

# *Conocephalum conicum*- Massive Decline in Spore-elater Ratio

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**Abstract** Various populations of *Conocephalum conicum* were collected from different regions of Jammu division, Jammu and Kashmir, India. All the fertile populations showed less spore-elater ratio i.e 0.4:1 which is very much lower than the actual ratio in order Marchantiales. When compared with herbarium specimens of 1958, this plant showed same results means its ratio starts declining over a decade.

**Keywords:** *Conocephalum conicum*, spore-elater ratio

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## 1. Introduction

Bryophytes are considered first land dwellers which originated in Devonian period of Palaeozoic era since then they have been surviving and evolving in varying climatic conditions. They inhabit a very wide range of ecosystems, habitats and specific microhabitats, including substrates on which vascular plants cannot live.

The fitness of a species depends on its reproductive success and in this continuously changing climate, the most successful species are the ones that exploit all kinds of reproductive strategies to produce larger number of propagules. The rich and luxuriant flora have shown considerable decline in recent years. A number of them are even threatened with extinction (Singh, 1999). There are few greater obstacles to sexual reproduction than the rarity or absence of one sex. limited or no sexual reproduction can result in species inability to a changing environment, leading to population declines and eventually species extinction (Mc Letchie, 1993). It is further compounded by the inherent nature of most liverworts to adapt genetically to various environmental changes (Singh, 1997). Sex-specific microhabitat specialization by dioecious bryophytes is also known to influence population sex ratio. Maintenance of sexually dimorphic traits and biased sex ratios can lead to a lack of sexual reproduction (McLetchie *et al.*, 2002). Apart from that, the decrease in evolutionary plasticity, consequent decline of populations below a critical level leads to the senescence of the species (Schuster, 1966). Study on dioecious taxa, *Conocephalum conicum*, therefore, calls for a special attention.

*Conocephalum conicum* (L.) Dumort. is one of the largest thalloid hepatics. Thalli can be identified on the basis of a) tiny hexagonal areolae on dorsal surface of thallus b) faint sweet scent when rubbed between the

fingers and c) conical archegoniophores. Due to these three peculiarities, it is commonly called snake liverwort, great scented liverwort and cone headed liverwort respectively. It is one of the threatened dioecious hepatic taxa in which studies have revealed extremely low production of spore and elaters.

## 2. Material and Methods

Seven fertile populations of *Conocephalum conicum* inhabited diverse habitats (plate 1) were collected from various districts of Jammu division (J&K, India, Plate 2, Table 1).

Sporophytes were collected from all the accessions. For spore/elater output, a capsule was crushed on a glass slide with the help of a needle and mounted in a drop of glycerine. For counting them a cover slip was divided into 9 quadrats with the help of a marker. Number of viable and non-viable spores and elaters were counted individually for each quadrat. Spore /elater output per capsule were calculated by adding the number of spores and elaters recorded for all quadrats. Measurements of spores and elaters were done with the help of ocular meter (Erma make) calibrated with stage micrometer. Spore – elater ratio was calculated by using the formula:

$$\text{Spore – elater ratio} = \frac{\text{No. of spores per capsule}}{\text{No. of elaters per capsule}}$$

Repeated the same procedure for five capsules and took out the mean value. Similarly the ratios were determined from herbarium specimens collected in 1958 (Darjeeling) and 1980 (Mussorie and Chakrata, Uttarakhand). The figures thus obtained were compared with those earlier determined figures by Iqbal *et al.* (2011), Bhagat *et al.* (2012) and Dolma (unpublished data).

**Table 1. Sites of collection of various populations of *Conocephalum conicum***

S.No.	District	Site of collection	Habitat	Accession no.	Altitude (m)
1.	Udhampur	Patnitop	Non-epilithic (moist soil)	Cc 01	2060
2.	Kishtwar	Mughal Maidan	Epilithic (stone wall) (on the rock)	Cc 02 Cc03	1005 1706
3.	Doda	Gandoh	Non-epilithic (moist soil)	Cc04	1250
		Bhaderwah	Non-epilithic (moist soil)	Cc05	1813
4.	Poonch	Noori Chamb	Epixylic	Cc06	1820
			Non-epilithic (moist soil)	Cc07	1850

**Table 2. Spore-elater ratios in different populations of *C. conicum***

S.No.	Site of collection	Accession no.	Year	Spore-elater ratio
1.	Patnitop	Cc 01	2010-2013	0.42:1
2.	Mughal Maidan	Cc 02	2011-2013	0.38:1
		Cc03	2012-2013	0.34:1
3.	Gandoh Bhaderwah	Cc04	2011-2013	0.41:1
		Cc05	2009-2013	0.36:1
		Cc06	2009-2013	0.45:1
4.	Noori Chamb	Cc07	2011-2013	0.42:1

### 3. Results and Discussion

*Conocephalum conicum* is a dioecious hepatic taxon in which preliminary studies have reveals low production of sporophytes and spores (Iqbal *et al.*, 2011 and Bhagat *et al.*, 2012). As we know, in hepatics, archesporium gets differentiated into sporocytes and elaterocytes. Each sporocyte undergoes meiosis and gives rise to four spores while elaterocytes simply form elaters. The basic ratio in this group is therefore, 4:1. Ratios were approaching 4:1 were obtained by Schuster (1966) who investigated various members of marchantiales. Highest ratios among marchantiales and jungermanniales are reported for *Marchantia polymorpha* (128:1) and *schistochila* (200:1) respectively. In such taxa, which possess spore-elater ratios higher than 4:1, the sporocytes undergo one or more mitotic divisions before undergoing meiosis. Increase in spore output is also accompanied by reduction in spore size but this taxon presents a different story.

*Conocephalum conicum* has been collected from all the three divisions of J&K i.e. Jammu, Kashmir and Ladakh with altitude ranging from 1000-4300 m. Kaul and Dhar (1968) reported it from Kashmir while Tanwir and Langer (2006) recorded five populations from Kargil (Ladakh) over an altitudinal gradient of 2600-4300 m. They (2005, 2008) also collected this taxon from Poonch but maximum numbers of populations were collected from Bhaderwah (Doda district) by Iqbal *et al.* (2011) inhabiting epilithic, non-epilithic and corticolous habitats. Out of 46 populations, sporophytes were observed only in single population and in that population, the spore-elater ratio came out to be 0.4:1 i.e. the plant produced far more elaters than the spores.

Failure of sporophyte production in dioecious hepatics is not uncommon. In such taxa which represent about 70% of liverworts, the antheridial and archeogonial gametophytes are often spatially separated and male gametes have a limited dispersal range. Rydgren *et al.* (2006) found that 85% of the female plants in *Hylocomium splendens* with sporophytes were situated within a distance of 5 cm from nearest male and the maximum distance travelled by antherozoids was 11.6 cm where as Vanderpoorten and Goffinet (2009) reported that in *Dawsonia supera*, the maximum distance travelled by antherozoids was 3.8 m but *C. conicum* seems to have

evolved a unique mechanism to overcome this problem i.e. the mature antherozoids may be projected 15 cm upward and become airborne, greatly increasing the chances of reaching a female plant (Shimmamura *et al.*, 2008). Furthermore, the problems of spatial distribution and limited range are not encountered in *C. conicum* as both male and female plants were found growing in close vicinity.

In order to ascertain the reasons behind the drop in spore output, studies were done on seven more populations collected from Gandoh (three), Bhaderwah (two), Patnitop (one) and Kishtwar (one) Plate 3, Table 2. Even in these accessions, the spore-elater ratio was observed to be 0.4:1. In order to understand whether the ratios have declined over the years in response to climate change, herbarium specimens of this species were collected from herbarium of Panjab University, Chandigarh and NBRI, Lucknow. (Table 3). The populations were collected from Darjeeling 1958; Mussorie, Uttarakhand (1980) and Chakarta (1980) and surprisingly, in these populations the spore elater ratio was 0.4:1. Spores are oval or rounded in shape. spores of the species are reported to be endosporic, germinating even before leaving the capsule (Ellen 1920; Farmer, 1895; Bapna and Kachroo, 2000. Brown and Lemmon (1988) reported that *C. conicum* is the only liverwort that produces spores in rhomboidal or linear rather than tetrahedral arrays through a unique process of cytoplasmic portioning. Elaters are brown, healthy, branched/unbranched, bispiral-tetraspiral.

**Table 3. Spore-elater ratios in herbarium specimens of *C. conicum***

S.No.	Site of collection	Year	Spore-elater ratio
1.	Darjeeling	1958	0.40:1
2.	Mussorie (Uttarakhand)	1980	0.45:1
3.	Chakrata (Uttarakhand)	1980	0.45:1

The low spore-elater output clearly indicated that a single genotype has spread over the country at least for the last five decades. Species, therefore, calls for studies on more Indian populations before arriving at any final conclusion on its genetic structure.

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