IMPACT OF DEVELOPMENTAL ACTIVITIES ON THE ECOSYSTEM PROCESSES AT KODAYAR IN KANYAKUMARI DISTRICT, TAMILNADU

P.S. Swamy, S. Chandrasekaran, SM. Sundarapandian

Abstract

Western Ghats of Tamilnadu, at Kodayar in Kanyakumari district has undergone heavy environmental transformation in the recent past for various developmental activities such as hydro-electric power projects, change in the land use pattern, (chiefly, raising of monoculture plantations) and human settlements. Unfortunately, the rich flora and fauna of this district have been disturbed due to clearing of the forest areas for these activities. Further, as one of the consequences of above activities, exotic plant invasions have become menace to both agriculture and forestry operations now. The paper emphasizes the need to manage the exotic plant invasions effectively, so as to arrest the threat posed by these in degrading the land productive potential, shrinkage of effective grazing land area and the decline of biodiversity.

Introduction

Kanyakumari district situated in the southern tip of Western Ghats of Tamilnadu consists of varied terrestrial and aquatic ecosystems with rich biodiversity. Forest ecosystems here at Kodayar represents dry deciduous to evergreen types. These forests have been subjected to anthropogenic pressure for various developmental activities in the past. These activities include hydro-electric project, conversion of climax forests into monoculture plantations, rubber production and development project and the consequent road and building constructions for the mobility of personel and products. The above developmental activities and the associated biotic pressures certainly had a bearing on native flora, fauna and the Wildlife habitat (Swamy and Chandrasekaran 1994). Effects of these disturbances on damage to ecosystem structure and function, rates of regeneration and changes in species composition received attention (Silver & Vogt 1993). The objective of this communication is to analyse the effects of developmental activities on certain forest ecosystem processes at Kodayar as part of multidisciplinary research project initiated recently.

Study Area

Study area at Kodayar, 400 km south of Madurai (77° 15' E, 8° 29' N) is at about 360 m elevation. The normal annual rainfall in the site is 2700 mm, in which 90% of the rainfall occures from June to November. December to March represents a brief dry period. Average monthly maximum and minimum temperature during summer were 30° C to 20° C and 28° C to 24° C in winter respectively.

Methods

Phytosociological analysis of community structure and composition in selected study sites of deciduous and evergreen forest ecosystems were done using 20 randomly placed 1x1 m^2 quadrats for herbs, 5x5 m^2 shrubs and tree seedlings and saplings and similar number of randomly placed 10x10 m^2 quadrats for tree species. The importance value index were calculated using relative frequency, relative density and relative basal area of the species (Misra 1968; Kershaw 1973).

Similarly herbaceous community was analyzed in natural (grassland and disturbed forest) and man-modified ecosystems such as agro-ecosystems, wastelands, teak plantation, rubber plantation under closed open canopies in each site (failure area of the plantations and disturbed microsites of the forest were considered as open canopy and successful plantation sites and undisturbed forest were considered as closed canopy).

Total above ground standing crop biomass of the herbaceous community was done through 20 randomly placed quadrats in closed and open canopies in all disturbed sites. Plants were cut at ground level and fresh weight biomass was obtained separately for each plant. Dry weight was calculated on the basis of weighed samples dried at 80° C to constant weight.

Result

Plant community structure and composition have been analyzed under deciduous and evergreen forest ecosystems through phytosociological approach (Fig. 1) It is found that evergreen forests have rich plant diversity compared to that of deciduous forests. Herbaceous and shrub community represented with higher density under deciduous forests that evergreen forests. Open canopy caused by natural (tree fall gap) or man made disturbance increased the herb layer dominance in both the forest ecosystems. Evergreen forests represented with larger proportion of buttressed tall primary trees, woody lianas and rich epithytic flora. It is also observed that deciduous forest ecosystems seldom dominated by fire adapted grass community (*Themeda and Cymbopogan*) with very few isolated leguminuous tree species (*Pterocarpus*). However on hill slopes, due to recurrent of annual wildfires succession got arrested at savannah stages.

Alien or exotic plant invasions have been one of the important consequence of human interference with natural ecosystem. Thus, phytosociological analysis of herbaceous community in natural (grassland and disturbed forest) and man-modified ecosystems such as agroecosystems, wastelands, teak and rubber plantations revealed that exotic plants (*Ageratum conyzoides, Eupatorium odoratum, Hyptis saulveolensis, Lantana camara, Mimosa pudica and Syndrella nodiflora*) contributed about 36% of total biomass under man-modified ecosystems. Whereas under natural ecosystems their contribution was only 14%. Canopy opening of rubber plantation and the disturbed forest had more contribution than closed canopy. Reverse was true in case of teak plantation and the grassland ecosystem. However uncultivated wasteland had more exotic contribution than those of others. Similarly exotic plants contributed about 17 and 35% total importance value indices in natural and man-modified ecosystems in the study sites.

Department of Plant Sciences, School of Biological Sciences, Madurai Kamaraj University, Madurai - 625 021

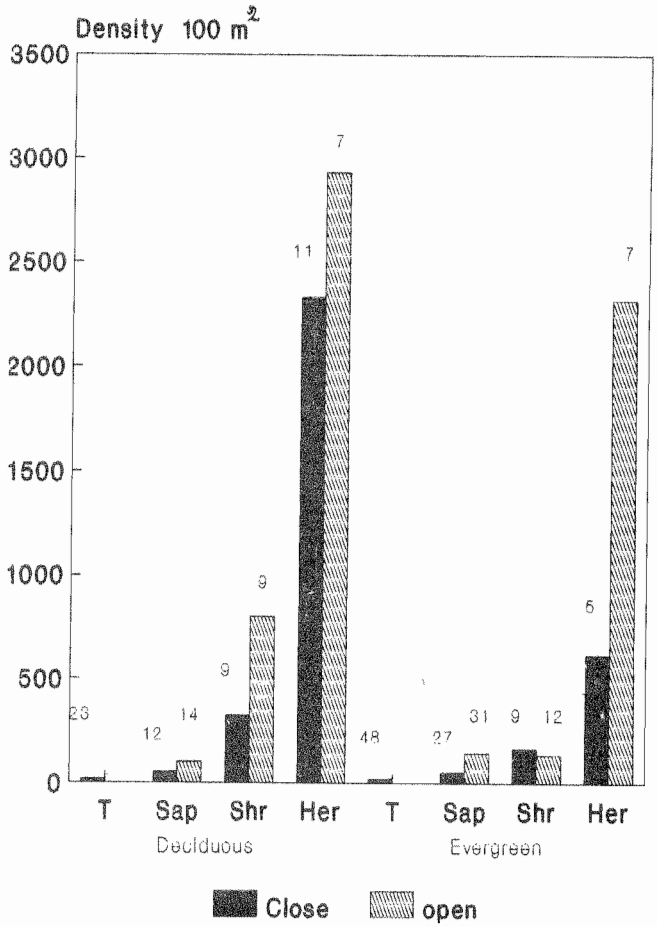

Fig. 1. Density of trees (T), seedlings and Saplings (Sap), Shrubs (shr) and herbs (her) in deciduous and evergreen forests at Kodayar in Western Ghats of Tamil Nadu.

Discussion

Perturbation of any kind to the ecosystem results in alteration to the structure of biological community. However certain degree of perturbation are imminent for the maintenance of biotic diversity. But large scale and frequent perturbations results in the erosion of biotic diversity and proliferation of noxious and abnoxious weeds (Ramakrishnan, 1992).

Climatic and edaphic similarities between the original habitat of the exotics and the new habitat are the important factors which contribute to successful colonization by exotic plant species. *Eupatorium odoratum* and *Lantana camara* being Latin American origin produces abundant seeds dispersed by wind and birds respectively also regenerate through vegetative means. Thus, it is reasonable to expect high degree of colonization of invaders under open habitats with reduced competition created by a high degree of disturbance in man-modified ecosystems, in the present study compared to that of undisturbed natural ecosystems.

In deciduous forest, forest floor dominated by grass community has been subjected to annual wild fires. Bharucha and Shankaranarayan (1958) reported that fire stimulated the lush growth of grasses such as *Aristida*, *Dichanthium* and *Themeda* etc. *E. odoratum* failed to colonize successfully under these environments, may be because of competition for resources with stress tolerant grasses. In many cases, *L. camera*, *E. odoratum* and *S. nodiflora* coexisted. Where two or more exotic species co-exist in the same area they possibly do through mutual avoidance (Ramakrishnan, 1972).

Contribution of greater fraction of biomass by the exotic plant species to the herbaceous community under man-modified ecosystems in the present study is also in confirmation with Toky and Ramakrishnan (1983) and Swamy and Ramakrishnan (1987). An important attribute of exotic invaders in the wide ecological amplitude, either through extreme phenotypic plasticity or due to ecological races adopted to specific habitats (Ramakrishnan, 1991) and also allelopathic properties of exotic invaders that confer upon them a distinct edge over the existing native species.

E. odoratum and *L. camara* being not normally consumed by cattle, these species have selective advantage over palatable native species (Sastry and Mahadevan 1963). Thus, heavy infestation of these weeds under disturbance regimes and newly opened up areas reduced the effective grazing area in the region. Further, invasion of these weeds also pose a threat of extinction of local flora, fauna and degradation of their wild habitat.

In conclusion, developmental activities in and around these forest ecosystems at Kodayar in the past and other intentional and unintentional ecosystem perturbation altered the

structure, composition and processes. Some of the important consequences of these activities are: a) degradation of forested environment b) reduction of effective grazing land area due to invasion of unpalatable exotic weeds c) decline of land productive potential d) and threat of extinction of native flora, funa and wild habitat. The present investigation suggests that effective management of exotic plant invasions should be given immediate attention in order to avoid further shrinkage of effective grazing land area in the region, erosion of biodiversity and the land productive potential. Considering the socio-economic problems of the region exotic plant biomass utilization may be considered as one of the viable option in addition to chemical and biological control (Vasudevan and Jain 1991). Further, it is suggested that the perturbations to deciduous forests should be kept minimal to avoid further environmental degradation.

Acknowledgement

We thank the Department of Environment and Forests, Govt. of India for financial assistance through research grant.

References

Allen, S.E., Grimshew, H.W., and Quarmby, C, (1974). *Chemical analysis of ecological materials,* Blackwell Scientific publications. Oxford, London, Edinburgh, Melbourne.

Bharucha, F.R. and Shankarnarayanan, K.A. (1958). Studies on the grasslands of the Western Ghats, India. *Journal of Ecology* 46: 681 - 705.

Cuevas, E., Alceste, C. and Mothes, M. (1992). Decomposition dynamics of teak litter TSBF, Report: 32 - 33.

Kershaw, K.A. (1973). *Quantitative and Dynamic Plant Ecology* (2 nd Ed.) Edward: Arnold, London.

Mishra, R. (1968). *Ecology work book.* Oxford and IBH Publ. Company, New Delhi.

Ramakrishnan, P.S. (1991). Ecology of Biological Invasion: an overview. pp. 1-19. *In:* P.S. Ramakrishnan (ed.) *Ecology of Biological Invasion in the Tropics.* Int. Sci. Publications. New Delhi.

Ramakrishnan, P.S. (1992). *Shifting Agriculture and Sustainable Development.* UNESCO, MAB, Paris, P. 424.

Ramakrishnan, P.S. and Ram, S.C., (1988). Vegetation, biomass and productivity of seral grasslands of Cherrapunji in north east India. *Vegitatio* 74: 47 - 53.

Swamy P.S. and Ramakrishnan P.S. (1987). Contribution of *Mikania micrantha* during secondary succession following slash and burn agriculture (Jhum) in north-east India. Biomass, Litterfall and productivity. *Forest Ecology and Management* 22: 229 - 237.

Swamy P.S. and Chandrasekaran S. (1994). *Exotic plant invasion*: A growing challenge to grazingland ecosystem management In: :National Workshop on Grassland Management in India New opportunities and challenges, IIFM, Bhopal India.

Sastry, M.S. and Mahadevan V. (1963). Investigation of toxicity of *Lantana camara* Linn. *Indian veterinary Journal* 40: 79-82

Silver, W.L. and Vogt, K.A., (1993). Fine root dynamics following single and multiple disturbances in a subtropical Wet forest ecosystem. Journal of Ecology 81: 729 - 738.

Toky, O.P. and Ramakrishnan P.S. (1983). Secondary succession following slash and burn agriculture in north-east India. I. Biomass, litterfall and productivity, *Journal of Ecology* 71: 735 - 745.

Vasudevan, P. and S.K. Jain (1991). Utilization of exotic weeds: an approach to control. pp. 157 - 175. *In:* P.S. Ramakrishnan (ed.) *Ecology of Biological Invasion in the Tropics.* Int. Sci. Publications, New Delhi.

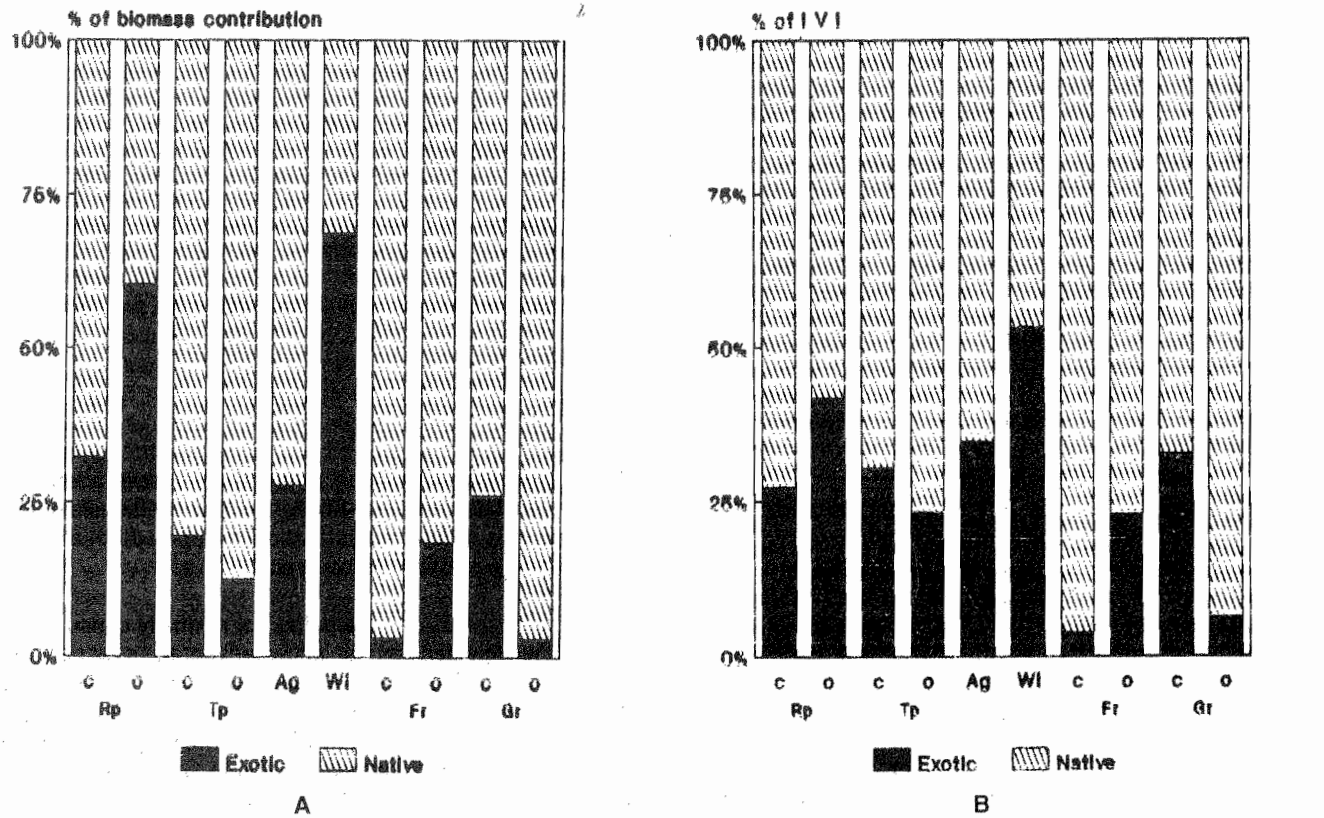

Fig. 2. Percentage of biomass (A) and importance value indices (B) contribution to herbaceous community structure and composition by exotic and native plants in Rubber (Rp), Teak (Tp), Agroecosystem (Ag), Wasteland (Wl), Forest (Fr) and Grassland (Gr) ecosysytems at Kodayar ("c" represents closed; "o" for open canopies).