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Regeneration Pattern in Oak-mixed forests at High Altitude of Uttarakhand Himalaya.

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***Abstract*— Four forest habitats varying in important dominant tree species were studied along an altitudinal range of 2200-2500 m asl high altitude forests. These forests were low disturbance by human activities. The stream bank habitat Rhododendron arboreum was the dominant species showing the presence of saplings. The forest was young with preponderance of younger size classes. The relative density of trees of the older size classes was low. The seedling recruitment in all the under canopy tree species (Lyonia ovalifolia, Q. leucotrichophora and Q. semecarpifolia) was low. The dry habitat Quercus leucotrichophora was the dominant species showing the presence of seedlings, saplings and young trees. Seedlings of R. arboreum, Q. semecarpifolia and L. ovalifolia were absent. The seedling relative density of Q. leucotrichophora was low as compared to sapling relative density. The seedling recruitment in all the canopy tree species namely Quercus leucotrichophora, Quercus semecarpifolia and Rhododendron arboreum was low. The ridge habitat Lyonia ovalifolia was the dominant species and presence of seedlings, saplings and young trees. The density of seedlings of R. arboreum was low as compared to sapling density. The forest was young with preponderance of younger size classes. The relative density of the trees in the older size class was low. The moist habitat Rhododendron arboreum was the most dominant tree species and showing the presence of seedlings, saplings and young trees. The seedling density of Lyonia ovalifolia was low compared to the sapling density. The forest was young with preponderance of younger size classes. The under canopy tree species on this habitat were Q. semecarpifolia, Q. leucotrichophora and L. Ovalifolia. The high altitude of all habitats Quercus leucotrichophora and Q. semecarpifolia were dominant. The presence of seedlings and saplings of both the Quercus species at all locations indicates that these oak species are regenerating fairly well in the high altitude habitats.**

***Keywords* — Habitats, Forest, Population structures, Regeneration.**

I. INTRODUCTION

Regeneration of a species is one of the most important phenomena for maintaining the forest cover. It sustains actual and potential bio resource in consequent year for the forth-coming generation. However, large scale deforestation has deteriorated the temperate and tropical forest worldwide to the large extent. A report of United Nation Environment Programme (UNEP, 1992) stated that in the last 30 years about two million km2 forests have been cleared, which is equivalent in area to more than the territory of Mexico. Deforestation and unsustainable land use are causing extensive land degradation, which is serious problem of the Indian Himalayan Mountain. About 50% of land of the region is degraded because of external as well as internal pressures. Remote sensing survey indicates that close forest covers hardly 11% of the geographical area of the country. Ecologically, population is a group of interbreeding organisms of the same kind occupying a particular species [1]. It has age structure, the ratio of one age class to another. Change in age or size structure reflects change in the birth rates, survival rates and age specific death rates. In view of this, the collection of data about age structure of individuals, particularly the species which largely influence a community is of considerable significance. A stationary population will have a more even distribution of age classes and a declining population will have large proportion of old [1]. A study conducted by [3] in the evergreen temperate forest dominated by Q. leucotrichophora, Lyonia ovalifolia, R. arboreum, Myrica esculenta, Cedrus deodara and Abies pindrow in relation to structural analysis exhibited that few forests show successful regeneration. This study concluded that the population structure of Q. leucotrichophora, Rhododendron arboreum and Lyonia ovalifolia, showed successful regeneration. Light is also a major limiting factor for natural regeneration potential of species in the higher altitudinal region. They suggest that the successful regeneration of light loving species is directly related to increasing level of light. The interpretation of population structure of tree species was based on the assumption that size classes correspond with the age of individuals. The present study in an attempt regeneration pattern in four habitat forest within the western Pinder region of Badrinath forest division of Garhwal Himalaya between 2200-2500 m asl elevational range.

II. METHODS

In order to develop population structure and to understand regeneration of tree species individuals were measured for height and circumference at breast height (cbh) with a girthing tape. At each site all individuals were counted for each tree species. In addition to seedling and sapling classes [4]. six more classes based on cbh were arbitrarily established as following: (A) Seedling - Less than 10 cm cbh,

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(B) Sapling - 10-30 cm cbh, (C) Trees - Above 30 cm cbh, (D) 60-90 cm cbh, (E) 90-120 cm cbh, (F) 120-150 cm cbh, (G) 150-180 cm cbh, (H) 180-210 cm cbh, (I) 210-240 cm cbh, (J) 240-270 cm cbh, (K) 270-300 cm cbh, (L) 300-330 cm cbh, (M) 330-360 cm cbh, (N) 360-390 cm cbh, and (O) 390-420 cm cbh. From this information the total number of individuals belonging to above mentioned size classes was calculated for important species on each location. The density of each girth class for each species was divided by total density of that species on a location. The resulting value was multiplied by 100 to yield relative density for each size class and species, the relative density was plotted against the corresponding girth class.

III. RESULTS

Population structures were developed to observe the regeneration status of important species. Four dominant tree species were considered to understand regeneration pattern at high elevation range by considering seedling, sapling and young trees.

Stream bank habitat:- Rhododendron arboreum was the dominant species on the stream bank site showing the presence of saplings. The forest was young with preponderance of younger size classes. The relative density of trees of the older size classes was low. The seedling recruitment in all the under canopy tree species (Lyonia ovalifolia, Q. leucotrichophora and Q. semecarpifolia) was low. It was noted that Q. leucotrichophora and L. ovalifolia had many seedlings indicating that regeneration is not a major problem on this habitat. Population structures are shown in Figure.1.

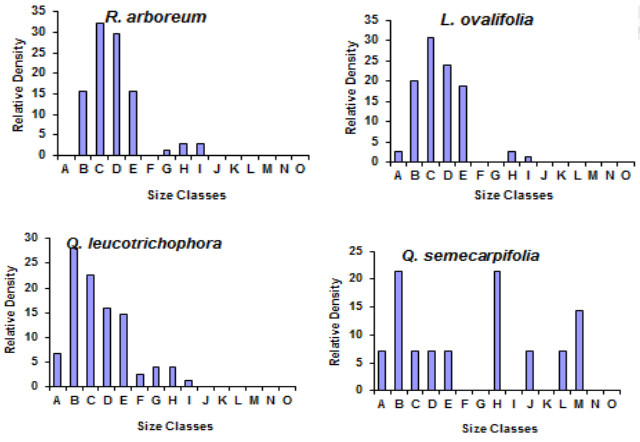

Fig- 1. Population structures of major tree species in the stream bank habitat.

Dry habitat:- Quercus leucotrichophora was the dominant species on this habitat, showing the presence of seedlings, saplings and young trees. Seedlings of R. arboreum, Q. semecarpifolia and L. ovalifolia were absent. The seedling relative density of Q. leucotrichophora was low as compared to sapling relative density. The seedling recruitment in all the canopy tree species namely Quercus leucotrichophora, Quercus semecarpifolia and Rhododendron arboreum was low. It was noted that all the species had young seedlings indicating that regeneration is not a major problem on this site except Lyonia ovalifolia. The sapling density in all the under canopy tree species was higher the seedling density. Population structures are shown in Figure.2.

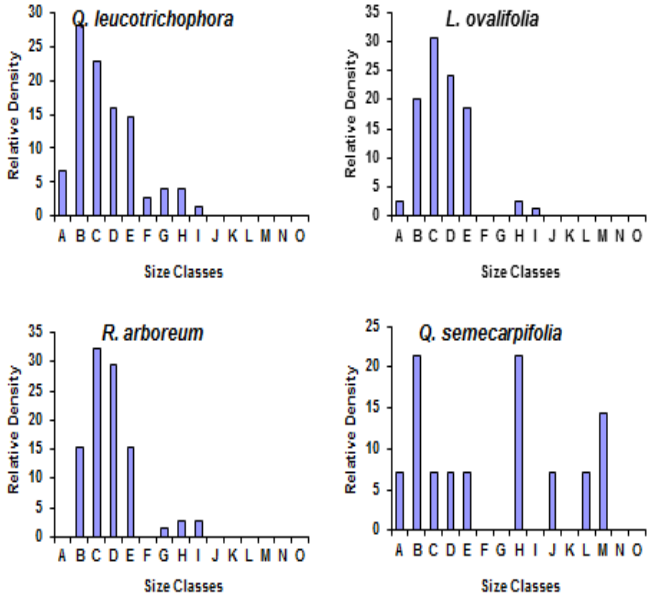

Fig- 2. Population structures of major tree species in the dry habitat.

Ridge habitat:- Lyonia ovalifolia was the dominant species on this habitat with presence of seedlings, saplings and young trees. The density of seedlings of R. arboreum was low as compared to sapling density. The forest was young with preponderance of younger size classes. The relative density of the trees in the older size class was low. The seedling recruitment in all the under canopy tree species namely R. arboreum, Q. leucotrichophora and Q. semecarpifolia was low. However, it was interesting to note that all the species had young seedlings indicating that regeneration is mostly successful. The sapling relative density in all the under canopy tree species was higher than the seedling density. Population structures are shown in Figure.3.

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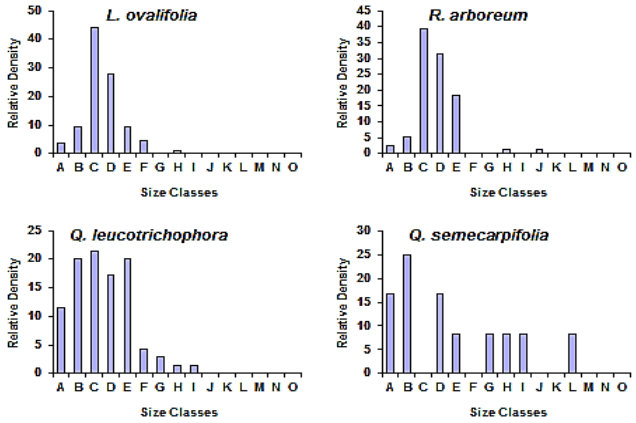

Fig- 3. Population structures of major tree species in the ridge habitat.

Moist habitat:- Rhododendron arboreum was the most dominant tree species on this habitat showing the presence of seedlings, saplings and young trees. The seedling density of Lyonia ovalifolia was low compared to the sapling density. The forest was young with preponderance of younger size classes. The under canopy tree species on this site were Q. semecarpifolia, Q. leucotrichophora and L. ovalifolia. However, it was interesting to note that all the species had young seedlings indicating that regeneration is not a major problem on this habitat. The sapling density in all the under canopy tree species was higher than the seedling density. Population structures are shown in Figure.4.

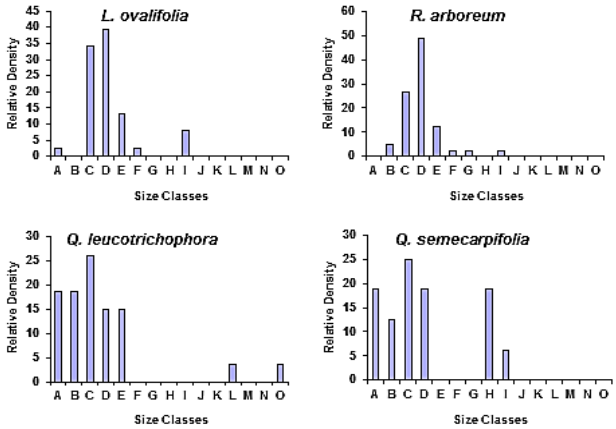

Fig- 4. Population structures of major tree species in the moist habitat.

IV. DISCUSSION

The density values of seedlings and saplings are considered as indicator of regeneration potential of the species. The presence of good regeneration potential shows suitability of a species to the environment. Climatic factors and biotic interference influence the regeneration of different species of the vegetation [5]. All the habitats, Quercus leucotrichophora and Q. semecarpifolia trees ware dominant. The presence of seedlings and saplings of both the Quercus species at all locations indicates that these oak species are regenerating fairly well in the higher elevation habitats. Contrary to this, several reports indicate that the Himalayan brown oak (Quercus semecarpifolia) is not regenerating fairly well. The density of these two oaks was low but persistent was reported at all locations (generally below 20 seedlings per hectares). Rhododendron arboreum at the moist habitat and the stream bank habitat had no seedlings as indicated by the values of relative density. The high intensity of flower collection from these locations which are more easily accessible could have resulted in low seed formation and no regeneration. The other under canopy tree species, L. ovalifolia at the moist habitat at high elevation showed absence of saplings truly indicating that the recruitment of seedlings is also low and must had been arrested since last several years. [1] have considered three major components which cause the successful regeneration of tree species. These components are the ability to initiate new seedlings, ability of seedling and saplings to survive and ability of seedlings and saplings to grow. In the case of the declining population structure the absence of seedlings, or seedlings and saplings, probably indicates recent disturbances, preventing regeneration [6].

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