A Study on Mangrove Density and Diversity in Vasai Virar City using GPS

Deepak Mhatre
(M.Sc. Botany, P.G.D Horticulture) Mumbai, 400030

Abstract: **Mangrove ecosystems are threatened all over the world, wherever they occur, and it is in the interest of the global community in general and coastal communities in particular to conserve these fragile ecosystems. Keeping this in mind, based on our field observations and data analyses, a mangrove conservation plan has been developed for the mangroves of Vasai Virar City. We hope this section aids in forming conservation priorities of the Vasai Virar City Municipal Corporation for the mangroves under their jurisdiction.**

In this section, we have detailed out the characteristics of each sampling site and identified locations in need of urgent attention in terms of conservation. Sites were assessed based on the overall health of the mangroves and associated fauna, species composition and level of disturbance from anthropogenic pressures. We have later discussed possible measures to curb damage to the disturbed sites.

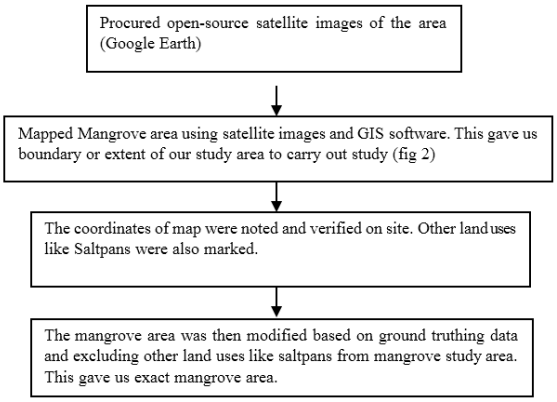
Keywords: ***Exocaria agalocha, Rhizophora mucorana*** **,** ***Aegiceras corniculatum***

INTRODUCTION

Mangrove Plants: The term “mangrove” refers to an assemblage of tropical trees and shrubs that grow in the muddy intertidal zone. The intertidal zone is that stretch of land that lies between the low and high tide elevations. It consists typically of beaches, mudflats and rocky shores. Mangroves grow wherever the intertidal zone is made up of gently sloping mudflats, provided some other conditions are also met and also extend along tidal rivers. This stretch of land is a hostile one, being constantly subjected to salinity changes, tidal fluctuations and anaerobic soils. Any other terrestrial tree species would not be able to survive these conditions. However, over an evolutionary history that began 80 million years ago, mangroves have evolved special morphologic and physiologic features that enable them to survive these harsh habitats. Mangrove trees are thus characterized by the presence of special root systems that support them in the muddy ground and also excrete salts, thick leaves to reduce transpiration loss, salt glands on bark and leaf surfaces and such other features.

MATERIAL AND METHODS

1. Estimating total area under mangrove cover
Total mangrove area was estimated by spatial analyses. It included ground truthing, followed by digitization and preparation of a mangrove cover map in a GIS environ.



Ground truthing was carried out in field with a GPS instrument. In this exercise, remote sensed data was matched with actual ground realities. This helps to relate image data to real features and materials on the ground. It calibrates remote-sensed data, and aids in the analysis of what is being sensed.

Through our GIS analysis, we found that mangroves of Vasai Virar City are not found in vast continuous stretches, but small patches poorly connected to each other. Many trees grew along the banks of small creeks and creek-lets in a linear fashion. Based on these observations, the mangroves of Vasai Virar City were classified as dense, sparse patches, very sparse patches, and linear patches.

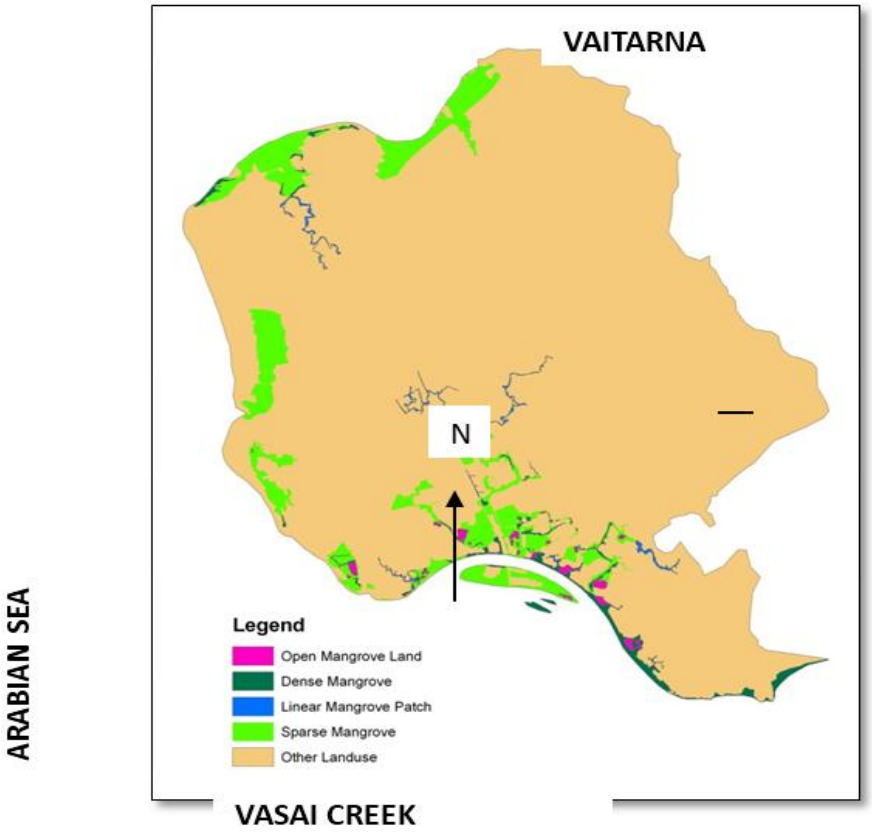


Figure 1 Map of Vasai Virar City showing types of mangrove cover

Mangrove Flora Survey

Floral survey was conducted in such a way as to include tree species in each maturity class, viz. adult tree, sapling and seedling. Plants below 1m height were grouped into seedlings, plants between 1 to 4 m in height were grouped as saplings, while plants taller than 4 m were considered as adult trees. The following protocol was followed:

- A transect perpendicular from the landward edge to the seaward edge was drawn.
- A 10 m x 10 m square plot was marked by using the GPS at the high, mid and low shore along transect.
- Within this 100 sq m plot, counts were made for adult trees.
- Further 1 m x 1 m sub-plots were made within each 10 m plot. Seedlings and saplings were counted in these.

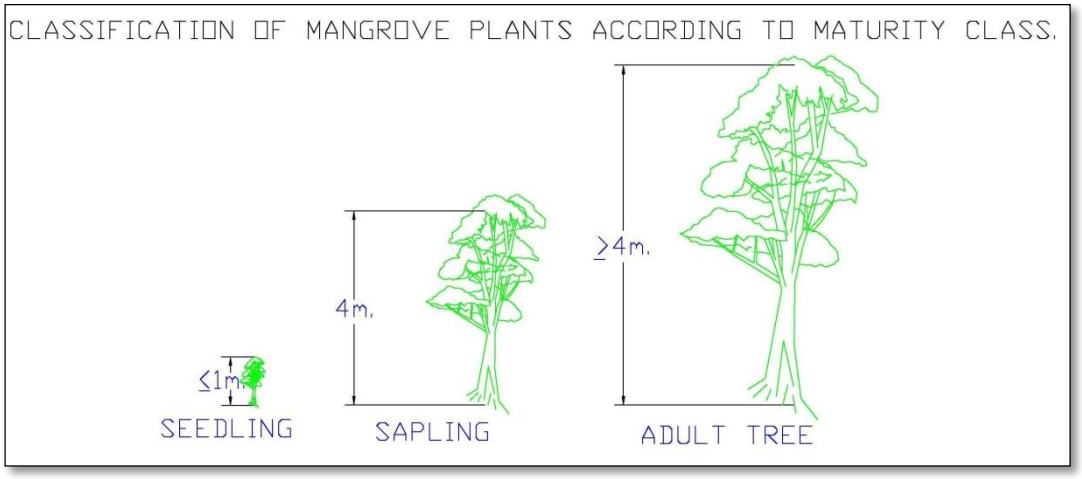


Figure 2 Mangrove plants classified according to maturity class

The narrow strip of land where mangrove occurrence ends and occurrence of other non-mangrove plants begins is occupied by a peculiar set of plants. These are known as Strand Vegetation. Separate sampling technique was employed to ascertain their number. Belt transects of 100 m x 5 m dimensions were placed randomly. Each and every species of associate flora within these belts was counted and noted.

RESULTS & DISCUSSION

Total mangrove cover in Vasai Virar City

Through our spatial analyses it was found that the total mangrove cover in Vasai Virar City is 30.5 sq. km. This accounts for 8.9% of the total area under VVMC.

Table 1 Showing Comparative Analysis of Mangrove Cover of Vasai Virar City with neighbouring cities

SN	Region	Mangrove Area (sq.km)	Percentage Cover of Total City Area
1	Mumbai (City + Suburb)	45	7.5%
2	Mira Bhainder	20.7	22.5%
3	Vasai Virar City	30.5	8.9%

The mangroves in Vasai Virar City are spread across small disconnected or poorly connected patches. Each site has, over time, developed its own uniqueness in terms of community composition and characteristics. Spatially, the mangrove patches can be divided into dense, sparse, very sparse and linear patches.

- Dense patches were those that had approximately more than 70% canopy cover.
- Sparse patches had 40-70% canopy cover.
- Very sparse patches had 10- 40% canopy cover and were found to be dotting around salt pan areas and other such open landuses with density of about 1 adult mangrove tree per 100m2.
- Linear patches were found lining edges of small creek-lets and open landuses like saltpans with a width of not more than 10 m. These patches were consisted typically of trees growing singly in a line along the edge of a small water body.

Table 2 Mangrove Cover of Vasai Virar City

SN	Density Gradient	Area (sq. km)
1	Dense (> 70% canopy cover)	3.5
2	Sparse (40 – 70% canopy cover)	24.6
3	Very Sparse (10 – 40% canopy cover)	1.1
4	Linear (< 10 m width)	1.2
	TOTAL	30.5

Floral Survey Findings

Total number of mangrove tree species

A total of 10 mangrove species have been recorded through our survey *(Annexure 1)* out of the 17 known to exist along the Maharashtra coast. Adjoining Mira-Bhainder also has a record of 10 mangrove species. However, the species composition for the two areas is slightly different with *Lumnitzera racemosa* found in Mira-Bhainder, but absent in Vasai Virar City; and *Bruguiera gymnorrhiza* found in Vasai Virar City but not in Mira-Bhainder.

Frequency and Relative Frequency

Frequency refers to the number of individuals of a given species found in a given area. It helps in studying the degree of dispersion of individual species in an area and is usually expressed in terms of percentage occurrence. It is calculated by the following formula:

$$\text{Frequency} = \frac{\text{Number of plots in which a species occurs}}{\text{Total number of plots sampled}}$$

Relative frequency helps to study the degree of dispersion of individual species in comparison with the number of all species occurred. It is calculated by the following formula:

$$\text{Relative Frequency} = \frac{\text{Frequency value for a species}}{\text{Total of frequency values for all species}} \times 100$$

Avecennia marina was the most abundant species, occurring in almost all of the quadrats followed by *Exocaria agalocha. Rhizophora mucorana* and *Aegiceras corniculatum* occurred at the same frequencies of 9.1.

A. marina also happens to be the most abundant species in the saplings and seedlings count.

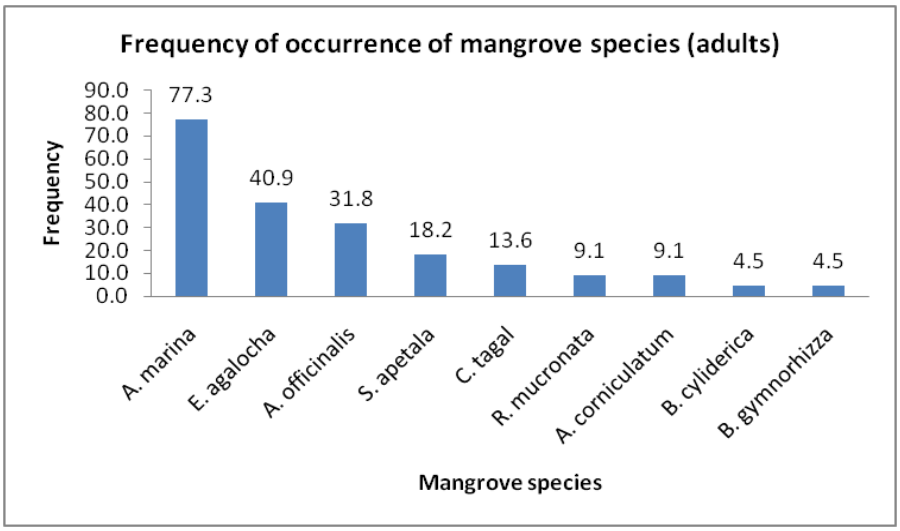


Figure 3 Frequency of Occurrence of Adult Mangrove Trees

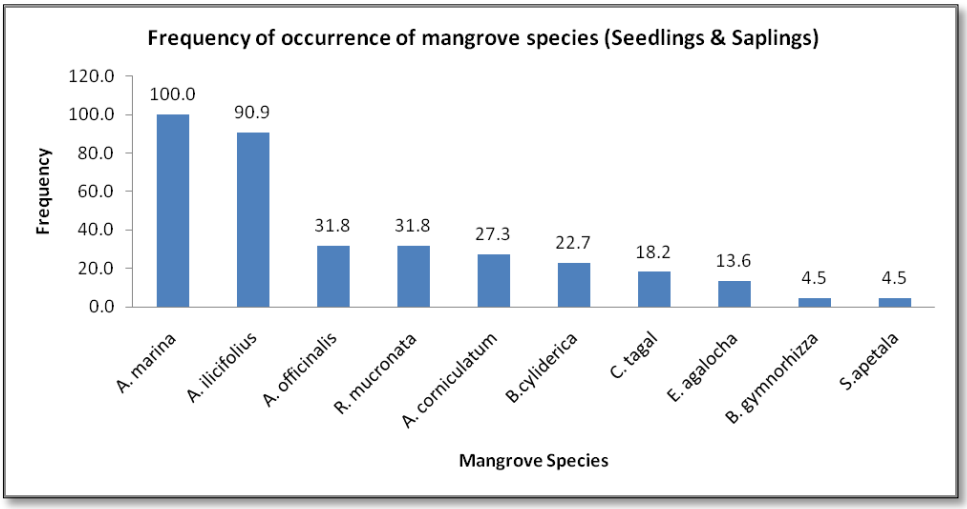


Figure 4 Frequency of Occurrence of Mangrove Seedlings and Saplings

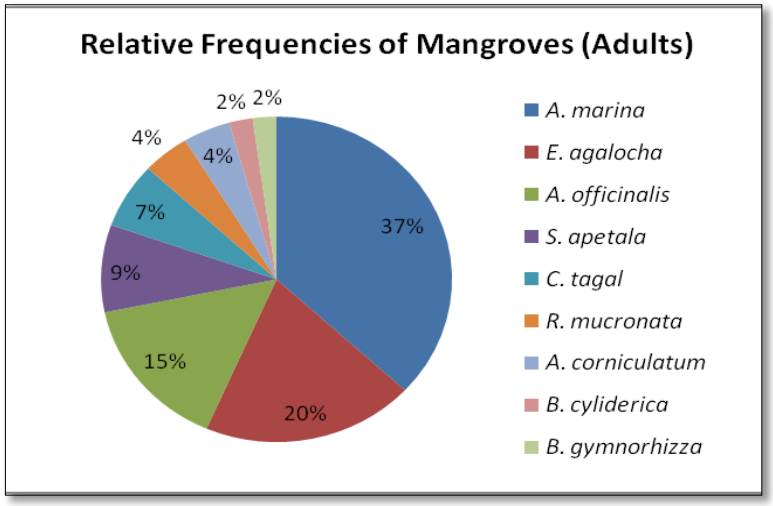


Figure 8 Relative Frequencies of Adult Mangrove Plants

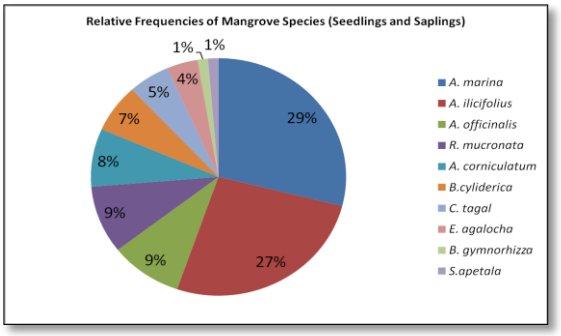


Figure 5 Relative frequencies of Mangrove Seedlings and Saplings

Density of trees

Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrats is divided by the total number of quadrats studied. It is calculated by the equation:

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats studied}}$$

South zone i.e. zone along the Vasai creek proved to have maximum density in terms of seedlings, saplings as well as adult trees. This zone is the most dense and most luxuriant among the three areas.

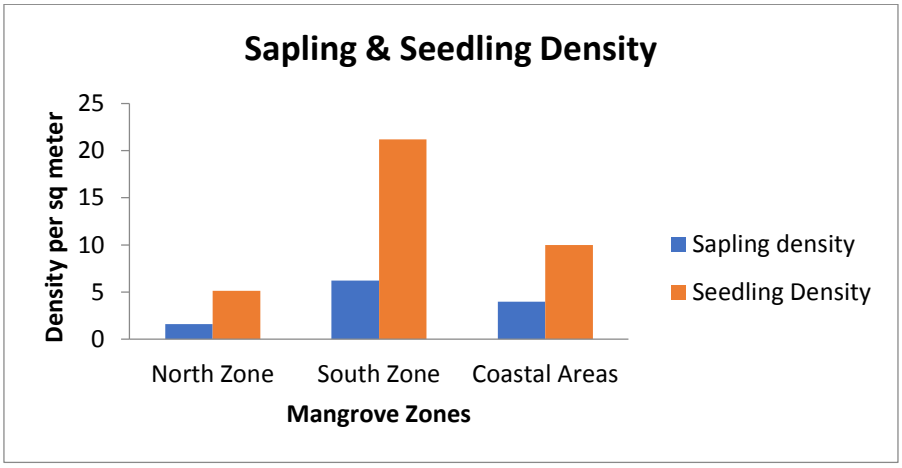


Figure 6 Zone-wise Density of Seedlings and Saplings

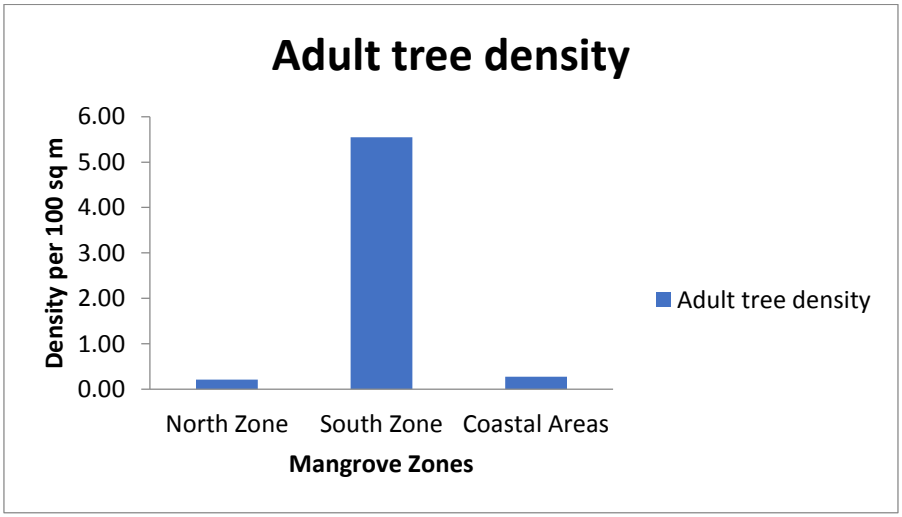


Figure 7 Zone-wise Density of Adult Trees

CONCLUSION

Living at the interface between land and sea, mangroves are well adapted to deal with natural stressors (e.g. temperature, salinity, anoxia, UV). However, because they live close to their tolerance limits, they may be particularly sensitive to disturbances like those created by human activities.

The depletion of mangrove forests due to anthropogenic pressures has become a serious problem. Habitat destruction through human

encroachment is a major threat to mangrove cover in developing countries, especially close to growth centres such as Mumbai and other rapidly growing towns. Measurements reveal alarming levels of mangrove destruction. Some estimates put global loss rates at one million ha per year, with mangroves in some regions in danger of complete collapse.

Because of their proximity to population centres, mangroves have historically been favoured sites for sewage disposal. Continued dumping of domestic and industrial waste has resulted in change in direct physical and physiological damage to the plants and also changed the species composition at these sites.

In addition, mangroves are extremely vulnerable to climate change-induced rises in sea level rise, which change their salinity distribution and hence, productivity and cause a loss in the land occupied by them. Changes in precipitation, resulting from climate change, will retard growth, productivity and seedling survival in mangroves. Decreased precipitation, in conjunction with increased salinity due to salt water intrusion, could favour more salt-tolerant species and change the species composition. This could in turn, affect mangrove provisioning services. Large-scale changes in species composition and zonation in mangrove forests are also expected as a result of changes in sedimentation and organic accumulation.

Increased number of natural disasters will increase physical damage to mangroves, while changing wave climates which increase coastal erosion, will also degrade these habitats.

REFERENCES

[1] Agung sedayu et al.,(2012). Adult mangrove stand does not reflect the dispersal potential of mangrove propagules: Case study of small islets in Lampung, Sumatra, Nusantara Bioscience.

[2] Ajala, O.O. (1997). Evaluation of wood and fibre characteristics of Nigerian grown Pinus carribaea, Department of Forest Resources Management, University of Ibadan, Ibadan, Nigeria.

[3] Ajuziogu, G. C., Nzekwe,U. & Chukwuma, H. I. (2010). Assessment of Suitability of Fibres of Four Nigerian Fruit Trees for Paper–Making, Bio-Research, Vol. 8, (2)

[4] Awaku, F.A. (1994). Anatomical properties of Afina [Strombosia glaucescens, var Lucida (J. Leonard)]. Ghana Journal of Forestry, Vol.1, 30-33.

[5] Bhatt, d.g. Shah & n. Desai (2009), The man grove diversity of Purna

[6] Bhosale, L. J., (2005). Field guide to: Mangrov e of Maharashtra. First Edition, black mangrove on the Central Texas Coast. Ecology 52 (5): 927-930.

[7] Chapman, V.J. (1976). Mangrove Vegetation. J. Cramer, Vaduz.

[8] Chandra, G. and Joseph, M., (2008). Mangrov e forest distribution and dynamics.

[9] Chen et al., (2009) Recent progresses in mangrove conservation, restoration and research in China, Plant Ecology, Vol 2.

[10] Cintron & Novelli, (1984). vegetation characteristics to calculation method.

[11] Duke, N.C. (1992). In: Robertson, A.I. and Alongi, D.M. (Eds). Coastal and Estuarine studies: Tropical Mangrove Ecosystems, American Geophysical Union, Washington DC., USA,

[12] O.S. Eludoyin ; C.C. Wokocha ; G. Ayolagha, (2011) GIS Assessment of Land Use and Land Cover Changes in OBIO/AKPOR L.G.A., Rivers State, Nigeria Research Journal of Environmental and Earth Sciences Vol: 3

[13] Emuobonuvie Amy Emerhi., (2012) International Journal of Forest, Soil and Erosion, Vol: 2

[14] Mayowa johnson fasona (2011) , A Study of Land Degradation Pattern in the Mahin Mud-beach Coast of Southwest Nigeria with Spatial-statistical Modelling Geostatistics Journal of Geography and Geology , Vol: 3

[15] Frimpong-Mensah, F. (1992). Wood quality variation in the trees of some endemic Tropical species. In: Association pour la Reserche sur le bois en Larraine (Ed) All Division 5 Conference “Forest Product” Working Session Vol. 1, Nancy, France.

[16] Gokhale M.V. et al., (2012). Pollen fertility status of 30 species including mangroves, mangrove associated species and coastal flora of Maharashtra and Goa states of India. International journal Botany. Vol 8(2).

[17] Jagtap, T.G., Untawale, A. G. and Inamdar, S. N., 1994. Study of mangrove

[18] Jordan B. L. And Chandra G. (2011), Mapping the Philippines’ Mangrove Forests

[19] Kun Xin ; Xing Huang (2010) Qingqing Zhou Evaluation of Ecological Function of Mangrove Soil on Absorbing Heavy Metals: A Case Study from the Dongzhaigang Mangrove in China Journal of Ecology and Field Biology , Vol: 33
[20] Luis C., (2011) Identification of Mangrove Areas by Remote Sensing: The ROC Curve Technique Applied to the Northwestern Mexico Coastal Zone Using Landsat Imagery Remote Sensing , Vol: 3
[21] Monteoliva, S., G. Senisterra, J. L. Marquina, R.M. Marlats & G.R. Ciocchini. (2002). Clones de sauce, longitud de fibras en su madera. Rev. FCA UNCuyo, Tomo XXXIV, (2): 49–56.
[22] Monteoliva, S., Senisterra, S. & Marlats, R. (2005). Variation of wood density and fibre length in six willow clones (Salix species). IAWA Journal, Vol. 26 (2), 2005: 197–202.
[23] Muhammad K and Stuart P (2011) Hyperspectral Data for Mangrove Species Mapping: A Comparison of Pixel-Based and Object-Based Approach, Volume 3 ,Issue 2.
[24] Muller-landau, M. (2004). Interspecific and intersite variation in wood specific gravity of tropical trees. Biotropica 36, 20-32.
[25] Nikam V.S. et al., (2008). Conservation of wetlands and mangroves in Thane creek and Ulhas river Estury in india. The 12th World Lake Conference:1632-1664.
[26] Rao N. (2010) Mangroves and Associated Flora of Vashista and Vainateyam research in China. Journal of Plant Ecology, VOLUME 2, NUMBER 2, PAGES 45–54 responses to global climate change. Estuarine, Coastal and Shelf Science, 76: 1-13.
[27] Tavi supriana (2010) , Social-economic aspects of coastal community that influence mangrove forest degradation in secanggang village langkatr egency Bumi lestari , vol: 10
[28] Wan et al., (2012) Sustainable Management of Forest Biodiversity and the Present Malaysian Policy and Legal Frame work Journal of Sustainable Development, Vol 5.