The Habitats of some minute Cyclophorids, Hydrocenids and Vertiginids on a Malayan Limestone Hill

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(Received July, 1961)

Introductory

STUDIES ON THE Cyclophorids, Hydrocenids, Vertiginids, and Streptaxids which inhabit limestone hills in South-East Asia have been limited to distributional and taxonomic surveys made by Tweedie, van Benthem Jutting, Laidlaw, and others. These have been based on dry shell material collected from debris around the bases of limestone outcrops. Thus, although much is known of distribution of these snails in Malaya (reviewed by Tweedie, 1961), many authors have emphasised how little is yet known of the ecology, general biology, and even the anatomy of these animals. Many species have not yet been seen alive.

Site and Method of Collecting

The present author has collected and studied live snails from Bukit Chintamani between Bentong and Karak in Pahang, (3° 27′ N., 102° 05′ E.). This is an isolated outcrop of Permian limestone, far-separated from Batu Caves to the West, Bukit Serdam to the North, and Gunong Sinyum to the North-East, (Paton, 1961).

Most of the western face of Bukit Chintamani is being quarried, leaving the eastern and southern faces relatively undisturbed (Fig. 1).

Trees and other vegetation grow on top of the hill, on the earthy scree around its base, and in places on narrow ledges on the otherwise nearly vertical limestone surfaces. This vegetation provides shade for much of the rock surface. During and after rain some areas of the rock remain damp and in many places there are extensive patches of moss. Other areas dry quickly after rain and some are directly exposed to the sun. No place remains wet after a few rainless days, and in long dry periods even the moss becomes dry and brittle. In some moss-free areas the rock surface is covered with lichen. Thus, animals living on the limestone walls may be subjected to conditions ranging from rain-soaked moss with water freely flowing down the rock to complete dryness and exposure to full sun.

The entire lower eastern part of the hill was searched for snails on nine occasions between February 1960 and June 1961, and within a selected 30 foot length of well-shaded rock face ("A" in Fig. 1), four-inch-square samples were taken at random from between ground level and seven feet above ground. A four-inch metal frame was used, and all material within it brushed into a container. This rock face "A" lies roughly on a line 115° east of North, thus facing about 25° east of North. It is thus well shaded during

the months of the northern winter, but receives sunlight during the northern summer. Large areas of this section are covered by moss, and there are areas, particularly at each end, where the rock is bare.

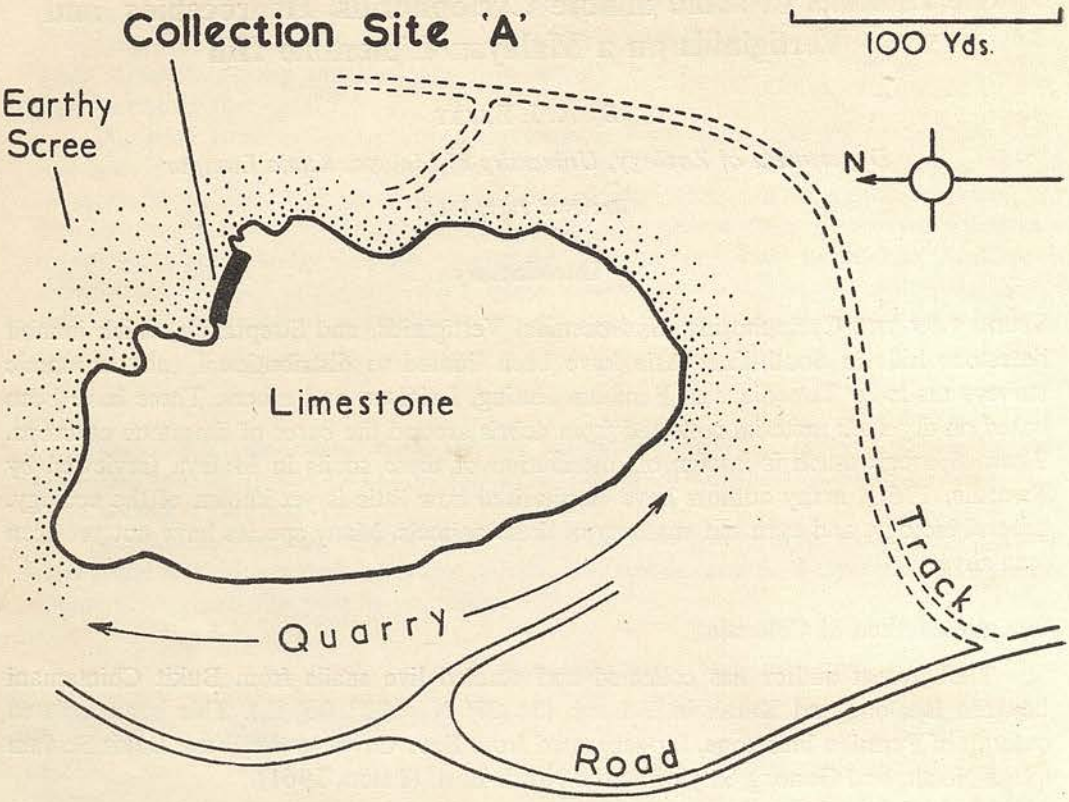

FIGURE 1

Sketch plan of Bukit Chintamani with the location of the site where four-inch-square samples were collected.

The gastropod fauna

The snails so far known from Bukit Chintamani include the following:— (see Tweedie, 1961):—

Cyclophoridae:	*Opisthostoma (Plectostoma) retrovertens* Tomlin
	Opisthostoma (Opisthostoma) hypermicrum van Benthem Jutting
	Diplommatina ventriculus v. Möllendorff
Hydrocenidae:	*Hydrocena monterosatiana* (Godwin Austen & Nevill)
Vertiginidae:	*Gyliotrachela hungerfordiana* (Möllendorff)
	G. depressispira van Benthem Jutting
	Hypselostoma terae Tomlin
Streptaxidae:	*Oophana eutropha* van Benthem Jutting
	Sinoennea chintamanis Tomlin

Of these I have so far found alive *Opisthostoma (P) retrovertens, Hydrocena monterosatiana, Gyliotrachela hungerfordiana, G. depressispira,* and *Hypselostoma terae.* It is possible that failure to find the remainder has been due to their low numbers or to their inhabiting special niches such as soil pockets in the rock, particular plants, or the less accessible parts of the hill.

Various other snails occur in the immediate neighbourhood of the hill. *Achatina fulicha* (Ferussac) is abundant. *Hemiplecta cymatium* (Pfeiffer), *Cyclophorus perdix tuba* (Sowerby), and others not limited to limestone regions, occur on the earthy scree around the hill.

The species on the limestone itself were found to have particular habitat requirements and occurred most abundantly in particular situations on the rock face. The areas directly exposed to the sun, with little or no shade, bore no snails or vegetation. Regions which were shaded and where there was complete lichen coverage had very few snails; snails were hardly ever found actually on lichen. Regions which were shaded and free of lichen and moss were inhabited by the two species of *Gyliotrachela* and by *H. monterosatiana.* Moss-covered areas yielded *O. retrovertens, H. monterosatiana,* and *G. hungerfordiana.*

Table 1 shows details of the occurrence of adult snails in four-inch-square samples collected in February 1960, December 1960, and in June 1961. *O. retrovertens* is seen to occur only on moss-covered rock, and has never been found on bare surfaces. *Hydrocena* occurs among moss and on bare rock, but in larger numbers in the former situation. *G. depressispira* was found only on bare rock, and never on moss. On the other hand *G. hungerfordiana,* while preferring bare rock, was also found in small numbers among moss. The numbers of *Hypselostoma* seem hardly sufficient to allow any conclusions as to its optimum habitat, and it is possible that greater numbers of this species may be found in situations as yet unlocated.

Except for *Opisthostoma,* all regions of Bukit Chintamani confirmed that the habitats of each species were as in the sampled region. *O. retrovertens* was only found in rock face "A". Similar rock faces with apparently identical moss coverage and other general conditions occur North and South of "A", but *Opisthostoma* was not found on them. At present no reason can be offered for the apparent restriction of this species to a relatively small part of the hill.

Discussion

Opisthostoma and *Hydrocena* are both prosobranches and respire by gills and a vascularised mantle wall. The gills, however, are reduced and probably play a small part in respiration. In periods of dryness both can close the shell aperture with the operculum, and *Opisthostoma* has survived four months on unmoistened dry moss in the laboratory; but while active both might be very susceptible to dessication. It seems likely that the air in a dense growth of moss will remain more constantly humid than that near a bare rock surface, and that this will be important to prosobranch snails.

Table 1 shows that the numbers of *Opisthostoma* and *Hydrocena* were greatest in the February 1960 collection, and that relatively few *Opisthostoma* were found in June 1961. Ten four-inch-square samples taken on 25th May, 1961 from moss covered areas in the collecting zone "A" contained an average of only 1.7 adult *Opisthostoma.* It may be that the heavier rainfall in the period September–January in this region of Malaya

TABLE 1

Numbers of snails in four-inch-square samples collected from rock-face "A", Bukit Chintamani.

Date	Species	Samples from Moss-Free Surfaces											Samples from Moss-Covered Surfaces										
		1	2	3	4	5	6	7	8	9	10	Ave.	1	2	3	4	5	6	7	8	9	10	Ave.
7–2–1960	*O. retrovertens*	0	0	0	0	0	0	0	0	—	—	0.0	10	11	12	13	8	23	19	22	—	—	14.7
	H. monterosatiana	9	11	9	7	7	10	8	6	—	—	8.4	16	14	14	15	12	5	11	8	—	—	11.9
	G. depressispira	7	9	3	6	3	4	5	5	—	—	5.3	0	0	0	0	0	0	0	0	—	—	0.0
	G. hungerfordiana	1	3	7	4	0	2	3	2	—	—	2.8	1	0	0	0	0	5	2	4	—	—	1.5
	Hypselostoma terae	0	0	0	0	0	0	0	0	—	—	0.0	0	0	0	0	0	1	0	1	—	—	0.25
14–12–1960	*O. retrovertens*	0	0	0	0	0	0	0	0	—	—	0.0	10	8	6	15	11	9	5	7	—	—	8.9
	H. monterosatiana	6	12	8	11	5	9	4	7	—	—	7.8	12	10	15	11	7	10	8	3	—	—	9.5
	G. depressispira	4	7	3	2	0	6	0	8	—	—	3.8	0	0	0	0	0	0	0	0	—	—	0.0
	G. hungerfordiana	3	0	3	6	2	3	5	0	—	—	2.8	0	2	1	0	0	1	2	0	—	—	0.8
	Hypselostoma terae	0	0	0	0	1	0	0	0	—	—	0.13	0	1	0	0	0	0	0	0	—	—	0.13
26–6–1961 (moss-free)	*O. retrovertens*	0	0	0	0	0	0	0	0	0	0	0.0	4	3	3	8	7	3	5	3	12	4	5.2
	H. monterosatiana	11	3	2	19	9	12	6	2	1	8	7.3	11	8	18	3	32	6	8	2	6	5	9.9
	G. depressiapira	2	0	2	2	0	13	6	7	3	11	4.6	0	0	0	0	0	0	0	0	0	0	0.0
21–6–1961 (moss-covered)	*G. hungerfordiana*	1	2	1	6	7	0	0	0	1	1	1.9	0	0	1	1	0	0	0	0	0	0	0.2
	Hypselostoma terae	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0.0

(Dale, 1959), may cause a seasonal increase in the numbers of snails at this time, and that the relatively dry period of February–August may cause mortality or a slowing in the reproductive rate.

Gyliotrachela on the other hand is an air breathing pulmonate, and thus less likely to be affected by dryness and fluctuations in the humidity of the air. During long periods of dryness individuals seal the rim of the aperture to the dry rock surface with mucus and remain immobile. In the laboratory this inactive period has lasted up to 34 days in the case of *G. depressispira,* when activity commenced on moistening.

Besides respiratory and water-loss considerations, the food of the snails appears to be correlated with their habitats. The stomachs of dissected *Opisthostoma* contained mostly groups of algal cells, scraped from the rock and moss, and occasional fragments of moss itself. *Hydrocena* stomachs contained algae, fragments of moss, and in the case of those on bare rock, varying amounts of lichen. The stomachs of *Gyliotrachela* usually contained algal cells, often large amounts of lichen, but never fragments of moss.

References

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