*, the most extensively planted tree in the University. Some recent finds such as *Battarrea* recorded since a decade is today common as a mycorrhizal association. *Ganoderma*, a root rot fungus reported rare earlier is in fact quite common causing even uprooting of trees. However, some genera have either become rare or locally extinct. We did not actually find the mushroom *Lentinus*, previously recorded. Likewise, *Amanita albobfloccosa* is also earlier recorded from Pune but not encountered by us. While greater sampling can help relocate these taxa, the hindrance of stray animals and soil profile modifications due to human activity, dumping of glass, rubber and thermocol waste, urban encroachment, tree cutting etc. pose serious threats to existence of the fungal diversity, especially in the Pune University campus.

### Bibliography

- Ainsworth G.C., Sparrow, F. K. and Sussman, A. S. 1973. The Fungi : An Advanced Treatise. Vol. IV-B, A taxonomic Review with Keys : Basidiomycetes and Lower Fungi. Academic Press.
- Pegler, D. 1977. Preliminary Agaric flora of East Africa. Billing & Son's Ltd., Guildford, England.
- Ryverden, R. 1991. Genera of Polypores: Nomenclature and Taxonomy. *Synopsis Fungorum-5*, Fungiflora, Oslo, Norway.
- Sathe, A. V. and Deshpande S. 1980. Agaricales of Maharashtra State. Agaricales (Mushrooms) of South West India. Maharashtra Association for Cultivation of Sciences. Monograph No. 1., Pune, India. pp. 9-42.



**ANNEXURE : Distribution of Fungal Genera Across Habitat Types**

F- Forest, S- Scrub, P- Plantation, H- Habitation, L- lake

A- Abundant, C- Common, Ex- Extinct, O- Occassional, R- Rare

LOC (Locality) : C- Chandani Chowk, P- Pashan, R- Range Hills, S- Sinhgad, U- University

Note : Specific localities not indicated for widespread fungi

Group/Family	Genus	F/S	P	H	L	LOC
<b>Ascomycetes</b>						
Geoglossaceae	<i>Daldinia</i>	C	C		R	U,C
	<i>Geoglossom</i>	R	A			
	<i>Sarcoscypha</i>	C	R		R	
Xylariaceae	<i>Xylaria</i>	C	C		O	
<b>Agaricales (Mushrooms)</b>						
Agaricaceae	<i>Agaricus</i>	C	C	C	O	
Bolbitiaceae	<i>Agrocybe</i>	O	C	C	R	
Tricholomataceae	<i>Anthracoephyllum</i>	O	O	C	R	
Auriculariaceae	<i>Auricularia</i>	C	C	C		
Bolbitiaceae	<i>Bolbitius</i>	C	O	O	R	
Tricholomataceae	<i>Calocybe</i>	C	C	C		
Cantharellaceae	<i>Cantharellus</i>	C	C	R	R	
Lepiotaceae ?	<i>Chlorolepiota</i>	O	C	R		
Lepiotaceae	<i>Chlorophyllum</i>	O	C	C		
Tricholomataceae	<i>Clitocybe</i>	C	C	C	R	
Bolbitaceae	<i>Conocybe</i>	C	C	C	R	
Tricholomataceae ?	<i>Copelandia</i>	R				S
Coprinaceae	<i>Coprinus</i>	C	C	C	O	
Tricholomataceae	<i>Favolashchia</i>		R			U
Tricholomataceae	<i>Hemimycena</i>		O			U
Hygrophoraceae	<i>Hygrocybe</i>	R	C			U,S
Hygrophoraceae	<i>Hygrophorus</i>	R	O			U,S
Tricholomataceae	<i>Lactocollybia</i>		O			U
Tricholomataceae	<i>Lentinus</i>		R			U,Ex?
Lepiotaceae	<i>Lepiota</i>	O	C	O	O	
Lepiotaceae	<i>Leucocoprinus</i>		R			U
Amanitaceae	<i>Limacella</i>		R			U
Tricholomataceae	<i>Lyophyllum</i>		O			U
Lepiotaceae	<i>Macrolepiota</i>	O	C	R		
Tricholomataceae	<i>Marasmiellus</i>		R			U
Tricholomataceae	<i>Marasmius</i>	C	A	C	A	
Tricholomataceae	<i>Mycena</i>	C	A	C	A	
Coprinaceae	<i>Paneolus</i>	R	C		O	U,S,P
Strophariaceae	<i>Pholiota</i>	R	C		O	U,S,P
Tricholomataceae	<i>Pleurotus</i>	C	A	C	O	
Entolomataceae	<i>Rhodocybe</i>		R			U
Tricholomataceae	<i>Schizophyllum</i>	C	A	O	R	
Tricholomataceae	<i>Termitomyces</i>	O	O			
Tremellaceae	<i>Tremella</i>	O	A			
Tricholomataceae	<i>Tricholoma</i>	C	C	O	O	

FUNGAL GENERA DISTRIBUTION ACROSS PUNE CITY

Group/Family	Genus	F/S	P	H	L	LOC
Tricholomataceae	<i>Tricholomopsis</i> <i>Unidentified sp.1</i> <i>Unidentified sp.2</i>	C R R	C	C	R	C S
<b>Gasteromycetes</b> (Puffballs, Stink Horns)						
Astraeaceae	<i>Astraeus</i>	C	C		C	
Tulostomaceae	<i>Battarrea</i>		R			U
Lycoperdaceae	<i>Bovista</i>	C	C		O	
Nidulariaceae	<i>Cyathus</i>	C	C	O	C	
Geastraceae	<i>Geastrum</i>	O	C	R	O	
Phallaceae	<i>Itajahya</i>		O			U
Lycoperdaceae	<i>Lycoperdon</i>	C	C	R	O	
Phallaceae	<i>Muntinus</i>		R			R
Astraeaceae	<i>Myriostoma</i>		R			U
Phallaceae	<i>Phallus</i>	R	O			U,S
Tulostomaceae	<i>Tulostoma</i> <i>Unidentified</i>		O O			U U
<b>Polypores (Bracket Fungi)</b>						
Clavariaceae	<i>Clavaria</i>	R	R			U,S
Polyporaceae	<i>Daedalea</i>	O	C		O	
Polyporaceae	<i>Daedaleopsis</i>	O	C		O	
Polyporaceae	<i>Favolus</i>	R	O			U,S
Ganodermataceae	<i>Ganoderma</i>	C	A	C	C	
Polyporaceae	<i>Hexagonia</i>	C	A		R	
Hydnaceae	<i>Irpex</i>	C	C		O	
	<i>Laetiporus?</i>	O	C		R	
Polyporaceae	<i>Microporus</i>	O	O			U,S
Polyporaceae	<i>Oxyporous</i>	O	A			
Hymenochaetaceae	<i>Phellinus</i>	C	A	O	C	
Podoscyphaceae	<i>Podoscypha</i>	C	A	R		
	<i>Ramaria</i>	O	C	R	R	
	TOTAL	65	64	27	33	
	UNIQUE	3	15	0	0	

□

## Herb Diversity of Some Habitats of Pune City

*Anagha Ranade*

### Introduction

Herbs are seasonal plants without woody tissues. Herbs as a group are omnipresent, inhabiting all types of habitats and localities. The herbaceous flora of Pune environs is well documented since long (Razi, 1951) but it contains no analysis of the distribution across habitat types and localities except for the modest attempts regarding aquatic plants by Ghate and Vartak (1981). This note thus explores the distribution of species richness across habitat types with focus on Katraj hills, besides looking at the sharing of the flora between hills and the city habitats. The term herb is used in a broad sense here, reflecting all non-tree flowering plants, which include shrubs and climbers.

### Methodology

The flora of Katraj Ghats (Vartak, 1960) is used as the baseline document as it almost covers the wild flora in the Pune city environs. National Defence Academy (NDA), Khadakwasla and Sinhagad hills have about twice and thrice the rainfall respectively while the latter boasts over two times the elevation. Thus, NDA and Sinhagad may harbour some moisture loving species not recorded from Katraj but their floristic records are limited (Santapau, 1951). This note focuses on the immediate neighbourhood of Pune city to explore the pattern of species sharing across the hillocks and the urbanised areas. Based on descriptions and field visits, the distribution remarks from Katraj flora (Vartak, 1960) were assigned to following habitat types in the decreasing order of human influence :

1. Spur, Ghat, Ravine, Base : Forest/scrub (low human impact)
2. Hedges : thickets and fences (medium human impact)
3. Village, Garden, Roadside : Human dwellings (high human influence)
4. Grassland and sandy soils : (low human impact)
5. Stream, stream bank, tank, pond, waterlogged soil : Riparian (variable human impact)

The species richness i.e. number of species recorded from each of these habitat types was enumerated with minor modifications from field observations. Secondly, the degree of sharing of species between Katraj, Pachagaon (Kulkarni *et al*, 1989), Law College hills (Kumbhojkar *et al*, 2000) and the Ganeshkhind campus (Varadpande, 1974) is also estimated, the last being more human influenced than others. We could access only the analysis (Vartak, 1959) but not the species list of the flora of Fergusson College campus and hills, which could have given a better understanding of species thriving or even flourishing under pronounced human influence. As for aquatic plants, Ghate and Vartak (1981) provide a comprehensive baseline document for the Pune environs as Katraj flora mentions only a few of them. The aspect of distribution of the species therein across habit classes and localities is numerically represented here.

### Results and Discussion

The herb flora of Pune city environs is estimated to consist of about 600 species. Table 1 lists the five most dominant families and their species richness, which is similar to the floristic pattern mentioned by Dr. Vartak

HERB DIVERSITY OF SOME HABITATS OF PUNE CITY

**Table 1 Most dominant families in the herb flora of Pune city**

Family	No. of Spp.
Poaceae	100
Asteraceae	60
Cyperaceae	40
Fabaceae	30
Mimosaceae	20

**Table 2 Habitat-wise distribution of flowering plants at Katraj hills**

Habitat Type	% of Total (510) Spp.
Forest/scrub	30
Hedges	6
Habitation	40
Grassland	15
Riparian	15

(Vartak, 1960). Some species like *Brassica juncea*, *Linum usitatissimum*, *Sesamum indicum*, etc. inhabit all localities while those confined to wilderness localities like Katraj include *Impatiens balsamina* and *Raphanus sativus*. Prominent escapes from cultivation, now naturalised in wilderness zones include *Cosmos bipinnatus*. Many herbs have medicinal value and some are even intensively harvested such as *Asparagus racemosus*, *Curculigo orchidoides*, *Gloriosa superba* and even weeds like *Mimosa pudica*.

Herb species constitute over two thirds of the total flora in low impact areas like Katraj hills while just the half in high impact zones like the Fergusson college (Vartak, 1959). Nearly half the herb species from the Katraj flora inhabit Pachgaon, Law College and Vetal hills while Ganeshkhind area shelters over two thirds. Interestingly, other hills around Pune hardly shelter any species not recorded from Katraj though Ganeshkhind area harbours a few such species, primarily exotic cultivars. Each of these areas harbours over 300-400 species i.e. two thirds the species richness of Katraj. The Fergusson College Campus is reported to

have sheltered over 600 species (Vartak, 1959). Thus, while human influence appears to markedly alter species composition, species richness is maintained or even enhanced.

Table 2 indicates that nearly half the species inhabit human influenced areas like gardens, fields, roadside etc. Less than a tenth of the species are cultivated while just over a tenth are weeds, primarily exotic. The wilderness (forest, scrub, grasslands, riparian) preferring species constitute just less than two thirds the flora of Katraj, some of them also thriving under human influenced habitats as noted above.

Table 3 shows that the Mutha river harbours over 80% of the aquatic flowering plants recorded from Pune city environs, while seasonal puddles host lowest species richness, about a quarter of those found in the Mutha river. Amongst perennial stagnant waterbodies, Pashan lake hosts the most species while Padmavati pool the least. About a third species also colonise abandoned stone quarries.

The nature of changes in herbaceous flora is hardly studied, primarily due to difficulties in fixing the

**Table 3 Habit-wise distribution of aquatic flowering plants diversity : Pune city**

Habit	Mutha River	Pashan Lake	Bhosari Tank	Katraj Reservoir	Padmavati Pond	Monsoon puddles	Quarry Ponds
Aquatic	8	8	5	4	4	2	3
Attached floating	3	4	3	0	2	0	0
Free Floating	5	1	2	0	1	2	1
Amphibious	15	10	7	8	4	3	5
Marshy	43	34	29	31	20	13	19
Submerged	6	6	3	0	0	2	3
Wetland	22	16	12	12	8	6	15
TOTAL	102	79	61	55	39	28	46

location of given species. Nevertheless, Joshi *et al* (1992) mention the loss of 30 species from Vetar hills in Pune city, of which over three fourths are herbaceous, causing concern. While the authors fix the blame of local extinction of species on the biotic factors such as grazing, the role of encroachments by development projects like housing colonies and roads needs exploration. There has been public concern about loss of rare species, particularly herbs that tend to be ignored, such as *Ipomoea sp.* along the river bank at Vitthalwadi due to so called development (Ingalhallikar, 2000).

### References

- Ghate V. S. and Vartak, V. D. 1981. Studies on the aquatic flowering plants from Greater Pune area. Part I. Enumeration. *Jr. Poona Univ. (Sci. & Tech.)* 54 : 121-129.
- Ingalhallikar S. 2000. Development or environmental destruction? (Marathi). *Sakal (Disha)*. 27 November. p1.
- Joshi V. N., Kumbhojkar M. S. and Kulkarni D. K. 1992. Changing floristic pattern of Chatushringi-Vetar plateau near Pune – A comparative study. *Jr. Econ. Tax. Bot.* 16 (1) : 133-139.
- Kulkarni D. K., Kumbhojkar, M. S. and Vartak V. D. 1989. Floristic studies on the Pachgaon Parvati hill near Pune. *Jr. Econ. Tax. Bot.* 13(1) : 117-155.
- Kumbhojkar M. S., Ghate V. S. and Joshi V. N. 2000. Report of the vegetation survey in the ILS Law College Campus. Agharkar Res. Inst., Pune.
- Razi, B. A. 1951. Some aspects of vegetation of Poona and neighbouring districts. *Jr. Poona Univ. (Sci. & Tech.)* 1(2) : 1-57.
- Santapau H. 1951. A contribution to the flora Simhgad hill, Poona district. *Poona Agri. Coll. Mag.* 41(4) : 270-284.
- Varadpande, D. G. 1973. The flora of Ganeshkhind, Poona. *Jr. Poona Univ. (Sci. & Tech.)* 44 : 97-133.
- Vartak V. D. 1959. The flora of the Fergusson College Campus, Poona District. *Fergusson College Magazine.* 50(2) : 1-4.
- Vartak. V. D. 1960. The study of the flora of the Katraj Ghat. *Jr. Poona Univ. (Sci. & Tech.)* 22 : 85-117.
- Vartak. V. D. 1960. The arboreal flora of the Poona Corporation Campus. *Jr. Poona Univ. (Sci. & Tech.)* 44 : 97-133.

□

## Tree Diversity of Pune Urban Area : Cosmetic Increase?

Ankur A. Patwardhan<sup>1</sup> and R. V. Gandhe<sup>2</sup>

### Introduction

Trees are amongst the most significant elements of landscape, both due to biomass and diversity. Tree diversity of the Pune Corporation Area (PCA) was first comprehensively recorded by Vartak (1964) who had earlier (1960) recorded the floristic composition of Katraj hill forests. Some pockets like Ganeshkhind area were resurveyed by Varadpande (1973), while Ghate (1990) studied the whole area again. Amongst hill forests, Kulkarni *et al* (1989) studied the vegetation composition of Parvati-Pachgaon. The first attempt to detect floristic changes was by Joshi *et al* (1992) who later (1997) also recorded plants from Vetar hills. Besides attempting another re-survey for change detection, the present study also evaluates the role of human influences at a broader level, in and around Pune city.

### Methodology

The present paper is based on the survey during 1999 and 2000, of the PCA and neighbouring hills viz. Katraj, National Defence Academy (NDA) campus and Sinhgarh. Various localities within this area were visited for species enumeration during different seasons, with focus on localities indicated in the literature as hosting rare species. Katraj hills harbour dry deciduous forests, with 5-10 m tall trees, often interspersed amidst grasses. NDA campus is moister, and houses taller (10-15 m) forests and scrub, prone to fire. Sinhgarh houses the most moist forests in the area, with tallest trees (15-20 m) in the valley (Santospau,

**Table 1 Species richness recorded by successive surveys**

The surveys compared include those by Vartak (1964), Ghate (1990) and Patwardhan (present)

Author/s	No. of species
Vartak, Ghate & Patwardhan	207
Vartak and Ghate only	4
Vartak and Patwardhan only	18
Ghate and Patwardhan only	58
Vartak only	57
Ghate only	3
Patwardhan only	33
<b>Total</b>	<b>380</b>

1951). The so called forests within the PCA are located at Parvati Pachgaon, Law College (Vetar, Bhamburda) hills and are comprised of dwarf, scattered natural trees (3-6 m tall) amidst planted exotic trees. At each of these localities, ecological preferences of each species, influencing factors etc. were also noted and discussed with local people.

### Results And Discussion

A total of 380 tree species have till date been recorded from the study area, two thirds of them being cultivated, mostly exotics and one third wild, native (Table 1). To begin with, Vartak (1964) recorded

1. Abhayankur, 14 Nityanand Society, Dhankawadi, Pune 411043. Email : ankurpatwardhan@hotmail.com

2. Botany Department, Modern College, Pune 411005.

**Table 2 Tree species diversity and exclusiveness across habitat types**

Habitat type/ zone	No. of Total Species	No. of Exclusive Species	Exclusive species as % of total
Forest (F)	94	71	75
Scrub (S)	62	42	67
Plantations (P)	245	193	79
Habitation (H)	57	7	12
Wilderness (FS)	137	127	93
Influenced (HP)	252	243	96

293 tree species from PCA that forms much of the present study area (Table 2). Three fourths of the trees were recorded at present within PCA. Ghate (1990) and the present survey added 33 species to the earlier lists much due to covering of area beyond PCA limit but could not record 57 species recorded by Vartak (1964), a majority of them being exotic species of *Eucalyptus* or palms, accurately distinguished due to his high taxonomic abilities. Some of these may not be actual losses. Omissions by Vartak (1960) include common and prominent species such as *Sterculia urens*. Thus on the whole, the floristic richness of the study area remains much the same notwithstanding the striking differences as per the records. However, Joshi *et al* (1992) have reported loss of 30 flowering plants including 4 tree species viz. *Grewia laevigata*, *Morinda citrifolia*, *Randia dumetorum* and *Schrebera swietenoides* during the last 7 decades from the Vetil Hill due to human pressures like cutting and fires. However, these species do exist elsewhere such as at Katraj at present.

Wide niched species include *Mangifera indica*, *Syzygium cumini*, *Ficus benghalensis*, *F. glomerata*, *Pongamia pinnata* and *Cassia fistula* that inhabit most habitat types and localities. Dominant forest species include *Tectona grandis*, *Lannea coromandelica*, *Terminalia bellerica*, *Buchanania lanzan*, *Gmelina arborea*, *Cochlospermum gossypium*, etc. Some like *C. gossypium* and *Diospyros melanoxylon* show clumped distribution. *Holarrhena antidysenterica* and *Helicteris isora* form the forest undergrowth. Scrub is dominated by thorny species such as *Acacia leucophloea*, *A. chundra*, *Zizyphus xylopyra*, *Meytenus rothiana*, etc. while *F. arnottiana* inhabits rocky outcrops. *Pongamia pinnata* and *Syzygium cumini* are predominantly seen near ravines, especially streambanks.

Most popular plantation and habitation dwelling trees are exotic and include Rain tree (*Samanea saman*), Copper pod (*Peltophorum ferruginum*), Gulmohar (*Delonix regia*), Silver Oak (*Grevillea robusta*), Bottle palm (*Roystonea regia*), Asoka (*Polyalthia longifolia* var. *pendula*), Fountain tulip (*Spathodea campanulata*), Siamese Cassia (*Cassia siamea*), Neelmohor (*Jacaranda mimosaeifolia*) and Cork (*Millingtonia hortensis*). Trees dominating plantations particularly on forest department lands include *Eucalyptus*, *Gliricidia*, *Leucaena* and *Dalbergia sissoo*. Unfortunately, the increase in populations of most of these exotic, ornamental trees has been at the cost of local, fruit tree species with decreasing populations over the last few decade. These include Neem (*Azadirachha indica*), Mango (*Mangifera indica*), Jackfruit (*Artocarpus integra*), Tamarind (*Tamarindus indica*), Jamun (*Syzygium cumini*), Guava (*Psidium guajava*), Banyan (*Ficus bengalensis*), Peepal (*F. religiosa*) and Wild fig (*F. glomerata*). Some of them like the figs (*Ficus spp.*) were common as avenue and habitation trees earlier, but are no more planted and in fact chopped down due to increasing congestion. Mango, Guava etc. were common in orchards along city fringes but such areas are now encroached by housing colonies. The famous Babul-van i.e. gallery thorn forest along river banks dominated by *Acacia nilotica* trees are all cut and encroached, which has also erased stretches of Wild date palm (*Phoenix sylvestris*).

Our patterns of species distributions and changes are parallel to those reported by Gadgil and Parthasarathy (1977) for Bangalore city, though we have no census data like them. Such dynamics could be quantified for making feasible, informed recommendations by accessing and analysing the enormous tree census data available with the Pune Municipal Corporation (PMC).

#### Acknowledgements

RANWA sponsored this study. Utkarsh Ghate and Mandar Datar shared their data and ideas. These studies have been greatly encouraged by Mr. Y.S.Khaire, Garden Superintendent, PMC. We are obliged to them all.

#### Bibliography

- Deshpande, M.V. et al, 2000. Flora and Fauna of NCL.  
 Gadgil, M. and Parthasarathy, M.A. 1977. Trees of Bangalore. *Indian Farming* 26 : 64-68.  
 Ghate, U. 1990. The Arboreal Flora of Poona Corporation Campus. RANWA, Pune.  
 Ghate V. S. and Vartak, V. D. 1981. Studies on the

TREE DIVERSITY OF PUNE URBAN AREA : COSMETIC INCREASE?

- aquatic flowering plants from Greater Pune area. Part I. Enumeration. *Jr. Poona Univ. (Sci. & Tech.)* 54 : 121-129.
- Joshi V. N., Kumbhojkar M. S. and Kulkarni D. K. 1992. Changing floristic pattern of Chatushringi-Vetal plateau near Pune – A comparative study. *Jr. Econ. Tax. Bot.* 16 (1) : 133-139.
- Joshi V. N. and Kumbhojkar M. S. 1997. Floristic study on Vetal Hill and its adjacent hills in Greater Pune Area. *Jr. Econ. Tax. Bot.* 21(3) : 507-529.
- Kulkarni D. K., Kumbhojkar, M. S. and Vartak V. D. 1989. Floristic studies on the Pachgaon Parvati hill near Pune. *Jr. Econ. Tax. Bot.* 13(1) : 117-155.
- Razi, B. A. 1951. Some aspects of vegetation of Poona and neighbouring districts. *Jr. Poona Univ. (Sci. & Tech.)* 1(2) : 1-57.
- Santapau H. 1951. A contribution to the flora Simhagad hill, Poona district. *Poona Agri. Coll. Mag.* 41(4) : 270-284.
- Varadpande, D. G. 1973. The flora of Ganeshkhind, Poona. *Jr. Poona Univ. (Sci. & Tech.)* 44 : 97-133.
- Vartak V. D. 1959. The flora of the Fergusson College Campus, Poona District. *Fergusson College Magazine.* 50(2) : 1-4.
- Vartak. V. D. 1960. The study of the flora of the Katraj Ghat. *Jr. Poona Univ. (Sci. & Tech.)* 22 : 85-117.
- Vartak. V. D. 1964. The arboreal flora of the Poona Corporation Campus. *Jr. Poona Univ. (Sci. & Tech.)* 44 : 97-133.

**Annexure : Tree species distribution in the Pune urban area**

HB (**Habitat Preference**) : F – Forest, S – Scrub, P – Plantations, H – Habitations

AB (**Abundance**) : A- abundant, C- common, O- occasional, R- rare

AU (**Authors**) : G- Ghate (1990), P- Patwardhan (present), V- Vartak (1964)

**Localities** : AGC- Abasaheb Garware College, BG- Bund Garden, BMCC- Brihan Maharashtra College of Commerce, BSI- Botanical Survey Of India Campus, DG- Deccan Gymkhana, EG- Empress Garden, FCBG - Fergusson College Botanical Garden, FN- Forest Nursery, JNH - Jawaharlal Nehru Herbarium, K – Katraj, KG - Khadki Garden, KNP - Kamla Nehru Park, MACS - Maharashtra Association for Cultivation Of Sciences, N- National Defense Academy, NIBM - National Institute Of Business Management, P - Parvati-Pachgaon, PUC - Pune University Campus, PUC-BG - PUC Botanical Garden, PUC-MB- PUC Main Building, S-Sinhgarh, SN- Sahakar Nagar, SPC - S. P. College.

CHG (**Change**) : I-increase, D-decrease DF (**driving force**) : Af- Afforestation, Av- Avenue

\* New additions to the earlier lists (VG) # not seen or heard of presently Ex. Locally Extinct

FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
DILLENACEAE <i>Dillenia indica</i>	F	O	VGP			
MAGNOLIACEAE <i>Michelia champaca</i>	HP	C	VGP			
ANNONACEAE <i>Annona muricata</i> <i>Annona reticulata</i> <i>Annona squamosa</i> <i>Sageraea dalzelli</i> * <i>Miliusa tomentosa</i> <i>Polyalthia longifolia</i> <i>Polyalthia longifolia var. pendula</i>	PH P P FS F PH PH	R O C R O C A	VGP VGP VGP V P VGP VGP	FCBG SN K K		mistaken     I Beauty
MENISPERMACEAE <i>Cocculus laurifolius</i> #	P	R	V			



FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
<b>CAPPARIDACEAE</b> <i>Capparis grandis</i> <i>Crataeva religiosa var. nurvala</i>	P P	O O	VGP VGP	BMCC		
<b>BIXACEAE</b> <i>Bixa orellana</i> <i>Cochlospermum gossypium</i> * <i>Flacourtia latifolia</i> <i>Flacourtia ramontchi</i> #	P F S F	C O O O	VGP VGP P P	N S	I	
<b>GUTTIFERAE</b> <i>Garcinia livingstonei</i> # <i>Calophyllum inophyllum</i> <i>Garcinia indica</i> * <i>Mesua ferrea</i> <i>Mammea longifolia</i>	F F F P P	R O O O O	V VGP VGP P GP	MACS, AGC NCL SPC, PUC, AGC, DG		
<b>MALVACEAE</b> <i>Hibiscus mutabilis</i> * <i>Kydia calycina</i> <i>Thespesia populnea</i>	P F P	C O C	VGP VP VGP	S		
<b>DIPTEROCARPACEAE</b> <i>Shorea robusta</i>	F	R	GP	Smruti - Van, PUC-BG		
<b>BOMBACACEAE</b> * <i>Chorisia speciosa</i> <i>Adansonia digitata</i> <i>Bombax ceiba</i> * <i>Bombax ellipticum</i> <i>Ceiba pentandra</i> * <i>Pachera insignis</i>	H P F P F P	R O A R C R	P VGP VGP P VGP P	Model Colony and Yena Bunglow, Paud Road PUC PUC-BG SN, Vartak Bunglow		
<b>STERCULIACEAE</b> <i>Guzuma ulmifolia</i> <i>Helicteres isora</i> <i>Kleinhovia hospita</i> <i>Pterospermum acerifolium</i> <i>Sterculia alata</i> <i>Sterculia urens</i> <i>Sterculia foetida</i> <i>Sterculia guttata</i> <i>Theobroma cacao</i> * <i>Dombeya acutangula</i> * <i>Grewia laevigata</i> <i>Grewia tiliaefolia</i> * <i>Grewia pilosa</i> <i>Grewia asiatica</i> <i>Erinocarpus nimmonii</i> #	P F P H P F F F P P S FS S P F	O O O C C O O O R R O C O O R	VGP GP VGP VGP VGP P VGP VGP GP P P VGP P VGP V	SPC SN, Vartak Bunglow N K,S		

TREE DIVERSITY OF PUNE URBAN AREA : COSMETIC INCREASE?

FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
ELAEOCARPACEAE <i>Muntingia calabura</i> <i>Elaeocarpus ganitrus</i> #	P F	C R	VGP V	FCBG	I	Birds
ZYGOPHYLLACEAE <i>Guaiaicum officinale</i>	P	R	VGP	PUC		
GERANIACEAE <i>Averrhoa bilimbi</i>	P	R	VGP			
RUTACEAE <i>Aegle marmelos</i> * <i>Citrus aurantium</i> <i>Citrus maxima</i> <i>Citrus medica</i> <i>Citrus medica var. acida</i> <i>Citrus medica var. limonium</i> <i>Citrus sinensis</i> <i>Ferronia elephantum</i> <i>Limonia acidissima</i> # <i>Murraya koenigii</i> * <i>Murraya paniculata</i>	S P P P P P P P P H H	C R O O C O R C R C O	VGP P VGP VP GP GP VGP VGP V VGP P	P		
SIMAROUBACEAE <i>Ailanthus excelsa</i> <i>Balanitis roxburghii</i> <i>Ochna squarrosa</i> <i>Boswellia serrata</i> <i>Bursera delphinchinensis</i> * <i>Commifera mukul</i> <i>Garuga pinnata</i>	S S P F P P F	C O R C R R O	VGP VGP VGP VGP GP P VGP	N PUC-BG BSI JNH		
MELIACEAE <i>Amoora rohituka</i> <i>Azadirachta indica</i> <i>Chloroxylon swietenia</i> <i>Heynea trijuga</i> # <i>Khaya anthotheca</i> <i>Khaya senegalensis</i> <i>Melia composita</i> <i>Melia azadarach</i> <i>Swietenia macrophylla</i> <i>Swietenia mahogany</i> <i>Toona ciliata</i> #	P H S F P P S P P P P	C A O R O R R C O A R	VGP VGP VGP V VGP GP VP VGP VGP VGP VG	K KNP	I D  I I I	
CELASTRACEAE <i>Cassine glauca</i> <i>Meytenus rothiana</i> * <i>Meytenus montana</i>	F S S	C C O	VGP GP P	K,S		

FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
<b>RHAMNACEAE</b>						
<i>Zizyphus jujuba</i>	FS	C	VGP			
<i>Zizyphus xyloprya</i>	S	O	VGP			
<b>SAPINDACEAE</b>						
<i>Dodonea viscosa</i>	P	O	VGP			
<i>Filicium decipiens</i>	P	O	VGP			
<i>Litchi chinensis</i>	P	R	VGP	FN, BSI		
* <i>Harpulia zanguebarica</i>		R	P	MACS, PUC-BG		
<i>Sapindus laurifolius</i>	F	C	VGP			
<i>Schleichera trijuga</i>	F	O	VGP	N,S		
<b>ANACARDIACEAE</b>						
<i>Anacardium occidentale</i>	HP	O	VGP			
<i>Buchnanania lanzan</i>	F	C	VGP			
<i>Mangifera indica</i>	FPH	A	VGP		D	
<i>Lannea coromandelica</i>	F	C	GP			
<i>Semecarpus anacardium</i>	F	C	VGP			
<i>Spondias pinnata</i>	P	O	GP			
<b>MORINGACEAE</b>						
<i>Moringa oleifera</i>	PH	C	VGP			
<b>PAPILIONACEAE</b>						
<i>Butea frondosa</i>	FSP	C	VGP			
<i>Castanospermum australe</i>	P	R	GP	Latkar Press, Tilak Road		
<i>Dalbergia latifolia</i>	S	C	VGP		FN, FC	
<i>Dalbergia melanoxylon</i>	S	C	VGP		I	
<i>Dalbergia sissoo</i>	S	C	VGP		I	Af
<i>Dalbergia lanceolaria</i>	FS	C	VGP			
<i>Erythrina suberosa</i>	FS	R	GP			
<i>Erythrina stricta</i>	F	R	GP	Near FC		
<i>Erythrina variegata</i>	HP	C	VGP		I	Beauty
<i>Erythrina variegata var. parcelli</i> #	P		G			
<i>Erythrina variegata var. alba</i>	P	R	GP	Mitramandal		
<i>Erythrina variegata var. candida</i>	P	R	VP	N		
<i>Gliricidia sepium</i>	P	A	VGP		I	Af
<i>Milletia ovalifolia</i>	P	O	VGP			
<i>Ougeinia oojeinensis</i>	S	R	VGP	AGC		
<i>Pongamia pinnata</i>	P	C	VGP			
<i>Pterocarpus marsupium</i>	F	R	GP	N,K		
<i>Sesbania grandiflora</i>	HP	C	VGP			
<b>CAESALPINIACEAE</b>						
<i>Bauhinia racemosa</i>	F	O	VGP			
<i>Bauhinia galpini</i>	P	R	GP	PUC-BG		
<i>Bauhinia hookeri</i>	P	R	VGP	MACS		
<i>Bauhinia monandra</i>	P	O	VP	P, FN		
<i>Bauhinia retusa</i>	P	R	GP	MACS, Mitramandal		

TREE DIVERSITY OF PUNE URBAN AREA : COSMETIC INCREASE?

FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
<i>Bauhinia tomentosa</i>	P	O	VGP	PUC, FCBG		
<i>Bauhinia variegata</i>	P	C	VGP			
<i>Brownea coccinea</i>	P	R	VGP	FN		
<i>Caesaplinia coriaria</i>	P	C	VGP	PUC-MB		
<i>Caesaplinia ferrea</i>	P	R	VGP	KG		
<i>Caesaplinia pulcherrima</i>	HP	A	GP			
<i>Cassia fistula</i>	FSPH	C	VGP		I	Beauty
<i>Cassia javanica</i>	P	O	VP			
* <i>Cassia marginata</i>	P	C	P			
<i>Cassia siamea</i>	P	A	VGP		I	
<i>Cassia spectabilis</i>	P	C	VGP			
* <i>Cassia glauca</i>	P	C	P			
<i>Cassia grandis</i>	P	C	VGP			
<i>Cassia nodosa</i>	P	R	VGP	PUC, FCBG, JNH		
<i>Cassia renigera</i>	P	A	VGP			
<i>Cassia roxburghii</i>	P	O	VGP			
<i>Cassia surattensis</i>	P	O	VGP			
<i>Colvillea racemosa</i>	P	R	VGP	PUC-MB, FN		
<i>Delonix regia</i>	PH	A	VGP			
<i>Delonix elata</i>	P	R	VGP	BG		
<i>Haematoxylon campechianum #</i>	P	R	VG	FC		
<i>Hardwickia binata</i>	S	O	VGP			
<i>Parkinsonia aculeata</i>	P	O	VGP	SPC		
<i>Peltophorum inermi</i>	P	A	VGP		I	Av
<i>Saraca indica</i>	P	C	VGP	SPC		
<i>Tamarindus indica</i>	PH	A	VGP		D	
<i>Bauhinia purpurea</i>	P	C	VGP			
<i>Bauhinia variegata var. candida</i>	P	O	GP	N		
<b>MIMOSAE</b>						
<i>Acacia chundra</i>	S	C	VGP			
<i>Acacia farnesiana</i>	S	O	VP			
<i>Acacia leucophloea</i>	S	A	VGP			
<i>Acacia nilotica</i>	S	A	VGP		D	
<i>Acacia suma</i>	S	O	VGP			
<i>Acacia eburnea</i>	S	O	VP			
<i>Acacia nilotica var.</i>	S	R	VGP			
<i>Acacia cupressiformis</i>						
<i>Acacia auriculiformis</i>	P	A	VGP			
* <i>Acacia ferruginea</i>	S	O	P			
<i>Acrocarpus fraxinifolius</i>	FP	O	VGP			
<i>Adenanthera pavonia</i>	P	O	VGP	FCBG		
<i>Albizia lebbek</i>	P	O	VGP			
<i>Albizia procera</i>	FS	O	GP			
<i>Albizia amara</i>	F	R	VGP			
<i>Albizia odoratissima</i>	S	R	VP			
<i>Calliandra hematocephala</i>	HP	C	GP	SPC, PUC		
<i>Calliandra sp.</i>	P	R	GP			
<i>Ceratonia siliqua</i>	P	O	GP	PUC		

FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
<i>Inga dales</i>	P	C	VGP	Modi Ganapati, Narayan Peth	I	Af
<i>Leucaena leucocephala</i>	P	A	VGP			
<i>Parkia biglandulosa</i>	P	C	VGP			
<i>Pithecolobium saman</i>	P	A	VGP			
<i>Prosopis juliflora</i>	P	O	VGP			
<i>Prosopis spicigera</i>	P	R	VGP			
ROSACEAE						
<i>Eriobotrya japonica</i> #	P	O	V			
RHIZOPHORACEAE						
<i>Carallia brachiata</i> #	P	R	V			
COMBRETACEAE						
<i>Anogeissus latifolia</i>	FS	C	VGP	FN FN, Gokhale Nagar		
<i>Anogeissus acuminata</i>	F	R	GP			
<i>Anogeissus pendula</i>	P	R	VGP			
<i>Terminalia crenulata</i>	F	C	VGP			
<i>Terminallia bellirica</i>	F	O	VGP			
<i>Terminallia arjuna</i>	F	R	VGP			
<i>Terminallia arjuna</i> var.	F	R	G			
<i>Terminallia angustifolia</i> #						
<i>Terminallia catappa</i>	PH	C	VGP			
<i>Terminallia chebula</i>	F	O	VGP			
MYRTACEAE						
<i>Barringtonia acutangula</i> #	F	R	V	KNP	I	Af
<i>Callistemon lanceolatus</i>	PH	C	VGP			
<i>Couroupita guianensis</i>	PH	O	VGP			
<i>Eucalyptus citriodora</i> #	P	R	V			
<i>Eucalyptus crebra</i> #	P	R	V			
<i>Eucalyptus globulus</i>	P	A	VGP			
<i>Eucalyptus leucoxylon</i> #	P	R	V			
<i>Eucalyptus rostrata</i> #	P	R	V			
<i>Eucalyptus tereticornis</i>	PH	A	GP			
<i>Eucalyptus umbellata</i> #	P	R	V			
<i>Psidium guajava</i>	PH	A	VGP			
<i>Syzygium aromaticum</i> #	P	R	V			
<i>Syzygium cumini</i>	FPH	A	VGP			
<i>Syzygium heyneanum</i> #	F	R	V			
<i>Syzygium jambos</i>	F	R	GP			
LACYTHIDACEAE						
* <i>Careya arborea</i>	F	O	P	N		
LYTHRACEAE						
<i>Lagerstroemia parviflora</i>	S	O	P	PUC-MB		
<i>Lagerstroemia floribunda</i>	F	R	GP			
<i>Lagerstroemia flos-reginae</i>	PH	O	VGP			

TREE DIVERSITY OF PUNE URBAN AREA : COSMETIC INCREASE?

FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
<i>Lagerstroemia lanceolata</i> * <i>Duabunga sonneratioides</i>	FS	C R	VGP P	Vetal Hill FN		
SAMYDACEAE * <i>Casearia esculenta</i>	F	R	P	N		
PUNICACEAE <i>Punica granatum</i> <i>Carica papaya</i> <i>Carica cauliflora</i> # <i>Carica candamarcensis</i> # <i>Carica microcarpa</i> #	P HP P P P	A A R R R	VGP VGP V V V			
RUBIACEAE * <i>Adina cordifolia</i> <i>Anthocephalus cadamba</i> <i>Coffea arabica</i> <i>Gardenia jasmonoides</i> <i>Gardenia latifolia</i> <i>Gardenia lucida</i> * <i>Gardenia turgida</i> <i>Hamelia patens</i> * <i>Hymenodictyon excelsum</i> <i>Ixora parviflora</i> <i>Meyna laxiflora</i> <i>Mitragyna parviflora</i> <i>Morinda tomentosa</i> <i>Morinda citrifolia</i> <i>Randia dumetorum</i> <i>Randia uliginosa</i> #	F P PH P SP S S PH F P FS S S S F F	R O O C R O O C R C C C C O R	P GP VGP VGP VP VGP P VGP P GP P VGP VGP VGP VGP VG	S NIBM  PUC, FCBG N N		
MEMLASTOMACEAE <i>Memecylon umbellatum</i>	FS	R	GP			
SAPOTACEAE <i>Achras sapota</i> <i>Chrysophyllum cainito</i> <i>Madhuca latifolia</i> <i>Madhuca longifolia</i> <i>Mimusops hexandra</i> <i>Mimusops elengi</i>	HP P F F P P	A R C O O C	VGP VGP VGP VGP VGP VGP	FN SPC		
EBENACEAE <i>Diospyros melanoxylon</i> <i>Diospyros embryopteris</i> * <i>Diospyros montana</i>	F F F	C O R	VGP VGP P	BSI, PUC K		



TREE DIVERSITY OF PUNE URBAN AREA : COSMETIC INCREASE?

FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
<i>Tabebuia speciosa</i>	P	O	GP			
<i>Stereospermum tetragonum</i> #	F	R	V	KG		
<i>Parmentiera cereifera</i> #	P	R	V	FCBG, EG		
* <i>Markhamiya platycalyx</i>	P	R	P	PUC		
<b>VERBENACEAE</b>						
<i>Citharexylum subserratum</i>	P	O	VGP	Prabhat Road, Model Colony		
<i>Gmelina arborea</i>	F	O	VGP			
<i>Tectona grandis</i>	F	C	VGP			
<i>Vitex altissima</i>	P	R	VGP	FN		
<i>Vitex limonifolia</i>	P	R	GP	FN		
<i>Vitex negundo</i>	P	A	VGP			
<i>Vitex leucoxylon</i>	P	R	VP	FN		
<b>POLYGONACEAE</b>						
<i>Coccoloba uvifera</i>	P	R	VGP	FCBG		
<b>LAURACEAE</b>						
<i>Persea americana</i>	HP	R	G	MACS		
<i>Persea gratissima</i> #	P	R	VG	KG		
<b>SANTALACEAE</b>						
<i>Santalum album</i>	S	A	VGP			
<b>PROTEACEAE</b>						
<i>Grevillea robusta</i>	P	A	VGP		I	Av
<i>Macadamia ternifolia</i> #	P	R	V	EG		
<b>EUPHORBIACEAE</b>						
<i>Bridelia retusa</i>	FS	C	GP	N		
<i>Cicca distichus</i>	P	A	VGP			
<i>Givotia rotteriformis</i> #	S	O	V	K		
<i>Hevea brasiliensis</i>	P	A	GP	BSI, FN		
<i>Hura crepitans</i>	P	O	VGP	MACS, FN		
<i>Jatropha curcas</i>	S	C	GP			
<i>Phyllanthus emblica</i>	F	A	VGP			
<i>Putranjiva roxburghii</i>	P	A	VGP			
<i>Euphorbia tirucalli</i>	S	O	VP			
<i>Bridelia squamosa</i>	F	O	VP			
<i>Mallotus philippinensis</i>	F	O	VP	FN		
<i>Excoecaria bussei</i> #	F	R	V	PUC		
* <i>Sapium sebiferum</i>	P	R	P	FN		
<b>ULMACEAE</b>						
<i>Holoptelia integrifolia</i>	FS	C	VGP			
<i>Trema orientalis</i>	F	O	VGP			
<b>MORACEAE</b>						
<i>Artocarpus integra</i>	PH	A	VGP		D	



FAMILY, Genus, Species, Variety	HB	AB	AU	Locality	CHG	DF
<i>Artocarpus incisa</i> var. <i>communis</i>	PH	O	VGP			
<i>Artocarpus lakoocha</i>	PH	O	VGP			
<i>Broussonetia papyrifera</i>	P	C	VGP			
<i>Ficus bengalensis</i>	FSPH	A	VGP		D	
<i>Ficus glomerata</i>	FSPH	A	VGP			
<i>Ficus religiosa</i>	FSPH	A	VGP		D	
<i>Ficus arnottiana</i>	S	R	GP			
<i>Ficus benjamina</i>	PH	A	GP			
<i>Ficus carica</i>	P	O	VGP	MACS		
<i>Ficus cellu</i>	S	O	GP			
<i>Ficus decora</i>	P	C	GP			
<i>Ficus elastica</i>	PH	O	VGP			
<i>Ficus hispida</i>	S	O	GP			
<i>Ficus lyrata</i>	P	O	GP	EG		
<i>Ficus mysorensis</i>	P	O	VGP			
<i>Ficus retusa</i>	F	O	VGP			
<i>Morus alba</i>	PH	O	VGP			
<i>Ficus tesiela</i> #	P	R	V	NCC Ground		
<i>Ficus tsjakela</i> #	P	R	V			
<i>Ficus diversifolia</i> #	P	R	V	FCBG		
<b>CASUARINACEAE</b>						
<i>Casuarina equisetifolia</i>	PH	A	VGP			
<i>Casuarina cunninghamia</i>	P	R	VGP	FN		
<b>SALICACEAE</b>						
<i>Salix tetrasperma</i>	P	O	VP	DG		
* <i>Populus</i> sp.	P	O	P	FN		
<b>CONIFERAE</b>						
<i>Agathis</i> spp.	P	O	GP	SPC		
<i>Araucaria cunninghami</i>	P	R	VGP	PUC-BG		
<i>Araucaria excelsa</i>	P	C	GP	SPC, FCBG, EG		
<i>Cupressus glauca</i>	P	R	GP	FCBG		
<i>Cupressus sempervirens</i>	P	O	GP	FN		
<i>Podocarpus wallichianus</i>	PH	O	GP			
<i>Thuja orientalis</i>	HP	A	VGP			
<i>Callistris calcarata</i> #	P	R	V	FN		
<i>Callistris robusta</i> #	P	R	V	FN		
<b>PINACEAE</b>						
<i>Pinus longifolia</i>	P	R	GP	SPC		
<b>CYCADACEAE</b>						
<i>Cycas circinalis</i>	PH	C	VGP			
<i>Cycas revoluta</i>	P	O	GP	FCBG		
<i>Encephalortus</i> spp. #	P	R	V	FCBG		



## Aquatic Insects and Molluscs of Pune City

Rupesh N. Raut<sup>1</sup>, Shruti Desai<sup>2</sup>, Rohini Bapat<sup>3</sup> and S. S. Kharat<sup>4</sup>

### Introduction

Fresh water macro-invertebrates include sponges, nematodes, annelids, mollusks, larvae and adults of crustaceans as well as aquatic insects. Aquatic insects and mollusks are major components of fresh water ecosystem. Insect larvae and snails play a critical role in maintaining the aquatic ecosystem by breaking down the organic matter and thereby recycling both nutrients and energy (Wallace and Webster, 1996).

Aquatic insects are either primary consumers or detritus feeders. Some of them are also predatory. However, majority of the mollusks are detritus feeders. Thus they are involved at various trophic levels in fresh-water food web. Further, they also constitute the bottom stratum of the energy pyramid by serving as nutrition for fish. Aquatic insects are important indicators for ecosystem assessment due to their dual role in foodweb, besides contribution to aquatic as well as terrestrial biota as nymphs and adults respectively. There are a few publications (Tonapi 1959, 1963, 1971; Tonapi and Mulherkar 1963; Tonapi and Ozarkar 1969, 1970) about the survey of aquatic insects and molluscs around Pune. Recently, another survey was conducted by G. K. Wagh during 1992-96 (Wagh 1999, Ph.D. Thesis). His survey covers all above mentioned aquatic macroinvertebrates as well as aquatic aneospans. However, due to urbanization and industrialization, the aquatic environment in and around Pune city is changing very rapidly. Sewage and toxic

industrial effluents are polluting the waterbodies at large. Thus it is very important to conduct such type of surveys frequently.

### Methodology

During 2000, we surveyed in each season, various localities within a 15 km radius of Pune city centre. Less polluted water-bodies include the Pavana river near Punavale, the Bhugaon lake, and the Khadakwasla reservoir that have just begun to show signs of organic pollution. Industrial effluents and sewage pollute the Warje site on the Mutha river while Kawadi along the Mula-Mutha rivers suffer from solid waste dumping. The Pashan lake is polluted as its source, the Ramnadi is infested by sewage while the Taljai lake at Parvati Pachgaon hills is dying due to dumping of plastic waste. These localities were sampled during the period December 1999 to October 2000. Aquatic snails and insect nymphs were collected respectively by picking and by using simple fish-net. Aquatic insects were preserved on the field in the vials using 4% buffered formalin while molluscan shells were dry preserved in polythene bags in the laboratory. The collection, along with the respective field ecology notes was identified with the help of the available fieldguide (Sivaramkrishnan *et al*, 1998).

### Result and Discussion

We recorded 15 species of molluscs belonging to 10 genera and aquatic insects belonging to 13 families

1. 136 Budhwar Peth, Pune 411 002. Email : rautrupesh@usa.net
2. 10 Hill View Apartments, Lane 9, Dahanukar Colony, Kothrud, Pune 411 029.
3. A/6 Suryodaya Complex, Kalbhornagar, Chinchwad, Pune 411 029.
4. Lecturer, Zoology Department, Abasaheb Garware College, Pune 411004.

AQUATIC INSECTS AND MOLLUSCS OF PUNE CITY

from 9 orders were recorded from various localities (Table 1). Each site samples contained between 2 to 6 families of aquatic insects and 1 to 8 species of snails. The Pashan sample was the richest amongst either groups, with 6 families and 8 species respectively, while Kawadi was the poorest in either case with just 2 families and 1 species respectively. Less polluted samples contained 4.6 families and 5 species of aquatic insects and molluscs per site respectively. This exceeds the polluted site samples that averaged 3.3 and 4.3 respectively. Amongst aquatic insects, Damsel flies, Diving beetles, Dobson flies, Netspinners and Stoneflies were confined to less polluted waters, as also stressed by Shivaramkrishnan *et al* (*in press*). Dragonflies were common to both less and more impacted waters as per the river continuum hypothesis as also observed in the above study. Further, we also confirm midges and mosquito larvae to favour polluted waters while water bugs frequent water surface covered with vegetation.

Amongst molluscs, Tonapi (1963) and Tonapi and

Mulherkar (1963) have reported 53 species belonging to 28 genera within 17 families. Moreover around 17 species were reported to be very common. In the current studies, however, we could observe only 15 species belonging to 10 genera within 7 families. Many of then common species are not found today while two of them *Thiara scabra* and *Perreysia corrugata* are now very rarely found. This change is due to habitat loss and pollution. Members of family Unionidae and Corbiculidae as well as *Thiara Scabra* were found in partial to less polluted waters whereas others were found to inhabit polluted waters.

The microhabitat specificity of macroinvertebrates is only expected given their sensitivity to substrate type (Arunachalam *et al*, 1991). Presence of midges in most waterbodies indicates widespread pollution (Krishnamurthy and Reddy, 1995). Habitat loss also involves encroachment of ditches and temporary rain water pools by housing colonies, such as at Kothrud (Padhye, A. D., *pers.comm.*). Fortunately, eco-restora-

**Table 1 Sitewise abundance and ecological attributes of taxa**

**Sites :** Bh-Bhugaon lake, Ks-Khadakwasla reservoir, Kw-Kawadi (Mula-Mutha river), Pc-Pachgaon pond, Ps-Pashan lake, Pu-Punawale (Pavna river), Wj-Warje (Mutha river)

**Impact :** P-Polluted L-Less polluted

**Abundance :** A-Abundant, C-Common, O-Occasional, R-Rare

**HB (Habitat) :** D-Ditches, R-Rivers, L-Lakes, P-Ponds, St-Streams, Sb-Sand bank, Mb-Mud bank

**MH (Microhabitat) :** Rs-Rock side, Su-Surface water, Wb-Water bottom, Wc-Water column, Bw-Water bank, Sd-in Sand

**FG (Feeding Guild) :** D-Detritus, A-Algae, O-Omnivore, P-Predator

Aquatic insect Families		Impact :									
Family	Common Name	HB	MH	FG	P	P	P	P	L	L	L
					Wj	Pc	Kw	Ps	Ks	Bh	Pu
Chironomidae	Midges	R, D, P, L	Wb	D		A	A	C	C		
Orthoptera	Semiaquatic Grass-Hopper	St, D, L	Su, Bw	A				C	C		C
Naucoridae	Creeping Water Bug	St, D, P	Wb	P, D			A	A		A	C
Economidae	Net Spinners	St, L, P	Su	O						C	
Calopterygidae	Damsel fly (Nymph)	St, R, P, L	Wb	D						A	
Ditiscidae	Diving Beetles	St, D, P	Wb, Su	P						A	
Ditiscidae	Ditiscus	St, D, P	Wb, Su	P				R			
Notonectidae	Backswimmers	St, P, R	Su, Wc	P				C			A
Corydalidae	Dobson flies (Nymph)	D,P	Wb	P, D							A
Aeschnidae	Dragon fly (Nymph)	St, D, P, R	Wb	P, D	C	C					
Libellulidae	Dragon fly (Nymph)	St, D, P, R	Wb	P, D	C						A
Gerridae	Water strider	St, D, P	Su	P		C			A		C
Perlidae	Stone fly (Nymph)	D, P, L, R	Rs	P, A					O		
Culicidae	Mosquito larvae	D	Wc	D	C			C			
				<b>Total :</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>6</b>

Aquatic snails											
Family	Species	HB	MH	FG	Wj	Pc	Kw	Ps	Ks	Bh	Pu
Viviparidae	<i>Bellamya bengalensis</i>	D, P, L	Wb, Rs	D, A	A	A	A	A	C	C	
Viviparidae	<i>Bellamya dissimilis</i>	P, Mb	Wb, Rs	D, A	A						
Piladae	<i>Pila globosa</i>	D, P, St	Su, Rs	D, A	C			A			
Piladae	<i>Pila virens</i>	D, P, St	Su, Rs	D, A					R		
Thiaridae	<i>Thiara scabra</i>	P, T, Sb	Rs	D, A					R		
Thiaridae	<i>Thiara tuberculata</i>	P, T, St	Rs	D, A	A				A	C	
Thiaridae	<i>Paludonus inflatus</i>	R	Sd	D, A	R				O		
Lymnaeidae	<i>Lymnea acuminata</i>	St, P, D	Su	D, O		A		A			
Lymnaeidae	<i>Lymnea luteola</i>	St, P, D	Su	D, O	C	A		A			
Planorbidae	<i>Indoplanorbis exustus</i>	P, D	Su	D, O	C	C			A		
Planorbidae	<i>Indoplanorbis sps.</i>	P, D	Su	D, O	C						
Planorbidae	<i>Gyrulus labiatus</i>	P, D, St	Su	D	O						
Unionidae	<i>Lamellidens marginalis</i>	St, R	Wb	D	C				A		
Unionidae	<i>Perreysia corrugata</i>	St, R	Wb	D					R		
Corbiculidae	<i>Corbicula striatella</i>	St, R	Wb	D					A		
				<b>Total :</b>	<b>10</b>	<b>4</b>	<b>1</b>	<b>4</b>	<b>9</b>	<b>2</b>	

tion on Pune hills, such as at Parvati Pachgaon provides a silver lining, with the roadside water tanks housing dragonfly nymph moults, indicating fresh colonisation.

**Acknowledgements**

We are thankful to Smt. S. P. Modak, Head, Department of Zoology, and Dr. A. S. Inamdar, Principal, Abasaheb Garware College, Pune 4, for providing laboratory facilities. Prof. Milind Watve made valuable suggestions and Prof. Anand Padhye and Mr. Utkarsh Ghate helped us in preparation of the manuscript. Mr. Subbu (CES, IISc, Bangalore) and Mr. N. A. Arvind (ATREE) have extended their valuable help in taxonomic identification. Our friends Neelesh Dahanukar and Mukul Mahabalashwarkar helped us variously. We thank them all. Authors are thankful to RANWA for providing financial assistance and Prof. Dr. Madhav Gadgil for providing us unparalleled research opportunity.

**References**

Arunachalam M. K., Madhusoodanan Nair K. C., Vijverburg J., Kortmuldar K. and Suriyanarayanan H. 1991. Substrate selection and seasonal variation in densities of invertebrates in stream pools of a tropical river. *Hydrobiologia* 2/3 : 141-148.  
 Krishnamurthy S. V. and Reddy Ravichandra S. 1995. Seasonal fluctuations and periodicity in the insect larval drift in an unpolluted tropical river Tunga, Western Ghats, India. *Int. Jr. Ecol. Env. Sci.* 22 :

261-270, 1995.  
 Sivaramkrishnan, K. G., Madhyastha N. A. and Subramaniam, K. A. 1998. A field guide to aquatic macroinvertebrates. Center for Ecological Sciences, Indian Institute of Sciences, Bangalore.  
 Sivaramkrishnan, K. G., Venkatraman, K. Moorthy, R. K., Subramanyam, K. and Utkarsh, G. (*in press*) Aquatic Insects Diversity of the Stream of the Western Ghats, India. *Jr. Ind. Inst. Sci.*  
 Tonapi G. T. 1959. Studies on the aquatic insect fauna of Poona (Aquatic Heteroptera) *Proc. Nat. Inst. Sci. Ind.* 258(6) : 158-9  
 Tonapi G. T. 1963. Studies on the fresh water molluscs of Poona. *Jr. Bom. Nat. Hist. Soc.* 60(1) : 104-120  
 Tonapi G. T. and Mulherkar 1963. On the fresh water mollusca of Poona. *Jr. Bom. Nat. Hist. Soc.* 60(a) : 104-120.  
 Tonapi G. T. and Ozarkar V. A. 1969. A study on aquatic coleoptera of Poona (Maharashtra) *Jr. Bom. Nat. Hist. Soc.* 66(2) : 310-316.  
 Tonapi G. T. and Ozarkar V. A. 1970. A study on aquatic coleoptera of Poona (Maharashtra) *Jr. Bom. Nat. Hist. Soc.* 66(3) : 533-538.  
 Wallace J. B. and Webster J. R. 1996. The role of macroinvertebrates in stream ecosystem function, *Ann. Review Entom.* 41 : 115-139.  
 Wagh G. K. 1999. Study of Fish, Macroinvertebrate and Aquatic Angeosperm Biodiversity of the river Mutha. Ph.D. Thesis submitted to Pune University.

□

## Ant Genera Distribution Across Habitats of Pune City

Tejaswini Pachpor<sup>1</sup>, Yogita Ghodke<sup>2</sup> and Anand Padhye<sup>3</sup>

### Introduction

Being most common as well as very tiny, ants are always neglected. When we saw some beautiful nests of ants, we were attracted to them and then we decided to work on ants. We started from our own houses and gardens and the ants boosted our enthusiasm to extend the study for the entire city.

Ants deserve a special place in the study of ecology, including behaviour; given their species richness, social habits and high densities contributing much of the animal biomass on earth (Gadagkar *et al*, 1993). Unfortunately, studies and publications on ecology of ants are scarce compared to other animals, especially in India (Rastogi *et al*, 1997). As ants can be studied virtually everywhere from forest interiors or below ground right up to the kitchen, we tried to explore their distribution across a variety of habitat types around Pune city.

### Methodology

We sampled ants from various localities in and around Pune city, within 10 km of the city centre. The ecological habitats distinguished for sampling included forests, scrub and grasslands in the wilderness zone and tree plantations, agriculture and human habitations in the zone with pronounced human influence. We employed all out search for about two hours in the morning as proposed by Rastogi *et al*, (1997). Ants were collected during summer and early monsoon, when they are reportedly found in peak abundance. A

few individuals from each trail or congregation of apparent recognisable taxonomic units (RTU) were collected and preserved at the Abasaheb Garware College, Pune, with careful notes of their locality, habitat and relative visual abundance. We identified the collection up to the genus level based on literature (Holldobler and Wilson, 1990).

### Results and Discussion

Our ant sampling yielded 13 genera belonging to 4 sub-families depicted in the annexure. Table 1 reveals this to be less than half the genera (33 from 6 sub-families) recorded for Bangalore city (Sunil Kumar *et al*, 1997) or even a single locality therein (Rastogi *et al*, 1997). This could be primarily attributed to much greater sampling efforts at Bangalore, where researchers could add about a quarter species by using other techniques like pitfall and scented traps besides all out search. Preliminary calculations based on probability theory using methods adopted by Gadgil *et al* (2000), we expect Pune city environs to harbour about two dozen genera. Applying the genera to species ratios in above studies at Bangalore, we estimate ant fauna of Pune city to harbour at least four dozen species.

Table 1 indicates that tree plantations are most diverse, in terms of ant genera while the rest harbour about half the generic richness, with habitations equaling the agriculture and grasslands. Thus, residential area alongside tree plantations is the richest in ant fauna, as evident from the fact that eleven out of total thirteen genera were collected in Kothrud, where tree-

1. Anand, 6/10 Krutarth Society, Pune 411 037.

2. Flat 103, Shishir Apartments, Lane 3, Happy Colony, Kothrud, Pune 411 029.

3. Lecturer, Department of Zoology, Abasaheb Garware College, Karve Road, Pune 411004. Email : nandudp@yahoo.com

**Table 1 Habitatwise Genus Richness sampled at Pune and Bangalore cities**

Habitat type	Pune*	Bangalore
Forest/Scrub	6	25
Tree Plantation	10	28
Grassland	4	15
Agriculture	4	20
Human Habitation	5	12
TOTAL GENERA	12	33

\* comparatively much underexplored, comparison is made only to highlight similar diversity pattern across habitat gradient

clad housing colonies are fringed by earstwhile scrub, grassland and agricultural area, including remnant groves of fruit trees like Mango. Thus, a mosaic of habitats here harbours nearly twice the diversity as compared to even areas with low human impact such as Bhamburda and Pachgaon hill forests or banks of Pashan lake. These trends resemble the pattern for Bangalore city where Sunil Kumar *et al* (1997) report highest diversity from a public garden amidst habitation and lowest from an industrial estate devoid of trees. Indian Institute of Science (IISc) campus (Rastogi *et al*, 1997), is the other Bangalore landscape harbouring a mosaic of habitat types including the remnant wilderness habitats such as scrub and grasslands amidst extensive tree plantations. IISc supports the second highest diversity among the Bangalore localities.

A few ant genera as *Myrmicaria*, *Crematogaster*, *Leptogenys* and *Camponotus* are most ubiquitous, being commonly found in all the habitats and most localities. A few genera are confined to a few localities or habitat types, such as *Pheidole* and *Cryptopone* recorded only from hill forests and thus are more vulnerable. Our abundance estimates need verification to account for seasonal changes and the fact that many surface ants often reflect unknown proportion of their population, mostly housed beneath ground. Even *Crematogaster* ants reported to build nests of dried leaves and mud in tree canopy (Rastogi *et al*, 1997) showed no such nest in Pune but were seen to emerge from ground inlets. This could possibly be attributed to the lack of suitable tree canopy for nest building.

*Myrmicaria*, the biting, small, red ants are the most well known to all. They are commonly seen everywhere, even foraging in houses and gardens. *Tapinoma* and *Catalaucas* are also found right up to the kitchen. *Leptogenys* ants are seen foraging in gardens and plantations. *Camponotus* are also common, often tending and protecting bugs that secrete sugary solution devoured by ants. Further studies on the ecology and behaviour of these omnipresent animals would be an interesting and rewarding endeavour even for other college students.

#### Acknowledgements

Smt. S. P. Modak, Head, Department of Zoology and Dr. A. S. Inamdar, Principal, Abasaheb Garware College, Pune 4, provided laboratory facilities. Prof. Dr. R. Gandagkar and Dr. Mrs. Tresi (CES, IISc, Bangalore) as well as Dr. N. A. Madhyastha (Poornaprajna College Udupi) and Dr. Revathi Nandan (N. M. Collge, Sulya) kindly provided their valuable methodological and taxonomic guidance. Dr. Milind Watve and S. S. Kharat have given valuable suggestions and Utkarsh Ghate helped us in preparation of the manuscript. Our friends Sachin Ranade, Neelesh Dahanukar and Mukul Mahabaleshwarkar extended their kind co-operation. Authors are thankful to all of them. We are also thankful to Mr. Utkarsh Ghate and RANWA for providing financial assistance and Prof. Dr. Madhav Gadgil for providing us unparalleled research opportunity.

#### References

- Gadagkar, R., Nair, P. Chandrashekhar, K. and Bhat, D. M. 1993. Ant species richness in some selected localities in Western Ghats, India. *Hexapoda* 5:70-94.
- Gadgil et al, 2000. Participatory Local Level Assessment of Life Support Systems. Centre for Ecological Sciences, Indian Institute of Sciences, Bangalore, Technical Report no. 78.
- Holldobler, B. and Wilson, E. O. 1990. *The Ants*. Springer-Verlag.
- Rastogi, N., Nair, P., Kolatkar, M., William, H. and Gadagkar, R. 1997. Ant fauna of the Indian Institute of Science campus- Survey and some preliminary observations. *Jr.Ind.Inst.Sci.* 77 : 133-140.
- Sunil Kumar, M., Shrihari, K. T., Nair, P., Varghese, T. and Gadagkar, R. 1997. Ant Species Richness at selected localities of Bangalore. *Insect Environment* 3(1) : 3-5.

ANT GENERA DISTRIBUTION ACROSS HABITATS OF PUNE CITY

**Annexure : Distribution of Ant genera around Pune city**

**Habitats :** F- Forest, S- Scrub, G- Grassland, P- Plantation, A- Agriculture, H- Human Habitation

**Microhabitats :**

**Ab (Abundance) :** A- Abundant, C- Common, O- Occasional, R- Rare

**Localities :** Localities: Bg-Bhugaon, Bm-Bhamburda, C-Chandani Chowk, K- Kothrud, Pc-Pachgaon, Pv- Parvati, Ps-Pashan, U-University

Sub-family, Genus	Habitats	Abd	Localities
<b>Dolichodirinae</b> Tapinoma Technomyrmex	PH P	C C	Bm, K U
<b>Formicinae</b> Polyrachis Camponotus	P FSGPAH	C A	K, U all but Pv
<b>Myrmicinae</b> Aphaenogaster Catalaucas Crematogaster Monomorium Myrmicaria Pheidole	P PH FSGPA P FSGPAH F	C C A C A C	C, K, U Bg, K, Ps, Pc all but Pv K, Pv, U all Pc
<b>Ponerinae</b> Cryptopone Leptogenys	S FSGPAH	C A	Bm all but Pv

□





## Butterfly Diversity of Pune City along the Human Impact Gradient

*Krushnamegh Kunte*

### Introduction

India hosts 1,501 species of butterflies (Gaonkar 1996), of which peninsular India hosts 350, and the Western Ghats, 331. Pune falls in the relatively species-poor, drier region of the northern Western Ghats. Above literature on biogeographic distribution and habitat preference indicates that the Pune district may harbour about 170 species (Kunte, unpubl.), of which 103 are so far reported from Pune urban area within a 20 km radius. Remaining species are mostly forest dwellers and may not be found in the urban area. There is hardly any literature specific to Pune butterflies.

### Methodology

While observations here are based on seasonal visits to many localities in and around Pune, the author explored six sites more intensely, given their contrasting vegetation types and levels of disturbance (Kunte, 1997). The sites include the moist deciduous forests at Sinhgad hills; forests and grasslands prone to fire and grazing, amidst deserted habitation around NDA; much drier, fire prone scrub and grasslands with little grazing, besides afforestation at Pachgaon, highly grazed but hardly burnt grasslands (so called 'barren land') at Malwadi; well-wooded campus of S.P. College with profusion of old, native trees, besides exotics ones, amidst a mosaic of concrete buildings, the marshes and scrub along the Mutha riverbank at Dattawadi. Besides noting relative abundance and even seasonal counts (Kunte, 1997), the author also recorded larval host plants and their phenology, be-

sides nectar plants, predators and early stages of butterflies.

### Results And Discussion

**Diversity and distribution :** The annexure depicts the distribution patterns of 104 butterfly species recorded so far. Some butterfly species, which perhaps evaded detection or precise field identity, may include Lineblues, other Blues, Swifts and Skippers. Further survey may not record more than 120 species from the study area. Table 1 summarises the annexure in terms of habitatwise species richness and uniqueness. Over two thirds are found in denser forest habitats such as valleys of Sinhgad and Peacock Bay, 11 of which are found nowhere else. Scrub appears to be most species rich habitat frequented by three fourths of the species though only two of these were exclusive to it, seldom recorded elsewhere. Forest, on the other hand harboured a bit lower diversity with only two thirds the species, but highest level of uniqueness, with nearly a dozen species exclusive to it. Plantations also harboured two unique species, though low species richness. Agriculture and grassland harbour high and lowest species richness respectively though without any species being exclusive to them. Together, wilderness areas i.e. forest, scrub and grasslands harbour three fourths of the species, about a fourth of them being exclusive to wilderness zone. The plantations clinging the township, along with the agriculture represent more human impacted zone which harbours about two thirds of the total species recorded from Pune, but some of them have their larval food plants located in the wilderness zone. The habitat specialists

**Table 1 Habitat-wise species richness**

	No. of total species	No. of Unique Species
Forest (F)	68	11
Scrub (S)	76	2
Grassland (G)	38	0
Plantations (P)	57	2
Agriculture (A)	69	0
Wild (F,S,G)	80	20
Impacted (P,A)	70	0

include predominantly forest dwellers like the Bushbrown, few species of Yellows and Flats; while the Tailed Jay is a habitation specialist. The habitat generalists include Common Rose, Lime Butterfly, species of Grass Blues etc. found in a variety of habitat types.

**Seasonality :** Table 2 presents the number of total species recorded along transects at four localities (Kunte, 1997) across seasons. This excludes species with unreliably low abundances and the plantation fauna. Kunte (1997) describes in detail the seasonality patterns, technically termed flight periods, of species and groups, including factors affecting it. Butterflies in all habitats have distinct flight periods. Almost all butterflies have very short seasonal peaks, and they are either absent or rare in other seasons. However, their interesting patterns probably reflect phenophases of their host plants. Some species occur throughout the year with a short population peak in a specific season, and some species occur only for a few months, such as the Spotless Grass Yellow and the Common Hedge Blue, respectively (at Sinhadagad). A few species have a single, short flight period such as Lineblues (at Sinhadagad) whereas some have two short peaks (e.g. Common Five-ring at Sinhadagad). Yet others have just one, but fairly long flight period (e.g. Chocolate Pansy

at Sinhadagad). Although with little fluctuations, a few species (e.g. Common Evening Brown at Sinhadagad) have similar abundance throughout the year. Most butterflies, in terms of number of individuals and number of species, fly in Pune during late monsoon and winter. The populations are low in spring and summer, probably due to fires at Peacock Bay and Pachgaon, and scarcity of water and ground flora at Malwadi and Sinhadagad. Usually at all the sites, the populations start building from early monsoon and show the first peak in late monsoon, followed by a second peak in winter.

**Fire and grazing impacts :** Certain hillocks in Pune are grazed by migratory herds of sheep and resident livestock. Some are annually burned in uncontrolled and artificial fires. Intense grazing seriously alters the composition of ground flora in grasslands. Cattle up-root grasses while feeding on them, and therefore decrease their density, promote unpalatable herbs, at the cost of tall grasses such as at Malwadi. On the other hand, the fire-afflicted site of Pachgaon hosts tall grasses but herbs are rare. Given these difference in larval and adult food resources, the butterfly fauna of Malwadi grasslands differs from the Pachgaon grasslands. For instance, species such as Grass Blues, Grass Jewel, Joker and Blue Pansy are much more common mainly at the fire-free site of Malwadi than Pachgaon, especially during winter. Since larval as well as imaginal stages of these butterfly species inhabit extremely disturbed vegetation, it is possible that they have evolved in secondary, disturbed grasslands. Fire can occur naturally or be initiated by human beings. It plays a very important role since it affects the vegetation directly. However, despite affecting species composition, fire does not seem to affect the species richness (Table 2). Butterflies such as common evening brown, plains cupid, spotless grass yellow, blue pansy, lemon pansy, painted lady and leopard were found at fire-free as well as at fire-afflicted sites. These species had more intense peaks at fire-afflicted areas with highly seasonal occurrence.

**Table 2 Seasonal variation in species richness at the four sites**

	Feb.-Mar.	Apr.-May	Jun.-Jul.	Aug.-Sep.	Oct.-Nov.	Dec.-Jan.
Sinhadagad	8	7	17	19	16	14
Peacock Bay	6	6	7	14	19	12
Pachgaon	4	3	14	25	18	21
Malwadi	14	8	10	14	18	12

On the other hand, in the fire-free areas their occurrence was less seasonal and spread across more seasons. Control of annual fires will be a singular, and perhaps the most important, effort at conserving butterflies in Pune.

**Population changes :** In the absence of earlier studies, it is impossible to quantify if certain butterfly population have increased or decreased over the last decades. It is obvious that loss of the habitat and the increased use of the inorganic pesticides in recent decades have adversely affected many butterfly species. Yet, no species might have gone locally extinct in Pune, given the long history of modification of the land in this region. In contrast, populations of at least two butterflies, evergreen and semi-evergreen forest dwellers viz. Blue Mormon and the Plain Puffin have increased prominently in the last 10 years, thanks to the home gardens that host their larval host plants viz. *Citrus spp.* and *Drypetes roxburghii* respectively. Common Albatross and the Plain Puffin both feed on *D. roxburghii* and co-occur at the probable source population, in Bheemashankar in the Western Ghats. But so far only the Plain Puffin has been successful in establishing in the drier east of Pune while only the Common Albatross has established itself in parts of moister, western Mumbai city. Populations of the Tailed Jay and the Common Mormon from the evergreen and deciduous forests respectively seem increasing, benefiting from the avenue and homestead plantation of larval host trees such as *Polyalthia longifolia* and *Citrus spp.* The plants apparently helped in widening the habitat preference of butterflies.

**Conclusion :** Nearly half the species are recorded in the city, including various kinds of plantations of trees and shrubs in the home gardens, public gardens, avenues etc. However, all of them may not survive if the natural vegetation like forest and grasslands surrounding the city vanish. For, some of the species seen around human habitation have their food plants or source populations in such wilderness zones skirting the city. Together, a fifth of the species are recorded primarily from such wilderness, rarely encountered in the city. These are thus most vulnerable to any further destruction of wilderness areas. This can be minimised by promoting these food plants (Kunte, 2000),

whether herbs or climbers, rather than planting exotic trees. Controlling hill fires is also a pressing need.

### Acknowledgements

Radhika Godbole helped me during the fieldwork while Dr. Makarand Dabak and Thomas Gay shared their perceptions especially about the past records. My teachers such as Dr. Pendse of S. P. College encouraged this extracurricular interest that cost my college schedule. I thank them all, besides my cooperative family and friends.

### Bibliography

- Evans, J. H. 1932. Identification of Indian Butterflies. BNHS (repr.). Mumbai.
- Gaonkar, H. 1996. Butterflies of the Western Ghats with notes on those of Sri Lanka. A report to Centre for Ecological Sciences, Indian Institute of Science, Bangalore; Zoological Museum, Copenhagen and Natural History Museum, London.
- Kunte, K. J. (unpubl.) Checklist of the Butterflies of the Western Ghats.
- Kunte, K. J. 1996. Strange behavior of Mottled Emigrant males. *J. Bombay Nat. His. Soc.*, 93(2) : 307-308.
- Kunte, K. J. 1997. Seasonal patterns in butterfly abundance and species diversity in four tropical habitats in northern Western Ghats. *J. Biosc.*, 22(5) : 593-603.
- Kunte, K. J. 1998. Common Silverline caterpillar feeding on *Cadaba indica*. *J. Bombay Nat. His. Soc.*, 95(1) : 139.
- Kunte, K. J. 1998. Plain Puffin: Behavior, life history and distribution. *J. Bombay Nat. His. Soc.*, 95(1) : 137-139.
- Kunte, K. J. 2000. Butterflies of Peninsular India. Indian Academy of Sciences, Bangalore and Universities Press, Hyderabad.
- Larsen, T. B. 1987-88. The butterflies of the Nilgiri mountains of southern India (Lepidoptera : Rhopalocera). *J. Bombay Nat. Hist. Soc.*, 84(1) to 85(1).
- Wynter-Blyth, M. A. 1957. Butterflies of the Indian Region. Bombay Natural History Society, Mumbai.

BUTTERFLY DIVERSITY OF PUNE CITY ALONG THE HUMAN IMPACT GRADIENT

**Annexure : Distribution and abundance of butterflies in the Pune urban area**

Habitats : F-forest, S-Scrub, G-Grassland, P-Plantations, A-Agriculture

ABD (Abundance) : A-Abundant, C-common, O-Occasional, R-rare, S-Stray

Remarks : LC- Law College, PU- Pune University

The common names are adopted from Evans (1932) and Winter Blythe (1957). For scientific nomenclature, consult Gaonkar (1996).

Sr.no.	Common Name	ABD	Habitats	Remarks	
<b>Family Papilionidae</b>					
1	Common Rose	C	FSGPA	source at 40 km?	
2	Crimson Rose	O	FSPGA		
3	Tailed Jay	C	P		
4	Common Mime	S			
5	Lime	A	FSGPA		
7	Common Mormon	C	FP		
8	Blue Mormon	O	FP		
8	Blue Mormon	O	FP		increasing
<b>Family Pieridae</b>					
9	Common Emigrant	A	FSPA	Seasonal forms  rare, Sinhagad  fresh arrival sporadic  only PU & LC LC hill	
10	Mottled Emigrant	A	SGPA		
11	Small Grass Yellow	C	FSGPA		
12	Spotless Grass Yellow	A	FSGPA		
13	Common Grass Yellow	A	FSGPA		
14	Three-Spot Grass Yellow	?	F		
15	Common Jezebel	C	FP		
16	Psyche	C	FSPA		
17	Common Gull	A	FSGPA		
18	Pioneer Or Caper White	A	SGPA		
19	Plain Puffin	O	P		
20	Striped Albatross	R	SGA		
21	Small Salmon Arab	S	SA		
22	Small Orange Tip	C	SGA		
23	Plain Orange Tip	R	SGA		
24	Crimson Tip	R	SGA		
25	Large Salmon Arab	R	SGA		
26	White Orange Tip	O	FSPA		
27	Yellow Orange Tip	S	FS		
28	Common Wanderer	C	FSPA		
<b>Family Nymphalidae</b>					
29	Common Evening Brown	A	FSGPA		winter winter
30	Common Treebrown	R	FS		
31	Common Bushbrown	O	F		
32	Common Threering	C	FSGA		
33	Common Fivering	C	FS		
34	Common Nawab	R	FPA		
35	Black Rajah	R	FSPA		
36	Tawny Coster	C	SGPA		
37	Common Leopard	C	FSA		

Sr.no.	Common Name	ABD	Habitats	Remarks
38	Common Sailer	C	FS	source at Sinhgad?
39	Common Baron	C	FPA	winter
40	Baronet Or Red Baron	R	FS	frequents Malwadi
41	Joker	O	SGA	localized
42	Angled Castor	R	SA	
43	Common Castor	A	FSPA	
44	Yellow Pansy	C	FSGPA	
45	Blue Pansy	C	SGPA	
46	Lemon Pansy	A	FSGPA	
47	Peacock Pansy	C	FSPA	Waterbodies
48	Grey Pansy	C	FSPA	Waterbodies
49	Chocolate Pansy	C	F	
50	Painted Lady	O	SGA	highly seasonal
51	Great Eggfly	O	FSPA	
52	Danaid Eggfly	O	FSPA	
53	South Indian Blue Oakleaf	R	F	
54	Glassy Tiger	O	FSPA	
55	Blue Tiger	C	FSPA	
56	Plain Tiger	A	SGPA	
57	Striped Or Common Tiger	O	FSPA	
58	Common Indian Crow	A	FSGPA	
<b>Family Lycaenidae</b>				
59	Plum Judy	O	F	highly seasonal
60	Apefly	S		
61	Common Pierrot	C	FSPA	
62	Angled Pierrot	O	F	highly seasonal
63	Rounded/Rusty/Striped Pierrot	O	SPA	
64	Zebra Blue	C	FSPA	
65	Bright Babul Blue	O	FSA	
66	Dull Babul Blue	O	FSA	
67	African Babul Blue	C	SA	
68	Common Hedge Blue	O	F	highly seasonal
69	Pale Grass Blue	C	SGPA	
70	Dark Grass Blue	C	SGPA	
71	Lesser Grass Blue	C	SGPA	
72	Tiny Grass Blue	C	FSGPA	
73	Lime Blue	O	PA	
74	Small Cupid	S?	SGA	
75	Plains Cupid	C	SGPA	
76	Grass Jewel	C	SGA	highly seasonal
77	Gram Blue	A	FSGPA	
78	Forget-Me-Not	O	F	
79	Pea Blue	C	FSGPA	
80	Dark Cerulean	O	FA	
81	Common Cerulean	A	FPA	
82	Common Line Blue	O	FS	
83	Red Pierrot	C	SPA	localized
84	Common Silverline	R	FPA	

BUTTERFLY DIVERSITY OF PUNE CITY ALONG THE HUMAN IMPACT GRADIENT

Sr.no.	Common Name	ABD	Habitats	Remarks
85	Shot Silverline	S?	S	
86	Scarce Shot Silverline	S?	S	
87	Peacock Royal	O	FA	
88	Indian Red Flash	O	FS	
89	Slate Flash	O	FS	
90	Indian Sunbeam	O	FSPA	
	<b>Family Hesperidae</b>			
91	Common Banded Awl	A	FSPA	highly seasonal
92	Brown Awl	O	F	
93	Common Spotted Flat	R	F	
94	Malabar Spotted Flat	R	F	
95	Common Small Flat	R	SG	
96	Spotted Small Flat	R	SG	
97	Indian Grizzled/Indian Skipper	O	SGPA	
98	Grass Demon	C	FP	
99	Indian Palm Bob	O	PA	
100	Pale Palm Dart	O	FS	
101	Dark Palm Dart	O	FS	
102	Rice Swift	C	FSPA	
103	Bevan's Swift	C	FSGPA	

□

## Decline of Fresh-Water Fish of Pune Urban Area

S. S. Kharat<sup>1</sup>, Neelesh Dahanukar<sup>2</sup> and Rupesh Raut<sup>3</sup>

### Introduction

This paper explores the condition of fish fauna of Pune urban area that once revealed 25 species new to science out of total 26, described by Sykes in 1841 during his study on the fish fauna of the Deccan. After a silent century, there was a sudden spurt of publications. The huge collection of fish made by Fraser (1942) from Pune area was investigated by Hora and Misra (1942) recording 54 fish species. Suter (1944) added 17 species to the Pune list. Tonapi and Mulherkar (1963) recorded 60 fish species from Pune, 25 being new local records. Tilak and Tiwari (1976) surveyed fish fauna of the whole district. Yazdani and Mahabal (1978) recorded 34 fish species from the Indrayani river. To assess the urbanization impact, Ghate and Wagh (*pers. comm.*) resurveyed the Mula and Mutha Rivers between 1992 and 1995, to list 64 fish species, 14 of which were newly recorded for the area. All this literature records 110 fish species from Pune urban area, studied by us here. This re-survey reports about species extinction, population changes and introductions in relation to each other and various human influences.

### Methodology

Our study area covers 25 km radius from the Pune City Post. Waterbodies here include the Mula River, the Mutha River, the Mula-Mutha River, a part of the Indrayani River, a part of the Pavana River, and three lakes – Katraj upper lake, Pashan lake, and Lakaki

lake. Sampling this year involved collection at randomly chosen spots at these waterbodies and the related local markets. The specimens were preserved in 5% formalin in Abasaheb Garware college. Fish were identified with the help of literature (Talwar and Jhingran, 1992; Menon, 1987; Jayaram, 1991; Day, 1878). Identification was verified with the help of Kerala Forest Research Institute (KFRI), Peechi where we found accessible expertise. Relative abundance of each fish species, population changes, and probable driving forces for the change were recorded from field observations and interviewing local fishermen.

### Results and Discussion

We presently recorded 66 species from 38 genera and 18 families, taking the records for the area to 114 species from 47 genera and 22 families, depicted in the annexe along with ecological parameters. We could not collect 48 species recorded earlier of which 18 fish species appear to be locally extinct. Remaining 30 species are too rare, besides possibly escaping detection due to seasonal variations and sampling limitations. We doubt the presence of 12 fish species recorded earlier from Pune. Population of 6 species appears to be declining. Seven fish species have been introduced here recently. As shown in the annexure, we recorded afresh 4 natural species from this area.

The common and widespread species include *Notopterus notopterus*, *Salmostoma boopis*, *Rasbora daniconious*, *Garra mullya*, *Mystus bleekeri*, *Oreochromis mossambica*, *Channa marulis*, etc. Five species are rare

1. Lecturer, Zoology Department, Abasaheb Garware College, Pune 411004.

2. 1104 B, Shivaji Nagar, Shashi Apartments, Model Colony, Pune 411 016. Email : neeshdahanukar@usa.net

3. 136 Budhwar Peth, Pune 411 002. Email : rautrupesh@usa.net

while another 7 are only occasionally encountered. About 25 species are recorded from one or two localities each. Aundh and Yerwada are the most important localities hosting about a dozen such localised species each.

The 18 species that have most possibly become localized are primarily large-size fish belonging to genera such as *Anguilla*, *Tor*, *Bagarius*, *Silonia*, etc. having high consumption value and subject to heavy harvesting. Siltation due to catchment erosion or waste dumping makes the water column shallow, depriving the larger fishes their habitat. Human harvests affect 19 species including 6 that have shown significant decline, given their high food value and demand. Pollution seems to be responsible for the drop in population of many species. A locally extinct fish *Ompak pabo* was recorded here by Fraser in 1942. Of late, it has been recorded only in the far upstream of the Mula River (Kharat *et al.*, unpubl.). The two major rivers of Pune city, Mula and Mutha, are highly polluted owing to organic and inorganic waste. The Mula River flows through an industrial zone and hence inorganic salts and heavy metals from the industrial wastes contaminate the water. This has probably resulted in the absence of all fish species except *Oreochromis mossambica* near Khadki. Organic pollution has triggered the spread of water hyacinth plants covering water surface in many places. While Katraj upper lake is polluted mainly by domestic sewage, Pashan lake is polluted also by industrial effluents. While this has affected most fish negatively, populations of a few species such as *Heteropneustus fossilis* that can withstand organic pollution due to its breathing ability are even increasing. The introduction of commercially important fish such as *Cyprinus carpio communis*, *Oreochromis mossambica* have probably driven fishes such as *Labeo fimbriatus*. Population decline of *Aplocheilichthys lineatus* feeding on larvae may be attributed to resource competition with introduced exotic larvivorous fish of the family Poeciliidae.

We doubt, based on circumstantial evidence, earlier records of a dozen fish species such as *Notopterus chitala* here. *Neoissochilus wynnaadensis*, a cyprinid fish recorded by Tonapi and Mulherkar (1963) is actually a species endemic to Kerala (Shaji and Easa, 1998). Singh and Yazdani (1992) had likewise doubted the occurrence of *Osteobrama cotio cunma* from the Mula-Mutha River. We report four species for the first time from the area. *Cirrhinus cirrhosus*, the Cavery white carp, is a common fish in the Deccan (Nagulu *et. al.*, 2000) and one specimen was collected from our study area. However, despite these four new geographical

records, we conclude our findings on the sad note of decline of over a third of the recorded species, another sixth having become locally extinct. Impending fish erosion cannot be minimised without halting siltation and promote optimal, rather than maximal harvests; and exploring checks on growth of exotic species.

#### Acknowledgment

Smt. S. P. Modak, Head, Dept. of Zoology and Dr. A. S. Inamdar, Principal, Abasaheb Garware College encouraged us by kindly providing laboratory facilities. Dr. H. V. Ghate, Head, Dept. of Zoology, Modern College, Pune guided us all through. Dr. C. P. Shaji, KFRI, Peechi confirmed identity and shared valuable perceptions. Mr. Anand Padhye helped in manuscript preparation. Mandar Paingankar and Mukul Mahabaleshwarkar helped us in the sampling. RANWA, particularly Utkarsh Ghate motivated and sponsored this study, besides trip to KFRI. We thank them all.

#### References

- Day, F. 1878. Fishes of India (Vol. I and II). William Dawson and Sons Ltd., London.
- Fraser, A. G. L. 1942. Fish of Poona- Part 1. *Jr. B.N.H.S.* **43** : 79-91.
- Fraser, A. G. L. 1942. Fish of Poona- Part 3. *Jr. B.N.H.S.* **43** : 452-454.
- Hora, S. L. and Misra, K. S. 1942. Fish of Poona- Part 2. *Jr. B.N.H.S.* **43** : 218-228.
- Jayaram, K. C. 1991. Revision of genus *Puntius* (Hamilton) from Indian region (Pisces : Cypriniformes : Cyprinidae : Cyprininae). Records of Zoological Survey of India (ZSI) Occasional Paper No. 135. ZSI, Calcutta.
- Kharat, S. S., Dahanukar, N., Raut, R., and Mahabaleshwarkar, M. (unpublished) Changing fish fauna of Mula Mutha rivers.
- Menon, A. G. K. 1987. Fauna of India and adjacent countries (Pisces) Vol 4 (Part 1), Homalopteridae. ZSI, Calcutta.
- Nagulu V., Rao V. V. and Shrinivasulu C. 2000. Wildlife Heritage of the Deccan : Deccan Heritage. University Press, Hyderabad.
- Shaji, C. P. and Easa, P. S. 1994. Status and distribution of endemic fresh water fishes in Kerala, Western Ghats of India. *Tiger paper* **25** : 21-24.
- Singh, D. F. and Yazdani, G. M. 1991. *Osteobrama bhimensis* : a new Cyprinid fish from Bhima River, Pune District, Maharashtra. *Jr. B.N.H.S.* **89** : 96-99.
- Suter, M. J. 1944. New records of fish from Poona. *Jr. B.N.H.S.* **44** : 408-414.



Talwar, P. K. and Jhingran K. C. 1992. Inland fishes (Vol. I and II), Oxford and IBH, New Delhi.  
 Tilak, R. and Tiwari, D. N., (1976), On the fish fauna of Poona District (Maharashtra), News Letter Zoo-

logical Survey of India, **2 (5)** : 193-199.  
 Tonapi, G. T. and Mulherkar, L.,(1963), Notes on the freshwater fauna of Poona, Part : 1, Fishes, Proc. Ind. Acad. Sci., **58** : 187-197.  
 Yazdani and Mahabal (1978), Fishes of Indrayani River, Biovigyanam (Poona) **2** : 119-121.

**Annexure : Distribution pattern of fresh-water fish of Pune city.**

\* Records doubtful.

Localities are indicated only for species found at one or two sites

ABD (abundance) : A-abundant, C-common, O-occasional, R-rare

CHG (change) : D-decreasing, F-first record, IN-increasing, IT-introduced, N-presently unrecorded, X-extinct

DF (Driving Forces) : H-harvest, IE-introduced sp. effect, P-pollution

Fish Species	ABD	CHG	DF	Locality
<b>Family : Notopteridae</b>				
<i>Notopterus chitala</i> (Hamilton-Buchanan)*		N		
<i>N. notopterus</i> (Pallas)	A			
<b>Family : Anguillidae</b>				
<i>Anguilla bengalensis bengalensis</i> (Grey)		X	H	
<b>Family : Cyprinidae</b>				
<b>Subfamily : Cyprininae</b>				
<i>Catla catla</i> (Hamilton-Buchanan)	C			
<i>Cirrhinus cirrhosus</i> (Bloch)	O	F		Aundh
<i>C. fulungee</i> (Sykes)	A			
<i>C. mrigala mrigala</i> (Hamilton-Buchanan)	C			Yerwada
<i>C. reba</i> (Hamilton-Buchanan)	C			
<i>Cyprinus carpio coomunis</i> Linnaeus	O	IT		
<i>Gonoproktopterus kolus</i> (Sykes)	A			
<i>G. thomassi</i> (Day)		N		
<i>Labeo ariza</i> (Hamilton-Buchanan)	R	D	H	Yerwada
<i>L. boggut</i> (Sykes)	R	D	H	Yerwada
<i>L. calbasu</i> (Hamilton-Buchanan)	A			
<i>L. fimbriatus</i> (Bloch.)		X	H, IE	
<i>L. kawrus</i> (Sykes)		X	H, IE	
<i>L. porcellus</i> (Heckel)	C			
<i>L.potail</i> (Sykes)		X	H	
<i>L. rohita</i> (Hamilton-Buchanan)	A			
<i>L. sindensis</i> (Day)		X	H	
<i>Neolissochilus wynaadensis</i> (Day)*		N		
<i>Osteobrama cotio cunma</i> (Day)*		N		
<i>O. cotio peninsularis</i> Silas	C			
<i>O. neilli</i> (Day)	C			Aundh
<i>O. vigorsii</i> (Sykes)	A			
<i>Osteocheilus (Osteochilichthys) godavarinsis</i> (Rao)	C	F		Vishrantwadi
<i>O. (Osteochilichthys) nashii</i> (Day)	A			Warje, Aundh
<i>O. (Osteochilichthys) thomassi</i> (Day)*		N		
<i>Puntius amphibius</i> (Valenciennes)	A			Aundh, Yerwada

DECLINE OF FRESH-WATER FISH OF PUNE URBAN AREA

Fish Species	ABD	CHG	DF	Locality
<i>P. arenatus</i> (Day)		N		
<i>P. chola</i> (Hamilton-Buchanan)	A			
<i>P. conchoni</i> (Hamilton-Buchanan)	O			Warje, Aundh
<i>P. dorsalis</i> (Jerdon)		N		
<i>P. jerdoni</i> (Day)	C			Aundh
<i>P. melanostigma</i> (Day)		N		
<i>P. sarana sarana</i> (Hamilton-Buchanan)	R	D	H	Yerwada
<i>P. sarana subnasutus</i> (Valenciennes)	A			
<i>P. sophore</i> (Hamilton-Buchanan)	C			
<i>P. ticto</i> (Hamilton-Buchanan)	A			
<i>Rohetee ogilbii</i> (Sykes)	C			Aundh
<i>Schismatirhynchus (Nukta) nukta</i> (Sykes)		X	H	
<i>Tor khudree</i> (Sykes)		X	H	
<i>T. mussulah</i> (Sykes)		N		
<b>Subfamily : Cultrinae</b>				
<i>Chela cachi</i> (Hamilton-Buchanan)		N		
<i>C. laubuca</i> (Hamilton)		N		
<i>Salmostoma acinaces</i> (Valenciennes)		N		
<i>S. boopis</i> (Day)	C			
<i>S. clupoides</i> (Bloch)		N		
<i>S. novacula</i> (Valenciennes)	C			
<i>S. phulo</i> (Hamilton)		N		
<b>Subfamily : Rasborinae</b>				
<i>Amblypharyngodon mola</i> (Hamilton-Buchanan)	C			Aundh
<i>Barilius barna</i> (Hamilton-Buchanan)		X	H	
<i>B. bendelisis</i> (Hamilton-Buchanan)	C			
<i>B. gatensis</i> (Valenciennes)		X	H	
<i>Danio aequipinnatus</i> (Mc-Clelland)	A			
<i>D. devario</i> (Hamilton- Buchnan)*		N		
<i>D. malabaricus</i> (Jerdon)	C			Aundh
<i>Rasbora daniconious</i> (Hamilton-Buchanan)	A			
<i>R. labiosa</i> (Mukerji)	O	F		
<b>Subfamily : Garrinae</b>				
<i>Crossocheilus latius latius</i> (Hamilton- Buchanan)		X	P	
<i>Garra gotyla gotyla</i> (Gray)	C			Aundh
<i>G. mullya</i> (Sykes)	A			
<b>Family : Parapsilorhynchidae</b>				
<i>Parapsilorhynchus tentaculatus</i> (Annandale)		X	P	
<b>Family : Balitoridae</b>				
<b>Subfamily : Nemacheilinae</b>				
<i>Nemacheilus anguilla</i> Annandale	C			Warje
<i>N. denisoni dayi</i> Hora		N		
<i>N. denisoni denisoni</i> Day	A			
<i>N. evezardi</i> Day	A			
<i>N. moreh</i> (Sykes)	A			
<i>N. rueppelli</i> (Sykes)	C			Aundh, Yerwada
<i>N. savona</i> (Hamilton-Buchanan)		N		

Fish Species	ABD	CHG	DF	Locality
<i>N. striatus</i> Day*		N		
<i>N. sps.</i> (resembling <i>N. cincticauda</i> (Bliith))*		N		
<i>N. sps.</i> (resembling <i>N. multifasciatus</i> Day)*		N		
<i>N. sps.</i> (resembling <i>N. savona</i> Hamilton)*		N		
<b>Family : Cobitidae</b> <b>Subfamily : Cobitinae</b> <i>Lepidocephalus guntea</i> (Hamilton-Buchanan) <i>L. thermalis</i> (Valenciennes)	C	N		
<b>Family : Bagridae</b> <i>Aorichthys seenghala</i> (Sykes) <i>Mystus bleekeri</i> (Day) <i>M. cavasius</i> (Hamilton-Buchanan) <i>M. gulio</i> (Hamilton-Buchanan) <i>M. malabaricus</i> (Jerdon) <i>Rita kuturnee</i> (Sykes) <i>R. pavimentata</i> (Valenciennes) <i>R. rita</i> (Hamilton- Buchanan)*	C C A C O	X  X N	H	Aundh, Yerwada Aundh
<b>Family : Siluridae</b> <i>Ompok bimaculatus</i> (Bloch) <i>O. pabo</i> (Hamilton) <i>Wallago attu</i> (Schneider)	A R	X D	H, P H	
<b>Family : Schibeidae</b> <b>Subfamily : Schibeinae</b> <i>Proeutropiichthys taakree taakree</i> (Sykes) <i>Silonia childreni</i> (Sykes)	R	D X	H, P H	Yerwada
<b>Family : Sisoridae</b> <i>Bagarius bagarius</i> (Hamilton-Buchanan) <i>B. yarrelli</i> Sykes <i>Glyptothorax conirostre poonensis</i> Hora <i>G. lonah</i> (Sykes) <i>G. madraspatanum</i> (Day) <i>Nangra itchkeea</i> (Sykes)	O	X N X X N	H  H	Yerwada
<b>Family : Heteropneustidae</b> <i>Heteropneustes fossilis</i> (Bloch)	C	IT, IN	P	Yerwada
<b>Family : Belonidae</b> <i>Xeneotodon cancila</i> (Hamilton-Buchanan)	C			Yerwada
<b>Family : Aplocheilidae</b> <i>Aplocheilus lineatus</i> (Valenciennes) <i>A. panchax</i> ( Hamilton - Buchanan)*	O	D N	IE	Vittalwadi,K'wasla

DECLINE OF FRESH-WATER FISH OF PUNE URBAN AREA

Fish Species	ABD	CHG	DF	Locality
<b>Family : Poeciliidae</b> <i>Gambusia affinis</i> (Baird & Girard) <i>Poecilia (Labistes) reticulata</i> Peters <i>Xiphophorus hellerii</i> Heckel	A A C	IT IT IT		Warje, Vitthalwadi
<b>Family : Ambassidae</b> <i>Chanda nama</i> Hamilton-Buchanan <i>Pseudambassis ranga</i> (Hamilton-Buchanan)	C C			Warje
<b>Family : Mugilidae</b> <i>Rhinomugil corsula</i> (Hamilton-Buchanan)	C	IT, IN	P	Yerwada
<b>Family : Cichlidae</b> <i>Oreochromis mossambica</i> (Peters)	A	IT, IN	P	
<b>Family : Gobiidae</b> <b>Subfamily : Gobiinae</b> <i>Glossogobius giuris</i> (Hamilton-Buchanan)	C			
<b>Family : Belontiidae</b> <i>Macropodus cupanus</i> (Valenciennes)		N		
<b>Family : Channidae</b> <i>Channa marulius</i> (Hamilton-Buchanan) <i>C. orientalis</i> Bloch & Schneider <i>C. punctatus</i> (Bloch) <i>C. striatus</i> (Bloch) * <i>C. sps.</i>	C  A	N  N N		
<b>Family : Mastacembelidae</b> <i>Mastacembelus armatus</i> (Lacepede)	C			

□



## Amphibian Species Decline in Pune City

A. D. Padhye<sup>1</sup> and Mukul Mahabaleshwarkar<sup>2</sup>

### Introduction

Amphibians are probably the best indicators of environmental health of all vertebrates, being extremely sensitive to temperature and humidity (Daniels, 1991). Their easily permeable skin makes them susceptible to environmental changes, including pollution. They are also sedentary, unlike birds that have strong dispersal ability. Thus, any change in amphibian population alarms conservationists the most.

For last 30 years, Pune has been a center of industrialization and concomitant urbanization. As a result the city is growing in size as well as population rapidly, at the cost of its environment. This has a severe impact on amphibian fauna of the city and outskirts. This prompted us to undertake the present investigation. Earlier studies by Yazdani and Mahabal (1976) and Paranjape and Mulherkar (1979) together record 13 amphibian species from Pune City.

### Methodology

ADP has been collecting amphibian eggs for experiments and natural history studies since 1986 from Pashan, Khadaki, University, Vitthalwadi, the Mutha river banks till Khadakwasla, Hingane, Kothrud, Hadapsar, Yerawda, Nagar road and adjacent areas, besides observing habitat changes therein. These and other places around Pune city were more intensely surveyed during the monsoon 2000 (late May to Oct. end) for estimating their current status. Presence of frog species was based on sighting, presence of egg clutches or the calls. In case field identity was found

difficult, the specimens were collected and identified in the laboratory with the help of literature (Daniel, 1963 and 1975, Daniel and Sekar, 1989). During the field visits, ecological factors like abundance, habitat, microhabitat, food preferences, human influence were also noted. We have also studied various museum collections.

### Results and Discussion

Our present survey reveals 14 species belonging to 7 genera and 4 families (Annexure). Nine of these today occur only outside the city while five of them are recorded only beyond 10 km from the city centre. Three species inhabit all localities, another three inhabit all or most localities except the city, while three such as *Uperedon globulosus* are highly localised. In fact, five of the previously reported species could not be presently retraced in their reported localities or elsewhere and may be locally extinct. These include *Rana hexadactyla*, *Bufo stomaticus*, *B. parietalis*, *B. microtympanum* and *Philautus bombayensis*. This is expected as per the indications of amphibian decline given by Paranjape and Mulherkar (1979) and by Ghate and Padhye (1996).

Much of the amphibian decline can be attributed to the habitat loss due to rampant urbanisation, accompanied by quarrying and slums that have not even spared hills. Over 70% of the past amphibian habitat area is now encroached. Recent Industrial estate at Pirangut has reduced the *Tomopterna* and *Rana malabarica* populations that were aplenty earlier, the latter being nearly wiped out due to loss of paddy

1. Lecturer, Department of Zoology, Abasaheb Garware College, Pune 411 004. Email : nandudp@yahoo.com

2. Flat 15, 24 E, Paschima nagari Society, Kothrud, Pune 411 029. Email : chidanand@ip.eth.net

fields which served as their major breeding ground. Construction of Sports City at Balewadi and the highway bypass has stretched the habitat loss further. Resultant loss of scrub, grasslands, paddy fields; compaction and modification of the soil has ceased the formation of rainwater pools that are critical to amphibian sustenance. The important breeding grounds along the riverbed within the city had somehow survived this fringe expansion until recently, but are not spared by the recent river decoration and river-side road construction. The inclusion of fringe villages into municipal corporation limits will further intensify habitat destruction, with conversion of farms, grasslands, paddy fields, river banks and the so called barren lands that harbour puddles to urban habitation and infrastructure. Suburbs and fringe villages of Pune city that once hosted prime amphibian habitats now barely shelter small, fragmented populations, prone to extinction with aberrations like monsoon delay or failure. Any major calamity, like scanty or irregular monsoon, will totally wipe out such fragmented populations. Recently, herpetologists have begun debating the global amphibian decline, even in low human impact areas like Brazilian rainforests possibly due to the ongoing climate change. This can hardly be detected around the scientific and educational city of Pune, where not the global climate but urbanisation will spell doom for amphibians.

Fortunately, a few low impact areas like scrub and grasslands within military campus such as NDA still offer some peace to amphibians despite the ever-increasing human pressures. Many hills around Pune city have become tree clad due to the efforts of the Forest Department, some housing societies, temple trusts and NGOs. The consequent recolonisation of these sinks from the connected source populations such as at Katraj and Sinhagad have enabled the visitors, for instance, to chance upon tree frogs at Pachgaon. Such areas offer last vestiges for amphibian survival and even re-introduction of the lost species. Protection of the habitats, especially breeding sites,

and to keep them free from human interference is a must. Pune city that boasts of a snake park, must think ahead of even running an amphibian park, if Forest Department, Municipal Authorities and NGOs can collaborate. This park may also provide captive breeding facility besides public awareness and education.

#### Acknowledgements

Rahul Marathe, Nilesh Dahanukar, Rupesh Raut, Sachin Ranade, helped us in the survey and field work. Vivek Gaur Broome and Sanjay Thakur shared their perceptions. Dr. H. V. Ghate guided us variously including in manuscript preparation. Dr. Milind Watwe encouraged us. Smt. S. P. Modak, Head, Zoology Department and Dr. A. S. Inamdar, Principal, Abasaheb Garware College obliged by providing infrastructural facilities. Prof. Madhav Gadgil provided us unparalleled research opportunity. RANWA sponsored the project. We are thankful to all of them.

#### References

- Daniel, J. C. 1963. Field guide to the amphibians of the Western India, Part 1 & 2. *Jr.B.N.H.S.* 60 : 415-438, 690-702.
- Daniel, J. C. 1975. Field guide to the amphibians of the Western India, Part 3. *Jr.B.N.H.S.* 72 : 506-522.
- Daniel, J. C. and Sekar, A. G. 1989. Field guide to the amphibians of the Western India, Part 4. *Jr.B.N.H.S.* 86 : 194-202.
- Daniels, R. J. R. 1991. The problem of conserving amphibians in the Western Ghats, India. *Current Science* 60 (11) : 630-32.
- Ghate, H. V. and Padhye, A. D. 1996. Impact of urbanisation on amphibians of Pune. *Zoo's print* 11 : 14-16.
- Paranjape, S. Y. and Mulherkar L. 1979. On the survey of amphibian fauna in and around Pune. *J. Univ. Poona, Sci. & Technol.* 52 : 423-434.
- Yazdani, G. M. and Mahabal, A. 1976. Amphibians of Poona. *ZSI Newsletter* 2 : 138-139.

**Annexure : Ecological preferences and changes of amphibian species of Pune**

HABITATS : A-Avenue, C-Cultivation, D-Ditches, Fr-Forest, Gr-Grassland, Hg-Home gardens, Hs-Hillslopes, L-Lakes, P-Ponds, Pg-Public gardens, Pf-Paddy fields, Pwb-Perennial waterbodies, R-River, S-Streams, Sc-Scrub;  
 MICROHABITATS : B-Bushes, Bk-Bark, Bw-Water bottom, Cp-Canopy, Lf-Leaf, Rt-Rocktop, Sd-Sand, Sl-Soil, Su-Surface water, T-Trees, Tm-Termite mounts, Ug-Underground, Un-Undergrowth, Ur-Under rock, Wb-Waterbank;  
 AB (Abundance) : Vc-very common, C-common, O-occasional, R-rare;  
 PC (Population changes) : C-constant, D-decline, En-endangered;  
 CAUSES : Hh-Human harvest, Hl-Habitat loss, Pl-Pollution;  
 Localities : Blw-Balewadi, Kth-Kothrud, Mst-Mastani pond, Psh-Pashan, Sgd-Sinhgad, Unv-Pune University, Amb-Ambegao-Narhe

Species	Common Name	Preferred Habitats	Microhabitat	AB	PC	Causes	Localities
<b>Family Ranidae</b>							
<i>Rana cyanophlyctis</i>	Skipper Frog	S, R, D, P, L, Pwb	Su, Bw, Wb	Vc	D	Pl, Hl	all
<i>Rana tigrina</i>	Indian Bull Frog	Gr, C, Pg, Hg, Pf	Su, Wb	C	D	Hh, Hl, Pl	all but city
<i>Rana malabarica</i>	Fungoid Frog	S, R, P, L, D, Pwb	Bw	O	En	Hl	Sgd*
<i>Rana leithii</i>	Leith's leaping Frog	Gr, C, A, Hs, Pf	Sl, Wb, Ur	R	En	Hl	Sgd*
<i>Rana lychnocharis</i>	Cricket Frog	S, Gr, C, A, Sc, Hs, Pf	Sl, Rt	O	D	HL	most but city
<i>Rana sahyadrensis</i>	Tiny Cricket Frog	S, Gr, C, A, Pg, Hg, Sc, Hs, Pf	Sl, Rt	Vc	C		all
<i>Tomopterna rolandii</i>	Southern Burrowing Frog	Sc, Gr, C, A, Mb	Sl, Sd, Ug	C	D	Hl	Kth, Psh, Mst*
<i>Tomopterna breviceps</i>	Indian Burrowing Frog	Sc, Gr, C, A, Mb	Sl, Sd, Ug	C	D	Hl	most but city
<i>Tomopterna rufescence</i>	Rufescent Burrowing Frog	Sc, Gr, C, A, Mb	Sl, Sd, Ug	R	D	Hl	Amb*, Sgd*
<b>Family Rhacophoridae</b>							
<i>Philautus bombayensis</i>	Bombay Bush - Frog	Fr, A, Sc	Lf, Un, Bk, B	C	En	Hl	Sgd*
<i>Polypedatus maculatus</i>	Common Tree Frog	Fr, A	Cp, Lf, Bk, T	O	En	Hl	Blw*, Sgd*
<b>Family Bufonidae</b>							
<i>Bufo melanostictus</i>	Common Indian Toad	Fr, Gr, Pg, Hg, Sc, Hs	Sl, Sd, Rt, B, Ur	Vc	C		all
<b>Family Microhylidae</b>							
<i>Microhyla ornata</i>	Ornate frog	Sc, Gr, A, Pg	Sl, Sd, Ur, Ug, Tm	Vc	D	Hl, Pl	most but city
<i>Uperodon globulosus</i>	Great Ballon Frog	Sc, Gr, C	Sl, Sd, Ur, Ug	O	En	Hl	Psh, Blw*

\* beyond 10 km from city center

□

## Reptiles of Pune Urban Area : Increase or Decline?

*Sanjay Thakur<sup>1</sup> and Vivek Gour-Broome<sup>2</sup>*

### Introduction

Reptiles, given difficulty in their detection due to cryptic nature, are less documented than other classes of vertebrates. The first records dealing exclusively with the reptiles found in and around Pune appear to have been written by Underwood (1948) who reported 26 species, including 12 species of snakes. Since then there have been few publications that have added to the list of reptiles found in the city and its suburbs. Subsequently, Chopra (1964), Khaire and Khaire (1985) and Ghatpande et al. (1990) added a few records. Comprehensive review of snakes (Khaire and Khaire, 1985) reports 23 species, double that of the Underwood's list (1948). Recently, Wadadekar has reported about a dozen species of snakes just from the Pune University campus <[www.iucaa.ernet.in/~yogesh/snake.html](http://www.iucaa.ernet.in/~yogesh/snake.html)>.

### Methodology

Our list is based on first hand observations over the past ten years as well as reliable oral information, besides literature. We have included species reported from within a radius of 25 km from the Pune city centre. We have used relative encounter rates of various reptiles across various habitat types as an abundance index. Identifications were based on keys in Smith (1933, 1935, 1943). The literature revealed past occurrence of species. We also gathered perceptions of several field experts, especially about ongoing population changes. Reptiles not seen by us have been attributed to the individuals who recorded them. All

reptiles found by the authors were identified and released unharmed.

### Results and Discussion

We report 52 reptilian species (annexure) from the area, about two thirds of which are snakes. We report nearly thrice as many snake species as five decades ago (Underwood, 1948) while one and half times the decade old record (Khaire and Khaire, 1993). This increase in species richness is however cosmetic, resulting neither from recent colonisation nor eco-restoration but only from more intensified combing and accumulation of knowledge amongst naturalists. Diversity reported by us is nearly twice that of Delhi while one and half times that of Bangalore (Nalavade et al, this volume). The high diversity at Pune can be primarily attributed to its mantle of rivers and hill chains that possibly serve as corridors for the dispersal of even the Western Ghats specialists like the shield tail snakes.

Table 1 depicts the distribution of species diversity across habitat types. Nearly three fourths of the total species inhabit forest while a fifth are confined to the low impact zone comprising of forest, scrub and grassland habitats. More than 50% of the species inhabit the high impact zone comprising of plantations, agriculture and habitation, just two of them being exclusive. Forest is the most species-rich habitat type, harbouring nearly two thirds of the total species, seven of them being exclusive. Human habitation is the most species poor, hosting just 8 species, none being exclusively so. None of the high impact habitat types

1. 666/1 Bhoi Ali, Raviwar Peth, Talegaon Dabhade, Pune District, 410 506, India.

2. J. E. Farm, Marunji P.O., Taluka Mulshi, District Pune 411 027, India.



**Table 1 Reptile species richness across habitat types**

Habitat Type	No. of Total Species	No. of Unique Species
Forest	30	7
Scrub	20	1
Grassland	20	-
Plantation	24	-
Agriculture	22	-
Housing	8	1
<b>Low impact zone</b> (Forest, Scrub, Grassland)	41	11
<b>Impacted zone</b> (Plantation, Agriculture, Habitation)	28	2

harbour any exclusive species. Thus, habitat loss resulting from urbanisation poses threat to nearly half the reptilian species. The Mula-Mutha river bed is an excellent foraging ground for snakes due to abundance of prey species such as rodents and frogs. However, much of this fertile breeding ground is lost due to channel walls and ongoing road along the riverbed, demolishing also crab holes that shelter snakes. Similarly, encroachment of grassland and barren lands i.e. so called wasteland along city fringes by urbanisation has affected species such as the Saw scaled viper. Habitat loss includes deforestation that especially affects tree dwelling species such as Bamboo pit viper, Cat and Vine snakes. However, habitat of grassland dwellers like Racer snakes is lost due to monoculture plantations around Pune, especially on hillocks. Forest restoration along the hill chain may theoretically benefit many reptile species. However, slum dwellers and labourers if not the elite that frequent the hills variously kill most of the snakes.

Besides direct loss of habitat as above, habitat degradation also variously affects reptiles. Excessive cattle grazing and concurrent fires hold threats for Racer and Cat snakes, besides skinks. Tree snakes are affected by the fuelwood collection rampant in the hills. Saw scaled vipers are susceptible to rock excavation along hills, while soil extraction from riverbed and banks affects shield tail and worm snakes. Keelback snakes seem susceptible to chemical water pollution. Fertiliser and pesticidal effluents from agriculture affect the breeding of most species therein while domestic chemical sprays threaten house geckos. Wanton

killing by humans out of fear psychosis threatens all snake species, resulting in paucity of full grown specimens, entailing very limited breeding population. Perhaps as many or more might be caught for venom extraction. These are rarely killed but effectively removed from the habitat, affecting the natural breeding population. Killing out of fear has ensured that hardly any snake species is found abundantly. Killing out of superstitions affects Chameleon the most. Turtle and monitor lizard are hunted for consumption as food and for medicinal purpose.

To conclude, we emphasise that notwithstanding the increase in the reported species richness due to enhanced inventory, most reptiles are gradually declining in numbers and face a bleak future. Possible corrective measures include encouraging restoration of not just hill forests but also grasslands and rocky areas from fringe villages as well as the restoring the riverbed ecology, besides generating public awareness to minimise the fear-borne killing.

#### Acknowledgement

In the first place, we are indebted to all the informants. Ashok Captain also helped in manuscript preparation. Drs. M. S. Pradhan and B. D. Bastawade from Zoological Survey of India and Drs. H. V. Ghate, Anand Padhye, S. B. Nalavade provided valuable literature and suggestions. Prakash Gole provided crucial suggestions in manuscript preparation. All colleagues from Kalpavriksh and friends like Kaustubh Moghe provided a congenial working environment. Utkarsh Ghate also helped and prodded us. We thank all these people.

#### Bibliography

- Daniels, J. C. 1983. The Book of Indian Reptiles. Oxford.
- Chopra, R. N. 1964. Notes on Some Lizards of Poona. *Jr. Univ. Poona (Sci&Tech)* 28 : 39-42.
- Das I. 1997. Checklist of the Reptiles of India with English Common Names. *Hamadryad*. 22(1) : 32-45.
- Ghatpande, S. K., Joshi, S., and Khaire, A. 1990. Additional Information on the Ophiological Fauna of Pune Region. *Herpeton* 3 : 1-2.
- Khaire, A and Khaire, N., 1985. A List of Snakes in the Neighbourhood of Poona, Maharashtra with Some Observations. *Geobios* : 4 : 112-114.
- Khaire A and Khaire N 1993 Occurrence of Brown Whip Snake *Ahaetulla Pulverulenta* (Dum. and Bibr.) in Pune, India. *The Snake* 25 : 147-8.
- Smith, M. A. 1933. The Fauna of British India, Ceylon

REPTILES OF PUNE URBAN AREA : INCREASE OR DECLINE?

- and Burma, including the whole of the Indo-Chinese subregion. Reptilia And Amphibia. Vol. I, Loricata, Testudines. Taylor and Francis, London. Pp. i-xxviii + 1-185.
- Smith, M. A. 1935. The Fauna of British India, Ceylon and Burma, including the whole of the Indo-Chinese subregion. Reptilia And Amphibia. Vol. II. Sauria. Taylor and Francis, London. Pp. i-xiii + 1-440.
- Smith, M. A. 1943. The Fauna of British India, Ceylon and Burma, including the whole of the Indo-Chinese subregion. Reptilia And Amphibia. Vol. III, Serpentes. Taylor and Francis, London. Pp. i-xii + 1-583.
- Tikadar B. K. and Sharma, R. C. 1992. Handbook of Indian Lizards. Zoological Survey of India, Calcutta. Pp. xv, 250.
- Underwood, G., 1948.- Notes on Poona Reptiles. *J. Bombay nat. Hist. Soc.* 47(4) : 627-632.

**Annexure : Distribution of Reptiles in Pune Urban Area**

CODES :

**Localities** : An- Aundh, Bm- Bhamburda, Cc- Chandani Chowk, Fc- Fergusson College, Kj- Katraj, Kw- Khadakwasla, Kt- Kothrud, Mw- Malwadi, Pc- Pachgaon, Pd- Paud, Ps- Pashan, Sg- Sinhgad, Uv- University, Wj- Warje, Yw- Yerwada, Vs- Vadgaon-sheri

**Habitats** : F- Forest, S- Scrub, G- Grassland, P- Plantation, A- Agriculture, H- Habitation, W- Water, R-Rocky

**Ab (Abundance)** : A- Abundant, C- Common, O- Occasional, R- Rare

**Remarks** : Species recorded without our own observations are accredited to reporters : AK- A. Khaire, RM- R. Marathe; besides literature as per the case.

No	Common name	Scientific name	Localities	Habitats	Ab	Remarks
1	Indian flapshell turtle	<i>Lissemys punctata</i>	KjPsKwUv	W	C	Introduced as water purifier
2	Fat-tailed gecko	<i>Eublepharis macularius</i>	Uv			Underwood 1945
3	Rock gecko	<i>Hemidactylus maculatus</i>	SgKj	R	O	Forts
4	Brook's house gecko	<i>Hemidactylus brookii</i>	All	FSGPHA	C	
5	Northern house gecko	<i>Hemidactylus flaviviridis</i>	All	PH	A	
6	Bark gecko	<i>H. leschenaultii</i>	All	FSPH	O	
7	Termite hill gecko	<i>Hemidactylus triedrus</i>	SgPcKjKwPdPs	SGA	R	
8	Deccan ground gecko	<i>Geckoella dekkansensis</i>	Sg	F	R	
9	Indian garden lizard	<i>Calotes versicolor</i>	All	SGPA	A	
10	Roux forest lizard	<i>Calotes rouxii</i>	Sg	F	R	
11	Fan-throated lizard	<i>Sitana ponticeriana</i>	SgKjPcBm CcPsKw	SG	O	
12	Chamaeleon	<i>Chamaeleon zeylanicus</i>	SgKj	FSP	R	Abundant at Vs
13	Lined supple skink	<i>Lygosoma lineata</i>	Uv	S	R	
14	Spotted supple skink	<i>Lygosoma punctatus</i>	Yw		R	Chopra, 1964
15	Gunther's supple skink	<i>Lygosoma guentheri</i>	Model colony		R	Chopra, 1964
16	Three lined grass skink	<i>Mabuya trivittata</i>			?	Chopra, 1964
17	Keeled grass skink	<i>Mabuya carinata</i>	All	FSGPA	C	
18	Pune mole skink	<i>Eumeces poonaensis</i>	Kj		?	Sharma, 1964
19	Snake eyed lacerta	<i>Ophisops jerdoni</i>	SgKjPcBm WjKw	SG	O	
20	Common Indian monitor lizard	<i>Varanus benghalensis</i>	KjSgPcBm CcPdPsKw	FSGPA	R	

No	Common name	Scientific name	Localities	Habitats	Ab	Remarks
21	Brahminy worm snake	<i>Ramphotyphlops braminus</i>	All	FSGPHA	C	
22	Beaked worm snake	<i>Rhinotyphlops acutus</i>	All	SGPA	O	
23	Common sand boa	<i>Eryx conica</i>	KjSg	FSGPA	O	
24	John's earth boa	<i>Eryx johnii</i>	Vs	SGPA	O	AK
25	Bombay shieldtail	<i>Uropeltis macrolepis</i>	PsKSgKwPd	SPA	O	
26	Phipson's shieldtail	<i>Uropeltis phipsonii</i>	UvPsSgAu	SGPA	O	
27	Common vine snake	<i>Ahaetulla nasutus</i>	KjKwSg	FSPA	O	
28	Brown vine snake	<i>Ahaetulla pulverulenta</i>	KtKj	S	R	AK
29	Buff-striped keelback	<i>Amphiesma stolata</i>	All	FSGPHA	C	
30	Banded racer	<i>Argyrogena fasciolatus</i>	KtPsBmPg MwKj	FSGPHA	O	
31	Common Indian cat snake	<i>Boiga trigonatus</i>	KtSgPgCc MwPd	SPHA	O	
32	Slender racer	<i>Coluber gracilis</i>	PsFcKj	G	R	
33	Indian smooth snake	<i>Coronella brachyura</i>	Kt		R	AK
34	Common Indian trinket snake	<i>Elaphe helena helena</i>	All	FSGPHA	O	
35	Common wolf snake	<i>Lycodon aulicus</i>	All	FSPGHA	C	
36	Yellow-spotted wolf snake	<i>Lycodon flavomaculatus</i>	Lately only at Talegaon		Ex?	Smith
37	Barred wolf snake	<i>Lycodon striatus</i>	KjSgKwPs	FSA	R	AK
38	Travancore wolf snake	<i>Lycodon travancoricus</i>	Confirmed from Torna			Ghatpande Mistaken?
39	Green keelback	<i>Macropisthodon plumbicolor</i>	All	FSGPHA	C	
40	Banded kukri snake	<i>Oligodon arnensis</i>	All	SGPHA	O	
41	Streaked kukri snake	<i>Oligodon taeniolatus</i>	Kt	G	R	Ghatpande
42	Pakistani ribbon snake	<i>Psammophis leithii</i>	SgKw	F	R	AK
43	Indian rat snake	<i>Ptyas mucosus</i>	All	All	C	
44	Cantor's black-headed snake	<i>Sibynophis sagittaria</i>	UvKjSgAn	FSPA	R	<i>S. subpunctatus</i>
45	Checkered keelback water snake	<i>Xenochrophis piscator</i>	All	All	C	
46	Common Indian krait	<i>Bungarus caeruleus</i>	All except city core	All	O	
47	Common slender coral snake	<i>Calliophis melanurus</i>	KjKtAn Hadapsar	SGPA	R	AK, RM
48	Black slender coral snake	<i>C. melanurus nigrescens</i>	Sg	F	R	<i>C. nigrescens khandalensis</i>
49	Spectacled cobra	<i>Naja naja</i>	All but city	All	O	
50	Russell's viper	<i>Daboia russelli</i>	All but city	all	O	
51	Saw-scaled viper	<i>Echis carinatus</i>	All but city	All, no F	O	
52	Bamboo pit viper	<i>Trimeresurus gramineus</i>	KjSgKw	FS	R	

□

## Bird Diversity Changes of Pune Urban Area

*S. Ingalhallikar<sup>1</sup>, R. Purandare<sup>2</sup>, S. Nalavade<sup>3</sup> and S. Dhole<sup>4</sup>*

### Introduction

Birds are perhaps the most studied amongst the animal groups. Incidentally cities are known to be richer in birds than in any other taxa. The richness of birds in Indian cities is mainly attributed to abundant food supply through garbage dumps etc., large number of planted trees that provide the nesting sites, shelter and the traditional goodwill of Indians to all living beings (Burton, 1977). Many large cities in India support over 300 bird species with Delhi leading with 434 species, followed by Mumbai 350 species (Ali and Abdulali, 1941) and Bangalore 315 species (Karthikeyan, 1999). Pune is no exception to this with 332 species listed here. Besides the checklist, we also review ecological distribution and changes over times as inputs for future management.

### Earlier Work

In the fourth quarter of the 19<sup>th</sup> century many workers, mostly British civil and military officers, contributed to the study of the bird fauna of the Deccan plateau of which Pune is a part. The significant works of the period were those of Davidson and Wenden (1878), Butler (1880), Barnes (1888-1890) and Davidson (1895). Wenden (1885) described 55 shore and waterbirds from the lake Fife (Khadakwasla). Bentham (1899, 1902) wrote extensively about birds nesting around Pune and neighbourhood. Trevenen (1922) mostly dealt with the game birds found in and

around the station. Apte (1950-51, 1957) wrote a series of popular articles about the common birds of the area. Ambedkar's (1964) landmark study about the breeding biology of the Common Baya Weaverbird was based at Pune. The first ever checklist for the city was given by Gole (1972), which included about 150 species. Goel (1976) came out with a checklist of about 80 bird species for Pune University campus, which is one of the most popular birding spots around the city. A more comprehensive checklist covering larger area was published by Friends of Animals Society (Mundkur and Kelker 1981). This checklist covered areas upto Sinhagad and included about 250 species. Dr. Singh of the ZSI (1984) provided a short list of birds seen at two waterbodies near the city. Ingalhallikar and T. Gole (1987) recorded 290 species for a slightly larger area. Bradbeer (1987) published a checklist from London, which covered 295 bird species he observed from around Pune during the previous year. Mahabal and Lamba's (1987) systematic list of 329 species and subspecies from 'Pune and vicinity' was based on bird specimens present in the collections of the Virus Research Station and the Western Regional Station of the Zoological Survey of India, Pune. T. Gole (1987) described owls around Pune while Ingalhallikar (1988) threw some light on the birds of prey around Pune. Gole (1984) gave a concise account of birds of Pune region. A recent addition to the checklist-like literature was by Nalavade (1999) who recorded 90 bird species for the Fergusson col-

1. 'Nishad', 12, Varshanand Society, Anandnagar, Hingane Khd., Sinhagad Road, Pune 411051. Email : lexon@pn2.vsnl.net

2. No. 78, Kapila Society, near Patrakar Nagar, Pune, 411 016. Email : rahulpu@mahindrabt.com

3. Department Of Geography, Fergusson College, Pune, 411 004. Email : nalavade123@vsnl.net

4. Flat 5, Bldg. 3 Anand Park, Shankarshet Road, Pune 411 037. Email : konitari@hotmail.com

lege campus.

Besides mere listing, Pune birds have also been variously studied ecologically. Gole (1980) counted the city birds. The bird census covering 120 sq.km of the city area, enumerated about 55,000 birds belonging to 130 species with a density of 1.8 birds per acre. Nalavade (1981) geographically analyzed the city birds on the basis of their distribution. Gole (1985) studied the avifauna of the polluted stretches of the Mula-Mutha river and tried to describe some indicator species. Purandare (1984) did a systematic year-long study of breeding behaviour of Blackwinged Kite from a riverside grove along the Mutha river. Mahabal (1983) made a comprehensive census of communally roosting birds and counted about 1,60,000 birds for Pune city. His observations about Common Indian Myna are varied and include such aspects as roosting behaviour (1983), population fluctuations (1990), intra and interspecific assemblages (1992), communal display behavior (1993a), flocking behaviour (1993b), activity time budget (1993c) etc. Purandare (1994) conducted another significant study about the breeding biology of Large Pied Wagtail along with a list of 102 birds found in the wagtail habitat.

Many explored the appearances, occurrences, range extensions, first sighting/breeding records etc. of various birds. These include Abdulali (1961), Gole (1971, 1977), Ingalthalikar and Kothari (1978), Ingalthalikar and Dharap (1979), Mundkur (1981, 1983a, 1983b, 1984a, 1984b, 1985, 1986), Bapat (1982), Ara (1987), Ingalthalikar, Mundkur and Gole (1988). Watve's (1989, 1994) observations about Bonelli's Eagle and his path breaking findings about the thinking ability of Small Green Bee-eater (Smitha *et al* 1999) need special men-

tion. Enthusiasts like A. Chaoji have been regularly monitoring and maintaining records of waterbirds under the Asian Waterfowl Census since 1990. Similarly, M. Gupte, S. Pande, S. Tambe have been regularly contributing articles supported with photographs to many Pune newspapers and magazines.

**Distribution of birds across habitat types**

The city and environs harbour six major habitat types that include Forest (F), Scrub (S), Grassland or 'maals' (G), Tree plantation (P) including garden, orchards and avenues, Houses (H), Agriculture (A) and Waterbodies (W). The first three habitat types (F, S, G) comprise the wilderness zones with low human impacts while the next three (P, H, A) comprise the impacted zone on land. Table 1 presents the number of species found across various habitat types. About a third of the species are waterbirds, primarily winter migratory. None of them are exclusive to impacted areas though a few, such as Blackwinged stilt are most abundant in polluted water. Even in terrestrial habitats, exclusive species are wanting though few species such as sparrow, crow and common myna prefer human habitations, being commensals of man. Less than a tenth of the total species inhabit human habitations while only a third inhabit impacted zone, hardly any being exclusively so. On the contrary, over 90% of the total species inhabit the wilderness zone, over two thirds of them being exclusively so. This emphasises why hill forests, grasslands and waterbodies are essential to maintain over a third of the urban avifauna.

As a matter of fact, due to the mosaic of habitats the city region supports here threr are more bird species than the surrounding countryside. Populationwise also, the city region supports more birds than the surrounding countryside. According to a survey made by one of the authors (SN), the average bird density within the city was 2.75 birds per hectare against 0.8 birds per hectare beyond the city's eastern outskirts. Four species viz. House Sparrow, Crows (both House and Jungle), Common Myna and Blue Rock Pigeon form almost 70% of total bird population in western suburbs (mainly Kothrud). Four habitat types viz. Hill forest and scrub, tree plantations and waterbodies together support most of the urban avifauna. Well-wooded compounds with large, tall trees are popular roosting sites for communal birds like Crows, Mynas, Herons and Egrets, Parakeets and Kites. The five most important roosting areas for the communal birds include Peshwe park-Sarus Baug complex, Vaikuntha crematorium, Police Parade ground-Agriculture college campus, Pune University campus (old garden)

**Table 1 Species Diversity and Exclusivity across habitat types**

Species	Total	Unique
Agriculture (A)	100	1
Forest (F)	125	40
Scrub (S)	140	10
Grassland (G)	55	2
Habitations (H)	30	2
Plantations (P)	80	-
Waterbodies (W)	105	80
Wilderness (FGSWu)	300	180
Impacted zone (AHPWp)	105	10

Wu = un/less-impacted Waterbodies

Wp = polluted waterbodies

and the Bund garden-Koregaon park-Empress garden belt.

Three species – House Sparrow, Common Myna and Blue Rock Pigeon exclusively build nests in human habitations. The number of individuals belonging to the following species increase during the monsoon season- Crows, Common Myna, Common Pariah Kite, Black Drongo, Longbilled and White-backed Vultures and Blue Jay. The heavy rainfall from the Ghat country probably forces these birds eastwards! According to Aitken (1905) – “The Common Kites go to Poona with the Government, for the monsoon months”. Almost all kinds of Egrets and Herons disappear from the city with the commencement of the monsoon. They reappear after the rainy season is over. They probably go down to Konkan for breeding (Mahabal, *pers. comm.*). House Crows, House Sparrows, Common Mynas, Roseringed Parakeets and Cattle Egrets go out of the city in the morning and return by evening. Their daily commuting routes more or less coincide with the river courses and the hill ranges.

### Changes in the bird fauna

Remarkable changes in the status of some species and likely environmental factors that may be responsible for these changes are discussed in brief here. Forest dwelling raptors like Crested Serpent Eagle and Crested Hawk Eagle have declined in numbers though they have been observed to be nesting regularly. High rate of mortality of chicks may be due to infertile and brittle eggs! The Flycatchers and other forest dwelling insectivorous species have also shown a decline in numbers. Grassland raptors such as Buzzards, Harriers and Kestrels have declined. Laggar Falcon and Redheaded Merlin have also declined in number. Scavengers like Vultures have shown a sudden decline in the last few years. Reduction in their number is alarming. They might be victims of epidemic reported all over India. Another possible localized reason is the closure of the bone crushing factory at Kondhva, which used to be the main haunt of all sorts of Vultures.

Commoner species such as House Sparrows and Crows are showing a declining trend particularly in the last five years. The proportion of Jungle Crow to House Crow has increased. The Redwhiskered Bulbul, once considered to be uncommon within the city has now started replacing the Redvented Bulbul as around Bibwewadi and Sinhagad road. Is this due to loss of treecover on the city outskirts? Little Brown Dove also seems to be declining. The removal of age-old Banyan

and other fig trees from Pune-Paud road, Pune-Panshet road, Pune-Satara-Bangalore Highway and University road is probably preventing the Common Green Pigeon from visiting the area. Till recently the Green Pigeons were regular visitors to the roadside trees.

The waders along rivers, streams and lakes have declined significantly. There is however, not much change in the population of Egrets and common Ducks. The rapid colonization of the riverbank and lakeshores could be the possible reason. The Little Cormorant, considered to be an uncommon bird in the past, has now become numerous especially along the rivers Mula and Mutha. The Blackwinged Stilt has also become numerous, especially around those spots, where sewage water enters the river. The Pied Kingfisher has declined in number, particularly along the much polluted stretch of the Mula-Mutha, where turbid water prevents it from fishing. The carpet of water hyacinth in the Mula river has also forced this beautiful Kingfisher to move elsewhere!

Yellow-wattled Lapwing, Indian Courser, Painted Sandgrouse, Brahminy Myna and some Quails are showing a declining trend. Non-insectivorous species of grassland and cultivations have not declined compared to the insectivorous species. Species such as Magpie-Robin, Iora, Sunbirds, Tailorbird, Redvented Bulbul, which are indirectly associated with urban habitats have not been affected. Owls as a whole except the Spotted Owlet are showing a declining trend.

To conclude, urbanisation is having a significant impact on the bird fauna, in terms of species diversity and composition as well as their populations. We hope that this glimpse will motivate many birdwatchers to carefully monitor these ongoing changes and guard against deleterious ones.

### References

- Abdulali, H. 1961. Occurrence of the blacknecked Grebe (*Podiceps caspicus* Hablizl.), near Poona, Maharashtra. 58 : 276-77.
- Aitkin, E. H. 1905. Common Birds of Bombay. Thacker and Co., Bombay. 1947 Ed.
- Ali, S. and Abdulali, H. 1941. The birds of Bombay and Salsette. Prince of Walse Museum (Natural history Section). Bombay.
- Ambedkar, V. C. 1964. Some Indian Weaver Birds. University of Bombay, Bombay.
- Anon 1997. Fauna of Delhi. Zoological Survey of India. Calcutta.
- Anon 2000. Asia-Pacific Migratory Waterbird Conservation Strategy : 2001-2005 and Action Plans

- <<http://ngo.asiapac.net/wetlands/mwbird.htm>>. Wetlands International-Asia-Pacific. Kuala Lumpur.
- Apte, M. V. 1950-1. Indian Birds (Marathi). Srushtigyaan. No.269 Vol.5-No.279 Vol.3.
- Apte, M. V. 1957. Pakshidarshan (Marathi). Extramural Education Board, University of Poona, Poona.
- Ara, J. 1987. Birds seen at the Mula-Mutha sanctuary, Poona. *Newsl. Birdw.* 27 : 9-10 : 0-1.
- Bapat, A. 1982. Reef Herons in Poona. *Newsl. Birdw.* 27 : 9-10 : 10-12.
- Barnes, H. E. 1888-90. Nesting in Western India. *Jr. Bom. Nat. Hist. Soc.* 7 parts (Vol.3-5).
- Bentham, R. M. 1899. Occasional notes on the Birds nesting in the neighbourhood of Poona. *Jr. Bom. Nat. Hist. Soc.* 12 (4) : 778-82.
- Bentham, R. M. 1902. Miscellaneous notes on the Birds' nesting around Poona and elsewhere. *Jr. Bom. Nat. Hist. Soc.* 14 (2) : 396-400.
- Bradbeer, P. 1987. Birds seen in Maharashtra (Mainly around Pune) in 1986-87.
- Burton, J. A. 1977. Nature in the City in 'Worlds Apart' (Vol. II). Double day and Co. New York.
- Butler E. A. 1880. A tentative catalogue of birds of the Deccan and South Mahratta Country. *Stray Feathers* 9(5-6) : 367-442.
- Davidson, C. S. and Wenden, C. E. 1878. A contribution to the avifauna of the Deccan. *Stray Feathers* 7 : 68-95.
- Davidson, J. 1895. The Birds of the Bombay Presidency. *Jr. Bom. Nat. Hist. Soc.* 9 (4) : 488-489.
- Goel, S. C. 1976. The birds of the campus of Poona University. *Jr. Poona Univ. (Sci Tech.)* 48 : 109-118.
- Gole, P. 1971. Turnstone [*Arenaria interpres i.* (Linn.)] in Poona, *Newsl. Birdw.* 11(1) : 3.
- .....1972. Dwijagan Awaghe Vrukshi (Marathi). Rajas Prakashan, Pune.
- .....1977. Damoiselle Cranes near Poona. *Jr. Bom. Nat. Hist. Soc.* 73 (2) : 391-392.
- .....1980. A March Bird Count in Poona. *Jr. Bom. Nat. Hist. Soc.* 77 (1) : 49-55.
- .....1984. Birds of Pune region. *Newsl. Birdw.* 24 : 1-2 : 7-9.
- .....1985. Birds of a polluted river. *Jr. Bom. Nat. Hist. Soc.* 81 (3) : 613-25.
- Gole T. 1987. Owls around Pune. *Jr. Ecol. Soc.* 1 : 67-69.
- Ingallahlikar, S. 1988. Birds of Prey around Pune. *Jr. Ecol. Soc.* 1 : 59-66.
- .....and Dharap S. 1979. Nesting of the tree Swift at Sinhgad near Poona. *Hornbill* Apr. June : 17-18.
- .....and Gole T. 1987. Checklist of Birds around Pune.
- .....and Kothari, 1978. Purplerumped Sunbird as Foster Parents. *Jr. Bom. Nat. Hist. Soc.* 74(3) : 530-531.
- .....Mundkur, T. and Gole T. 1988. The Goshawk, *Accipiter gentilis* (Linn.) in Poona, Maharashtra. *Jr. Bom. Nat. Hist. Soc.* 84(2) : 434-35.
- Kartikayan S. 1999. The vertebrate and butterfly fauna of Bangalore : A checklist. WWF-India, Karnataka State Office. Bangalore.
- Mahabal, A. 1983. Studies on population ecology and social behaviour of Indian Myna *Acridotheres tristis* (Linn.) in Pune. Ph. D. Thesis, University of Pune, Pune.
- .....1990. Spatial and Temporal Fluctuations in the Population of Indian Myna *Acridotheres tristis* (Linn.) in Pune. *Jr. Bom. Nat. Hist. Soc.* 87(3) : 392-398.
- Mahabal, A. 1992. Diurnal Intra- and Interspecific Assemblages of Indian Mynas. *Biovigyanam* 18(2) : 116-118.
- .....1993 a. Communal Display Behaviour of Indian Myna *Acridotheres tristis* (Linn.). *Pavo* 31 (1-2) : 45-54.
- .....1993 b. Seasonal changes in the flocking behaviour of Indian Myna *Acridotheres tristis* (Linn.). *Biovigyanam* 19(1-2) : 55-64.
- Mahabal, A. 1993 c. Activity-time budget of Indian Myna *Acridotheres tristis* (Linn.) during the breeding season. *Jr. Bom. Nat. Hist. Soc.* 90(1) : 96-97.
- Mahabal A. and Lamba, 1987. On the birds of Poona and vicinity. Records of the Zoological Survey of India, Occasional Paper No. 94. Calcutta.
- Mundkar, T. 1981. Pashan lake and new addition to the birds of Poona. *Newsl. Birdw.* 21 : 7 : 12-13
- Mundkar, T. 1983a. Birds in Pune. *Newsl. Birdw.* 23 : 7-8 : 5-11.
- Mundkar, T. 1983b. Yellow Bittern nesting in Pune. *Newsl. Birdw.* 23 : 9-10 : 19.
- Mundkar, T. 1984a. Painted Sandgrouse at Katraj Ghat. Pune. *Newsl. Birdw.* 24 : 5-6 : 17.
- Mundkar, T. 1984b. Occurrence of lesser Flamingo *Pheniconaias minor* (Geoffroy) in Poona, Maharashtra. *Jr. Bom. Nat. Hist. Soc.* 81(2) : 468.
- Mundkar, T. 1985. Observations of the roof nesting habit of the Redwattled Lapwing (*Vanellus indicus*) in Poona, Maharashtra. *Jr. Bom. Nat. Hist. Soc.* 82 (1) : 195-196.
- Mundkar, T. 1986. Yellow Bittern nesting, a new record for Poona. *Jr. Bom. Nat. Hist. Soc.* 82 (3) : 653-654.
- Mundkar, T. and Kelkar, K. 1981. Checklist of Birds in and around Poona. Friends of Animals Soc. Pune. 12.

BIRD DIVERSITY CHANGES OF PUNE URBAN AREA

- Naik, S.N. 1988. Demoiselle Cranes appear at Pune. *WWf India Quarterly* 9 (4) : 17.
- Nalavade, S.B. 1981. The Geographical Analysis of the Distribution of Avifauna in and around Poona. M. A. Dissertation, Geography Department, University of Poona.
- Nalavade, S. B. 1999. Birdwatching in and around Fergusson College Campus. *Fergusson College Magazine* 1998-99. Pp.11-13.
- Purandare, K. 1984. 'Kapshichi diary' (Marathi, Diary of the Black winged Kite). Nisarga Prakashan, Pune.
- Purandare, K. 1994. 'Muthevarcha Dhobi' (Marathi, Wagtail along the river Mutha). Utkarsha Book Service, Pune.
- Singh, D.F. 1984. The avifauna of two water bodies near Pune. *Newsl. Birdw.* 24 : 7-8 : 9.
- Smitha B., Thakar, J. and Watve, M. 1999. Do Bee eaters have theory of mind? *Current Science* Vol. 76 (4) : 574-577.
- Trevenen. W.B. 1922 Shikar near and around Poona. *Jr. Bom. Nat. Hist. Soc.* 28(4) :1075-81.
- Watve, M. et al. 1989 Food storage by Bornelli's Hawk eagle, *Heiraaetus fasciatus*, *Jr. Bom. Nat. Hist. Soc.* 86 : 446-447.
- Watve, M. et al. 1994 Why Bonelli's eagle hunt in pair? An assessment of individual and paired hunting successes. *Jr. Bom. Nat. Hist. Soc.* 91(3) : 355-59
- Wenden 1885. Birds of the lake Fife, Khadakwasla. Poona District Gazeteer. Vo. 2 : 382-384.

**Annexure : Birds Of Pune Urban Area**

**CODES : Seasonality :** R- Resident, L- Local Migratory, M- Winter Migratory; **Abundance :** Ab- Abundant, C- Common, O- Occasional, U- Uncommon, R-Rare, S-Stray; **Changes :** D- decrease, I-increase

Habitat Code	Habitat type	Typical localities
F	Forest	Sinhagad, Katraj
S	Scrub	Bhamburda, Chandani Chowk, Pachgao.
G	Grassland	Malwadi, Pune-Solapur, Pune-Nagpur Rd.
P	Plantation, gardens, avenues	University, Prabhat Road etc.
H	Houses	City core
A	Agricultural	Malwadi, Paud, Pashan, Manjari etc.
C	Cliffs	Sinhagad
R	Rocky Scarps	Sinhagad
Wi	Water inside	Pashan lake, Kawdi, Mula-Mutha, Katraj lake, etc.
Wb	Water bank	
Wa	Water aerial	
Wv	Waterside Vegetation	
Wp	Polluted Waterbody	

Hand-book No.	Common Name	Season-ality	Habitats preferred	Abundance	Change
5	Little Grebe	R	Wi	C	
26	Cormorant	L	Wi	O	D
27	Indian Shag	L	Wi	O	
28	Little Cormorant	R	Wip	C	I
29	Darter	L	Wi	U	
36	Grey Heron	L	Wb	O	I
37	Purple Heron	L	Wb	O	I
38	Little Green Heron	L	Wb	U	
42	Pond Heron	R / L	Wbp	C	
44	Cattle Egret	L	GWb	C	



JOURNAL OF ECOLOGICAL SOCIETY

Hand-book No.	Common Name	Seasonality	Habitats preferred	Abundance	Change
46	Large Egret	L	Wb	O	
47	Smaller Egret	L	Wb	C	
49	Little Egret	L	Wbp	C	
52	Night Heron	R	Wbp	O	I
55	Little Bittern	M	Wb	R	D
56	Chestnut Bittern	R	Wb	O	
57	Yellow Bittern	R	Wb	U	
60	Painted stork	M	Wb	O	
61	Openbill Stork	L	Wb	O	
62	Whitenecked Stork	R	Wb	C	
65	Black Stork	M	Wb	U	
69	White Ibis	L	Wb	O	
70	Black Ibis	R	Wb	O	
71	Glossy Ibis	L	Wb	O	
72	Spoonbill	L	Wb	O	
73	Flamingo	L	Wbi	O	
88	Lesser Whistling Teal	L	Wbi	O	
90	Ruddy Shelduck	M	Wi	O	
91	Common Shelduck	M	Wi	U	
93	Pintail	M	AWi	C	
94	Common Teal	M	Wi	C	
97	Spotbill Duck	R	Wi	C	
100	Mallard	M	Wi	U	
101	Gadwall	M	Wi	U	
103	Wigeon	M	GWi	O	
104	Garganey	M	Wi	C	
105	Shoveller	M	Wi	C	
107	Redcrested Pochard	M	Wi	U	
108	Common Pochard	M	Wi	O	
109	White-eyed Pochard	M	Wi	O	
111	Tufted Duck	M	Wi	O	
114	Cotton Teal	R	Wi	C	
115	Comb Duck	L	Wi	O	
124	Blackwinged Kite	R	AG	C	
130	Honey Buzzard	L	F	O	
133	Pariah Kite	R	AFGHPSWa	C	
135	Brahminy Kite	R	Wa	U	
139	Shikra	R	AFGPS	C	
148	Sparrow Hawk	M	F	O	
153	Longlegged Buzzard	M	AF	O	
157	White-eyed Buzzard	L	AFS	O	D
161	Crested Hawk Eagle	R / L	F	O	D
163	Bonelli's Eagle	L	AFS	O	D
164	Booted Hawk Eagle	M	F	O	D
168	Tawny Eagle	L	AHS	O	
171	Greater Spotted Eagle	L	AF	U	D
172	Black Eagle	L	F	O	
178	King Vulture	L	AGS	U	

BIRD DIVERSITY CHANGES OF PUNE URBAN AREA

Hand-book No.	Common Name	Seasonality	Habitats preferred	Abundance	Change
182	Longbilled Vulture	R	ACHR	O	D
185	Whitebacked Vulture	R	F	C	D
186	Egyptian Vulture	R	FP	O	D
190	Pale Harrier	M	AGS	O	D
191	Montagu's Harrier	M	AGWa	O	D
193	Marsh Harrier	M	Wa	C	
195	Short-toed Eagle	L	AF	C	
196	Crested Serpent Eagle	R	F	C	
203	Osprey	L	W	U	
208	Laggar Falcon	R	AFS	O	D
211	Shaheen Falcon	R	AHR	O	D
212	Hobby	M	FS	U	
215	Oriental Hobby	L	F	U	
219	Redheaded Merlin	R	AS	O	
221	Lesser Kestrel	M	ACGS	U	
222	Kestrel	M	ACGS	C	
241	Painted Partridge	R	GS	C	
246	Grey Partridge	R	AFS	C	
250	Grey Quail	M	AG	C	
252	Rain Quail	L	GS	C	
253	Bluebreasted Quail	R	GS	O	
255	Jungle Bush Quail	R	FS	C	
261	Rock Bush Quail	R	S	C	
275	Red Spurfowl	R	S	O	
278	Painted Spurfowl	R	FS	O	
301	Grey Junglefowl	R	FS	O	
311	Common Peafowl	R	AFS	O	
314	Yellowlegged Button Quail	R	GS	O	
318	Common Bustard Quail	R	AFGS	O	
320	Common Crane	M	AWb	O	
326	Demoiselle Cranes	M	AWb	O	
339	Ruddy Crake	R	Wv	O	
342	Brown Crake	R	Wv	O	
343	Whitebreasted Waterhen	R	Wvp	C	
347	Indian Moorhen	R	Wv	C	
349	Purple Moorhen	R	Wv	C	
350	Coot	R / L	Wi	C	
357	Lesser Florican	R	AG	R	
358	Pheasant Tailed Jacana	L	Wv	C	
359	Bronzewinged Jacana	R	Wvp	O	
366	Redwattled Lapwing	R	AGSWb	C	
370	Yellow-wattled Lapwing	R	AG	O	D
373	Eastern Golden Plover	M	GWbv	O	
380	Little Ringed Plover	M	Wb	O	
381	Kentish Plover	M	Wb	U	
388	Curlew	M	Wb	U	
389	Blacktailed Godwit	M	Wb	O	
391	Bartailed Godwit	M	Wb	O	

JOURNAL OF ECOLOGICAL SOCIETY

Hand-book No.	Common Name	Seasonality	Habitats preferred	Abundance	Change
393	Redshank	M	Wb	O	
395	Marsh Sandpiper	M	Wb	O	
396	Greenshank	M	Wb	C	
397	Green Sandpiper	M	Wb	C	
399	Spotted Sandpiper	M	Wb	C	
401	Common Sandpiper	M	Wb	C	
406	Pintail Snipe	M	GWb	O	
409	Fantail Snipe	L	Wb	C	
410	Jack Snipe	M	Wb	O	
414	Sanderling	M	Wb	U	
416	Little Stint	M	Wb	C	
417	Temminck's Stint	M	Wb	O	
420	Dunlin	M	Wb	O	
426	Ruff and Reeve	M	Wb	O	
429	Painted Snipe	L	Wb	O	
430	Blackwinged Stilt	M	Wbp	C	I
436	Stone Curlew	R	PS	O	
437	Great Stone Plover	L	Wb	O	
440	Indian Courser	R	AGS	O	
444	Small Indian Pratincole	L	Wb	O	
454	Brownheaded Gull	M	Wa	O	
455	Blackheaded Gull	M	Wa	O	
458	Whiskered Tern	L	Wa	C	
460	Gullbilled Tern	L	Wa	C	
463	Indian River Tern	L	Wa	C	
475	Little Tern	M	Wa	O	D
487	Indian Sandgrouse	R	AGS	O	
492	Painted Sandgrouse	R	SWb	O	
503	Yellowlegged Green Pigeon	R	FP	C	D
516	Blue Rock Pigeon	R	AHP	C	
521	Nilgiri Wood Pigeon	L	F	O	
530	Rufous Turtle Dove	L	F	O	
534	Ring Dove	R	AHPS	C	
535	Red Turtle Dove	R	AHS	O	
537	Spotted Dove	R	FS	C	
541	Little Brown Dove	R	AHPS	C	D
546	Alexandrine Parakeet	R	AFP	U	
550	Roseringed Parakeet	R	AFP	C	
558	Blossomheaded Parakeet	R	FS	C	
566	Indian Lorikeet	R	F	O	
571	Pied Crested Cuckoo	M	FS	O	
573	Common Hawk Cuckoo	L/R	AFPS	C	
576	Indian Cuckoo	M	F	O	
578	The Cuckoo	M	F	O	
582	Indian Baybanded Cuckoo	M	F	U	
584	Indian Plaintive Cuckoo	L	FPS	C	
588	Drongo-Cuckoo	L	F	U	
590	Koel	R	AFHPS	C	

BIRD DIVERSITY CHANGES OF PUNE URBAN AREA

Hand-book No.	Common Name	Seasonality	Habitats preferred	Abundance	Change
598	Sirkeer Cuckoo	R	FS	O	
600	Crow-Pheasant	R	AFPS	C	
606	Barn Owl	R	AHPS	C	
617	Scops Owl	R	F	O	D
627	Great Horned Owl	R	FS	C	
631	Brown Fish Owl	R	F(Wa)	U	
639	Barred Owlet	R	FS	O	
652	Spotted Owlet	R	AHPS	C	
657	Mottled Wood Owl	R	AFP	O	D
659	Brown Wood Owl	R	F	O	
671	Indian Jungle Nightjar	R	F	O	
680	Common Indian Nightjar	R	AGHS	C	
693	Alpine Swift	L	R	O	
703	House Swift	R	HC	C	
707	Palm Swift	R	AFGPS	O	
709	Crested Tree Swift	R	F	O	
719	Lesser Pied Kingfisher	R	Wau	C	
722	Small Blue Kingfisher	R	Wa	C	
735	Whitebreasted Kingfisher	R	AFPWa	C	
748	Bluetailed Bee-eater	L	FP	U	
750	Small Green Bee-eater	L	AGHPS	C	
755	Indian Roller	L	AFPS	C	
763	Hoopoe	R	AFPS	O	D
767	Common Grey Hornbill	R	AFPS	C	D
785	Small Green Barbet	R	F	O	
792	Coppersmith	R	FPS	C	
796	Wryneck	M	AS	O	D
819	Goldenbacked Woodpecker	R	FPS	O	
847	Yellowfronted Pied Woodpecker	R	FPS	C	D
851	Pigmy Woodpecker	R	FPS	R	I
867	Indian Pitta	L	FS	O	I
877	Redwinged Bush Lark	R	GS	C	
878	Ashycrowned Finch-Lark	R	AGS	C	
882	Rufoustailed Finch-Lark	R	AGS	C	
886	Short-toed Lark	M	G	O	
901	Malabar Crested Lark	R	AGS	C	
902	Sykes's Crested Lark	R	AGS	O	
907	Small Indian Skylark	L	AGS	C	
910	Collared Sand Martin	M	Wa	U	
912	Plain Sand Martin	M	AGS	O	
913	Crag Martin	M	R	C	
914	Dusky Crag Martin	R	AGHPSWa	C	
916	Swallow	M	APWa	C	
921	Wiretailed Swallow	R	ASWa	C	
922	Indian Cliff Swallow	L	GS	C	
923	Redrumped Swallow	R	AGHPS	C	
930	House Martin	M	AGPS	U	
933	Grey Shrike	L	APS	O	D

JOURNAL OF ECOLOGICAL SOCIETY

Hand-book No.	Common Name	Seasonality	Habitats preferred	Abundance	Change
940	Baybacked Shrike	R	APS	O	
943	Pale Brown Shrike	M	AS	U	
946	Rufousbacked Shrike	R	AFPS	C	
949	Brown Shrike	M	FSW <sub>v</sub>	U	D
952	Golden Oriole	R	FPS	C	D
958	Blackheaded Oriole	R	FP	O	
963	Black Drongo	R	AFGHPS	C	
965	Grey Drongo	L	FS	O	D
967	Whitebellied Drongo	L	F	O	
982	Ashy Swallow-Shrike	L	FGS	U	
987	Greyheaded Myna	L	FS	U	
994	Brahminy Myna	R	AGHPS	C	
996	Rosy Pastor	M	AGS	C	
997	Starling	M	APW <sub>a</sub>	O	
1006	Common Myna	R	AGHPS	Ab	
1008	Bank Myna	R	AHPW <sub>b</sub>	O	
1009	Jungle Myna	R	APS	C	I
1032	Indian Tree Pie	R	FS	C	
1049	House Crow	R	AHPW <sub>a</sub>	Ab	D
1054	Jungle Crow	R	AFHPS	Ab	I
1070	Common Wood Shrike	R	AFPS	O	
1072	Large Cuckoo Shrike	R	AFS	O	
1078	Blackheaded Cuckoo Shrike	R	FS	O	
1093	Small Minivet	R	FPS	C	
1096	Whitebellied Minivet	R	FS	O	D
1098	Common Iora	R	AFHPS	C	
1103	Goldenfronted Chloropsis	R	AFPS	O	
1120	Redwhiskered Bulbul	R	AFPS	C	I
1128	Redvented Bulbul	R	AFHPS	Ab	
1148	Black Bulbul	R	F	O	
1154	Spotted Babbler	R	FS	O	
1173	Slatyheaded Scimitar Babbler	R	FS	O	
1222	Rufousbellied Babbler	R	FGS	O	
1231	Yelloweyed Babbler	R	FS	C	
1254	Common Babbler	R	GS	U	
1258	Large Grey Babbler	R	APS	C	
1265	Jungle Babbler	R	AFPS	C	
1390	Quaker Babbler	R	FS	O	
1407	Brown Flycatcher	L	AFPS	O	
1411	Redbreasted Flycatcher	M	FPS	C	
1421	Whitebrowed Blue Flycatcher	R	FPS	U	D
1435	Whitebellied Blue Flycatcher	L	F	O	
1442	Tickell's Blue Flycatcher	R	FPS	O	D
1445	Verditer Flycatcher	L	F	O	
1449	Greyheaded Flycatcher	M	F	C	
1458	Whitespotted Fantail Flycatcher	R	FPS	O	
1461	Paradise Flycatcher	L	FP	O	
1465	Blacknaped Blue Flycatcher	R	FP	C	

BIRD DIVERSITY CHANGES OF PUNE URBAN AREA

Hand-book No.	Common Name	Seasonality	Habitats preferred	Abundance	Change
1498	Streaked Fantail Warbler	R	AG	C	
1503	Franklin's Wren Warbler	R	FPS	C	
1506	Rufousfronted Wren Warbler	R	S	O	
1511	Indian Wren Warbler	R	FS	O	D
1517	Ashy Wren Warbler	R	AGHPS	C	
1521	Jungle Wren Warbler	R	GS	C	
1538	Tailor Bird	R	AHPS	C	
1547	Bristled Grass Warbler	R	GR	O	
1550	Great Reed Warbler	M	SWv	O	
1556	Blyth's Reed Warbler	M	AS	O	
1562	Booted Tree Warbler	M	S	O	
1565	Orphean Warbler	M	S	U	
1567	Lesser Whitethroat	M	S	O	D
1574	Chiffchaff or Brown Leaf Warbler	M	GPS	O	
1644	Bluethroat	M	APWv	O	D
1661	Magpie Robin	R	AFHPS	C	
1665	Shama	R	F	U	
1671	Black Redstart	M	AS	O	
1697	Collared Bush Chat	M	AS	O	
1700	Pied Bush Chat	R	APS	C	
1720	Indian Robin	R	APS	C	
1723	Blueheaded Rock Thrush	M	F	O	
1726	Blue Rock Thrush	M	FS	C	
1728	Malabar Whistling Thrush	L	F	O	
1734	Whitethroated Ground Thrush	R	F	O	
1752	Blackbird	R	FP	C	
1794	Grey Tit	R	PS	C	
1809	Yellowcheeked Tit	R	FP	O	
1852	Indian or Paddyfield Pipit	R	AGS	C	
1854	Tree Pipit	M	AGS	C	
1868	Brown Rock Pipit	R	GSWb	C	
1876	Yellow Wagtail	M	Wb	O	
1883	Yellowheaded Wagtail	M	Wb	O	
1884	Grey Wagtail	M	Wbp	C	
1885	White Wagtail	M	APWb	C	
1891	Large Pied Wagtail	R	Wb	C	
1892	Thickbilled Flowerpecker	R	FPS	O	I?
1899	Tickell's Flowerpecker	R	FPS	C	D?
1908	Purplerumped Sunbird	R	FHPS	C	
1909	Small Sunbird	R	F	O	
1917	Purple Sunbird	R	FPS	C	
1933	White-eye	R	FPS	C	
1938	House Sparrow	R	AFGHPS	Ab	
1949	Yellowthroated Sparrow	R	AFS	O	D
1957	Weaver Bird	R	AGS	C	
1964	Red Munia	R	GWv	C	
1966	Whitethroated Munia	R	PS	C	
1974	Spotted Munia	R	AFPS	C	

JOURNAL OF ECOLOGICAL SOCIETY

Hand-book No.	Common Name	Season-ality	Habitats preferred	Abundance	Change
1978	Blackheaded Munia	R	AWv	O	D
2013	Common Rosefinch	M	S	O	
2043	Blackheaded Bunting	M	A	U	
2050	Greynecked Bunting	L	S	O	D
2057	Striolated Bunting	M	S	O	
2060	Crested Bunting	R	FGS	C	I

**STRAY RECORDS**

Handbook No.	Common Name	Location	Contribution
2	Great Crested Grebe	Panshet Dam	PG
63	White Stork	Dapodi	PG
74	Lesser Flamingo	Pashan	TM
87	Mute Swan	Kasurdi	BNHS
126	Goshawk	NDA	TM / SI
151	Besra Sparrow-Hawk	Law college Hill	KP
167	Imperial Eagle	Mula-Mutha	SD
169	Eastern Steppe Eagle	Alandi	NK
172	Whitebellied Sea Eagle	Khadakwasla Dam	SI
178	Black Vulture	Dhayari	SI
220	Redlegged Falcon	Sinhagad	SI
262	Sociable Lapwing	Mula-Mutha	SI
302	Turnstone	Mula-Mutha	PG
323	Sarus Crane	Katraj	PG
354	Great Indian Bustard	Jejuri	SN
405	Wood Snipe	Mhalunge	?
450	Herring Gull	Khadki	PG
484	Indian Skimmer	Mula-Mutha	DS
632	Brown Hawk-Owl	Empress Garden	SI
753	European Roller	Purandar	SP
776	Great Pied Hornbill	Sinhagad	ML
2039	Ortolan Bunting	Pashan	PG / PB

**Contributors :** PB-Paul Bradbeer, PG-Prakash Gole, TM-Tej Mundkur, SI-Shrikant Ingalthalikar, SD-Shirish Dharap, NK-Nilimkumar Khaire, TG-Tejas Gole, SP-Satish Pande, DS-Deepak Shinde, SN-Sanjeev Nalavade, KP-Kiran Purandare, ML-Mahabal and Lamba

□

## Bat Fauna of Pune City

K. D. Yardi<sup>1</sup> and V. S. Korad<sup>2</sup>

### Introduction

Ecologists from Pune are often found to speak about the flora and other disturbances in relation to fauna. The bat fauna that occupy the niche from evening to late night or early morning is ignored to this day. Role of bats in maintaining the balance of the ecosystem is actually well known. The large fruit bats often visit each and every corner of the city at night and small insectivorous bats devour a large number of insects including the mosquitoes. Even then the faunistic survey of bats from Pune region is restricted to a few publications mainly in the first half of the 19th century (Wroughton R. C., 1919; Wroughton and Davidson, 1920). Contribution of Brosset (1962 a, b, c) in this regard is remarkable. Therefore, it was thought that the study of bats in relation to the changing ecology of Pune city would be an interesting exercise.

### Methodology

A pilot survey was made visiting the likely places, where bats were supposed to be present. The visits were made in the evening hours considering the emerging time of the bats. The roosting sites were confirmed by day visits to the places locating the droppings of food items and excreta of animals. Behavioral changes in relation to the roosting sites, feeding peculiarities and biological conditions of bats were considered throughout the study for two successive years 1998-2000.

### Observations

The ecological study and the faunistic survey of bats was done considering the two groups of bats separately.

1. Fruit bats : Three species of megabats were recorded in the study area. They were *Pteropus giganteus* (Indian flying fox), *Pteropus vampyrus* (large flying fox) and *Cynopterus sphinx* (short-nosed fruit bat). Four distinct and distantly located roosting colonies of flying foxes were located in the study area. All the four colonies were found to be flourishing and harbored about 700-1000 adult as well as sub-adult bats. The colony at the Sangam bridge in the heart of the city and Uttamnagar area were even larger with more than 1000 bats. Each colony was spread over 7-10 trees mostly on the riverside or near the canals. The bats were safe at the roosting sites mainly because of the positive approach of people towards them. The colonies at Sangam bridge, Kothrud area and Aundh were actually guarded by the guards of the premises. The other site of large flying fox roost at Uttamnagar was protected by local people who have deep faith and love for them and considered their presence as the sign of good luck. Given the flying capacity and body mass of these flying foxes, it seems that they feed mainly on a variety of wild plants. The orchards around their

1. Visiting Faculty, School of Env. Sciences, Pune University

2. Department of Zoology Fergusson College, Pune



roosts are of small-sized cultivated trees such as guava, chikku whose height is not comfortable for these bats to feed on.

*Cynopterus sphinx*, the little short nosed fruit bat, was the most common species of the study area. The young males were found roosting in isolation, otherwise these bats were found in groups of 4-5 to 15-20 under the same shelter either in cluster or closely roosting. They seemed to prefer dark and humid ceilings of tall stony old buildings of the city or preferred thick foliage of drooping Ashok (*Polyalthia longifolia*). The hollow inflorescence of Fish-tail palm (*Caryota urens*) was also a common roosting place in the study area.

Their day as well as night roosting sites were marked by droppings of half-eaten fruits, their seeds, chewed leaves and excreta. They were observed to feed on wild varieties as well as the fruiting plants in the residential area and orchards.

2. Microbats : All the microbats studied so far were insectivorous species. Many of the bat species were so silent and non-disturbing that they remained unnoticed by local people. Most of the bats in the study area were located in old buildings and holes in the tree and in one cave on Chaturshringi hill. Darkness, inaccessibility and humidity were some of the factors which seemed to be considered while preferring the sites for roosting. Unlike fruit bats, a number of species of microbats were found in the area.

Only one species *Hipposideros speoris* was the cave species, the remaining were found roosting in old buildings mostly in the crevices of stony walls and old fashioned slanting clay tiles roof. The cave species occurred in large numbers (about 500 bats). The wrinkle-lipped free-tailed bats *Tadarida plicata* were found roosting in the premises of Nanawada in 8 to 9 groups, each harbouring about 7-8 bats. Both colonies included adults as well as subadults. They were once flourishing colonies. But unfortunately by January 2000 the colony of free-tailed bat disappeared as their shelters were removed from the wall and that of leaf-nosed bat disappeared in March 2000 due to human activities on the hill.

The remaining species of microbats were observed in small groups. Some of the roosting sites were occupied by bats for certain periods (mostly during mating season) and few were found to be permanent. In particular, *Pipistrelles* were seen to be changing roosting places within the same

premises. The microbats were found in abundance even in thickly populated and polluted areas like arches of bridges at river side and crevices in the stony walls on the river bank. The population of bats in tree holes was comparatively scanty in Pune city.

*Scotoecus palladius* was found roosting in a tree hole. It was also spotted wetting its wings or drinking on the wing in the swimming tank of a school.

### Discussion

The present study of bats in Pune city had revealed that the population of fruit bats was satisfactory but there was no species diversity among these bats. The large population of flying foxes and little-nosed fruit bats were found to be flourishing satisfactorily in the study area. As they depend mostly on wild varieties of fruiting plants, the study area seems to have enough potential to provide food throughout the year.

On the other hand, the microbats were insectivorous and exhibited a wide range of species diversity. The study area lacked natural caves that provide safe and permanent roosting sites. Since the old city is changing its appearance very fast to overcome the stress of steadily increasing rate of human population, roosting places of these bats were often destroyed. The old residential buildings the 'Wadas' and old big trees are vanishing at an astonishing rate and that certainly affects the natural fauna they harbour for many years. Secondly the bat population was less on the dry barren hills in the city. The exotic trees like *Glyricidia*, *Eucalyptus* on the hills did not provide the sheltering habitat for the bats. Similarly the modern cement construction was also not an alternative suitable roost site for bats. The bats are very sensitive to dryness of the climate and they are helpless creatures during daytime if not protected from predators like crows. The role of insectivorous bats in controlling insect fauna including mosquitoes is unbeatable. The sudden disappearance of large colonies of bats due to human interference is certainly a matter of concern for ecologists.

### Acknowledgements

We are thankful to UGC for providing financial assistance in carrying out this project. Thanks are also due to The Principal, Fergusson College and Head, Zoology Department of Fergusson College, Pune, for their cooperation and encouragement. We express our deep gratitude towards Dr. H. R. Bhat (Ex. Head, Dept. of Entomology NIV, Pune) and Dr. P. V. Joshi

BAT FAUNA OF PUNE CITY

(Ex. Head, Dept. and Professor, Dept. Zoology, Pune University, Pune) for their valuable guidance.

**Bibliography**

Bastawde, D. B. and Mahabal, A. 1976. Some bahavioral aspects of the Indian flying fox *Pteropus giganteus*. *Biovigyanam* 2 : 209-212.  
 Bates, P. J. J. and Harrison, D. L. 1997. Bats of Indian subcontinent. Harrison Zoological Museum Publication, England.  
 Bhat, H. R. 1994. Observation on the food and feeding behavior of *Cynopterus sphinx* Vahl (Chiroptera, Pteropodidae) at Pune, India. *Mammalia* 58 : 363-370.  
 Brosset, A. 1962a. The bats of central and western India. Part I. *Jr. Bom. Nat. Hist. Soc.* 59 : 1-57.

Brosset, A. 1962b. The bats of central and western India. Part II. *Jr. Bom. Nat. Hist. Soc.* 59 : 583-624.  
 Brosset, A. 1962c. The bats of central and western India. Part III. *Jr. Bom. Nat. Hist. Soc.* 59 : 707-746.  
 Sreenivasan, M. A., Bhat, H. R. and Geeverghese, G. 1974. Observations on the reproduction cycle of *Cynopterus sphinx sphinx* Vahl, 1797 (Chiroptera, Pteropodidae). *Mammalia* 55 : 200-202.  
 Wroughton, R. C. 1919. On the genus *Tadarida*. *Jr. Bom. Nat. Hist. Soc.* 26 : 731-733.  
 Wroughton, R. C. and Davidson, W. M. 1920. (i) Report No. 30 : Dekhan, Poona District (1025-1030); (ii) Report No. 31 : Nilgiris (1031-1035). Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. *Jr. Bom. Nat. Hist. Soc.* 25 : 1025-1035.

**Bats of Pune City During Study Period 1998-2000**

Sr. No.	Common Name	Scientific Name	IUCN status
01	Large flying fox	* <i>Pteropus vampyrus</i>	DD/N
02	Indian flying fox	<i>P. giganteus</i>	LR-nt/N
03	Short-nosed fruit bat	<i>Cynopterus sphinx</i>	LR-lx/N
04	Schneider's leaf-nosed bat	<i>Hipposiderous speoris</i>	LR-nt/N
05	Egyptian free-tailed bat	<i>Tadarida aegyptiaca</i>	LR-nt/N
06	Wrinkle-lipped free-tailed bat	<i>T. plicata</i>	DD/N
07	Asiatic lesser house bat	<i>Scotophilus kuhlii</i>	LR-nt/N
08	Whiskered bat	# <i>Myotis mystacinus</i>	DD/N
09	Nepalese whiskered bat	# <i>M. longipes</i>	EN/N
10	Kashmir cave bat	# <i>M. longipes</i>	EN/N
11	Water bat	# <i>M. daubentonii</i>	DD/N
12	Horsfield's bat	<i>M. horsfieldii</i>	LR-nt/N
13	Mountain Pupa pipistrelle	# <i>Pipistrellus paterculus</i>	LR-nt/N
14	Javan pipistrelle	<i>P. javanicus</i>	NE
15	Thomas's pipistrelle	<i>P. coromandra</i>	DD/N
16	Indian pigmy bat	<i>P. tenuis</i>	LR-lc/N
17	Kelaart's pipistrelle	<i>P. ceylonicus</i>	LR-lc/N
18	Kuhl's pipistrelle	# <i>P. kuhlii</i>	DD/N
19	Savi's pipistrelle	# <i>P. savii</i>	DD/N
20	Thomas's pipistrelle	# <i>P. cadornae</i>	DD/N
21	Chocolate pipistrelle	<i>P. affinis</i>	DD/N
22	Dormer's pipistrelle	<i>P. dormeri</i>	LR-nt/N
23	Bamboo bat	<i>Tylonycteris sp.</i>	-
24	Desert yellow bat	# <i>Scotoecus pallidus</i>	DD/N

Note : \* = Reported in India for the first time; # = Reported in western and central India for the first time; DD/N = Data deficient nationally, Non-endemic; LR-nt/N = Lower risk-near threatened nationally; LR-lc/N = Lower risk-least concerned nationally; NE = Not evaluated; EN/N = Endangered nationally



## Retreating Wild Mammals of Pune Urban Area

*Sanjeev B Nalavade*

### Introduction

Urban wildlife is one of the neglected areas of wildlife studies. Most of the wildlifers are urban-based, but their study sites are located in remote areas far away from their home-towns. Most of the city-dwellers consider urban wildlife as pests. As far as possible modern urban system discourages wildlife. In spite of all odds, our urban areas are inhabited by a reasonably good diversity of wildlife. Unfortunately urban wildlife is very much ignored by amateur as well as professional naturalists world over and Pune is no exception. Barring the birdfauna, hardly any other animal taxa including mammals, have been thoroughly studied. It is generally believed that mammals cannot thrive under urban environment. But there are many exceptions including cities like Pune. Within the radius of about 40km. from the city center, Pune has enlisted about 62 different kinds of mammals which is a reasonably high number for any metropolis in India.

### Earlier Studies

The first notable mammal study in Pune area was by Adams (1858) a medical officer in the British Army Station. Later, the District Gazetteer (Keyser, 1885) briefly describes wild life in the district with few references of those from around the city. About two dozen different mammal species were collected from Pune environs during the mammal survey of the Bombay Natural History Society during Jan.-May 1918 (Wroughten and Davidson, 1920). Trevenen (1922) while describing game birds around Pune, makes

passing remarks on few game animals. Darkness prevailed during the middle of this century until the establishment here of the western regional station (WRS) of the Zoological survey of India (ZSI) around 1960. During 1960-70, the ZSI(WRS) made wide spread collections especially of rodents and bats. Dr. H. R. Bhat of the National Institute of Virology, Pune, has been monitoring bats from the region since the early sixties. Dr. Mrs. Korad (*pers. comm.*) of the Fergusson College has so far enumerated 24 bat species from the city, some of them described for the first time for the area. Bastwade and Mahabal (1976) described the roosting behaviour, seasonal population changes and local migration of the Flying fox. New species descriptions include rodents belonging to genus *Millardia* from Sinhagad. Dr. R. V. Ranade of the Garware College studied shrews, especially the Grey musk shrew. The pest-control department of Pune Municipal Corporation has enormous population collection data for trapped rat and mice, stratified by species and wards. Write-ups by many shikaris i.e. hunters throw light on the past status of game animals. Notable accounts include those by Phadtare (1945), Chavan (1968,1978), Tilak (1970) and Phanse (1971,1985). These writings inspired Nalavade (1987) who enumerated 79 mammals species for the district, 60 of them recorded from the urban area.

### Methodology

The study is based on observations from field visits to many localities across different seasons since 1973. The evidences and clues employed to detect the presence of mammals include tracks and trails i.e. foot-

**Table 1 Mammal species diversity and exclusivity of Pune urban habitats**

Habitat Type	No. of Total Species	% of Unique Species
Forest	38	30
Scrub	20	10
Grassland	10	6
Plantation	12	-
Agriculture	22	-
Habitation	15	6
Low impact zone (Forest, Scrub, Grassland)	42	30
Impacted zone (Plantation, Agriculture, Habitation)	36	6

prints, plant feeding signs of herbivores, animal (carcass) feeding signs of carnivores, droppings, bones, nests and horns, calls, dead specimen as well as hair entangled in the wire fence etc. While most of the clues were photographed, most of the droppings, hairs etc.

were brought back and analysed. Farmers, sheperds, tribals, amateur wildlifers and shikaris were interviewed with a focus on the changing status. The records and collection at the ZSI (WRS) were also inspected. Unpublished thesis and dissertations added as much information as printed sources such as scientific and popular articles and books.

**Results**

Annexure depicts the habitat-wise distribution and ongoing changes of the 62 mammal species recorded till date from the area, including a few extinct ones. Table 1 shows that the forests constitute the richest habitat, sheltering over half the total species, grasslands and plantation being poorest, hosting a mere sixth while habitations harbour a fifth. Wilderness zone harbours over two thirds the species while impacted zone of habitation and cultivation hosts over a half. A third of the total species are confined to forests while nearly a sixth confined to agricultural landscape. Grasslands hardly host any species exclusively. Wilderness zone exclusively hosts a little less than half the total species while impacted zone nearly a third. The ten commonest mammal species for the area

**Table 2 Impact factors and levels regarding mammals of Pune urban area**

Influencing Factor	Critically Affected Species	Marginally Affected Species
Habitat Destruction Or Habitat Change	Barking Deer , Porcupine, Jackal, Indian Fox, Common Palm Civet, Black Buck	Hyaena, Jungal Cat, Leopard, Wild boar, Four-horned Antelope, Blacknaped Hare, Wolf , Small Indian Civet, Indian Bush Rat
Habitat Distrurbance	Jackal, Indian Fox, Hyaena, Jungle Cat, Four-Horned Antelope, Otter	Blacknaped Hare
Vehicular Traffic	Leopard, Common Mongoose, Most Rodents including Striped Squirrels	Grey Musk Shrew, Hyaena, Hanuman Langur, Bonnet Monkey
Hunting, Poaching, Poisoning	Wild Boar, Hare ,Four-Horned Antelope, Barking Deer, Porcupine, Indian Gazelle, Black Buck	Wolf , Otter, Pangolin, Hyaena, Jackal
Killing out of fear/ Ignorance/Blind faith/ for medicine	Common Palm Civet, Small Indian Civet	Flying Fox
Killing as Pest/Vermin	Most Of Rodents Except Striped Squirrels	Jungle Cat, Common Palm Civet, Small Indian Civet, Hyaena, Jackal
Electrocution	Flying Fox	Hanuman Langur, Bonnet Monkey
Pollution (Air, Water, Sound, Soil, Etc.)	No precise knowledge, but most species may be affected.	

include House rat, House mouse, Bandicoot rat, Three-striped palm squirrels, Kelaort's pipistrelle bat, Yellow house bat, the three fruit bat species, Grey musk shrew and Blacknaped hare. The seven rarest species include Blackbuck, Mouse deer, Leopard cat, Smooth-coated Otter and Painted bat, besides Tiger and Gaur that are locally extinct.

Table 2 depicts the eight major urban environmental factors affecting the mammals in decreasing order of relative impact. Habitat loss due to urbanisation has significantly affected about a third of the species. In

contrast, electrocution has affected only a handful. While pollution has probably affected most species, its precise impact remains unexplored. Table 3 depicts the rate of retreat of a dozen important species pushed away from the city. While sensitive species such as black buck and tiger are retreating at the fastest rate, nearly a kilometer per annum; the most tolerant species such as civets and hare are pushed barely a twentieth of that. Table 4 compares the species richness of various mammal groups of Pune with that of Bangalore.

**Table 3 Retreat of some wild mammals of Pune urban area**

CODES : C- common, F- frequent, O- occasional, R- rare

Past status compiled from various sources, present status based on first hand observations

Distance is measured as crow's flight i.e. straight line from the city center which is the City Post Office

Mammal species	Past situation				Present situation (1990)			Rate of Retreat m/yr
	Years	Nearest locality	Distance km	Status	Nearest locality	Distance km	Status	
Wolf	1940's	Vadgao (s), Nagar rd.	7.0	F	Koregaon on Bhima (Nagar Rd)	30	R	475
Smooth coated otter	1950's	Parvati Canal	2.0	O	Khadakwasla	18	R	375
Palm civet	1950's	City core	0.0	C	Fergusson College Agri. College Empress garden	2.0 2.5 4.0	O	50
Common mongoose	Late 1980's	Budhwar peth	0.0	O/R	Madiwale colony	1.0	O	100
Hyaena	1950's	Navi peth	2.0	C	Vetal hill Panchgaon	4.0	O	50
Tiger	1930's	NDA hills	15	S	Bhimashankar	75	S	900
Wild boar	1930's	Ganjwewadi (Navipeth)	1.5	O	Katraj, Chandani Chowk	8.0	R	100
Four-horned antelope	1960's	Fergusson college hill	3.0	O	Chandani Chowk	8.0	R	175
Black buck	1940's	Behind Agakhani Palace	7.0	O	Supe (Solapur Road)	50	R	850
Indian Pangolin	1920's	Natubag (Sadashiv peth)	0.6	O	Panchgaon NCL campus	4.0 5.5	R	70
Indian porcupine	1940's	Parvati-Panchgaon	4.0	O	Katraj valley	8.0	O	80
Blacknaped hare	1930's	Natubag	0.6	C	Fergusson hill, Panchgaon	3.0 4.0	F	40

**Table 4 Pune and Bangalore urban area mammal diversity at group level**

Sr. No.	Mammal group	No. of species		Common Species
		Pune	Bangalore	
1	True shrews	2	1	1
2	Tree shrews	1	-	-
3	Bats	16	9	9
4	Primates	2	2	1
5	Dogs	3	1	1
6	Otter	1	-	-
7	Civets	2	2	2
8a	Mongoose	2	2	2
8b	Hyaena	1	-	-
9	Cats	5	3	2
10	Sloth Bear	-	1	-
11	Wild Boar	1	1	1
12	Deer	4	3	3
13	Antelope	3	1	1
14	Gaur	1	1	1
15	Elephant	-	1	-
16	Pangolin	1	1	1
17	Rodents	15	10	10
18	Hare	1	1	1
Total		62	41	37

### Discussion

Notwithstanding the threats to wildlife that characterize most cities, Pune urban area hosts 65 species, ranking highest amongst Indian metropolis. Despite the extinction of few species and general population decline or retreat, rodents, particularly rats and mice appear flourishing. Squirrels can be spotted aplenty during the day, unlike most other species. Fruit bats have benefited most due to urbanisation, where home gardens bear many fruit trees. Habitat loss along the city outskirts entails that straying of wild animals into the city may increase in the future, such as the inexplicable occurrence of leopard captured earlier this year. Besides carnivores, herbivores inhabiting hills but foraging on crops in the plains are main sufferers of hill deforestation. Until two decades ago, thickets along the Katraj and Pashan lake were the favourite haunt of Jungle Cat that has disappeared today, as housing colonies have enveloped the lakes. At Pashan, the cat is only rarely sighted due to slightly better habitat. Habitat loss includes replacement of old wadas and bungalows with modern apartments and skyscrapers, virtually pushing out even the palm civets. The effect of growth of electrified lighting in pushing out the

nocturnal animals needs further study. Urbanisation at the cost of agriculture has constrained the wild boar population and movement, forcing them to shift from the urbanised Mula-Mutha valley to the less impacted Shivganga basin across the Katraj hills (Giri, *pers.comm.*).

Besides habitat loss, urbanization entails habitat degradation or disturbance. Multiplied human activities along the fringe areas, especially in the hill forests have forced the essentially secretive and nocturnal animals to come out in daylight or desert the area. Spotting a barking deer at the waterhole in Katraj valley even at noon time has become a thing of the past. Morning walkers or fuelwood collectors often disturb hares resting in the hills. Stray dogs and even unchained pet dogs chase and even pray upon such hares. At Parvati-Pachgaon over five dozen such dogs roam at any time, few of them some times chasing even four horned antelopes. Many wild mammals especially hyena, jackal, fox are run over by heavy traffic while crossing the highway bypass, that cuts across their traditional migration corridor. Even a leopard cub was run over at the Katraj Ghat section about two years ago. Numerous rats and mice get killed on roads especially on the outskirts. Scavengers such as crows and kites spend busy mornings clearing the roads. Among the diurnal animals, mongooses and squirrels are the main traffic victims. The dense network of overhead electric wires, poles and transformers in the city has become hazardous for some mammals. Flying foxes are the most vulnerable given their 1 m wingspan. Every year about 50-70 of them die due to electrocution, which is nearly 2% of their city population, estimated about 3000 individuals.

Other driving forces pale in comparison to urbanization. Pune always hosted many shikaris i.e. hunters who even cycled or walked to the hunting grounds such as hills, especially Sinhagad. Wild boar is the most heavily persecuted animal, having been shot, poisoned and even bombed! No wonder that the average herd size of wild boar has come down from 15-20 individual six decades ago to 8-10 individuals two decades ago (Phanse, D. S, *pers.comm.*). Five most hunted animals (with percentage share in parenthesis) by Phanse from around Pune from 1930 to 1980 include Wild boar (35%), Hare (23%), Barking deer (15%), Fourhorned antelope (15%) and Porcupine (12%). This resembles the perceptions of other hunters. Permitted hunting was driven by the desire for choice meat and in part, pelt or trophies such as a Leopard skin. Disappearance of Black buck from around Pune is largely due to military encampments

during the Second World War that enjoyed the hunting spree. Further, many local farmers possessed guns earlier under the guise of crop protection but freely used them for game hunting. Though permitted hunting is presently halted, poaching still unabatedly continues to persecute favourite species. Trapping of wildlife has hardly contributed to wildlife decline, given its small scale, practised mostly by specialists including the semiresident tribes such as Katkaris and nomadic tribes such as Phase-Paradhis. Their traditional practices of catching, trapping and hunting techniques turn out to be sustainable (Kailash Malhotra, *pers. comm.*). Superstitions prevailing even today take a toll of wildlife. For instance, Palm civets and Small Indian civets are still stoned to death, fearing that they attack children or exhume buried corpses. In contrast, despite being nuisance to poultry, the Mongoose is spared, being considered sacred. Flying foxes are hunted to fetch their fat used for harvesting a medicinal oil. Hundreds of wolves have already been poisoned through their kills whenever they have become a menace to the sheep herds. A few cattle lifter leopards have also faced a similar fate (Tilak 1970). Wildlife is also destroyed as vermin. For instance, the Municipal Corporation periodically captures numerous rats and mice. Privately, thousands of them are trapped to death. However, their population seems to be unaffected or may even be flourishing. Civets and Jungle cat are also killed whenever chanced upon especially for their menace to poultry. Pune shikaris have always shot many Jackals, Hyenas and wolves as vermin (Phanse, D. S., *pers. comm.*) in the past.

A comparison between the wild mammals of Pune with Bangalore (Table 4) is interesting and educative, given that these are situated on the same Deccan plateau, and inherit similar climate and the dry deciduous forest biome and have similar human population. One may expect Bangalore to boast higher species diversity owing to its proximity to southern Western Ghats and greater tree cover. However, recorded species richness of Pune city (62) far exceeds Bangalore 41 (Karthikeyam, 1999). Both the cities share 37 species. Bangalore exclusively hosts Slender loris, Rustyspotted cat, Sloth bear and Elephant. The first three had been recorded in the past century from Pune ghats. Pune hosts 25 exclusive species including the Bonnet monkey, Desert cat, Leopard-cat, Tiger, Wolf, Indian fox, Pigmy shrew, Five striped and Jungle striped squirrels, 3 rodent species, 7 bat species, Black buck, Mouse deer, Hyaena and Smooth-coated otter. Many of these species may exist around Bangalore but not recorded yet. Pune has the geographical advan-

tage, being situated between the moist Western Ghat hills to the west and the semi-arid Deccan plains to the east. Hence, Pune shares mammals typical of both biogeographic zones. The Western Ghats elements include Leopard cat, Barking deer, Mouse-deer, Jungle striped squirrels while the Deccan elements include Wolf, Fox, Black buck etc. Secondly, hills envelop Pune city and connect it to Western Ghats, unlike remotely and poorly connected Bangalore. Pune hills, especially the western ones have numerous ancient man-made caves locally termed 'Lene' that offer roosting habitats to many bats that visit the city. This explains the higher bat diversity at Pune. Larger proportion of area under canal irrigation along the eastern outskirts explains the higher diversity of rodents. While these trends may remain, deeper mammal exploration at Bangalore might add some species to the present list.

#### Acknowledgements

I was greatly encouraged into these studies by the Friends of Animals' Society (FAS) way back in 1980s. RANWA colleagues, especially Utkarsh Ghate and Raghu Velankar constantly persuaded me into this 'Pune Alive' project. Dr. M. S. Pradhan and colleagues at ZSI (WRS) are thanked for identification of some bat specimens, making available their records and for sharing their valuable information on species distribution. Perceptions of several 'old-time' shikaris greatly enriched this understanding. Kapil Sahsrabudhe helped secretarially. I am indebted to them all.

#### Bibliography

- Ali, Salim (1985) *The Fall of a Sparrow*. Oxford University Press, New Delhi. P.52.
- Bastwade, D. B. and Mahabal, A. (1976) Some behavioural aspects of Indian Flying fox, *Pteropus giganteus giganteus*. *Biovigyanam* 2 : 209-212.
- Chavan, V.M. (1968) *Paradh* (Marathi). Kesari Publ., Pune.
- Chavan V.M. (1978) *Sawaj* (Marathi). Vora and Co., Mumbai.
- Deshpande M.V. and Ghormade V. (2000) *Flora and Fauna of NCL*. Pune.
- Gay, Thomas (1977) *Poona*. *Imprint*. (Dec.) 1977.
- Kartikayan S. (1999) *The vertebrate and butterfly fauna of Bangalore : A checklist*. WWF -India, Karnataka State Office. Bangalore.
- Keyser, A. (1985) *Wild Animals*. In 'The Gazetteer of the Bombay Presidency-Poona District, Part 1. pp. 69-70.
- Khaire, N. (1998) *Maitr Jeevache* (Marathi). Indian

RETREATING WILD ANIMALS OF PUNE URBAN AREA

Herpetological Society, Pune.  
 Nalawade, S. B. (1987) Mammalian Fauna of Pune District. Friends of Animal Society, Pune.  
 Phadtare, R.V. (1945) Mrigaya (Marathi). Suyog Prakashan (1993 ed.), Pune.  
 Phanse, D. S. (1971) Shikaritul Jamati-Gamati (Marathi), Pune.  
 Phanse, D.S. (1985) Shikar- Katha (Marathi). Prasad publ., Pune.

Ranade, R.V. (1987) Anatomy of Indian House Shrew. Poona University Press, Pune.  
 Ranade R.V. (1989) A note on Pigmy Shrew (*Suncus etruscus*) *Jr.Bom.Nat.Hist.Soc.* 86 (2) : 238-39.  
 Tilak, Jayantrao (1970) Shikar (Marathi). Prestige Publ., Pune.  
 Trevenen, W.B. (1922) Shikar near and around Poona. *Jr.Bom.Nat.Hist.Soc.* 28 (4) : 1075-81.

**Annexure : Distribution Status Of Mammls In Pune Urban Area**

**Code :** ABD : A- Abundant, C- Common, O- Occassional, R- Rare, ?- Uncertain, S- Stray  
 Habitats : F- Forest, G- Grassland, H- Housing, P- Plantation, S- Scrub, W- Waterbodies, Ag- Agriculture  
 CHG (Change) : D- Decline, I- Increase  
 CS (Cause) : HH- Harvest, HL- Habitat loss  
 Remark : K- Katraj, Shgd- Sinhgad

Scientific Name	Common Name	Habitat	ABD	CHG	CS	Remark
<b>Order Insectivora</b>						
<i>Suncus etruscus</i>	Indian pigmy shrew	HFS	O			
<i>Suncus murinus</i>	Grey musk shrew	H	A			
<b>Order Scandentia</b>						
<i>Anathana ellioti</i>	Common/Madras tree shrew	F	O			K, Shgd
<b>Order Chiroptera</b>						
<i>Rousettus leschenauti</i>	Fulvous fruit bat	HPFS	C	I		Suburbs
<i>Pteropus giganteus g.</i>	Indian flying fox	HPFS	C			one dozen colonies within the area
<i>Cyanopterus spinx</i>	Short nose fruit bat	HPFS	C	I		Suburbs
<i>Taphozous logimaus</i>	Longwinged Tombbats					
<i>Megaderma lyra</i>	Great false vampire bat	HF				Suburbs
<i>Rhinolophus rouxii</i>	Rufous horseshoe bat					
<i>Hipposideros speoris</i>	Schneider leaf nosed bat	HF	R			
<i>Myotis horsefieldii</i>	Horsefield's bat	H	R			formerly, Peshwa Bat!
<i>Pipistrellus ceylonicus</i>	Kelaarts pipistrelle	HPAgF	C			
<i>Pipisterillus coromandra</i>	Indian pipistrelle	HPAgSF	C			
<i>Pipisterillus tenuis</i>	Indian pigmy pipistrelle	HPAgSF	C			
<i>Hesperoptenus tickelli</i>	Tickells bat		R			
<i>Scotophilus heathll</i>	Great yellow housebat	HPAgSF	C			
<i>Scotophilus kuhlii</i>	Lesser yellow housebat	HPAgSF	C			
<i>Kerivoula picta</i>	Painted bat		R			
<i>Tadarida aegyptiaca</i>	Egyptian free tailed bat		R			
<b>Order Primates</b>						
<i>Macaca radiata</i>	Bonnet monkey	HPAgSF	C			
<i>Presbytis entellus</i>	Hanuman Langur	HPAgSF	C			Summer
<b>Order Carnivora</b>						
<i>Canis aureus</i>	Jackal	FGPSAg	O	D		



Scientific Name	Common Name	Habitat	ABD	CHG	CS	Remark
<i>Canis lupus pallipes</i>	Wolf	SG	R		HL	Summer emigrant
<i>Vulpes benghalensis</i>	Indian fox	HAgFG(W)		D	HL	eastern Fringes
<i>Lutra perspicillata</i>	Smooth-coated otter	F(W)	R	D		Parvati canal
<i>Viverriculla indica</i>	Small Indian civet	HAgSF				Dhayari
<i>Paradoxurus hermaphroditus</i>	Common palm civet	HPAgSF	C	D		
<i>Herpestes edwardsi</i>	Common mongoose	FSGPAg	C	D		Suburbs
<i>Herpestes smithi</i>	Ruddy mongoose	F	O			
<i>Hyaena hyaena</i>	Striped Hyaena	FS	O		HL	Fringes
<i>Felis silvestris</i>	Desert cat	A	?			
<i>Felis chaus</i>	Jungle cat	SG	O	D	HL	K, Pashan
<i>Felis benghalensis</i>	Leopard cat					not city
<i>Panthera pardus</i>	Leopard or Panther	F	O			Winter, K, Shgd
<i>Panthera tigris</i>	Tiger	F	O	Ex		NDA, 1930
<b>Order Artiodactyla</b>						
<i>Sus scrofa cristatus</i>	Wild boar	SAg	O	D	HH,HL	Mutha canal belt
<i>Tragulus memmina</i>	Mouse deer	F	R	D	HH,HL	NDA
<i>Muntiacus muntjak</i>	Muntjac or barking deer	F	O	D	HH,HL	K, Shgd
<i>Axis axis axis</i>	Cheetal or Spotted deer	F	C	I		NDA, Introduced
<i>Cervus unicolor</i>	Sambar deer	F	O	D	HH,HL	Rajgad
<i>Tetracerus quadricornis</i>	Four horned antelope	S	O		HH	
<i>Bos gaurus</i>	Gaur	F	S	?		K
<i>Antilope cervicapra</i>	Black buck/Indian antelope	G	O	Ex	HH	Agakhan Palace
<i>Gazella gazella benneti</i>	Chinkara or Indian gazelle	FS	O	D	HH	
<b>Order Pholidota</b>						
<i>Manis crassicaudata</i>	Indian pangolin	FS	R			
<b>Order Rodenta</b>						
<i>Funambulus palmarum</i>	Three striped palm squirrel	FPAg	A			
<i>Funambulus pennanti</i>	Five striped palm squirrel	PH	A			
<i>Funambulus tristriatus</i>	Jungle striped squirrel	F	R			Shgd
<i>Tatera indica</i>	Indian gerbil	Ag	C			
<i>Vandeleuria oleracea</i>	Long tailed tree mouse	F	S?			Erandawana, (Bhat pers. comm.)
<i>Golunda ellioti</i>	Indian bushrat	S	C			
<i>Millardia kondana</i>	Kondana field-rat	F	R			Mishra, 1976
<i>Millardia meltada</i>	Soft-furred field-rat	Ag	C			
<i>Rattus blanfordi</i>	Blandford's rat	F	O?			
<i>Rattus rattus</i>	Common house rat	H	A	I		Grainary
<i>Mus booduga</i>	Little Indian field-mouse	Ag	C			Fringes
<i>Mus musculus</i>	Common house-rat	H	C	I		Wadas, Grainary
<i>Mus platythrix</i>	Indian brown spine-mouse	Ag				Fringes
<i>Bandicota bengalensis</i>	Indian mole-rat	Ag				
<i>Bandicota indica</i>	Bandicoot rat	H	A	I		Drainage
<i>Hystrix indica indica</i>	Indian crested porcupine	FS	O	D	HH	
<b>Order Logomorpha</b>						
<i>Lepus nigricollis</i>	Indian blacknaped hare	FSAG		D	HH,HL	NDA

□



5



6



7



8



9

1. Hoopoes : Dr. Satish Pande
2. Jezebel Butterfly : Dr. Satish Pande
3. *Monsonia senegalensis* : Shrikant Ingaihalikar
4. Bonnet macaque : Sanjeev Nalavade
5. Indian Roller : Dr. Satish Pande
6. Barn Owl : Dr. Satish Pande
7. Cricket : Sanjeev Nalavade
8. Chameleon : Dr. Satish Pande
9. Russell's viper : Ashok Captain