

46. Brown-headed Storkbilled Kingfisher *Pelargopsis capensis*
Kingfisher
- Family: Cerylidae**
47. Lesser Pied Kingfisher *Ceryle rudis*
- Family: Coraciidae**
48. Roller *Coracias benghalensis*
- Family: Upupidae**
49. Hoopoe *Upupa epops*
- Family: Megalaimidae**
50. Lineated Barbet *Megalaima lineata*
51. Blue-throated Barbet *M. asiatica*
- Family: Hirundinidae**
52. Common Swallow *Hirundo rustica*
- Family: Meropidae**
53. Small Green Bee-eater *Merops orientalis*
54. Chestnut-headed Bee-eater *M. leschenaulti*
- Family: Corvidae**
55. Black-headed Oriole *Oriolus xanthornus*
56. Black Drongo *Dicrurus adsimilis*
57. Bronze Drongo *D. aeneus*
58. Tree Pie *Dendrocitta vegabunda*
59. House Crow *Corvus splendens*
60. Jungle Crow *C. macrorhynchos*
61. Common Wood Shrike *Tephrodromis pondicerianus*
62. Iora *Aegithina tiphia*
63. Gold-mantled Chloropsis *Chloropsis cochinchinensis*
- Family: Lanidae**
64. Grey backed Shrike *Lanius tephronotus*
65. Rufous-backed Shrike *L. schach*
- Family: Sturnidae**
66. Indian Myna *Acridotheres tristis*
67. Jungle Myna *A. fuscus*
68. Orange-billed Jungle Myna *A. javanicus*
69. Pied Myna *Sturnus contra*
70. Grey-headed Myna *S. malabaricus*
71. Hill Myna *Gracula religiosa*
- Family: Pycnonotidae**
72. Red-whiskered Bulbul *Pycnonotus jocosus*
73. Redvented Bulbul *P. cafer*
- Family: Muscicapidae**
74. Magpie Robin *Copsychus saularis*
75. Grey-headed Flycatcher *Culicicapa ceylonensis*
76. Red-breasted Flycatcher *Muscicapa parva*
77. Collared Bushchat *Saxicola torquata*
78. Jungle Babbler *Turdoides striatus*
79. Tailor-Bird *Orthotomus sutorius*
- Family: Passeridae**
80. Paddyfield Pipit *Anthus novaeseelandiae*
81. Large Pied Wagtail *Motacilla maderaspatensis*
82. White Wagtail *M. alba*
83. Yellow Wagtail *M. flava*
84. House Sparrow *Passer domesticus*
85. Spotted Munia *Lonchura punctulata*
- Family: Nectarinidae**
86. Purple Sunbird *Nectarinia asiatica*

So far the Pobitora WLS has received focus only for conservation of Rhino; the ponds, swamps, marshyland, grassland and other seasonal and perennial wetlands have also been provid-

ing suitable habitat to a number of avifauna in the sanctuary. Around 25% of the total area under wetlands of the sanctuary harbours a large number of waterbird species of both Oriental and Palearctic region (Talukdar, 1995). Places where waterfowls are abundant are Tamulidova, Haaduk Beel, Pagladova, Sarudova, Chitalmari Beel and Naitoli Beel. During the present study, it was found that bird like White Ibis, Greylag Goose, Spot-billed Pelican, White-eyed Pochard etc. are more abundant in Tamulidova and Sarudova Beel. The rare migratory Spotted Greenshank was recorded in Salmari Beel.

The survey showed that Pobitora is an important Sanctuary for a number of globally threatened species viz. Spot-billed Pelican, Greater Adjutant Stork, Lesser Adjutant Stork, White-eyed Pochard. Near-threatened species like Oriental Darter, Asian Open-billed Stork, Grey-headed Fishing Eagle has also been recorded. Another notable record was Orange-billed Jungle Myna.

During the present study siltation has been identified as one of the major threats to the diversity of both resident and migratory waterbirds. Illegal fishing and collection of firewood becomes a threat to this Sanctuary. Conservation measures should be taken up immediately by the Forest Department as well as local NGOs to preserve the habitat of the Sanctuary.

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NOTE

FEEDING IN SOME SPECIES OF TERRESTRIAL MOLLUSCS FROM KUMAON HIMALAYAN FORESTS

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Terrestrial molluscs, as primary consumers, play an important role in matter and energy transport from producer level to upper trophic levels, thus composing an important part in terrestrial ecosystem functioning.

Important contributions have been made by Mason (1970) who worked on 20 species of snails, Stern (1968, 1975) on *Arion rufus* and *Agriolimax reticulatus*, Jennings & Barkham (1976, 1979) on *Arion ater*, *A. fasciatus*, *A. hortensis*, *A. intermedius*, *A. subfuscus*, *Deroceras reticulatum* and *Limax marginatus*, Seifert & Shutov (1978, 1981) on *Bradybaena fruticum*, *Helix vulgaris* and *Eobania vermiculata*, Lazaridou-Dimitriadou & Daguzan (1978) on *Euparypha pisana*, Charrier & Daguzan (1980) on *Helix aspersa*, and Staikou & Lazaridou-Dimitriadou (1989) on *Helix lucorum*, & others. In India, Gupta & Oli (1998) have estimated that *Anadenus altivagus* consumes approximately 22.9

to 98.6 g dwt m⁻² yr⁻¹ of plant litter in Oak (*Quercus* spp.) dominated forests of Kumaon Himalaya.

The laboratory feeding experiments have shown that all species prefer to eat fresh leaves and flowers of certain plants (e.g. *Urtica parviflora*, *Poa annua*, *Iris germanica*, *Galinsoga ciliata*, *Ipomoea* sp., *Raphanus sativus*, *Cucumis melo*, *Cucurbita pepo*, etc.) Gupta & Oli (1997).

The object in the present study is quantity of food is consumed per day, and their assimilation efficiency in 4 species of terrestrial molluscs.

Individuals of four species of terrestrial molluscs were collected from their natural habitats (29°21'N - 29°23'N latitude and 79°24'E-79°28'E longitude at an altitude of 1650-2610 m above sea level). They were reared in the laboratory by providing slices of carrot (*Daucus carota*). A terrarium was used for *Anadenus altivagus* due to its large size (size: 14-16 cm, live weight 15 to 16 g, age approximately 2 years and immature individuals of 1 year age) and glass troughs were used for remaining 3 species viz- *Deroceas laeve* (Muller) (Size : ~2 cm, live wt. 0.08 to 0.14 g, age 60 days), *Euaustenia monticola* (Pfeiffer) (Size : ~ 8 cm, shell diameter ~ 1.7 - 2 cm, live wt. 3 - 4.5 g, age 1 year) and *Macrochlamys glauca* (Pfeiffer) (Size : 2-3 cm, Shell diameter ~ .8 -1 cm, live wt. 0.2-.3 g, age 1 year).

Known weight of *Urtica parviflora* leaf, which was highly palatable to all 4 species of land molluscs was used as nutritive substrate. Only fresh, fully expanded, non-senescent leaves were used in this experiment. The leaves were dried to constant weight at 60° C, and supplied to the molluscs as food. The Acceptability Index of *U. parviflora* leaf was > 50, for all 4 species, it was probably due to high protein content (Gupta & Oli, 1997). Two to twenty individuals were employed in the experiment. Container with filter paper on the bottom and weighed quantity of dried *U. parviflora* leaf (2 g). The leaf and paper were wetted once a day with 40-50 ml of distilled water; excess water was removed with cotton wool and the aquarium and troughs were covered with glass to reduce evaporation. The temperature during the experiment (August 1995) varied from 20-22°C and humidity between 80-90%. The light/dark regime was 13 L : 11 D hour. Before the experiment the molluscs were starved for 1-3 days to empty their guts (Oli, 1996).

To determine the consumption (mg dry weight (dwt) and Joule (J) was calculated per gram live weight (1wt) of animals) and assimilation (mg dwt g⁻¹ 1wt⁻¹ d⁻¹) for *U. parviflora* leaf; animal faeces were collected daily. Unconsumed leaves were collected and dried at 60° C to constant weight after 24 hours and weighed. The difference between the initial weight and the residual weight was taken as the amount of leaf eaten during 24 hours. The amount of faeces produced from the known quantity of food was determined by means of a marker technique (Phillipson, 1960;

Table 1: Daily consumption, egestion, assimilation and assimilation efficiency of 4 species of terrestrial molluscs for *Urtica parviflora* leaf (data in gravimetical terms)

Species	No. of individuals	Total Wt. before expt. (g)	Consumption rate	Assimilation rate (mg dwt g ⁻¹ 1wt d ⁻¹)	Faecal production	Assimilation efficiency (%)	Total Wt. after expt. (g)	Moisture content of faeces (%)
<i>M. glauca</i>	20	5.51	34.5	18	16.5	54	5.71	82
<i>E. monticola</i>	2	7.57	17	5	12	29	7.61	90
<i>D. reticulatum</i>	4	0.46	23	18	5	78	0.50	90
<i>A. altivagus</i> (immature)	5	13.73	35	34	1	97	14.85	92
<i>A. altivagus</i> (mature)	2	28.99	27	20	7	74	30.50	92

Table 2: Daily consumption, egestion, assimilation and assimilation efficiency of 4 species of terrestrial molluscs for *Urtica parviflora* leaf (data in energetical terms).

Species	No. of individuals	Total Wt. before expt. (g)	Consumption rate	Assimilation rate (J g ⁻¹ 1wt d ⁻¹)	Faecal production	Assimilation efficiency (%)	Total Wt. after expt. (g)
<i>M. glauca</i>	20	5.51	622	319	303	51	5.71
<i>E. monticola</i>	2	7.57	310	90	220	29	7.61
<i>D. reticulatum</i>	4	0.46	415	330	85	80	50
<i>A. altivagus</i> (immature)	5	13.73	631	617	14	98	14.85
<i>A. altivagus</i> (mature)	2	28.99	492	358	134	73	30.50

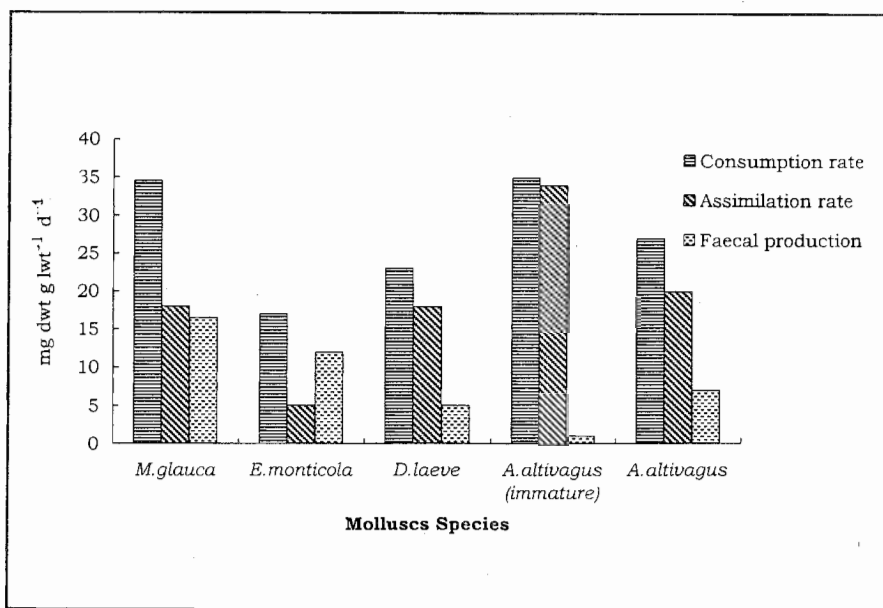


Fig 1. Daily consumption, assimilation and faecal production in 4 species of terrestrial molluscs for *Urtica parviflora* leaf.

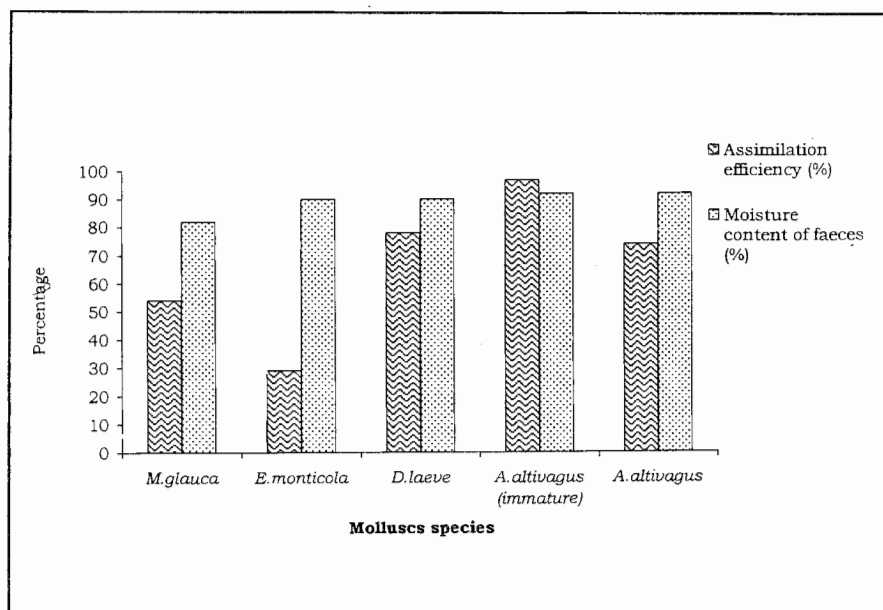


Fig 2. Assimilation efficiency (%) and moisture content of faeces (%) in 4 species of terrestrial molluscs for *Urtica parviflora* leaf.

Pallant, 1970). In this technique carrot slices were supplied to animals as food after 24 hours. The faecal matter produced from experimental food was identified without any difficulty because carrot food was identified without any difficulty due to the characteristic orange coloured faeces. The technique has been described in detail by Jennings & Barkham (1979). The assimilation rate of *U. parviflora* leaf was calculated in mg dwt g 1wt⁻¹ d⁻¹ by subtracting the daily faecal matter production from the daily food consumption. Assimilation efficiency was calculated by following formula:

$$A\% = (C-F)/C \times 100 \text{ where,}$$

C = consumption of food, and
F = faeces produced.

The moisture content of the faeces was calculated by weight loss method and expressed in percentage.

One glass trough for the investigation in leaf weight loss associated with microbial activity served as control for the experiment. Since the experiment were carried out only for 24 hours, the weight loss associated with microbial activity was found negligible.

Data on energy contents of leaves and faeces were assumed as 18,035 J g⁻¹ dwt and 18,41 J g⁻¹ dwt, respectively (Seifert & Shutov, 1981).

The results of feeding experiments showed that the consumption rate varied from species to species. The highest over-

all consumption rate for *U. parviflora* leaf was by immature individuals of *A. altivagus* (35 mg dwt g 1wt⁻¹ d⁻¹) while the lowest consumption rate was by *E. monticola* (17 mg dwt g 1wt⁻¹ d⁻¹).

Higher consumption by immature individuals of *A. altivagus*, showed lowest faecal production (1 mg dwt g 1wt⁻¹ d⁻¹), while *M. glauca* which also consumed good amount of food had highest rate of faecal production (16.5 mg dwt g 1wt⁻¹ d⁻¹). The faeces of molluscs have a high moisture content, of the order of 82-92% and are rich in nitrogenous materials.

Immature individuals of *A. altivagus* assimilated 34 mg dwt g 1wt⁻¹ d⁻¹ while *E. monticola* assimilated only 5 mg dwt g 1wt⁻¹ d⁻¹ from the consumed food.

Immature *A. altivagus*, with highest consumption rate, had highest assimilation efficiency (97%) also. The lowest assimilation efficiency was noted for *E. monticola* (29%).

All 4 species studied showed increase in biomass (live weight). It was lowest for *M. glauca* (0.2 g per day) and highest for *A. altivagus* (1.5 g per day). The consumption, assimilation, faecal production and assimilation efficiency, etc. estimated by the gravimetric and energy values method slightly differ (Table 1 and 2) (Figure 1 and 2).

Seifert & Shutov (1981), found minimum consumption in *Helix vulgaris* (3.4 mg dwt g 1wt⁻¹ d⁻¹) and maximum in unbanded *Bradybaena fruticum* (11 mg dwt g 1wt⁻¹ d⁻¹). The faecal production ranged between 2 to 4 mg dwt g 1wt⁻¹ d⁻¹ being minimum in banded *B. fruticum*, *H. vulgaris* and *Eobania vermiculata* while it was maximum in unbanded *B. fruticum*. The assimilation efficiency was lowest in *E. vermiculata* (52%) and highest in unbanded *B. fruticum* (64%).

Jennings & Barkham (1979) studied 6 species of slugs and found that the mean consumption rate (mg dwt g 1wt⁻¹ d⁻¹) ranged between 9.4 to 29.1, with a minimum in *Limax marginatus* and maximum in *Arion intermedius*. The mean assimilation rate (mg dwt g 1wt⁻¹ d⁻¹) was 6.2 (minimum) in *L. marginatus* and 20.3 (maximum) in *A. intermedius*. The mean faecal production (mg dwt g 1wt⁻¹ d⁻¹) was 3.2 (minimum) in *L. Marginatus* and 8.8 (maximum) in *intermedius*. The assimilation efficiency ranged between 64.4% to 72% being minimal in *Arion hortensis*, with a maximum in *A. intermedius*. The moisture content of faeces of these 6 species of slugs ranged between 84-88%.

Mason (1970), calculated the consumption rate of the snail, *Discus rotundatus* and found that it consumed 0.8 to 9.4 mg dwt g 1wt⁻¹ d⁻¹. Pallant (1970) estimated that *Deroceras reticulatum* consumed 36 mg dwt g 1wt⁻¹ d⁻¹ with 78% assimilation efficiency.

Jensen (1975) estimated that the assimilation efficiency in *Arion ater* (at 15° C) was 70-88%), while Jennings & Barkham (1976) estimated for *A. ater* (at 10° C) of 47-83%. Davidson (1976) studied 2 species of slugs and found that, *Limax flavus* had 48-90% and *Arion hortensis* had 74-99% assimilation efficiency. Hunter (1968) found that consumption of 3 species of slug (*Arion hortensis*, *Deroceras reticulatum* and *Milax budapestensis*) was in the order of 11 to 14 mg dwt g 1wt⁻¹ d⁻¹, may be due to the presence of large complement of enzymes as a general feature of molluscan digestive systems (Davidson, 1976; Evans & Jones, 1962). High values of daily consumption rates and daily assimilation rates in immature *A. altivagus* may be due to their high metabolic rate compared to older ones. The same phenomenon has been observed in *Arion ater* (Jennings & Barkham, 1976), in *Euparypha pisana* (Lazaridou-Dimitriadou & Daguzan, 1978), in *Eobania vermiculata* (Seifert & Shutov, 1978), in *Agriolimax laevis* (Stern, 1979), in *Helix lucorum* (staikou & Lazaridou-Dimitriadou, 1989) etc.

The slugs have high assimilation efficiency (> 60%), and may thus play an important role in the functioning of terrestrial ecosystems.

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