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DISTRIBUTION AND POPULATION OF TWO PESTIFEROUS LAND SNAILS, *ACHATINA FULICA* BOWDICH AND *MACROCHLAMYS INDICA* GODWIN-AUSTEN, IN WEST BENGAL

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ABSTRACT

Studies on the distribution and population status of *Achatina fulica* Bowdich and *Macrochlamys indica* Godwin-Austen have been made from West Bengal. Population density of the snails was estimated by counting the snails from five different square metre areas of the infested pocket and the mean was considered for actual population per square metre area. The snails are found abundant in the districts of lower and North Bengal. In West Bengal, *A. fulica* predominates except in Calcutta and Coochbihar districts where density of *A. fulica* and *M. indica* is nearly equal. In heavily infested pockets 18-32 *A. fulica* and 22-34 *M. indica* has been recorded. Of the sixteen districts Purulia is free from both the species of snail. Bioecological factors in relation to distribution and population density have been discussed. The variation in the size of snail population in different districts is directly related with the climatic conditions of the areas.

INTRODUCTION

Since its introduction in 1847 in Calcutta, West Bengal, no study on the distribution and population of the giant African land snail *Achatina fulica* Bowdich has yet been made. *Macrochlamys indica* Godwin-Austen, a native of India has also registered its name as an agri-horticultural pest but no report is available on its status and distribution. Both the species of snails are a menace to agri-horticulture in West Bengal as well as in other States of the Indian Union.

In West Bengal there are six well defined seasons—summer (from the middle of April to the middle of June), rainy (from the middle of June to the middle of August), autumn (from the middle of August to the middle of October), dewy (from the middle of October to the middle of December), winter (from the middle of December to the middle of February) and spring (from the middle of February to the middle of April). However, each season may overlap to some extent with the other.

MATERIALS AND METHODS

While surveying the distribution and present status of *A. fulica* and *M. indica* in West

engal attention was given to estimating the opulation density of these snails. In each ıfested area 5 gardens were selected at ındom and 5 sites from each garden were ɔnsidered for study, irrespective of snail opulations. From each of such selected tes snails present in a square meter area ounted during evening, between 6—30 to —00 P.M., when almost all the snails in the arden became active and usually found to rawl on the ground for feeding. The mean of such five reading from one garden was considered as the actual snails present in the garden in a square meter area. Accordingly, the mean of the readings from five gardens was considered as the actual snail population present per square meter area of the infested pocket. Only living snails were counted.

OBSERVATIONS

Distribution : Survey on the distribution

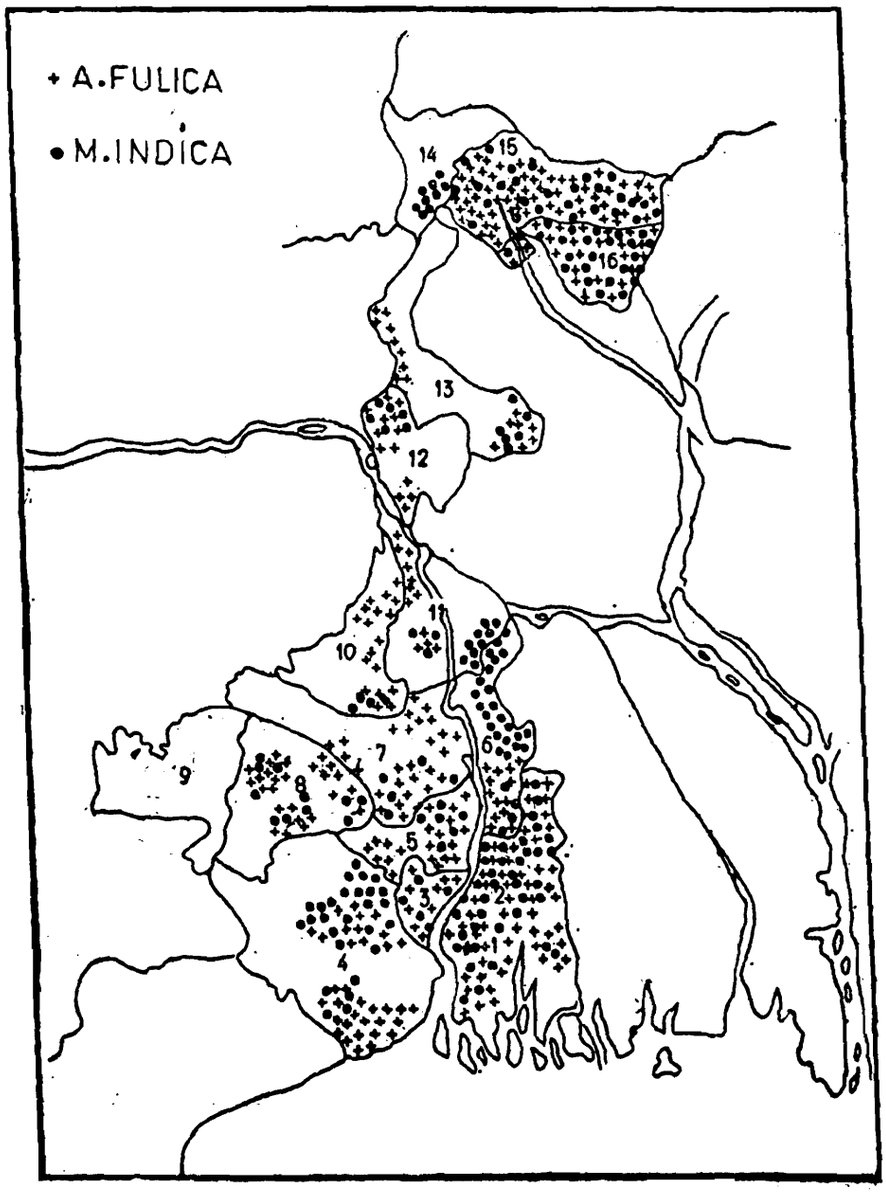

Fig. 1. Map of West Bengal showing distribution of *Achatina fulica* and *Macrochlamys indica*. 1=24-Parganas, 2=Calcutta, 3=Howrah, 4=Midnapore, 5=Hooghly, 6=Nadia, 7=Burdwan, 8=Bankura, 9=Purulia, 10=Birbhum, 11=Murshidabad, 12=Malda, 13=West Dinajpur, 14=Darjeeling, 15=Jalpaiguri, 16=Coochbihar.

of *A. fulica* and *M. indica* in all the 16 districts reveals that *A. fulica* are present and widely distributed in 14 districts (Fig. 1). They have not been found so far in Purulia and Darjeeling districts. *M. indica* have a similar distribution but they have been able to establish themselves in the Siliguri sub-divisions of Darjeeling district. So far Purulia district is devoid of *M. indica.*

In most of the infested areas both the species of snails are found, while in some areas either *A. fulica* or *M. indica* are present. The Contai sub-division of Midnapore district, Sainthia of Birbhum and Katoa of Burdwan are inhabited by *A. fulica* only. On the contrary, the northern half of Nadia district is *M. indica* dominated. Both the species of the snails on the whole, are equally common in wild and cultivated areas.

Population : Density of snail population

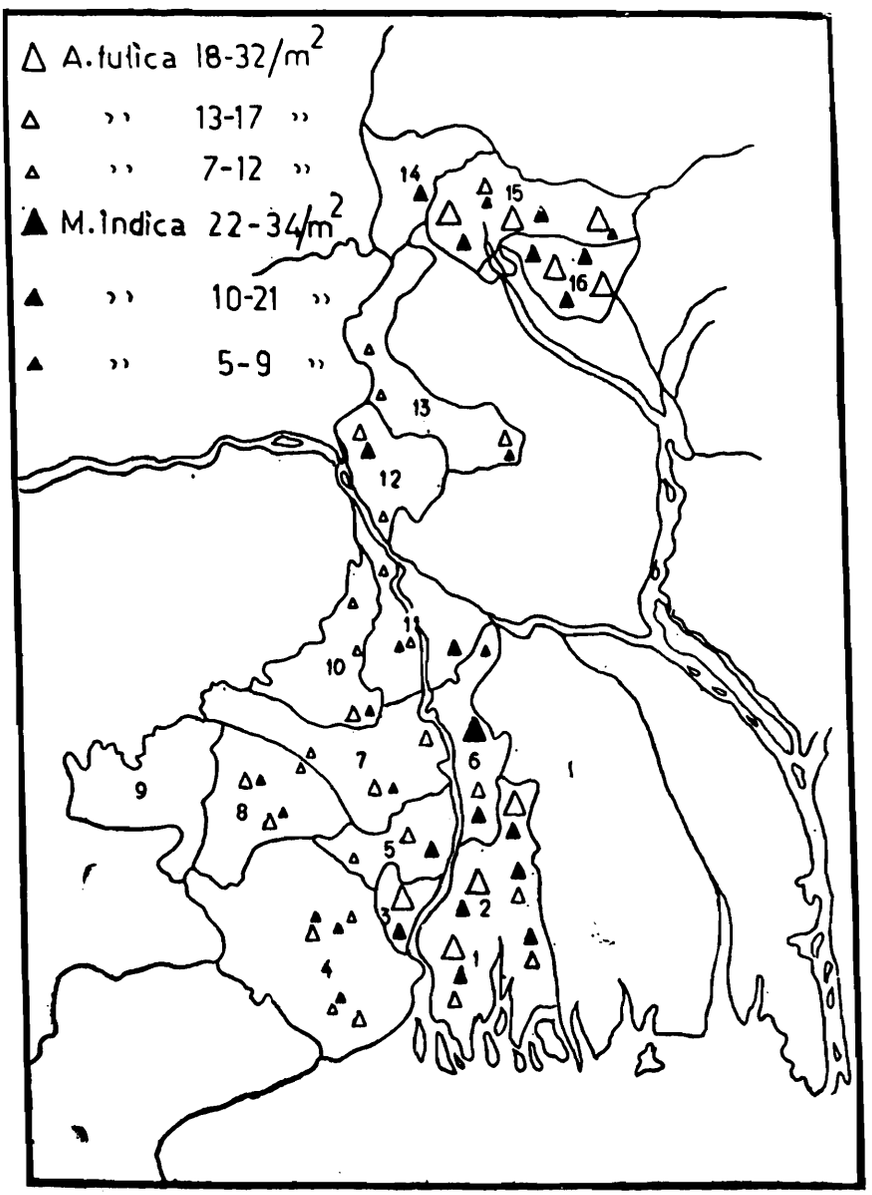

Fig. 2. Map showing population density of *Achatina fulica* and *Macrochlamys indica* in different infested pockets of the State of West Bengal. (For explanations (1-16) see Fig. 1)

in both the species showed a wide range of variation from one infested pocket to another. It is noteworthy that in west Bengal *A. fulica* predominates except in Calcutta and Coochbihar districts where density of *A. fulica* and *M. indica* population is nearly equal (Fig. 2). The maximum *A. fulica* population has been recorded from the districts—Calcutta, Howrah, 24-Parganas, West Dinajpur, Malda, Jalpaiguri Coochbihar. In heavily infested areas of these districts *A. fulica* were counted 18—32 in a square meter area with an average 25 snails. Minimum population was 7-12 with an average, 9 snails per square meter in the sparsely populated areas of the same districts. However, population is medium to low in the districts —Birbhum and Murshidabad. *M. indica* is

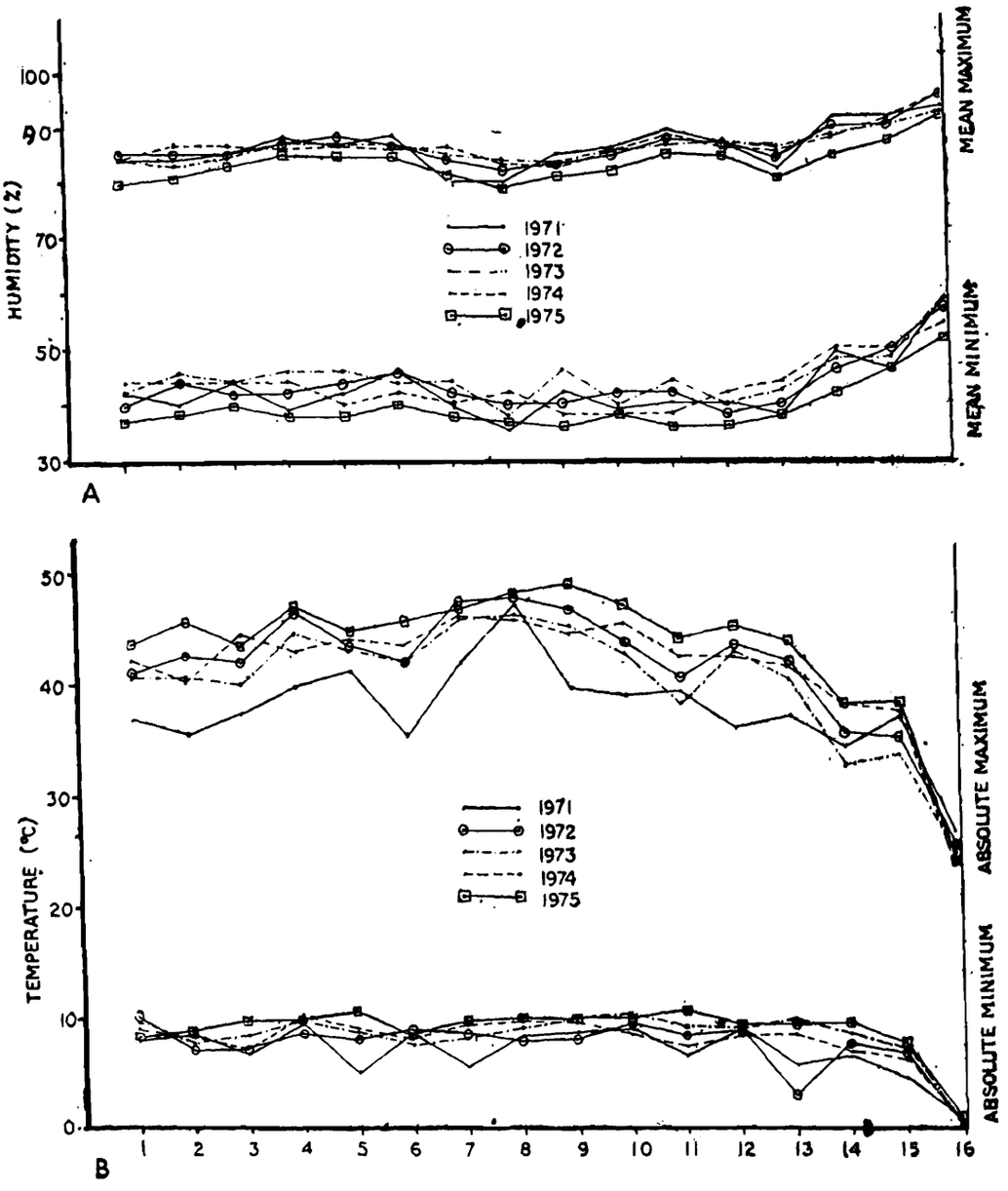

Fig. 3A. The temperature figures, the absolute maximum and the absolute minimum temperature (°C) for the 16 districts of West Bengal in the five years, 1971 to 1975.

3B. The mean relative humidity figures in percentages for the 16 districts of West Bengal in the five years, 1971 to 1975. (For names of districts (1-16) see Fig. 1.)

maximum in the northern part of Nadia, the number was 31 per square meter area. In other parts of the State West Bengal *A. fulica* is 7-16 in a square meter while it is 11-24 for *M. indica*. (Fig. 3 A)

Bioecological factors in relation to snail population and distribution : Population density of both *A. fulica* and *M. indica* exhibits variations from district to district, and even from one locality to another in the same district. It is rather common that snails are present in considerable number in one part, but completely absent in other part of the same district.

Physical and biotic factors of all the districts of West Bengal were considered to ascertain their role on the survival and multiplication of the snails. Information on soil was obtained from Mukherjee (1974). Data on the temperature, rainfall and humidity were supplied partly by the meteorological stations of the Government of India.

Soil : There are eight distinct groups of soil in West Bengal (Table I). In general, towards the south West Bengal, the maximum area is covered either by Gangetic alluvium or Vindya alluvium while it is mainly Terai and Testa alluvium in the north West

TABLE 1. The types and nature of soil in West Bengal (district wise)

District	Types of soil	Nature of soil		
		Acid (%)	Normal (%)	Alkaline (%)
Calcutta	Gangetic alluvium ; Coastal.	47	53	—
Howrah	Gangetic alluvium ; Coastal.	36	63	1
Hooghly	Gangetic alluvium ; Vindya alluvium.	56	44	—
Burdwan	Gangetic alluvium ; Vindya alluvium Laterite ; Gravelly (Western part).	69	31	—
Midnapore	Vindya alluvium ; Coastal ; Laterite ; Red ; Gravelly.	64	36	—
24-Parganas	Gangetic alluvium (North and South) ; Coastal.	27	71	2
Bankura	Vindya alluvium ; Laterite ; Red.	65	35	—
Purulia	Vindya alluvium ; Red ; Gravelly.	68	32	—
Birbhum	Vindya alluvium ; Laterite ; Red ; Gravelly (Western part).	82	18	—
Murshidabad	Gangetic alluvium ; Vindya alluvium (Western part)	25	74	1
Nadia	Gangetic alluvium.	28	70	2
Malda	Gangetic alluvium ; Red.	36	63	1
West Dinajpure	Terai and Testa alluvium (Only Islampur sub-division) ; Red.	75	25	—
Jalpaiguri	Terai and Testa alluvium	73	27	—
Coochbihar	Terai and Testa alluvium.	82	18	—
Darjeeling	Terai and Testa alluvium (Only Siliguri sub division) Brown forest.	92	8	—

Bengal districts. A peculiar soil character has been recorded in the districts—Purulia, Bankura, Birbhum and the western part of Midnapore, where laterite, red and gravelly groups of soil are found. Only a few pockets of the districts Birbhum and Bankura contain the Vindya alluvium.

In West Bengal, the soil is either acidic or normal (Table I). Acid soil prevails in the districts—Darjeeling, Jalpaiguri, Burdwan, Midnapore, Bankura, Purulia and Birbhum while the soil is mostly normal in Murshidabad, Malda and Howrah districts. Alkaline soil is practically absent in West Bengal.

Vegetation : It is rather rich in lower and north West Bengal. Both wild and cultivated vegetables are almost similar in lower West Bengal, *viz.*, Calcutta, 24-Parganas, Hooghly, Howrah and part of Nadia and Midnapore district and in north West Bengal *viz.*, Jalpaiguri and Coochbihar district. Contrast to this, vegetation is rather poor and restricted to some areas only in rest of the districts of the State.

Temperature : Range of temperature is rather wide in West Bengal (Fig. 3A), the lowest is recorded from Darjeeling district and highest from Purulia and Birbhum districts. The temperature range 20—30°C encouraging land snail population prevails in Calcutta, 24-Parganas, part of Howrah and Nadia, Jalpaiguri and Coochbihar, and population density in these districts is considerably higher than that in the rest of West Bengal.

Rainfall : The rainfall is highest in

TABLE 2. Average rainfall (mm) in different districts of West Bengal during the period 1971-1975

District	1971	1972	1973	1974	1975
Calcutta	2201.2	1966.6	1909.0	1864.2	1970.4
Howrah	2379.5	1367.4	2083.1	2240.8	1741.4
Hooghly	1900.0	1741.5	1805.0	1445.3	2105.0
Burdwan	2045.2	1407.2	1631.7	1704.4	1931.0
Midnapore	2060.3	1681.0	1478.4	1905.4	2207.2
24-Parganas	2621.5	2905.2	1968.0	2305.4	2281.9
Bankura	1868.0	1154.3	1601.4	1360.1	1465.1
Purulia	1789.5	943.1	1468.7	1001.6	1106.4
Birbhum	2043.8	1040.6	1610.5	1469.7	1421.2
Murshidabad	2769.2	2069.2	1915.4	1805.9	1701.4
Nadia	1682.9	1942.4	1508.2	1771.5	1626.1
Malda	1611.6	1040.5	1609.2	1711.4	1321.6
West Dinajpur	1989.0	1054.2	2065.4	1400.0	1700.0
Jalpaiguri	2870.0	2736.6	2264.1	2961.3	2884.6
Coochbihar	3221.2	2667.3	2960.6	2114.0	3040.0
Darjeeling	3436.1	2206.0	3442.4	3540.2	3345.5

Darjeeling while Jalpaiguri and Coochbihar districts are next in order (Table 2.). Rainfall is minimum in Purulia district. It has been observed that rainfall is sometimes continuous in Darjeeling district and most of the areas of the Siliguri sub-division remain under water for a considerable period during rains. The rainfall occurs mainly in monsoon months for a period of 3-5 months from June to October (including pre and post-monsoon months).

A number of districts usually face a long dry spell with no rainfall for a period of 5-8 months (Table 3) during winter and summer—the period when the snails take their aestivating shelter.

Humidity : It is almost similar in all the districts during monsoon, but varies considerably in other seasons of the year (Fig. 3B). The overall annual range of mean maximum and mean minimum humidity is apparently not significant in different district of West Bengal though this range is comparatively lower in Purulia district. But it is interesting to note that there exists a considerable degree of variability in humidity percent in different seasons except in monsoon.

Natural enemies : A number of predators *viz.* rat (*Bandicota indica*), birds (*Dendrocitta vagabunda, Centropus sinensis*) and planaria (*Bipalium indica*) and parasites—nematodes, some ciliates and microbes have been recorded. A leucodermia-like disease has also been observed (Raut and Ghose, 1977). Rat and planaria are equally effective in lowering the

TABLE 3. The period of dry spell in different districts of West Bengal during the period 1971-1975 (months indicate the period of dry spell, '—' indicates no dry spell period).

District	1971	1972	1973	1974	1975
Calcutta	—	—	—	—	—
Howrah	—	November to March	—	—	—
Hoogly	—	November to March	—	November to May	—
Burdwan	—	December to April	—	—	—
Midnapore	—	November to April	November to May	—	—
24-Parganas	—	—	—	—	—
Bankura	—	October to April	—	November to May	—
Purulia	—	October to June	—	November to April	—
Birbhum	—	November to June	—	—	—
Murshidabad	—	—	—	—	November to March
Nadia	—	—	—	November to April	—
Malda	—	November to May	—	—	November to March
West Dinajpur	—	November to June	—	—	—
Jalpaiguri	—	—	—	—	—
Coochbihar	—	—	—	—	—
Darjeeling	—	—	—	—	—

population of *A. fulica*. Rats are found in all the districts of West Bengal and their effectiveness in controlling the giant snail population has been studied (Raut and Ghose, 1978 In Press), while the role of planarians in monitoring the giant snail population is also encouraging (Raut and Ghose, 1978 In Press).

In general, it is estimated that around 14% of the *A. fulica* population is being controlled by the predators and parasites.

Discussion

From the study of distribution of *Achatina fulica* and *Macrochlamys indica* it is evident that the ecological conditions for their establishment and survival are most favourable in all the district other than purulia and Darjeeling (except Siliguri Sub-division). The variation in population density in both the species from district to district is probably due to a number of factors—biotic and abiotic.

As the snail population is maximum in the districts Jalpaiguri, Coochbihar and 24-Parganas, it is very likely that the snails preferred alluvium soil most. But they are also well established in some areas of a number of districts having only the coastal group of soil. The absence of both the species from areas with laterite, red and gravelly group of soils suggests that the soils imposed certain limiting factors for the snail's distribution. It is, probably, due to the fact that the laterite, red and gravelly group of soil become rather hot in sunny summer days and are incapable of retaining moisture. On the other hand, alluvium groups of soil can absorb and retain moisture, thereby suitable for luxuriant growth of vegetations, and offered a humid environment to the animals living there.

Distribution in respect to the pH of the soil clearly pointed out that acid soil has got no impact on the distribution of snails. They can thrive equally both in acid and normal soil. The role of alkaline soil on distribution of the snail species under observation can not be ascertained as there is no alkaline soil in the State.

Vegetation is one of the most important factors for the distribution and multiplication of animals. But in case of *A. fulica* and *M. indica*, vegetation does not appear to interfere much in the distribution as these snails have been found to establish themselves in a number of wild areas also, suggesting a wide range of food (plants) acceptability.

The influence of temperature on the distribution of snails is, however, significant. From the present study it can safely be concluded that the snails may establish in any part of West Bengal other than the hilly regions of Darjeeling. At present, *M. indica* is thriving successfully in the plains of Darjeeling (Siliguri sub-division). The ecological condition of Siliguri and Jalpaiguri are similar, but *A. fulica* is not found in Siliguri while both the species are available in large numbers in Jalpaiguri. This clearly suggests that *A. fulica* will find a new home at Siliguri in near future. But it may not be possible for both the species to establish in any other part of the Darjeeling district as the night temperature in those parts generally falls below 12°C during September—October while in other months it is below 8°C. The snails, being nocturnal are unable to withstand such temperatures. The absence of both the species from Purulia does not suggest that these snails will not survive there, because, inspite of almost similar temperature range, both the species of snails are still thriving well in the district town of Bankura and Midnapore, at Joypur of Bankura, Sainthia and Santiniketan of Birbhum and Calcutta also. Usually, these pockets are used to face an adverse climatic conditions (higher temperature 39°C—46.8°C)

similar to Purulia and Jhargram sub-division of Midnapore but still large number of snails are living there. This indicates that the snails can tolerate higher temperature. In fine, it may be concluded that such a higher temperature (upto 47°C) is not a limiting factor.

Humidity is the prime need for terrestrial animals and it is chiefly regulated by the rainfall, temperature and the velocity of the wind. From the collected data on rainfall it has been observed that there is a great variation in rainfall from district to district which has got a tremendous impact in maintaining the moisture of the soil and atmospheric humidity. As the population is variable with the amount of rainfall it indicates that the distribution and multiplication of both the species are dependent on it. Rainfall is higher in the districts—Coochbihar, Jalpaiguri and 24-Parganas and accordingly the snail population is higher—a direct relation with the size of the population and amount of rainfall would ensue.

However, inspite of nearly similar climate and vegetation, with fair chances of distribution the absence of *A. fulica* (if ever introduced) and less number of *M. indica* in the Siliguri sub-division of Darjeeling district are presumably due to higher rainfall and consequent inundation of most of the areas during rainy season. The ability of *M. indica* to stay at high places and even laying eggs there perhaps help them to survive in such areas (Raut, 1977)

The variation in the size of snail-population in different districts presumably due to the variance in the climatic conditions prevailed in the district concerned. Monsoon is the breeding season of *A. fulica* and *M. indica* and presumably it has no impact on the mass mortality of the snails. It appears to be influenced by the length of dry spell with which the snails are subjected. The snails in all the districts used to overcome an adverse climatic condition (such as long dry spell) from November to June by undergoing aestivation. During this period a large number of snails usually die due to drying up and dehydration. From the collected data it appears that all the districts other than Jalpaiguri, Coochbihar, Darjeeling and 24-Parganas had to overcome a long dry spell for a period of 5-8 months at a stretch either once or twice during the last five years, 1971-75. This might have resulted in higher mortality during aestivation in other districts. The present study, thus, lends support to the contention of Raut and Ghose (1978) that "the longer the dry spell the higher the mortality rate".

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