Quaternary International xxx (2016) 1–10

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Do the common natural pollen trapping media behave similarly? A comparative study of modern palynoassemblages from Chhattisgarh, central India

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ARTICLE INFO

Article history:
Available online xxx

Keywords:
Comparative pollen analysis
Pollen assemblages
Natural pollen traps
Chhattisgarh
Central India

ABSTRACT

We provide a detailed and critical account on the comparative study of modern palynoassemblages recovered from the natural pollen trapping media/substrates such as surface soils/sediments, moss cushions/polsters, modern tree bark samples and spider web samples, collected from various localities of Chhattisgarh, central India. The study shows that moss polsters demonstrate true vegetation scenario with an average 44.11% of arboreal pollen (APs-trees and shrubs) and average 53.51% of non-arboreal pollen (NAPs-herbs). It is followed by surface soils, modern tree bark samples and spider web samples with average 19.76%, 17.56% and 7.62%, respectively of APs, whereas 80.23%, 82.44% and 59.56%, respectively of NAPs. The reasons behind the irregularity in the representation of palynoassemblages amongst the various natural pollen trapping media could be manifold such as vegetation composition and its density, habit, habitat, timing of flowering of a particular plant and collection of samples, pollination types and modes, genetics, physiology, morphology, age of tree and bark, topography, pollen sinking speed, pollen catching/trapping capacity of the respective media, types of pollen transport (horizontal pollen transport and vertical pollen transport), differences in pollen transport distance, wind speed, its pace and direction, rainfall, specific gravity, climatic conditions, and human activities (including over-cultivation and overgrazing), etc. The study could aid in the preferential selection of natural pollen trapping substrate to understand the pollen deposition pattern in any area in question which has significant proposition for the reconstruction of past vegetation and climate, allowing the improved resolution of palaeoenvironmental changes.

1. Introduction

Understanding the pollen deposition pattern in sediments/pollen rain–vegetation relationship is an indispensable aspect of pollen analysis and one of the pre-requisites behind its success. This relationship is achieved through the pollen analysis of various typical and natural pollen trapping media/substrates such as surface soil/sediments, mud samples, moss cushions/polsters, spider web samples, leaves (of *Sarracenia*) and modern tree bark samples (Adam et al., 1967; Fægri and Iversen, 1989; Moore et al., 1991; Groenman-van Waateringe, 1998; Bera et al., 2002; Ranal, 2004; Song et al., 2007, 2013; Quamar and Chauhan, 2011b; Li et al., 2013; Quamar and Bera, 2014a,b,c,d, 2015a,b, 2016a,b; Song et al., 2014). These studies have provided factual data on the modern pollen rain as well as differential dispersal and deposition of its various entities in a particular geographical area, which could be of immense help to refine and strengthen the interpretation of fossil pollen samples (Wright, 1967; Flenley, 1973; Moore and Webb, 1978; Birks and Birks, 1980; Liu and Lam, 1985; Fall, 1992). Several mechanical pollen catching/trapping devices such as Rotorod™ sampler, Burkard Portable air sampler, Burkard Personal Volumetric Air sampler, Tauber trap, Behling trap, modified Oldfield trap, reference trap, etc., however, are also well known to pollen analysts to study the airborne pollen grains and spores in and around a geographical area (Bera et al., 2002; Jantz et al., 2013). Because of differences in pollen production, dispersal and preservation of taxa, pollen records do not directly reveal plant abundance (Prentice, 1988), ultimately causing the over-representation of some taxa and under-representation of others in pollen samples. The difference in pollen production, dispersal

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http://dx.doi.org/10.1016/j.quaint.2016.04.041
1040-6182/

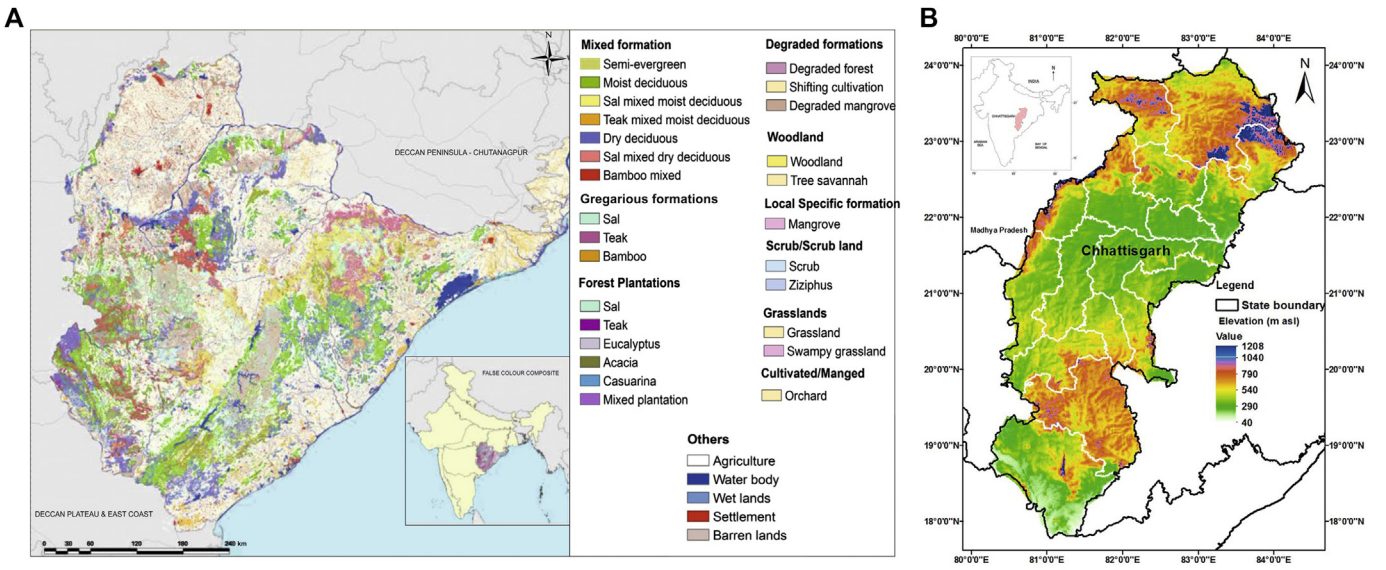

Fig. 1. A. Shuttle Radar Topographic Mission (SRTM) and B. Digital Elevation Map (DEM) of the study area in the Koriya and Korba districts of Chhattisgarh, central India from where the samples were collected (Modified after Roy et al., 2012).

and surface deposition depends on plant species and climatic conditions (Hicks, 2001; Spieksma et al., 2003). Anemophilous species produce enormous number of pollen grains and are repeatedly over-represented in palynoassemblages, while those having zoophilous mode of pollination produce far fewer pollen grains and are often under-represented (Fægri and Iversen, 1989). The pollen distribution depends on the pollen sinking speed, wind speed and direction, specific gravity, size and morphology of the pollen itself as well as the plant species, local climatic factors, etc. (Quamar and Bera, 2014b,c). In order to address the problem using different natural pollen trapping media, various studies have been conducted from different parts of the globe [As for example; Japan (Gotanda et al., 2008); Chile (de Porras, 2012); North China (Li, 2012); northeastern Japan (Nakamura et al., 2012); Amazonia (Guimarães et al., 2014); Indian Ocean and Indonesia (Poliakova and Behling, 2012);China (Yang et al., 2016, etc.)] and India as well (Table 1). These studies have provided plausible assessment of the palaeovegetation and contemporary climatic scenarios from their respective regions during the Late Quaternary Period. However, no attention was paid regarding the comparison of modern palynoassemblages recovered from the pollen analyses of different natural trapping media. Therefore, We compared the modern palynoassemblages recovered from the pollen analyses of four typical and natural pollen trapping media acquired from various localities of Chhattisgarh (central India). Chhattisgarh, regarded as a herbal state (between 80° 15′ & 84° 20′ E and between 17° 46′ and 24° 5′ N), is one of the greenest states of India and covers over 44% of its total area under lush forests, and about 8–12% of the total forest cover of the country. In this maiden attempt, we answer the following questions:

1. How well the vegetation is reflected in modern pollen assemblages from the studied natural pollen traps?
2. What could be the reasons behind the discrepancy in the pollen representation of the studied natural pollen traps?
3. Which pollen trap is most suitable for reflecting the overall vegetation scenario in the area of investigations?

Table 1
Vegetation zones/parts of India from where the relevant studies were carried out and the concerned references.

Vegetation zones/Parts of India	Relevant references
Tropical evergreen and deciduous forests in south India and Sri Lanka	Bonnefille et al., 1999; Anupama et al., 2000; Barboni and Bonnefille, 2001
Foothills of the Himalaya	Sharma, 1985; Gupta and Yadav, 1992; Chauhan and Sharma, 1993; Quamar and Srivastava, 2013; Ranhotra and Bhattacharayya, 2013; Kar et al., 2016
Kashmir	Vishnu-Mittre, 1966; Vishnu-Mittre and Sharma, 1966, Vishnu-Mittre and Robert, 1971
Ladakh	Bhattacharayya, 1989a
Himachal Pradesh	Sharma, 1973; Bhattacharayya, 1989b, 1989c; Bera and Gupta, 1990, Kar et al., 2015
Tropical deciduous scrub vegetation in Rajasthan desert	Singh et al., 1973
Eastern Madhya Pradesh, **central India**	Chauhan, 1994, 2008; Chauhan et al., 2013; Chauhan and Quamar, 2013; Quamar and Chauhan, 2007
Southwestern Madhya Pradesh, **central India**	Quamar and Chauhan, 2010, 2011a,b, 2014, 2013a,b, 2015; Chauhan and Quamar, 2012a,b; Quamar and Bera, 2014c
Chhattisgarh **and Maharashtra, central India**	Quamar and Bera, 2014a,d, 2015a,b, 2016a,b; Riedel et al., 2015
Silent Valley, Tamil Nadu	Bera and Gupta, 1992
south India	Gupta and Bera, 1996
Uttar Pradesh	Sharma et al., 2007; Trivedi and Chauhan, 2011; Tripathi et al., 2015
Northeast India	Gupta and Sharma, 1985; Bera and Gupta, 1992; Bera, 2000; Bera et al., 2012, 2013; Basumatary and Bera, 2007, 2010; Basumatary et al., 2013, 2014; Dixit and Bera, 2011, 2012a,b, 2013,
South and Little Andaman Islands	Singh et al., 2010
Odisha	Singh et al., 2011

Please cite this article in press as: Quamar, M.F., Bera, S.K., Do the common natural pollen trapping media behave similarly? A comparative study of modern palynoassemblages from Chhattisgarh, central India, Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.04.041