# Seasonal pattern of lichen fall from trees in an evergreen *Quercus Semecarpifolia* forest of Garhwal Himalaya, India

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**ABSTRACT:** The Himalaya is one of the richest sources with respect to the occurrence of lichen on oak species. These unique symbiotic organisms that contribute to biodiversity and are important as food and shelter for various wild animals are being lost because of unsystematic harvesting. We purpose that collection of fallen lichens would reduce lichen diversity loss. In the paper we have documented the seasonal pattern of lichen and twig fall, and frequency of fall of common genera in closed and open canopied forests of *Quercus semecarpifolia* (the brown oak) in a moist temperate forest of Garhwal Himalaya. The annual fall of marketable material was 6.4 kg/ha/yr in the open canopied forest. The lichen fall was maximum in the early summer seasons (April-May) at both sites. Lichen collection from the oak forests (*Quercus* species) is carried out without any consideration for sustainability. The branches are chopped and the bark scraped off using sickles and axes. [Nature and Science. 2009; 7(3):8-12]. (ISSN: 1545-0740).

**Keywords:** Lichen fall, *Quercus semecarpifolia*, Garhwal Himalaya

## INTRODUCTION

According to the concept of basic adaptational strategy of plants (Grime 1977), lichens are stress-tolerant organisms. Such organisms are not expected to survive deficiency in resources (stress), as well as destruction of biomass (disturbance). In Uttarakhand and much of the other Himalayan regions people harvest lichens from forests, particularly from oak (*Quercus*) trees without any consideration for sustainability. The lichen collectors damage trees by chopping branches for collecting lichens and firewood from trees for cooking food while camping in/around forest sites. Poverty is so acute in some sections of the society that incomes of Rs.10, 000-35,000 per annum are enough economic incentives for them.

Depletion of lichen populations is a matter of concern from conservation standpoint because of several reasons; being unique symbiotic organisms they contribute to biodiversity; they are ecologically important as food, shelter and nesting material for a variety of wild animals and birds (Mc Cune and Geiser 1997). Among the animals, which use lichens as food, include the rare species, Himalayan musk deer, and others such as goats, sheep, pikas, mice and bats. Some birds use lichens as nesting material (Banfield 1974, Conner 1983). Studies of the Northwest Pacific forests indicate that lichens are important component of food chain, and they play a significant role in forest nutrient cycling (Pike 1978; Maser et al. 1985).

In this article we describe the seasonal pattern of lichen fall from trees in a brown oak forest (*Quercus semecarpifolia*). No data are available on lichen fall in this part of world. We understand that collection of fallen lichens would reduce the depletion of lichen diversity and forest degradation. In order to collect lichens from the ground it is important to know the period of year when lichen falls are high. *Quercus semecarpifolia* is possibly; the most widely distributed species in high altitude areas (above 2400m) of the Himalaya, and is in a serious problem because of poor regeneration and aging population.

## MATERIALS AND METHODS

One plot each of 0.22ha. (110m X20m) was identified both within open canopied stand (located on a sun facing slope, having lower moisture and tree diversity) and closed canopied stand (slope having more in moisture, more forest cover, and more tree diversity of Kharsu oak) between 2750-2850m altitudes. 30 permanent plots of $1m^2$ were placed within each the plot. The tree density in the area was estimated by placing 10, $10X10m^2$ random quadrats (Saxena and Singh, 1982). Canopy cover was estimated using a densiometer.

The fallen lichen taxa from each permanent plot were collected at fortnightly interval (represented on monthly basis). Fallen twigs on ground, bearing lichens were collected carefully and were placed in poly bags for further identification. The lichens were scratched of the twigs using a sharp knife. Fresh weight of the collected material (lichens & twigs) taken using an electronic balance which was oven dried at 60ºc for 48 hours till constant weight. Seasonally collected fallen lichen and twig samples were weighted separately and packed carefully in hard card board notes bearing proper information viz. date of collection, name of collector, plot number, forest site, condition of fallen lichen samples (as lichen found with or without twigs) which have been presented at the Centre for Ecological Studies, A.T. India, Ukhimath (Uttarakhand) India.

Fortnightly information on climatic conditions of the area was documented through interaction with local persons who live there for approximately seven or eight months every year from May to December. On and around collection dates records were made about the visit of troop of langurs (*Prestbytis entellus*), events of heavy snowfall, heavy rainfall, strong wind blowing, hails, human activities (such as harvesting of fodder, lopping of branches for fuel wood, timber and agriculture implements).

## RESULTS

The tree density varied between 406 trees/ha at open canopied forest (OCF) and 712 trees/ha at closed canopied forest (CCF) and the forest cover between 42% and 58% (Table 1). The annual lichen fall from trees was 110.5 (±23) mg dry mass (DM)/m² and 158.5 (±28.6) mg DM/m² in OCF and CCF. CCF also had more twig fall than OCF 484.5(±136.5) mg vs. 378 (±129) mg DM/m² (Table 2 and 3).

Among the lichens *Everniastrum* was the largest major contributor to the mass of fallen lichen both in open and closed canopied sites. *Usnea* and *Parmotrema* are other regularly falling lichen species of the area. A total of ten fallen lichen taxa were recorded in the open canopied site of the study area, but in case of closed site it was nine. *Sulcaria* species of fallen lichens was not found in closed canopied site of the forest. *Parmelia, Leptogium* and *Sticta* rarely fall in the CCF, and in case of OCF fall of *Sticta* and *Sulcaria* species are rare, the frequency of these fallen lichens was below 1%.

The lichen fall peaked in April, and this month accounted for about 30% annual lichen fall. This was followed by May and July. Collecting lichens from ground in April and May is quit convenient because herbaceous cover was at the lowest point almost negligible.

**Table 1: Representation of density and forest cover in OCF and CCF**

| Forest site | Forest strata | Species | Density (plants ha ha⁻¹) | Forest cover (%) |
|---|---|---|---|---|
| OCF | Tree | *Quercus semecarpifolia* | 280 | 42 |
| | | *Rhododendron arboreum* | 100 | |
| | | *Acer sp* | 26 | |
| | | Total | 406 | |
| CCF | Tree | *Quercus semecarpifolia* | 293 | 58 |
| | | *Rhododendron arboreum* | 380 | |
| | | *Abies pindrow* | 13 | |
| | | *Taxus baccata* | 13 | |
| | | *Acer sp* | 13 | |
| | | Total | 712 | |

**Table 2: Seasonal pattern of lichen fall and twigs dry mass estimation in open canopied forest (OCF)**

| Year 2006-2007 | Dry mass of fallen material (mg/m²) | | No. of fallen lichen genera |
|---|---|---|---|
| | Lichens | Twigs | |
| May | 14.5 (±2.0) | 36.5 (±11.0) | 8 |
| June | 10 (±1.5) | 20 (±5.0) | 7 |
| July | 14 (±4.0) | 43.5 (±19.0) | 6 |
| August | 6.5 (±1.5) | 43 (±16.0) | 6 |
| September | 13 (±4.0) | 64 (±25.0) | 6 |
| October | 5.5 (±2.0) | 25 (±11.0) | 9 |
| November | 6 (±1.0) | 26 (±12.0) | 7 |
| December | 4 (±1.0) | 10 (±4.5) | 8 |
| January | 4.5 (±1.0) | 11 (±4.5) | 8 |
| February | * | * | * |
| March | * | * | * |

| | | | |
|---|---|---|---|
| April | 32.5 (±5.0) | 99(±23.0) | 9 |
| Total | 110.5 (±23.0) | 378 (±129.0) | |

**Table 3: Seasonal pattern of lichen fall and twigs dry mass estimation in closed canopied forest (CCF)**

| Year 2006-2007 | Dry mass of fallen material (mg/m²) | | No. of fallen lichen genera |
|---|---|---|---|
| | Lichens | Twigs | |
| May | 32.5 (±7.5) | 77 (±30.0) | 9 |
| June | 7.5 (±1.0) | 24.5 (±6.5) | 6 |
| July | 21.5 (±5.5) | 54 (±17.0) | 6 |
| August | 10.5 (±2.0) | 38.5 (±12.0) | 6 |
| September | 10.5 (±2.5) | 38.5 (±14.0) | 6 |
| October | 1.5 (±o.1) | 16.5 (±9.0) | 4 |
| November | 6.5 (±2.0) | 20.5 (±7.5) | 6 |
| December | 4.5 (±1.0) | 15 (±5.0) | 5 |
| January | 8.5 (±1.5) | 22.5 (±4.0) | 7 |
| February | * | * | * |
| March | * | * | * |
| April | 55 (±5.5) | 177.5 (±33.0) | 7 |
| Total | 158.5 (±29.0) | 484.5 (±137.0) | |

*The lichen fall could not be counted during February and March because of the inaccessibility of sites due to heavy accumulation of snowfall.

**Table 4: Frequency list of commonly fallen lichen genera in descending order in the study area:**

| S. No. | Fallen lichen genera | |
|---|---|---|
| | OCF | CCF |
| 1. | *Everniastrum* | *Everniastrum* |
| 2. | *Parmotrema* | *Usnea* |
| 3. | *Usnea* | *Parmotrema* |
| 4. | *Cetrariopsis* | *Heterodermia* |
| 5. | *Heterodermia* | *Ramalina* |
| 6. | *Ramalina* | *Cetrariopsis* |
| 7. | *Leptogium* | *Leptogium* |
| 8. | *Parmelia* | *Parmelia* |
| 9. | *Sulcaria* | *Sticta* |
| 10. | *Sticta* | *Sulcaria* |

## DISCUSSION

### Seasonal pattern of lichen fall

The higher tree density and canopy cover contributed to larger total lichen fall mass in the CCF. The twig fall consisted of both twigs with attached lichens and twigs without lichens. The similarity in lichen fall patterns between the two study sites indicates that lichen fall has a definite seasonal pattern, the knowledge of which can help collectors to decide on strategy to collect them. Storms and movement of monkeys seem to hasten twig fall, as following such events lichens could be seen all over the place. Seasonal pattern of twig fall was similar to that of lichen fall, indicating that lichen growth would hasten twig fall. The lichen cover might hasten twig senescence, or lichens grow well on senescing twigs. The abscission of wood is promoted by higher temperatures in the annual cycle (summer and rainy seasons) although abscission continues, though irregularly, through out the year as a mechanism of canopy clearing by self-pruning (Singh and Singh, 1992). According to the concept of Stone (1989) allogenic factors caused by outward growth of oak canopy, including changes in microclimate and thickening and sloughing of bark, appear to be far more important to most species than changes brought on by the epiphytic species.

On the basis of hypothesis of Larson (1984), Lawrey (1981), and Topham (1977) epiphytes could be competing for light, branch surface space, and water. Fruticose lichens (*Usnea* spp) and foliose lichens

(*Everniastrum* spp) were found dominant on twigs, competition in *Usnea* species appeared to be mainly intrageneric and therefore *Usnea* species should not be affected by clearing other species from around them. The primary succession on oak branches is mostly influenced by the allogenic factors of microclimate change brought by outward canopy growth. However, within the framework of allogenic factors, autogenic factors of competition and facilitation are similar to those, which cause secondary succession (Stone, 1989). Stone (1989) reported that foliose and fruticose lichens developed fully in 9-12 years. The ten most frequent genera were the same in two forest sites, but differed in their order of importance (Table 4).

Doignon (1954) reported that lichens begin to colonize oak twigs in Europe at about five years of tree age. Foliose lichens began to colonize on oak at Fontainebleau, France at about 15-20years. Generally, lichens found on leaves of very long durability are not obligate folicolous but also belong to the corticolous flora, indicating that the obligately folicolous lichens are perhaps restricted to their habitats because they are relatively poor competitors in other habitats. Slightly higher moss coverage on the south side of trunks, (Rincon, 1993) suggested that the combination of abundant moisture and more sunlight may result in greater photosynthetic production which in bryophytes translates into greater volume and biomass growth.

Some experimental studies of Graham (1971), on corticolous lichen (bark inhabiting), showed that the lichen thallus is partly responsible for the modification of its own environment, by increasing its own water holding capacity, it would be possible to grow lichens over a period of years and determine their increase in size and dry weight. A concept given by Denison (1973), he studied on air quality monitoring with lichens in Willamette valley (Oregon), there are major differences in amounts of light and moisture on different sites of a tree trunk. Moisture varies because rainwater flows down channels in the bark of the trunk, living intervening areas well up in the tree receive similar amounts of light and moisture whether they are on the north or the south site of the tree. By examining the lichens on branches we can limit differences caused by variation in light and moisture.

Light affects growth by affecting the rate of photosynthesis and ultimately the amount of assimilate available to the fungus. Most lichens are as matter of fact photophils, and any light reduction would probably come about by gradual closing of the forest canopy over many years. Hakulinen (1966) reported reduction in lichen growth caused by less light might conceivably be offset by an increase in moisture in a shaded habitat.

The market lichens are sold along with twigs, therefore we need to consider both lichens and twigs to which they are attached. Thus the annual fall of marketable material is 6.4 kg/ha/yr in the CCF and 4.9kg/ha/yr in OCF. These lichens are sold at rates of approximately half a dollar/kg in the local markets (Upreti et al 2005). The price however doubles when these lichens reach the central market areas. A trained collector can easily collect 6-8kg of lichens with twigs from the ground (collecting lichens from attached twigs slow down the collection as the entire branches are cut or the lichens are scraped off along with the bark and portion of sapwood). A collector for the major part of the year can earn a reasonable income by collecting the fallen lichens without being destructive with some knowledge of the fall and seasonal pattern.

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