NON-MARINE MOLLUSCS OF WESTERN GHATS: A STATUS REVIEW

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ABSTRACT

The study of land and freshwater snails of Western Ghats have been neglected for a long time. Western Ghats with its varied vegetation harbours 257 terrestrial molluscs and 57 freshwater species, and forms one of the megadiversity centres for molluscs. During our studies for the last three and a half years we were able to collect 190 species of land snails with 20 new reports for the region. But the alarming factor is that 12 genera reported earlier were not encountered in our present survey. We were able to collect 40 species of freshwater molluscs and three new reports for the region. In this review we have discussed the relative importance of non-marine molluscs of Western Ghats with respect to their ecology, zoogeography and biological significance.

KEY WORDS

Invertebrates, leaf litter/soil, non-marine molluscs, tropical forests, Western Ghats

Molluscs contribute the second largest invertebrate group on earth, next only to insects (Bouchett, 1992). The estimated number of species of molluscs today varies from 80,000 species (Boss, 1971) to 135,000 species (Abbott, 1989). Of these 31,000-100,000 are marine, 14,000-35,000 terrestrial and about 5,000 freshwater species (Abbott, 1989; Seddon, 2000). Invertebrates constitute 93.95% of India's faunal wealth whereas vertebrates constitute only 6.04% (Alfred *et al*., 1998) (Fig. 1). The lion's share is by the Phylum Arthropoda accounting for 74.32% followed by the Phylum Mollusca with 6.22%. The other invertebrates combine together to form 13.42% and the vertebrates altogether constitute 6.04% in India.

The Western Ghats along with Sri Lanka form one of the 25 hot spots of the world (Myers, *et al*., 2000). The Western Ghats sprawl 1,600 km along India's West coast, across the states of Kerala, Tamil Nadu, Karnataka, Maharashtra, Goa and Gujarat known for its rich flora and fauna with high endemism (Groombridge, 1993; Madhyastha, 2000). The Western Ghats are home to 257 terrestrial molluscs and 57 freshwater molluscs (Blanford & Godwin-Austen, 1907; Gude, 1914, 1921; Subba Rao, 1988) with a relative endemism of 73% (Fig. 2) demanding priority in conservation planning.

ECOLOGY

The terrestrial habitats are inhabited exclusively by the Class Gastropoda and freshwater habitats by Gastropoda and Bivalvia. Molluscs play a significant role as links in food chains as detritus feeders, improving bottom sediments and soil condition. In short they are the 'reducers' in natural ecosystem (Barker, 1989; Martin, 1991; Reddy, 1995). Some of the non-marine molluscs are habitat specialists, such as the spray zone species like *Cremnoconchus* and rock adhering *Pseudomulleria* but many are habitat generalists and are widely distributed, *viz*., *Achatina, Opeas, Pila, Thiara,* and *Lymnea*. Although some species viz., *Succinea, Lithotis, Cremnoconchus, Neritina* are recognized as fresh water forms, they are actually amphibious.

UTILITARIAN VALUE

Bio-indicators

Molluscan communities are good indicators of localized conditions. Many have limited migration patterns and are particularly well suited for assessing site-specific impacts. Freshwater molluscan genera like *Thiara* and *Indoplanorbis* thrive in slightly polluted environments whereas species like *Pseudomulleria dalyi* reside in highly specialized environments and are sensitive to pollution. The members of the freshwater genus *Lymnea* are opportunistic and thrive in polluted environments (Blay & Dongdem, 1996). Terrestrial micro snails are often diverse, are easily sampled and serve as indicators of leaf litter biodiversity. The presence of a thriving population of molluscs indicates the land is not acidic; hardly any molluscs survive beyond a pH of 5 (Boycott, 1934).

Molecular phylogeny

Land snail genera such as *Cepea,* have contributed to our understanding of population genetics (Cain, 1983), and shell fossils form one of the major sources for paleontologists (Vermeij, 1993). Chromosome number has led to the determination of three new species of *Bulinus* in Africa (Brown & Burch, 1967; Burch, 1972; Brown, 1976). Using cytochrome c oxidase subunit 1 DNA sequences, the evolutionary relationship of *Acostea* (Columbia, South America), *Pseudomulleria* (Kalsa, Western Ghats) and *Etheria* (South Africa & Madagascar) has been determined (Bogan & Hoeh, 2000). This has led to the recognition of *Pseudomulleria* as a new genus as against subgenus of *Acostea*.

Zoogeographic relationships

The Western Ghats is believed to be Gondwana relict, separated from Africa and Madagascar some 80 million years ago and there has been an argument put forth right during the period of Blanford that molluscs have Malayan affinities. The families *Cyclophoridae* and *Diplommatinidae* are remarkably well represented throughout the Oriental Region and both abound in the Himalaya and the Western Ghats, showing a link between the two fauna (Blanford, 1876; Naggs, 2000).

Cremnoconchus, a genus belonging to Littornidae (basically a marine family), is found in the spray zone of perennial waterfalls from Lonavala in Pune; Kadambi (13^0N, 75.01^0E) and Hulikal (13.75^0N, 75.50^0E) in Karnataka part of the Western Ghats, revealing its evolution from marine biota. This theory is further

Manuscript 1160; Received 6 March 2004; Revised received 16 July 2004; Finally accepted 20 October 2004;

Figure 1. Distributional pie of fauna in India

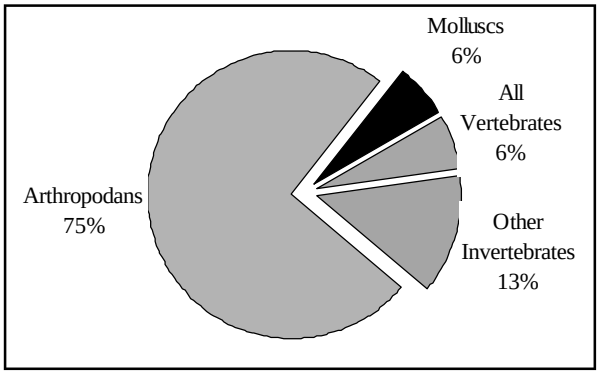
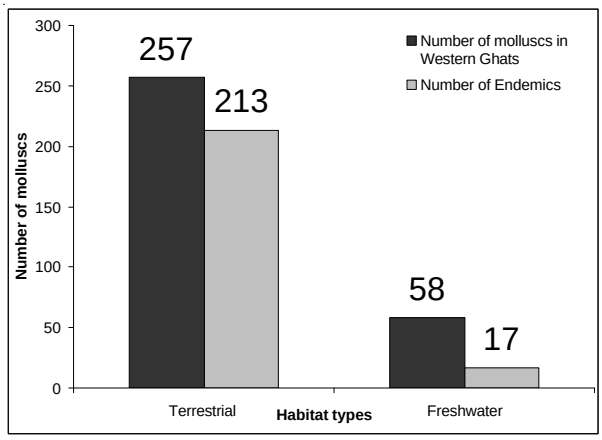


Figure 2. The endemic Molluscs of Western Ghats



supported by the presence of *Pseudomulleria dalyi* an endemic cemented bivalve of the rivers of Western Ghats (Madhyastha, 2000). It belongs to the family Etheridae, showing unique discontinuous distribution, with recognized genera, namely, *Acostea* (South America), *Pseudomulleria* (Western Ghats, India) and *Etheria* (Africa) (Smith, 1898; Rao, 1988; Bogan & Hoeh, 2000). We collected *Euplecta hyphasma* an endemic to Sri Lanka from Kalakkad-Mundunthurai Tiger Reserve giving precedence to the notion that the Western Ghats and Sri Lanka were a continuous hill chain during geological past.

Economic potential

A thriving shellfish market exists in northeastern India for various freshwater molluscs like *Pila globosa*, *Bellamya bengalensis*, *Lamellidens marginalis* and *Lamellidens corrianus* (Subba Rao, 1988). The potential of terrestrial molluscs as a source of food is relatively unknown. In Dongerwadi near Pune, villagers eat *Cyclophorus* as a source of proteinaceous and cheap food when the cost of fish goes up during monsoon. *Cyclophorus* is generally found abundantly on the slopes when present as seen during our collections at Thamini in Maharashtra, and Karwar in Karnataka. In coastal Karnataka, *Pila globosa* is used in the treatment of throat disease and in wound healing of fowls and also locally used as substitute for fish meat during monsoon months.

THE NEGATIVE SIDE

Pests and vectors

Some land snails are serious pests of agricultural crops and ornamental plants. Darwin (1859) described the effects of snails and slugs on seedling mortality. Recent studies have demonstrated that gastropod herbivory has an important effect on plant population and community dynamics (Silva, 1992; Rees & Brown, 1992; Hulme, 1994; Hanley *et al*., 1995a; Rodriguez & Brown, 1998; Sternberg, 2000). It has been shown that molluscan herbivory may lead to changes in the species composition of plant communities (Cottatm, 1986; Edwards & Gilman, 1987; Hanley *et al.*, 1995b; Wilby, 1996).

The most dreaded agricultural pest and intruder is *Achatina fulica* or the Giant African Snail (Mead, 1979; Subba Rao, 1975). Benson in 1847 introduced two specimens in Calcutta, from where it spread across India (Green, 1910). Of late it has become a pest in the Malnad region of Karnataka and has caused severe damage to garden plants. Many slugs cause damage to vegetable crops (Rao & Ramdoss, 1953). The slugs of the genus *Mariaella* endemic to the Western Ghat/ Sri Lanka ranges are serious pests of the commercial vanilla crop.

The Indian Scenario

The pioneers in the field of Indian malacology were the British. William Blanford entrusted with publishing the *Fauna of British India: Mollusca* died before the revisionary study of land snails was completed for volume I. G.K. Gude then completed the work on Volume II and III (Gude, 1914, 1921). Even today the Fauna of British India series is used as the bible for identification of Indian Land snails. The *Fauna of British India* describes most of the land snails found in the Western Ghats.

Many Indian workers like Annandale & Prashad (1919), H.S. Rao (1925), and others contributed to the *Records* and *Memoirs of Indian Museum* a large series of detailed systematic, structural and anatomical papers on non-marine molluscs of Western Ghats. The oldest paper on land snails of the Western Ghats was the *Contribution to Indian Malacology No VI*, through the descriptions of new land shells from the Nilgiris and Annamalai Hills and other places of peninsular India by W.T. Blanford in 1866. Sathyamurthi in 1960 brought out the *The Land and Freshwater Mollusca in the Collection of Madras Government Museum* and reported at least 11 new records of land snails from the Western Ghats. The land snails of Western Ghats are by and large unknown and no serious attempts have been made to review the existing literature as well. Only some information is available on the land snails of Pune and neighbouring areas (Tonapi & Mulherkar, 1963; Tonapi, 1971; Subba Rao & Mitra, 1979, 1986). Recently Ramakrishna and Mitra (2002) published a list of endemic land molluscs of India.

Of late the interest in non-marine molluscs has renewed, with the AICOPTAX initiative of the central government (Madhyastha, *et al.* 2002; Mavinkurve *et al.* 2004; Sandhya *et al.* 2004). In our studies conducted during the last three-and-a-

half years we were able to collect around 200 species in the Ghats. Of the 52 genera present in the Western Ghats only 39 genera were available, the status of the remaining twelve genera *viz.*, *Satiella, Pyramidula, Corilla, Amphidromus, Apatetes, Pupoides, Edouardia, Lithotis, Pearsonia, Mychopoma, Tortulosa* and *Cyclotopsis* needs to be evaluated and in all probability at least a few have gone extinct. A new species of *Arcidopsis* collected from the Tunga river is currently awaiting description.

The threat

In the world 27% of the birds are regarded as "restricted endemics" because they have ranges of less than 50,000km^2 (Groombridge, 1992) whereas Solem (1984) suggests that half of all terrestrial molluscan species have ranges less than 100km Non-marine molluscs, as a group, comprise the largest number of recorded extinctions in the last 300 years (284, listed by IUCN (Groombridge, 1993)) - this being far more than the combined bird and mammalian extinction during the same period (Ponder, 1997). Land species are more subject to local extinctions.

The need of the day

There is virtually no data regarding rare or threatened non-marine molluscan species for whole of India, except for a few exceptions (Hora & Rao, 1927). It is of utmost importance to build up a database of the species currently at our disposal and formulate a standardized method to evaluate their abundance level, endemism pattern and the amount of threat of extinction they face. High priority should be given to conserve tracts with narrow range distribution of molluscs. There is a need to have data on taxonomy, genetic diversity and distribution.

The staple food of gastropods is uncertain even with regard to the relative importance of senescent foliage in the diet of common slugs and snails. The lack of information on plant snail relationships explains the ignorance of the effects of gastropods on plant distribution and influence of vegetation on the density and distribution of gastropods.

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ACKNOWLEDGEMENTS
The authors are grateful to MoEF for the Grants to study molluscs of Western Ghats under the AICOPTAX scheme and to the principal, Poornaprajna College, Udupi. We thank the anonymous reviewers for constructive suggestions in improving the manuscript.

ANAEMIA IN A CINEREUS VULTURE *AEGYPIUS MONACHUS* - A CASE REPORT

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A young Cinereus Vulture *Aegypius monachus* weighing about 6.75kg was brought from Akhnoor (J&K) to Manda Zoo. A veterinary medical team from Faculty of Veterinary Sciences, SKUAST-J visited the zoo to monitor the health status of the bird. The total length (from forehead to feet) was 88cm, wing to wing length was 240cm and the length of the beak was 8cm. On physical examination the bird appeared weak but was found to feed normally. In order to check for condition of anaemia an aliquot of 1ml blood was collected from wing vein in a dry vial containing 10% Ethylene Diamine Tetra Acetic acid (EDTA) and blood smears were made for routine haematology.

Literatures concerning the normal hematological profiles of raptorial birds are scare and limited (Elliott *et al.* 1974; Cooper, 1975). However, Ivins *et al.* (1986) reported average haematological values of selected raptors while Villegas *et al.* (2002) recently documented the blood chemistry and haematocrit of Cinereous Vulture. Based on this haematological profile the Cinereous Vulture at Manda Zoo with a packed cell volume of only 19% was found to be anaemic (see Table). Oral mineral mixture (Agrimin forte powder Glaxo) was recommended at the dose of 200mg daily. After two weeks the vulture was found to be active, alert and feeding normally. The haematological profile was reevaluated and the haemogram had improved with a packed cell volume of 23% well within the normal range.

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ACKNOWLEDGEMENTS
The facilities and assistance rendered by the authorities of Department of Wildlife protection, Jammu are greatly acknowledged.

***Table 1. Haemotological Profile (Pre-treatment & Post-treatment) of* Aegypius monachus**

Haematological Profile	Pre-Treatment	Post-Treatment (14th Day)	Normal Haemogram
Packed Cell Volume (%)	19	23	24 - 52
Haemoglobin (g/dl)	6	10.20	10 - 19
Total Erythrocyte Count x 10^6/mm^3	1.8	2.5	2.0 - 2.8
Total Leukocyte Count x 10^3/mm^3	20	19.8	7 - 46
Differential leukocyte Count			
a) Heterophils x 10^3/mm^3	5	10.6	5 - 39
b) Lymphocytes x 10^3/mm^3	11	5.9	1.5 - 13.7
c) Monocytes x 10^3/mm^3	2	2.9	0 - 5.1
d) Eosinophils x 10^3/mm^3	1.4	-	0 - 0.38
e) Basophils /mm^3	-	296	0 - 380

Manuscript 1142; Received 13 January 2004; Revised received 19 October 2004; Finally accepted 7 November 2004; © Zoo Outreach Organisation; www.zoosprint.org