BIOGEOGRAPHY

The land area of India (20°00'N, 70°00'E) is about 3,287,263 km², which is 2.4% of the total surface of the world. The evolution of any group of biota is always intricately linked to the geomorphological evolution of the area. Hence, some salient features of the historical biogeography of India are mentioned here before we consider the biogeography of the Indian stygobionts.

TECTONIC EVOLUTION OF THE INDIAN PLATE AND ITS AFTERMATH

Current plate tectonic theory postulates that India was nestled in the supercontinent Pangaea at high southerly latitudes between Late Paleozoic and Early Permian ca. 255 Ma (Chatterjee & Scotese, 1999). The Pangaea was intact during the Late Triassic and Early Jurassic periods, but the first stage of its rifting took place in the Middle Jurassic period ca. 180 Ma. Before its journey into northern latitudes, the Indian plate rifted from other Gondwana landmasses at different times in the geological past—from Africa along with Madagascar ca. 180–170 Ma, from Antarctica-Australia ca. 130 Ma, and from Madagascar ca. 90 Ma. Eventually, the docking against Asia began ca. 55–65 Ma.

Apart from serving as Noah’s Ark to transport a variety of animals from Africa to Asia (Briggs, 1995), the Indian plate had apparently experienced extensive exchange between peninsular autochthonous and Asian Tertiary biota (Briggs, 1989, 2003; Mani, 1974; Ali & Aitchison, 2008). Out-of-India dispersal consequent upon India-Asia collision is evidenced by the fossil records of diverse taxa such as freshwater ostracodes,
ranid frogs, agamid lizards, grasses, diatoms and whales (Bajpai & Gingerich, 1998; Thewissen et al., 2007). It must also be noted that the dramatic latitudinal and climatic changes that affected the peninsular India during its northward drift caused substantial extinction in its original biota (Mani, 1974; Raven & Axelrod, 1974). Moreover, the massive Deccan Traps volcanism had a devastating impact on peninsular India biota, including the extinction of dinosaurs at Cretaceous-Tertiary boundary (Bajpai, 2009). On the whole, the researches carried out in stratigraphy, palaeomagnetics, and palaeontology provide a substantial body of knowledge about India’s past (Briggs, 2003).

CURRENT SCENARIO OF BIOGEOGRAPHY IN INDIA

Though nearly half of the country lies outside tropics, in the middle latitudes and within the temperate zone, it is customary to describe India as tropical, mainly because it is shielded off by the Himalaya in the north from the rest of Asia and has nearly uniform tropical monsoon climate. Nevertheless, the variety in elevation and the local climate is extremely remarkable and includes transitions from the nearly rainless Thar Desert in Rajasthan to the rainiest place on earth, i.e. Mawsynram in the East Khasi Hills district of Meghalaya state in north-eastern region (annual rainfall 11,872 mm), from Sriganganagar in Rajasthan, one of the hottest places on earth (54°C) to alpine and arctic conditions on the Himalaya, and from the geologically stable and ancient areas of the Peninsula with senile topography to geologically unstable and recent areas of youthful topography on the Himalaya. Except for the high-altitude Himalayan habitats, which are characteristically temperature-dominated, vast areas of monsoon-mediated ecology support tropical flora and fauna, but contain also numerous remarkable pockets of temperate biota. The uplift of the Himalayan Mountains exercised far-reaching influence on the climate and the
composition of the flora and fauna of the whole of India. In one word, the Himalaya presides over the ecology and biogeography of India.

As a result of the spectacular tectonic and historical biogeographic upheavals outlined above, the modern terrestrial and freshwater biota of India is “overwhelmingly oriental” though it does harbour but a few living relicts that might date back to the pre-drift period, e. g. the bivalve mollusk *Mullaria*, two genera of land snails, an earthworm species of the family Pheodrilidae, and some millipeds of the family Sphaerotheriidae, etc. (Briggs, 2003; Mani, 1974). And in zoogeographic approaches, India is generally placed in the Oriental Realm of Wallace (1876). According to Mani (1974), however, parts of the Punjab and the higher Himalaya should be included within the Palearctic, and also the western parts of the Indo-Gangetic Plains of north India are related more to the Ethiopian-Mediterranean than to the Malayan area. It cannot be overemphasized that the peninsular India is quite distinct geomorphologically and biogeographically from the rest of India and its primary faunistic affinities are to be traced back more to the Madagascan Region than to the Oriental or even the Malayan area. Thus, while the Peninsula *per se* is biogeographically *India vera*, the largest and the oldest region of differentiation of the original floras and faunas of India, the Himalaya and the other Extra-Peninsular parts are merely “biogeographical appendages of secondary importance” (Mani, 1974). It was further emphasized by Mani (1974) that the greatest bulk of the true Indian flora and fauna had differentiated and evolved in the Peninsula, throughout the Palaeozoic, Mesozoic and Tertiary, right nearly up to Pleistocene times, and spread extensively into the Extra-Peninsular areas during the late Tertiary. The fauna and flora that had differentiated in the Peninsula should be regarded as the original flora and fauna of India.
However, as mentioned above, for the sake of biogeographical convenience, the peninsular part and the Eastern Borderlands of India, despite their fundamental differences in history, flora and fauna, are regarded as parts of the Oriental Realm of Wallace.

GONDWANAN AFFINITIES OF THE INDIAN STYGOFaUNA

Generally, all the obligate subterranean fauna (stygobionts) may be good candidates for historical biogeography (Humphreys, 2008). However, the crustaceans as a group are better suited for this purpose because they are dominant and widespread in the ecosystems of both karstic and alluvial aquifers. Though bathynellaceans along with Parastenocaridids are the most characteristic elements of the freshwater interstitial fauna (Schminke, 1981b), the members of the order Bathynellacea, in particular, have long been recognized as suitable objects for understanding the history of the earth’s crust and biological speciation, the reasons being: (i) Bathynellaceae belong to an ancient lineage, dating back to Carboniferous; (ii) they live as unobtrusive ecological generalists; (iii) they occupy relatively inaccessible, cryptic habitats, i.e. interstitial spaces of sandy river banks, caves, etc., and (iv) have very limited powers of dispersal with no resting stages (Schram, 2008).

The spectacular Gondwanan heritage of the following Indian taxa viz. *Chilibathynella* (not met in the present study), *Habrobathynella*, now represented by 11 species, *Atopobathynella* with two species, *Parvulobathynella* with three species, and *Serbanibathynella* with two species (all belonging to Bathynellacea), and *Siolicaris* with a single species (see Corgosinho et al., 2012), *Kinnecaris* with a single species,
Haplocyclops, now with three species, Rybocyclops with two species, and Allocyclopina with one species, has already been underscored by Ranga Reddy (2011a). This study together with the first-time record of the Australian Anzcyclops and Dussartstenocaris and the additional new Indian species Habrobathynella, Atopobathynella Serbanibathynella, Haplocyclops, and Rybocyclops, dealt with in this thesis, further corroborates the definitive Gondwanan affinities of all the Indian bathynellaceans and some cyclopoid and harpacticoid copepods.

According to Noodt (1969), compared with the Bathynellacea, the Parastenocarididae is a much younger group, having originated possibly in the early Tertiary or even earlier. However, because parastenocaridids have no marine relatives or modern pathways between different continents (Boxshall & Jaume 2000), it has been postulated that they have a Pangaeian origin (Karanovic 2006). The latter taxon is now known by 19 species in India. While 14 species are distributed in alluvial sediments, one species each is restricted to a karstic cave and four to the phreatic riparian borewells. It is for the first time the Palaearctic parastenocaridid genus, Proserpinicaris Jakobi has been found in the present. The new genus Himalayacaris n. g. from the Himalayan river Alaknanda could be another Palaearctic taxon whereas Indocaris n. g and Brevicyclops n. g., just as Indobathynella, may turn out to be the Indian endemic taxa or Brigg’s (1989) “peculiar biota” in lending further support to the presumed tectonic history of the Indian plate.

Since the Gondwanan lineages represent the remnants of unique ancient biota (Mani, 1974), they require urgent attention from conservationists in order in order that the overall evolutionary history of Indian biota is preserved (Karanth, 2006). All in all,
these tiny ancient crustaceans inhabiting the sandy sediments are no less important than
the spectacular epigean vertebrates in understanding the evolutionary history of the
earth’s crust (Ranga Reddy, 2011a).