URBAN TREE DIVERSITY OF KARWAR, KARNATAKA

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ABSTRACT:

Urban trees serve many useful functions such as climate change mitigation by carbon sequestration, air quality improvement by air pollution abatement, biodiversity conservation and source of ecosystem goods to urban inhabitants. They also have aesthetic, socio-religious and recreational value in urban contexts. In spite of the importance, they have not received much scientific attention. This paper investigates the diversity and density of tree species growing both within the built environment as well as road-side avenues in the seaside town of Karwar which is the administrative headquarters of Uttara Kannada district of Karnataka. The total area of the town is 27.15 km^2 and population (2001 census) is 62,973.

The tree flora of Karwar comprises of about 106 species in which about 70% are indigenous species. The other 30% involves exotic and introducedd species. The top five dominant species are *Mangifera indica* (Wild mango, 20.016% of total tree population), *Polyalthia longifolia* (False Ashoka, 12.544%), *Peltophorum pterocarpum* (Yellow flame tree, 6.763%), *Samania saman* (Rain tree, 5.072%) and *Artocarpus heterophyllus* (Jackfruit, 5.045%). The tree diversity represents a good assemblage of different utility categories such as wild and cultivated fruit yielding trees, shade and ornamental trees, sacred and religious trees, etc. Besides the high proportion of older trees of wild mango and jackfruit, presence of other wild fruit yielding trees like *Artocarpus incisus* and *Spondias pinnata,* large sized sacred trees such as *Ficus religiosa* and *F. benghalensis,* rare medicinal species such as *Garcinia indica, Saraca asoca, Terminalia bellirica,* etc.*,* are some of the notable features of the urban tree flora of Karwar.

INTRODUCTION:

Presently, 50% of total global population live in cities which occupy only 3% of the land area, and it is expected that the urban population will further rise to 67% in the next 50 years (Grimm *et al*., 2008). In developing countries, about 44 % of the population currently live in urban areas, which is likely to increase considerably in the next 20 to 30 years (Montgomery, 2008). During the last 50 years the population of India has grown two and a half times, but the urban population has grown nearly five times (Taubenböck *et al*., 2009). This kind of rapid urbanization is bringing complex changes to ecology, economy and society at local, regional, and global scales (DeFries and Pandey, 2010).

Deteriorating quality of urban ecosystems has already become a major concern of urban planners and managers. Environmental problems such as air and water pollution are more rampant in urban areas which currently account for 78% of global carbon emissions, 60% of domestic water use, and 76% of wood used for industrial purposes. It is inevitable that essential steps are taken to redesign the urban ecosystems to ameliorate these environmental problems and to ensure availability of clean air, water and other ecosystem services needed for healthy urban living.

Conservation and restoration of urban green spaces comprising of urban trees and forests is one important aspect of improving the environmental quality of urban areas. The term 'urban trees' generally includes trees growing both within the built environment as well as road-side avenues and public places in urban systems. They play a very significant role in the urban environment and serve many important functions, such as climate change mitigation by carbon sequestration, air quality improvement by air pollution abatement, oxygen generation, noise reduction, mitigation of urban heat- island effects, microclimate regulation, stabilization of soil, ground water recharge, prevention of soil erosion, biodiversity conservation and source of ecosystem goods to urban inhabitants. They also have aesthetic, socio-religious and recreational value in urban contexts.

In spite of their eco-sociological importance, urban trees have not received much scientific attention in India. There are only a few detailed studies on the urban trees of cities like Bangalore (Sudha and Ravindranath, 2000, Nagendra and Gopal, 2010), Chandigarh (Kohli *et al*., 1994) and Nagpur (Gupta *et al*., 2008). We have initiated a study of the urban trees of Karwar, Karnataka and the preliminary data on the species diversity and population density of urban trees of this town is presented in this paper.

STUDY AREA AND METHODOLOGY:

Karwar is a small coastal town on the west coast of India and it is the administrative headquarters of Uttara Kannada district of Karnataka. The total area of the town is 27.15 km^2 and its population is 62,973 (2001 census). This town has gained a prominent place in the map of India because of the location of the recently commissioned Indian naval base called the 'Sea Bird', in its vicinity. It is also the nearest town to the Kaiga Atomic Power Station, which is situated in a distance of 40 km. Due to the arrival of these projects of national importance and also other developmental activities, the otherwise sleepy town of Karwar has seen considerable expansion and modernization during the recent years.

10 of the major roads of Karwar town, which together cover the different locations of the town, was selected for tree enumeration. All plants having an approximate girth of more than 15 cm. were considered as trees. All such trees visible on either side of the entire length of the selected roads were noted and their numbers counted,

while walking from one end of the road to the other. They included trees occurring on road sides, parks and also inside the compounds of both public and private buildings. Trees were identified with the help of local flora and other relevant literature (Cooke, 1967; Bhat, 2003; Swaminathan & Kochhar, 2003,).

RESULTS AND DISCUSSION:

The tree diversity of Karwar town comprises of 106 species which includes 104 angiosperms and two gymnosperms. These species represent a total of 86 plant genera and 40 families. A list of all these trees with their family, common name, flowering/fruiting season and major use category is provided as table 1. A total of 3667 trees belonging to all the species were enumerated during the present study. The tree species diversity of Karwar town is high when compared to the smaller area (27.15 km^2) of the town. A comprehensive study of urban forests of 360 km^2 area of Bangalore found 374 species in the different land-use categories (Sudha and Ravindranath, 2000). Urban forest in 43 ha of NEERI campus at Nagpur, Maharashtra has only 46 tree species (Gupta *et al.*, 2008). The 114 km^2 area of Chandigarh which is considered to be the greenest city of India has about 200 species which includes about 66 multipurpose trees (Kohli *et al.*, 1994).

About 70% of the recorded tree species of Karwar are indigenous while only 30% species are introduced or of exotic nature. Majority of the introduced tree species are observed in the roadside, parks and in front of government buildings as avenue and ornamentals whereas the trees grown and maintained within the compounds of residential buildings and private lands are predominantly the indigenous types with various beneficial properties. A few gigantic sized trees of *Samanea saman* and *Peltophorum pterocarpum* dominate the main roads of the centre of the town which represent the surviving older trees. Similarly, several large sized sacred and religious trees such as *Ficus religiosa, F. benghalensis, F. racemosa, Aegle marmelos, Mimusops elengi*, etc. are found at the vicinity of temples and other worship places.

When population density was considered, the top ten most common tree species are *Mangifera indica* (Mango, 20.016% of total tree population), *Polyalthia longifolia* (False Ashoka, 12.544%), *Peltophorum pterocarpum* (Yellow flame tree, 6.763%), *Samania saman* (Rain tree, 5.072%), *Artocarpus heterophyllus* (Jackfruit, 5.045%), *Terminalia catapa* (Wild almond, 3.625%), *Tectona grandis* (Teak, 3.599%), *Psidium guajava* (Guava, 3.408%), *Manilkara zapota* (Sapota, 2.291%) and *Artocarpus incisus* (Breadfruit, 2.4%). These 10 species together account for about 65% of the total trees of Karwar in which the share of the first five species is almost 50% (Fig. 2). The other 95 species together account for only 35% of trees. Among them, about 40 species are represented by only five or less number of trees each. Notable among such rare species with five or less number of trees are *Artocarpus gomezianus* (01 tree), *Adenanthera pavonia* (02 trees), *Averrhoa bilimbi* (02 trees), *Couropita guianensis* (04 trees), *Ceiba pentandra* (03 trees), *Dichrostachys cinerea* (03 trees), *Dalbergia latifolia* (02 trees),

Haldina cordifolia (03 trees), *Kigellia pinnata* (02 trees), *Mimusops elengi* (04 trees), *Santalum album* (03 trees), *Streblus asper* (01 tree), *Strychnos nux-vomica* (01 tree) and *Zanthoxylum rhetsa* (02 trees).

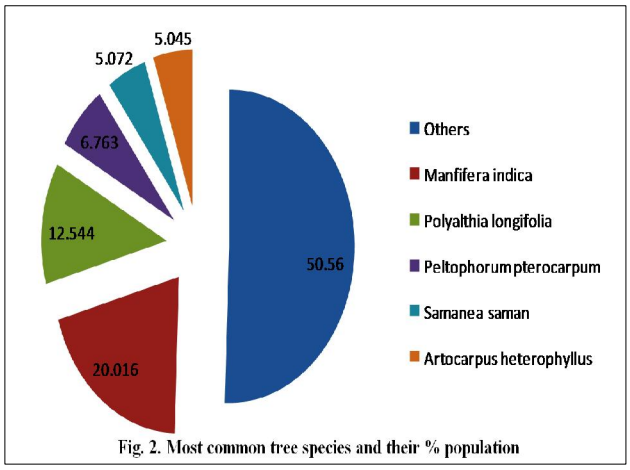

Fig. 2. Most common tree species and their % population

In general, the tree diversity represents a good assemblage of different utility categories such as wild and cultivated fruit yielding trees, shade and ornamental trees, sacred and religious trees, medicinally useful trees, etc. Besides the high proportion of older trees of wild mango and jackfruit, presence of other wild fruit yielding trees like *Artocarpus incisus* and *Spondias pinnata*, large sized sacred trees such as *Ficus religiosa* and *F. benghalensis*, gigantic exotic avenue trees such as *Samanea saman* and *Peltophorum pterocarpum*, rare medicinal species such as *Garcinia indica*, *Saraca asoca*, *Terminalia bellirica*, etc., are some of the notable features of the urban tree flora of Karwar.

REFERENCES:

1. Bhat, KG, 2003. *Flora of Udupi* , Indian Naturalists, Udupi.
2. Cooke T, 1967. *Flora of Presidency of Bombay*, Vol I-III. Botanical survey of India, Calcutta.
3. DeFries, R. and D. Pandey. 2010. Urbanization, the energy ladder and forest transitions in India's emerging economy. *Land Use Policy* 27(2): 130-138.
4. Grimm, N. B., S. H. Faeth, N. E. Golubiewski, C. L. Redman, J. Wu, X. Bai and J. M. Briggs. 2008. Global change and the ecology of cities. *Science* 319(5864): 756-760.
5. Gupta, R. B., P. R. Chaudhari and S. R. Wate. 2008. Floristic diversity in urban forest area of NEERI Campus, Nagpur, Maharashtra (India). *Journal of Environmental Science and Engineering* 50(1): 55-62.
6. Kohli, R.K.; Arya, K.S.; Singh, H.R; Dhillon, H.S. 1994. . *Tree directory of Chandigarh, India*, Dayanand National Academy of Environmental Sciences, Chandigarh.
7. Montgomery, M. R. 2008. The urban transformation of the developing world. *Science* 319(5864): 761-764.
8. Nagendra, H. and D. Gopal. 2010. Street trees in Bangalore: Density, diversity, composition and distribution. *Urban Forestry & Urban Greening* 9(2): 129-137.
9. Sudha, P. and Ravindranath, N. H. 2000. A study of Bangalore urban forest. *Landscape and Urban Planning* 47: 47-63.
10. Swaminathan, M.S. and Kocchar, S. L., 2003. *Groves of Plenty and Beauty – An Atlas of Major Flowering Plants of India*. MacMillan India Ltd, New Delhi.

11. Taubenböck, H., M. Wegmann, A. Roth, H. Mehl and S. Dech. 2009. Urbanization in India: Spatio-temporal analysis using remote sensing data. *Computers, Environment & Urban Systems* 33(3): 179-188

Table 1. Tree species recorded from Karwar town, Uttara Kannada, Karnataka.

Sl No.	Name of the species	Family	Common name	Native (N)/ Exotic(E)	Flowering/ Fruiting Season	Uses
01	*Acacia auriculiformis*	Fabaceae	Acacia	E	Sep-Dec	M
02	*Adenanthera pavonia*	Fabaceae	Gulugunji mara	I	Mar-June	M
03	*Aegle marmelos*	Rutaceae	Bilva	I	Apr-May	S
04	*Ailanthus triphysa*	Simoaroubaceae	Guggula dhoopa	I	Jan-Apr	M
05	*Albizia lebbeck*	Fabaceae	Bage	I	Apr-May	M
06	*Alstonia scholaris*	Apocynaceae	Halemara	I	Dec-Mar	M
07	*Anacardium occidentale*	Anacardiaceae	Geru, Godambi	E	Dec-June	F
08	*Annona reticulata*	Annonaceae	Rama phala	I	June-Aug	F
09	*Annona squamosa*	Annonaceae	Seeta phala	I	June-Aug	F
10	*Artocarpus gomezianus*	Moraceae	Vaate huli	I	Mar-Apr	F
11	*Artocarpus heterophyllus*	Moraceae	Halasu	I	Dec-June	F
12	*Artocarus incisus*	Moraceae	Deevi/Neeru halasu	I	Nov-Jan	F
13	*Averrhoa carambola*	Oxalidaceae	Carabalu	I	May-Aug	F
14	*Averrhoa bilimbi*	Oxalidaceae	Bimbuli	I	All months	F
15	*Azadirachta indica*	Meliaceae	Kahi bevu	I	Jan-July	M
16	*Bambusa arundinacea*	Poaceae	Bidiru, Bambu	I	-	M
17	*Bauhinia purpurea*	Fabaceae	Mandara	I	Sep-Mar	O
18	*Bauhinia tomemtosa*	Fabaceae	Mani Mandara	I	Nov-Jan	O
19	*Borassus flabellifer*	Arecaeae	Tale mara	I	Jan-Apr	F
20	*Caesalpenia pulcherrima*	Fabaceae	Rathnagandhi	I	All months	O
21	*Callistemon citrinus*	Myrtaceae	Bottle brush	E	Mar-Nov	O
22	*Calophyllum*	Clusiaceae	Sura Honne mara	I	Oct-Apr	M

	inophyllum					
23	*Caryota urens*	Arecaceae	Baine mara	I	All months	M
24	*Cassia fistula*	Fabaceae	Kakke mara	I	Mar-May	O
25	*Cassia siamea*	Fabaceae	-	I	-	O
26	*Casuarina equisetifolia*	Casuarinaceae	Galimara	E	-	M
27	*Ceiba pentandra*	Bombacaceae	Bili buruga	I	Dec-Jan	O
28	*Citrus grandis*	Rutaceae	Chakota	I	All months	F
29	*Cordia mixa*	Boraginaceae	Challe hannu	I	Mar-Apr	F
30	*Couroupita guianensis*	Lecythidaceae	Nagalinga pushpa	E	All months	O
31	*Croton roxburghii*	Euphorbiaceae	Somaru	I	Nov-Jan	M
32	*Dalbergia latifolia*	Fabaceae	Sissum	I	Dec-Feb	T
33	*Delonix regia*	Fabaceae	May flower	E	Apr-May	O
34	*Dichrostachys cinerea*	Fabaceae	Banni	I	Sep-Oct	S
35	*Eucalyptus sp.*	Myrtaceae	Nilgiri	E		M
36	*Ficus benghalensis*	Moraceae	Alada mara	I	Dec-Jan	S
37	*Ficus elastica*	Moraceae	Rubber mara	E	-	O
38	*Ficus hispida*	Moraceae	Geritalu	I	All months	M
39	*Ficus microcarpa*	Moraceae	Kirugoli	I	Dec-Jan	S
40	*Ficus racemosa*	Moraceae	Atti mara	I	All months	S
41	*Ficus religiosa*	Moraceae	Arali/Ashwatha	I	Mar-July	S
42	Unidentified 1 (*Ficus* sp.)	Moraceae	-	I	-	M
43	*Garcinia indica*	Clusiaceae	Murugalu	I	Nov-Feb	F
44	*Gliricidia sepium*	Fabaceae	Gobbara mara	E	Feb-Apr	M
45	*Grevillea robusta*	Proteaceae	Silver oak	E	-	M
46	*Haldina cordifolia*	Rubiaceae	Heddi mara	I	Sep-Oct	M
47	*Hibiscus mutabilis*	Malvaceae	Dasavala	E	Sep-Dec	O
48	*Hibiscus rosa-sinensis*	Malvaceae	Dasavala	I	All months	O
49	*Ixora brachiata*	Rubiaceae	-	I	-	O
50	*Kigelia pinnata*	Bignoniaceae	-	E	May-July	O
51	*Lagerstroemia speciosa*	Lythraceae	Nandi, Hole dasavala	I	Apr-June	O

52	*Leucaena leucocephala*	Fabaceae	-	I	-	M
53	*Macaranga peltata*	Euphorbiaceae	Chandakalu	I	Feb-Mar	M
54	*Mangifera indica*	Anacardiaceae	Mavu	I	Dec-Mar	F
55	*Manihot esculenta*	Euphorbiaceae	Maragenasu	E	-	T
56	*Manihot glaziovii*	Euphorbiaceae	Rubber tree	E	Sep-Jan	O
57	*Manilkara zapota*	Sapotaceae	Sapota	E	All months	F
58	*Melia azedarach*	Meliaceae	Hucchu bevu	I	Mar-May	M
59	*Michelia champaca*	Magnoliaceae	Sampige	I	All months	O
60	*Mimusops elengi*	Sapotaceae	Bakula	I	Mar-apr	S
61	*Moringa oleifera*	Moringaceae	Nugge mara	I	Jan-Apr	F
62	*Muntingia calabura*	Elaeocarpaceae	Singapore cherry	E	All months	F
63	*Murraya koenigii*	Rutaceae	Kari Bevu	I	Dec-Mar	M
64	*Myristica fragrans*	Myristicaceae	Jayikayi	I	All months	F
65	*Nerium indicum*	Apocynaceae	Kanagile	E		
66	*Nyctanthus arbor-tristis*	Oleaceae	Parijata	I	All months	O
67	*Peltophorum pterocarpum*	Fabaceae	Gulmohur	E	Jan-May	O
68	*Phyllanthus acidus*	Euphorbiaceae	Rajavale	I	Dec-May	F
69	*Phyllanthus emblica*	Euphorbiaceae	Nellikayi	I	Aug-Dec	F
70	*Plumeria obtusa*	Apocynaceae	Sampige	E	All months	O
71	*Plumeria rubra*	Apocynaceae	Gosampige	E	All months	O
72	*Polyalthia longifolia*	Annonaceae	Ashoka	I	Apr-June	O
73	*Pongamia pinnata*	Fabaceae	Honge	I	Apr-June	M
74	*Premna obtusifolia*	Verbenaceae	-	I	All months	M
75	*Psidium guajava*	Myrtaceae	Perale	E	All months	F
76	*Ravenala madagascariensis*	Musaceae	Travellers Palm	E	-	O
77	*Rhus odina*	Anacardiaceae		I	-	F
78	*Roystenia regia*	Arecaceae	Bottle palm	E	-	O
79	*Samanea saman*	Fabaceae	Rain tree	E	Mar-May	O
80	*Santalum album*	Santalaceae	Gandha	I	Mar-Aug	M
81	*Sapindus laurifolius*	Sapindaceae	Antuvala kayi	I	Oct-Dec	F

82	*Saraca indica*	Fabaceae	Ashoka	I	All months	S
83	*Spathodia campanulata*	Bignoniaceae	Flame tree	E	Sep-Dec	O
84	*Spondias dulcis*	Anacardiaceae	Sihi amate	I	Feb-Mar	F
85	*Spondias pinnata*	Anacardiaceae	Amate kayi	I	Feb-Mar	F
86	*Streblus asper*	Moraceae	Mitli mara	I	Jan-Mar	M
87	*Strychnos nux-vomica*	Loganiaceae	Kasaraka	I	Jan-Feb	M
88	*Syzygium aromaticum*	Myrtaceae	Lavanga	I	Jan-Apr	S
89	*Syzygium cumini*	Myrtaceae	Nerale	I	Mar-Apr	F
90	*Syzygium malaccensis*	Myrtaceae	Jambunerale	E	Apr-May	F
91	*Tabebia* sp.1	Bignoniaceae	-	E	Feb-Mar	O
92	*Tabebia* sp.2	Bignoniaceae	-	E	Feb-Mar	O
93	*Tamarindus indicus*	Fabaceae	Hunase mara	I	Apr-June	F
94	*Tectona grandis*	Verbenaceae	Saguvani	I	June-Aug	T
95	*Terminalia arjuna*	Combretaceae	Arjuna	I	Jan-Mar	M
96	*Terminalia bellirica*	Combretaceae	Shanti mara	I	Jan-Mar	M
97	*Terminalia catapa*	Combretaceae	Kadu Badami	E	Jan-Mar	O
98	*Thespesia populnea*	Malvaceae	Huvarasi	I	All months	O
99	*Thevetia peruviana*	Apocynaceae	Karaveera	E	All months	O
100	*Trema orientalis*	Ulmaceae	Kiruhale	I	Dec-Mar	O
101	*Vitex negundo*	Verbenaceae	Lakki	I	All months	M
102	*Zanthoxylum rhetsa*	Rutaceae	Jummanakayi	I	June-July	F
103	*Ziziphus mauritiana*	Rhamnaceae	Bugari mara	I	Mar-May	F
104	*Araucaria* sp.	Araucariaceae	Christmas tree	E	-	O
105	*Cycas* sp.	Cycadaceae	Cycas	I	-	O
106	Unidentified 2	Bignoniaceae	-	I	-	M

F = Fruit yielding, O = Ornamental, S = Sacred, M = Medicinal and other uses.