Journal of Advances and Scholarly Researches in Allied Education
Vol. 16, Issue No. 6, May-2019, ISSN 2230-7540

Variations in the Leaf Recruitment Patterns of the Dominant Tree Species in the Mid-Elevation of the Garhwal Himalaya: A Case Study

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Abstract – We investigated intra-species variation in the recruitment patterns of leaves of the plant species occurring at two different elevations in the central Himalaya. Plant species varied according to the growth forms i.e. evergreen and deciduous. Deciduous species showed earlier leaf emergence but shorter leaf longevity while in contrary evergreens responded with late emergence of leaves but retained leaves for longer duration. With decrease in temperature, leaf emergence tends to get delayed. Indirectly, our results allude to the resource acquisition by deciduous in contrary to evergreens adopting resource conservation. The divergent strategies may support stable coexistence of plant species.

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INTRODUCTION

Among phenological studies, those based on leaf phenology has gained much importance in recent years (Reich et al. 1991., Poorter & Banger 2006., Bai et al. 2015., Chaturvedi et al. 2018). It is primarily attributed to the critical role played by leaves in gross primary productivity and plant-biosphere interactions (Pau 2011). Leaf phenological responses such as leaf initiation, leaf recruitment period, leaf maturation is an interplay of different factors such as, climate (e.g. photoperiod, chilling requirements, solar insolation), abiotic factors (e.g. soil moisture availability, soil nutrient availability etc.) and other biotic factors (Reich et al. 1991., Bai et al. 2015).

Mountains provides an ideal setting for undertaking study based on species response as steep bio-climatic gradients helps to elucidate species response in a better way. This study we seek to understand the intraspecies variations in leaf-traits in the few selected tree species located in the mid-elevation of central Himalaya. Focus of the study is mid-elevation since it caters highest percentages of species diversity but simultaneously also exposed to highest anthropogenic interventions (Negi 2006).

MATERIAL & METHODS

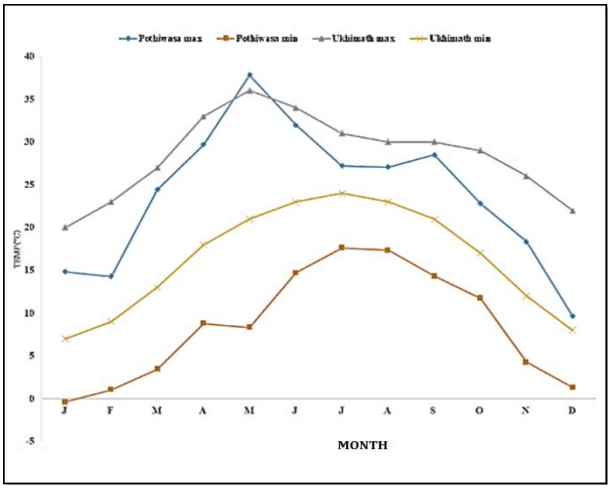
Study sites description

The study area chosen for the present study falls under Kedarnath wildlife sanctuary (KWLS) and is located in the Akshkamini valley of Rudraprayag district of Garhwal Himalaya. The KWLS is one of the unique biodiversity rich hot spots in Himalaya.

Two study sites, i.e. Salami (1400-1500 m) and Pothiwasa (2000-2300m) having similar species composition are located along an elevational gradient of 1400-2200m. Along this transect, mean monthly temperature varies from 7˚-36˚ at 1400 m and -0.4˚ to 28˚ along elevation (Fig. 1).

Fig. 1

Mean monthly variation in minimum and maximum temperature at the study sites



(source: HAPPRC Field station data)

Species selection, sampling strategy

To accomplish our set objectives species found common to both the study sites were selected to understand variations in leaf initiation and leaf recruitment pattern. Details of the species selected and their characteristics are mentioned in (table 2). For estimating the leaf initiation, 30 individuals of five selected plants were taken. 1000 leaf buds were tagged before start of growing season i.e. during Nov-December. Buds were marked at individuals which were almost of similar dbh (Diameter at breast height). During leaf initiation sites were visited at 3 days intervals to ensure that an initiation event does not get missed.

Table 2: List of selected plant species, Growth forms, growth characteristics and successional types

Species	Family	Growth-forms	Growth characteristics	Successional types
Alnus nepalensis	Betulaceae	Deciduous	Canopy	Early
Lyonia ovalifolia	Ericaceae	Deciduous	Subcanopy	Late
Quercus leucotrichophora	Fagaceae	Evergreen	Canopy	Late
Rhododendron arboreum	Ericaceae	Evergreen	Subcanopy	Late
Myrica esculenta	Myricaceae	Evergreen	Subcanopy	Late

Leaf measurements

For defining leaf initiation we adopted the criteria followed by Negi and Singh 1992, wherein leaf initiation was considered when minimum 5% of bud breaks which were marked before growing season took place. Leaf initiation days were calculated with the starting date of 1st January.

RESULTS & DISCUSSION

From the present study leaf initiation, peak leaf recruitment and leaf recruitment period is listed in table 3.

Deciduous species exhibited rapid recruitment compared to the evergreens.

Table 3: Leaf traits variations along elevation in the study sites.

Here LI = Leaf initiation calculated w.r.t. 1st Jan., PLR= Peak leaf recruitment following leaf initiation LRP = Leaf recruitment period, LL = Leaf lifespan. Units of all the parameters are in days

Site-Pothiwasa	LI	PLR	LE	LL
Alnus nepalensis	15	50	80	335
Lyonia ovalifolia	51	21	33	295
Quercus leucotrichophora	63	25	57	395
Rhododendron arboreum	51	64	69	483
Myrica esculenta	67	37	29	458.25

Site-Salami	LI	PLR	LE	LL
Lyonia ovalifolia	54	23	37	310
Alnus nepalensis	25	35	65	300
Rhododendron arboreum	42	69	75	510
Myrica esculenta	87	22	35	450
Quercus leucotrichophora	61	35	76	410

DISCUSSION AND CONCLUSION

Results allude to the influence of elevations on the response of the leaf traits. Leaf recruitment started earlier in deciduous species as compared to evergreens underlies the adaptive strategies by deciduous species to seek maximum benefits from the growing season and thus optimise their photosynthetic gains. However, evergreens in contrary showed leaf emergence later in the growing season but they retained the leaves for maximum period as seen with longer leaf-life span. These alternate strategies of the coexisting plant species suggests towards divergent ways of resource utilisation i.e. deciduous species underlies rapid resource acquisition while on the other hand evergreen demonstrated resource conservation strategies.

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