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Land mollusc fauna of the Kumaon Himalayan forest and the role of snail in plant litter decomposition

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The role of molluscs in the functioning of forest ecosystems is well recognised (Douce & Webb 1978; Gupta & Oli 1998; McBrayer 1977; Seifert & Shutov 1979). However, land mollusc fauna of Kumaon Himalayan forests has not received much attention of ecologists. The purpose of this paper is to describe thespecies richness, distribution, density and biomass of land molluscs in forest habitats of Kumaon Himalaya. In addition, the quantitative ecological role of a snail, *Macrochlamys glauca* Pfeiffer in plant litter decomposition at a collecting site (Khurpatal) is also described.

Twenty four sites (Fig. 1) varying in elevation from 900 m to 2610 m a s l were sampled. Field work was carried out during the peak period of monsoon (August, 1994) as the molluscan activities are mainly confined to the rainy season or shortly after period of rains. For species richness no attempt was made to standardize shape or size of sample areas which ranged from 50 m^2 to 200 m^2. From each sampling area molluscs were collected by hand for 90 minutes paying special attention to litters. Logos and stones wee removed to find hidden specimens. In addition, 5 litres of litter, soil or debris were collected from the most promising spots within each area. This material was brought to the laboratory and searched for molluscs under a bright light. The number of animals found in 1 m^2 area was treated as density. Dry biomass of animals including the shell was measured as shells are also eaten by birds in forests. The relationships between size and dry weight were developed in order to convert density into biomass (Table 1). Percent frequency occurrence (F) of each species was calculated by the formula : F (%) = (number of sites in which the species occurred/total no. of sites surveyed) X 100. Species showing 0-20% occurrence were considered as rare, 21-40% as occasional, 41-60% as frequent, 61-80% as abundant and 81-100% as very abundant.

Various ecological data at each site were collected by standard methods as given in Gupta & Oli 1998. Methods for measurement of litter production and decomposition rate at the site, and determination of consumption and assimilation of litter by the snail in laboratory and field were same as described in our earlier study for *Anadenus altivagus* (Gupta & Oli 1998). The ambient temperature at different sampling sites varied from 17°C to 32°C while the humidity ranged between 55% and 94%. The pH of the soil varied from 5.9 to 8 whereas the soil moisture content varied from 9% to 35%. Soils at most of the sites were rich in organic matter but at some sites they were poor. It varied from 4% to 15%.

Thirteen mollusc species were recorded: 9 snails and 4 slugs (Table 2). Of these, 10 species were rare while 4 were occasional. One species, *Turcomilax oli* Wictor is new record for the literature (Wictor et al. 1999). The species richness of land molluscs in Kumaon region appears to be low as compared to the other studies (e.g. Branson & Batch 1970; Cameron 1986; Coney et al. 1982).

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This reflects the very disturbed nature of the habitats sampled. In general, the density of individual species was low, however, few species had as many as 30 or 32 ind. m^{-2} due to clumped distribution. The values of estimated population density of different species 3-32 ind m^{-2}) fell in the range of densities reported by Cowie (1984). The biomass of various species of mollusks ranged between 0.01 g m^{-2} and 9.7 g m^{-2} at different sampling sites (Table 2). These values are much higher than those reported by Mason (1970). The total litter production (including shrub litter and ground flora) at the studied site (Khurpatal) was 803 g dry weight m^{-2} yr^{-1}. The fraction of litter decayed per year (k) was 0.56 while the turn over time (tt) was calculated to be 1.78 years, which is shorter than the values recorded for litter decomposition by Mason (1970).

The results of the litter feeding experiments on *M. glauca* showed that the snails consumption rate was 34 ± 6 mg dry weight per gram live weight per day (dwt g lwt^{-1} d^{-1}), assimilation was 18 ± 2.9 mg dwt lwt^{-1} d^{-1} and faecal production was 16 ± 3.2 mg dwt g lwt^{-1} d^{-1}. The assimilation efficiency was 53 ± 1.6%. The results of the field investigation on faecal production indicated that the snail produced 10 ± 0.4 mg of dry wt. faecal matter g lwt^{-1} d^{-1}. Using the relationship between food consumed and faecal matter produced and assuming digestive efficiency as independent of temperature, it was estimated that the daily field consumption rate was 21.3 mg dwt g lwt^{-1}. The estimated assimilation efficiency and consumption rate for *M. glauca* were within the range of data reported by Jennings & Barkham 1976. At the study site the snail *M. glauca* made up greater than 95% of the total live molluscan biomass. The live biomass m^{-2} of the species varied from one month to another during 1994 and the average live biomass was 4.5 ± 2.9 g m^{-2}. Using the relationship between food consumed and faeces produced it is estimated that the species with its mean live weight of 4.5 ± 2.9 g m^{-2} consumes ~ 35.1 g dwt m^{-2} yr^{-1} of plant litter which represents 4.4% of total litter input at this site. The information on litter consumption rate of various invertebrates reveals that this rate is within the range quoted by different workers (Bocock 1963; Gupta & Oli 1998; Barkham 1976).

On the basis of present study it is concluded that the diversity of mollusks in Kumaon Himalayan forests is low, though the snails, like other invertebrates may well makeup a significant direct contribution to litter decomposition process in this region. Efforts should be made to conserve the molluscan fauna in this region by controlling those factors which are responsible for forest disturbances. Our long experience suggest that forest fire damages the molluscan fauna to a great extent in this region. Therefore, it is suggested that forest fire should be checked to conserve the biological diversity in this region, and the quantitative ecological role of other mollusk species should be determined.

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