Regeneration patterns in a secondary mangrove forest, Pambala-Chilaw, Sri Lanka

E.A.S.N. Edirisinghe[1*], H.M.A.B.Dharmasena[1], M.P. Kumara[1] and D.Thisera [2]

[1]*Faculty of Fisheries and Marine Sciences, Ocean University, Sri Lanka.*

[2]*Small Fishers Federation of Lanka, Pambala, Chilaw, Sri Lanka*

Abstract

Mangrove forests are threatened by various anthropogenic stressors. If a part of a natural mangrove forest was clear-cut and was abandoned for a long period, a secondary forest could develop in the clear-cut area if the adjoin natural forest provides sufficient seeds to the clear-cut area. Comparative studies between such secondary forests and the adjoining natural mangroves reveals the recovery potential of mangroves against clear-cutting disturbances. The current research was aimed to fill the need of such information gap at the national level. Five 10m×10m plots were marked each in a 20 years old secondary forest (7.30' 26.69" N and 79 49' 19.85" E) and in the adjoining natural forest in Pambala-Chilaw Lagoon, Sri Lanka. All the plots were sampled for floral parameters in October 2014. The above ground tree biomasses were calculated using the common allometric equation. The mean young tree height between the natural (141.7± 58.0 cm) and the secondary forest (212.8±53.7 cm) were not significantly different ($p>0.05$). However, the adult trees of the secondary forest (693.6±29.8 cm) were significantly shorter than trees in the natural forest (889.6± 55.6cm) ($p<0.05$; two sample t-test). The densities of seedlings, saplings, young trees, adult trees as well as the densities of *Rhizophora apiculata, Brugurera gymnorrhiza, Excoecaria agallocha* adult trees were not significantly different between the two forests. However, the density of *Lumnitzera racemosa* was significantly higher in the secondary forest ($p<0.05$; two sample t-tests). The mean above ground tree biomasses between the natural (117±19 t ha^{-1}) and the secondary forest (120.3±12 t ha^{-1}) were not significantly different ($p>0.05$; two sample t-test). Thus, irrespective of the rather imbalanced species density, the former clear-cut area has formed a successful secondary forest with the supports of (a) sufficient seed supply (b) no further cuttings and (c) no land changes / reclamations.

Keywords :Mangroves, biomass, regeneration, long- term, secondary forest.

**Corresponding author: sajithedirisinghe@ymail.com*

Introduction

Mangrove forests are distributed in the inter-tidal regions of the tropics and the sub tropics in 112 countries, territories and global mangrove coverage range between 10 to 24 million hectares (Alongi, 2009, Kumara, 2011). More than 50% of total cover of mangrove forest has been reduced due to the anthropogenic pressure. Mangrove forests play a significant role in the socio-economical and ecological service in coastal (IUCN,

2009). However, the forest may recover again over time, if the cleared land is kept further undisturbed. This recovered forest is termed as a secondary forest (Chazdon, 2003). Understanding the potential of a clear-cut and abandoned mangrove area to produce a new Secondary forest could help making management plans for clear-cut mangrove areas. However, such comparative studies are limited for mangroves, in particular, no such studies have been done for Sri Lankan mangroves.

Materials and Methods

One side of a natural mangrove forest in Pambala-Chilaw Lagoon Sri Lanka (07°5´ N, 79°8´ E) had been completely cleared for making a shrimp pond in 1994. However, due to legal interventions, the clear-cut area was completely abandoned without any ponds excavations. In 2014 September, the site was visited and a secondary mangrove forest was noted. Five 10m×10m plots were marked on both sides of the border between the secondary and the undisturbed natural forest. All the tree individuals in each plot were identified counted and their heights were measured. For the trees above 1.5m, the diameter was measured at the breast height. The individuals in each plot were divided in to four regeneration classes as: seedlings (less than 40 cm in height) and saplings (between 40 and 150 cm height), young trees (between 1.5 m and 4.0 m) and adult trees (individuals above 4m). The Aboveground tree biomass (t ha^{-1}) was calculated for each plot using the common algometric equation by Chave *et al.* 2005 ($B=\rho*\exp[-1.349+1.980*\ln(D)+0.207*(\ln(D))^2-0.0281*(\ln(D))^3]$). The tree height, tree density (m^{-2}) and aboveground tree biomass were compared between the sites using separate two sample t-tests in MINITAB.

Results

Tree height between the secondary and the natural forests

The mean young tree height (mean ±SE) between the natural (141.7± 58.0 cm) and the secondary forest (212.8±53.7 cm) were not significantly different ($p>0.05$). However mean adult tree height between secondary forest (693.6±29.8 cm) were significantly shorter than the natural forest (889.6± 55.6cm) ($p<0.05$).

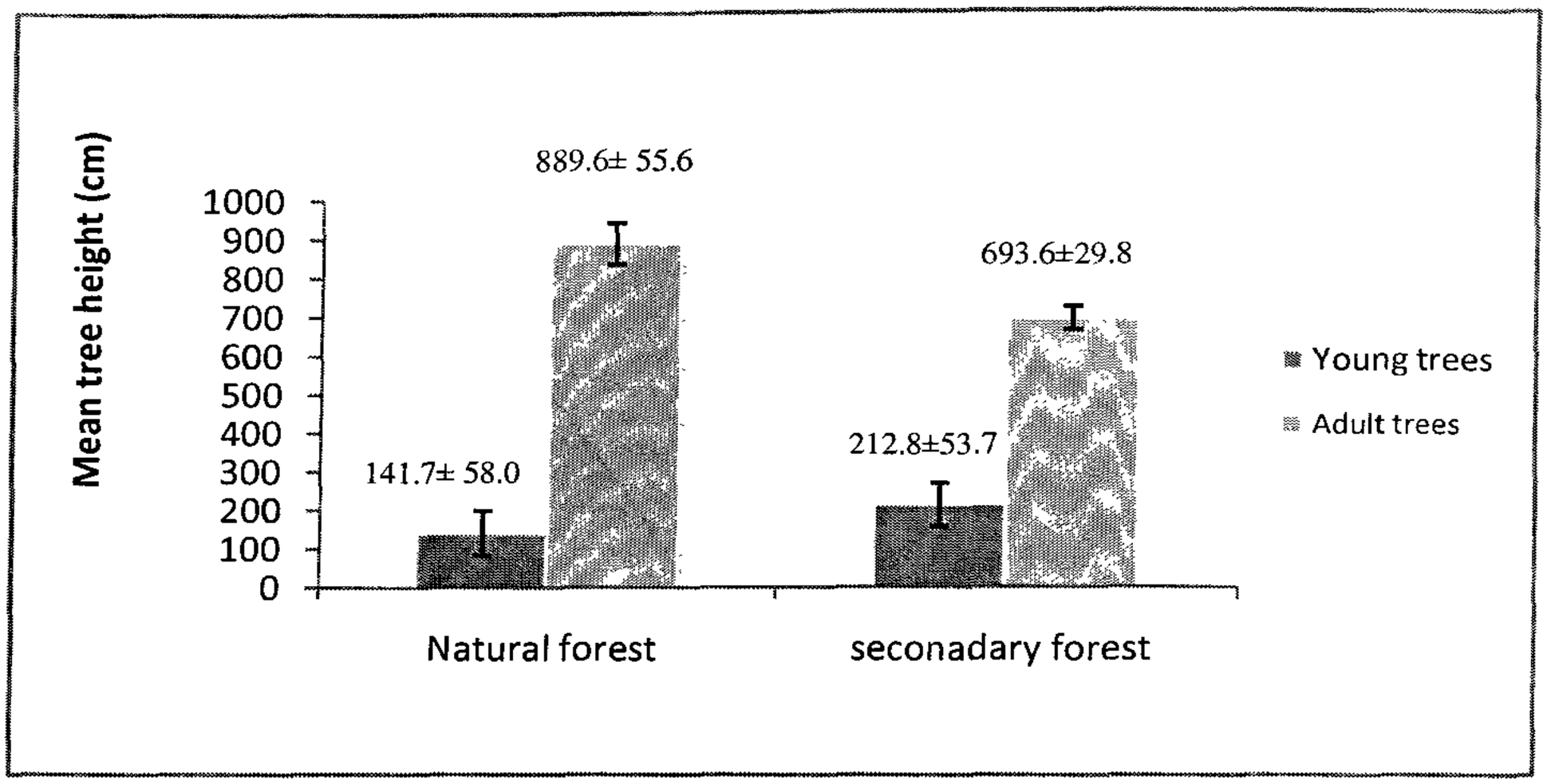

Figure 1: Height of young and adult trees (Mean±SE) between the Tree densities between the secondary and the natural forest

The mean seedling, sapling, young and adult densities between the natural and secondary forest were not significantly distributed. As well as the densities of *Rhizophora apiculata, Brugurera gymnorrhiza, Excoecaria agallocha* adult trees were not significantly different between the two forests. However, the density of *Lumnitzera racemosa* was significantly higher in the secondary forest.

Mean above ground tree biomass (mean ±SE) between the sites

The mean aboveground tree biomass (mean ±SE) between the natural forest (117±19 t ha^{-1}) and the secondary forest (120.3±12 t ha^{-1}) were not significantly different ($p>0.05$)

Discussion

The clear-cut mangrove area has recovered successful tree densities and aboveground biomasses compared to the natural forest. However, the trees in the secondary forest are still smaller in tree height with rather similar species composition.

The difference between adult trees in the two sites indicates that the secondary forest adult trees have not reached their maximum height as the natural forest. The same situation has been reported by Pinard, 1993. Densities of each regeneration classes of flora indicate rather similar natural recruitments for both forests. This shows that the tree density of the secondary forest has recovered similar to the natural forest over the past 20 years.

Therefore, a 20 year period has been sufficient for the secondary forest to fully recover its aboveground tree biomass.

Conclusion

The clear-cut mangrove area has successfully recovered into a secondary forest in terms of tree density and above ground biomass. However, the trees in the secondary forest are still in the growth phase as indicated by smaller tree height. The successful recovery of the secondary forest has been mainly due to (a) No further disturbances and (b) Adequate seed supply from the adjacent natural forest. However, the same levels of recovery could not be expected from clear-cuts at other places. Therefore the current research should be extended to many other different locations for making better conclusions.

Reference

- Chazdon, R.L. (2003). Tropical forest recovery: legacies of human impact and natural disturbances. Urban and Fischer Verlag 6/1,2, 51-71.
- Daniel M. Alongi (2009). Paradigm shift in mangrove Biology: coastal wetlands an integrated ecosystem approach (Gerardo M.E.Perillo,Eric Wolanski,Donaid R Kahoon, Mark M Brinson)Elsevier B.V 615-640
- IUCN, (2009). The management of natural coastal carbon sinks.
- Kumara, M.P. (2011). The impacts of tree density on the physical and biological characteristics of planted mangrove stands in Sri Lanka.
- Kauffman, J.B. Donato, D.C. (2012).Protocols for the measurement, monitoring and reporting of structure, biomass andcarbon stocks in mangrove forests. Center for International Forestry Research