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OBSERVATIONS ON REPRODUCTION, AESTIVATION AND POLYMORPHISM IN THE SNAIL, *LIMICOLARIA MARTENSIANA* (SMITH) FROM THE QUEEN ELIZABETH NATIONAL PARK, UGANDA.

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The land snail, *Limicolaria martensiana* (Smith) (Pulmonata-Achatinidae) is widely distributed in the Queen Elizabeth National Park, Uganda which lies in the western limb of the Rift Valley. The snail exists in five different polymorphic forms described as Streaked, Pallid 1, Pallid 2, Pallid 3 and Broken-streaked or Pallid 4 (Owen 1966, 1969). The frequency of polymorphic forms both in the living and fossil sites at Kichwamba and Kabazimu Island in Lake Edward have been described by Owen. The fossils date from 8,000 to 10,000 years old when widespread volcanic activity took place in the area and killed the snails as well as other animal life (Owen 1963). Owen (1964, 1967) has also described the occurrence of bimodal breeding peaks correlated with a biannual pattern of rainfall in this species in other areas; and aestivation during drought leading to the production of live young. All of the published work on the snails from the Park was carried out by Owen south of the Equator and was related to polymorphic forms. The purpose of the present study was to investigate further the aestivating behaviour of snails and to establish variations in the frequency of the different polymorphic forms in the previously undescribed northern part of the Park.

The present study area was a scattered forest of the *Euphorbia dawei* N.E.Br. trees (30° 05'E, 0° 07'N) used by Pink-backed Pelicans (*Pelecanus rufescens* Gmelin) and Marabou Storks (*Leptoptilos crumeniferus* (Lesson)) for nesting. The ground under the forest is covered with clumps of the bushes of *Capparis tomentosa* Lam. and *Securinega virosa*. (Roxb. ex Willd.) Baill. The snails were normally found on the ground in the shade of the bushes or feeding on the leaves. No living snails were found in the open patches of grass between the bushes although shells of dead snails were common. The surrounding vegetation of the forest consists largely of open savanna grassland of *Imperata cylindrica* (L) Beauv. studded with *Capparis* bush and *Acacia* trees. Further description of the vegetation in and around the forest is given by Din (1970). Attention was focused on a small area in the northern section of the forest 85×85m in extent. Usually two samples (sometimes one), each consisting of four quadrats (1 sq. m) were taken within the sample area. The bush and ground vegetation had to be cleared before taking the sample. The snails were stored in a large Kilner jar and transported to the laboratory for examination. The snails were boiled until dead and the body removed from the shell

with a needle. At times the columella adhered to the body in which case the shell had to be broken piecemeal with a thin pair of forceps until the body could be released. Eggs or young were conspicuous in the uterus but they were counted after rupturing the uterus. The eggs varied in coloration from pale yellow to white. The results are shown in Table 1.

Date	A	NA	Total	%A	Ground	Mean Rainfall (mm)
10. 1.69	45	160	205	22.0	Dry	Jan., 35.0
24. 1.69	4	293	297	1.3	Wet	
7. 2.69	1	215	216	0.5	Wet	Feb., 30.0
6. 3.69	1	347	348	0.3	Wet	
14. 3.69	0	224	224	0.0	Wet	Mar., 100.0
21. 3.69	0	249	249	0.0	Wet	
2. 4.69	345	0	345	100.0	Dry	April., 110.0
17. 4.69	2	195	197	1.0	Dry	
7. 5.69	0	154	154	0.0	Wet	May, 95.0
23. 5.69	0	158	158	0.0	Wet	
6. 6.69	0	65	65	0.0	Wet	June, 30.0
16. 6.69	48	40	88	54.5	Dry	
27. 7.69	100	0	100	100.0	Dry	Jul., 20.0
30. 7.69	10	73	83	12.0	Dry	
6. 8.69	123	0	123	100.0	Dry	Aug., 50.0
14. 8.69	48	60	108	44.4	Dry	
4. 9.69	1	52	53	1.9	Wet	Sept., 60.0
22. 9.69	0	62	62	0.0	Wet	
6.10.69	0	82	82	0.0	Wet	Oct., 95.0
22.11.69	0	80	80	0.0	Wet	Nov., 92.0
3.12.69	34	72	106	32.1	Dry	Dec., 70.0
Total	762	2,581	3,343	22.8	—	—

TABLE 1. The number of Aestivating (A) and Non-Aestivating (NA) snails in the *Euphorbia dawei* forest near Kamulikwezi in Queen Elizabeth National Park.

From the table it is clear that snails aestivate when the weather is dry. Before aestivating a thin layer of mucus is secreted over the mouth of the shell. When the weather is wet snails come out of their aestivation and begin to move about. The duration of the period of aestivation in the snail population could not be estimated accurately due to irregular sampling but they may go into aestivation even within a rainy season if dry periods exist. It is not clear what factors stimulate the snail to terminate its aestivation but according to Owen (1967) it is probably the pressure in the uterus of live young produced while the parent is still in aestivation—an 'internal synchronisation' correlated with the onset of the dry season. In the case of adult or immature snails which do not have eggs or young in the uterus, the termination of aestivation remains obscure. In the north of the Park, the two wet and two dry seasons in a year are well marked although variations in the amount of rainfall may occur from one year to another. In the sampled population aestivation was observed during the dry season of December and January but some rain during February prevented further aestivation. March, April and May are usually rainy months and sudden aestivation observed during April (2.4.1969) was again probably related to a short dry spell. The second dry season of June, July and August was observed to cause some aestivation in the snails but no aestivation was noticed, as expected, during the next wet season i.e. September, October, and November. It is thus concluded that aestivation is correlated with alternation of wet and dry seasons but short spells of drought during a wet season may also cause aestivation.

Out of a total of 3,343 snails sampled 1,305 (39%) were classed as mature i.e. $\geqslant$ 4.0 cm in length and 2,038 (61%) as immature. The mean clutch size of 114 gravid snails examined was found to be 12.5 (6 = 4.5). The clutch size given by Owen (1967)

in a population near Kampala was 9.2 (n = 54). Although both populations exist near the Equator, a larger clutch size in the former may be due to abundance of food and its undisturbed habit.

Using Owen's (1969) terminology for polymorphic forms 897 snails examined showed four distinct patterns consisting of Streaked (42.5%), Pallid 1 (34.9%), Pallid 2 (13.6%) and Pallid 3 (9.0%). The fifth form, Broken Streaked was absent from the population. This form is generally rare and Owen (1969) has noted its presence at very low frequencies in only three of the Park populations he sampled. Further, in the population near the Equator road, only Streaked (44.4%) and Pallid 1 (55.6%) forms were present. In the Kamulikwezi population under study at a distance of 17 km from the Equator road population, there are significant differences and the two populations are separate. The frequency of polymorphic forms is related to the density of snails in any one area and not to habitat. The Streaked form was found by Owen (1965) to be high in populations which were least dense, and low in populations which were dense. In populations with densities more than 100 per sq. m. the Pallid forms were present but in populations with less than 20-30 per sq. m the Pallid forms were almost rare. In the present study, at an average density of 52 per sq. m, the Streaked and Pallid 1 forms were the most common. Other than the four distinct polymorphic forms present, there are various intermediate patterns which were left unclassified.

The total area in which the snails live is 1.945×10^8 ha (750,000 sq. m) and harbours a population of about 42 million snails. This appears to be the largest discrete population from Uganda. The next biggest being from 70 to 80 thousand described by Owen (1967) in an area of 8.945×105 ha (3,450 sq. m) near Kampala.

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