Observations on the Movement and Diurnal Activity of the Giant African Snail in Hawaii (Pulmonata: Achatinidae)[1]

GEORGE D. BUTLER, JR.
UNIVERSITY OF ARIZONA, TUCSON, ARIZONA

(Submitted for publication September, 1964)

One of the outstanding characteristics of populations of the giant African snail, *Achatina fulica* Bowdich, is an extensive movement of the snails during favorable periods. An understanding of the factors influencing this movement is important in the development of sampling techniques, determination of the rate of spread and development of effective control measures.

Lange (1950) observed that the giant African snails on Saipan were more active at night than during the day, although they continued to feed during overcast or rainy days. The daytime refuges included trees, fence posts, sides of buildings, rock piles, and undersides of various objects. Chamberlin (1952) made extensive observations on the activity of the snails on Tinian, Mariana Islands. Snails were observed to migrate each night in the upwind direction over airstrips, roads, and even through vegetated areas. Certain factors such as topography, food, cover, and visual stimulation modified the precision of this amenotaxis.

The present author observed the distance and direction of movement of giant African snails during September 1958, in the Tantalus section of Honolulu, Hawaii, altitude 670 feet, in a dense *Leucaena glauca* area. A large tree was designated as the center point and four 80-foot strings were laid on the ground at right angles to each other from this point. Seven additional strings were laid out to form concentric circles at 10-foot intervals. String was found to be a poor marking material, as the snails consumed much of it, but, enough remained that this study could be completed. One thousand snails in the innermost, 20-foot diameter circle, were marked with a wide band of white enamel. No snails were added to this group and almost all those present at the start of the study were marked.

The number of marked snails in each quadrant and concentric circle was recorded 1, 3, 4, and 12 days later. The distances the snails had traveled are shown in Table 1. Within 24 hours, an outward movement had taken place, with an average distance traveled of 23.5 feet. Five individuals had traveled from 60 to 70 feet. This maximum day's travel on vegetated terrain agrees

[1] Presented at the Tenth Pacific Science Congress of the Pacific Science Association, held at the University of Hawaii, Honolulu, Hawaii, U.S.A., 21 August to 6 September, 1961, and sponsored by the National Academy of Sciences, B. P. Bishop Museum, and the University of Hawaii.

closely with the 63 feet observed by Chamberlin on Tinian. Four days after marking, the snails had traveled an average of 38.4 feet, but some snails had left the observation area, which was 80 feet in radius. Marked snails were found 100, 120, 140, 165, and 260 feet in various directions from the point where they were marked.

Table 1. Number of giant African snails recovered at various distances from marking site. All snails (1,000) within 10 feet of center marked September 5, 1958. Honolulu, Hawaii

Maximum Distance from Center in feet	Sept. 6	Sept. 8	Sept. 9	Sept. 17
10	115	73	68	62
20	152	116	112	53
30	85	111	113	42
40	35	47	72	34
50	19	22	56	28
60	6	15	59	18
70	5	8	18	16
80	0	4	15	6
No. snails	417	396	483	259
Av. ft./snail	23.5	28.1	38.4	32.3

The ground in the experimental area had a gentle slope and two lines of string were laid to demark an uphill and downhill half. The numbers of snails that were recovered in the two halves of the observation area are given in Table 2. There was a consistently larger number of snails in the uphill half. The magnitude of the directional movement was not nearly as great as that observed by Chamberlin on Tinian and the experiment was terminated without determining the cause of the movement. However, the movement was probably of importance in relation to the spread of the snails, as in this area of Honolulu the "front" of the infestation at that time was only a few hundred yards farther up the hill from the experimental area and was spreading upward.

Table 2. The number of giant African snails recovered uphill and downhill from marking site, Honolulu, Hawaii

Date	Uphill Half	Downhill Half	Date	Uphill Half	Downhill Half
Sept. 6	249	168	Sept. 9	272	211
Sept. 7	175	128	Sept. 13	199	174
Sept. 8	221	175	Sept. 17	134	125

Preliminary observations on the diurnal activity of the snails were made in a dense stand of *Leucaena glauca,* where large numbers of snails were observed resting on the dead branches of a few *Montanoa hibiscifolia* trees during the day. On September 8, on two branches of one tree 150 snails were painted red with an aerosol enamel bomb, as were 50 snails on another tree nearby, and 200 snails on the ground were painted yellow.

The distribution of the snails on the following morning is shown in Table 3. Many snails left the *Montanoa* trees at night and did not return, but their places were taken by an almost equal number of other snails. Fewer yellow snails, those marked on the ground, were found, and may have moved outside of the observation area because they had a head start over those that were up on the trees. On September 13, there were 22 red snails on the original tree, indicating that, for some individuals at least, there is the type of homing as observed by Hatai and Kato (1943).

Table 3. The number of snails recovered September 9, 1958, 24 hours after marking

	On Trees Where Marked	On Other Trees	On Ground	Total
Red snails	14	3	68	85
Yellow snails	6	7	27	40
Unmarked	172	—	—	—
Total	192			

More detailed observations of the diurnal cycle of activity of *Achatina* were made at Kaneohe, Hawaii, during a 42-hour period. Thirty trees (nine guava, six banana, seven haole koa, six kukui nut and two unknown) were selected in a wooded area along the bank of a stream, and an observation area on each tree trunk was marked by bands of paint. The number of sedentary snails and of active snails (with foot and tentacles extended), on each tree was recorded at 3-hour intervals. The number of snails on the ground was recorded by counting the number of snails in 30 yard-square areas, including 10 with sparse plant cover, 7 with gravel, 6 with heavy plant growth, 5 of open forest floor and 2 unclassified. Temperature and humidity readings were obtained in the test area with a dry and wet bulb thermometer.

The results of observations made at 3-hour intervals are presented in Table 4. The snails were all sedentary on the trees at noon and 3 P.M. At 6 P.M. some of the snails were active and began to leave the trees. Chamberlin observed that on Tinian the onset of activity of snails at the end of clear days was from about 4:30 to 6 P.M. In our observations, most of the snails left the trees by 9 P.M., with the smallest number of snails on the trees at midnight. At 3 A.M. some of the snails were returning to the trees, and by 6 A.M. many snails were back, approximately half of which were still active. Most of the snails had settled down on the trees by 9 A.M., and by noon all activity had ceased. Some trees had more than 60 snails in their sample areas during the day. The activity of the snails on the ground was essentially the reciprocal of the activity on the

Table 4. The number of giant African snails observed at three-hour intervals at Kaneohe, Hawaii, September 22–24, 1958

	On Trees			On Ground				
Date	Sedentary	Walking	Total	Sedentary	Walking	Total	Temp.	Humid.
Sept. 22								
4 pm	579	0	579	35	0	35	73	77
6 pm	357	145	502	22	10	32	72.5	80
9 pm	19	38	57	14	96	110	72.5	87
12 mid.	11	8	19	12	104	116	—	—
Sept. 23								
3 am	25	33	58	1	82	83	72	87
6 am	154	104	258	10	33	43	71	82
9 am	423	9	432	16	12	28	72	87
12 noon	457	0	457	25	0	25	73	75
3 pm	452	0	452	24	0	24	71	71
6 pm	427	29	456	22	0	22	71	80
9 pm	55	33	88	3	98	101	70	76
12 mid.	27	4	31	2	116	118	68	70
Sept. 24								
3 am	31	45	76	4	84	88	70	82
6 am	156	137	293	21	43	64	70	82
9 pm	402	19	421	26	5	31	70.5	65

trees. The period of maximum activity on the ground was at midnight. The density of snails on the ground varied from less than one per square yard during the day to almost four per square yard at night. Individual samples varied from 0 to 16 snails per square yard.

In addition to a count of the number of snails in 30 scattered yard-square areas on the ground, snails were also counted in a single yard-wide transect 30 yards long. When the total number of snails observed in each observation period in this transect was compared with the number of snails in the yard-square areas, a correlation coefficient value of "r" equal to 0.96 was obtained. This high correlation indicated that a single continuous sample area gave as good an estimation of the snail activity as scattered small sample areas, which were more time consuming to set up and to check. The time to obtain a maximum snail population count for such an area would be at midnight.

LITERATURE CITED

Chamberlin, J. L. 1952. Final report on an ecology and population study of the giant African snail on Tinian, Marianas Islands. Pacific Sci. Board, Nat. Research Council, Invertebrate Consultants Committee for Micronesia, pp. 1–21.

Hatai, S. and G. Kato. 1943. Observations upon growth of shells and ecology of Achatina fulica Ferussac in Palau. (*In* Chamberlin, J. L. 1952. Final report on an ecology and population study of the giant African snail on Tinian, Marianas Islands. Pac. Science Board, Nat. Research Council, Invertebrate Consultants Committee for Micronesia p. 19.)

Lange, W. M., Jr. 1950. Life history and feeding habits of the giant African snail on Saipan. Pacific Science 4: 323–335.