Studies on *Erosaria lamarckii* Gray (Gastropoda)

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(Mr. Benton collected all Erosaria lamarckii from Port Reitz, described the locality and forwarded the statistical data of 179 specimens to the Schilders who added the data of another 105 specimens from Port Reitz and of 269 from other localities, and investigated the results statistically.)

There are two geographical races of Erosaria lamarckii Gray: the Indian E. l. redimita Melvill (abbreviated "I" in this paper) from Penang to Karachi, the Seychelles, and Mauritius, and E. l. lamarckii s. str. (abbreviated "A") from Natal to Ras Ngomeni in Kenya; in Madagascar both races seem to occur (see Schilder, 1938). Recently, we have examined a large population living at Port Reitz near Mombasa, Kenya, which seems to be intermediate in some respects (abbreviated "R").

Port Reitz is named after Lieutenant Reitz of the Royal Navy who died in Mombasa as commandant of the island in 1825. It is merely an extension of Mombasa's main harbour, Kilindini, and is used as an anchorage for ocean-going vessels. The Erosaria lamarckii lamarckii have been found in two restricted areas on the shores of Port Reitz, namely, at an unnamed place on the north shore and at Ras Kigangone, or Flora Point, on the south shore. The rise and fall of the tide in these waters attains a maximum of 13 feet, and all cowries have only been found at very low spring tides. The water has always been very dirty and opaque.

On the north shore at low tide the sand of the beach gives way to thick black mud interspersed here and there with areas of mud-covered rock on which are found broken fragments of rock and weeds. It is in these areas that hundreds of Erosaria lamarckii lamarckii were found, usually partially hidden but always to some extent exposed to the unnatural elements of sun, rain, and wind. In the same place another cowrie, Monetaria moneta (Linnaeus, 1758), was very abundant, and E. erosa (Linnaeus, 1758), E. helvola (Linnaeus, 1758), and Erronea caurica (Linnaeus, 1758) were common, but Palmadusta diluculum (Reeve, 1845) [and one specimen of P. ziczac (Linnaeus, 1758)] were rare.

The conditions at Flora Point on the southern shore appear to be the same as on the northern, but here Adusta onyx (Linnaeus, 1758) predominated over Erosaria l. lamarckii; Erronea caurica was quite common; and Erosaria erosa occurred occasionally; but no Monetaria moneta nor Palmadusta diluculum were found. No explanation can be given for the complete absence of M. moneta nor for the apparent transposition of the relative frequencies of E. l. lamarckii and A. onyx between the two localities which are less than a mile apart. The collecting ground on the south shore is closer to the actual harbour at Kilindini and therefore receives more refuse from the ships. Deepwater berths have recently been constructed and opened to shipping, and one could be inclined to the belief that pollution of the water may be responsible for the present absence of cowries, which is hoped to be temporary only. Besides, the disturbance of the creek-bed by dredging has caused the collecting areas to be coated with a blanket of weed not hitherto seen.

The following characters of shells have been investigated in this study:

L = the length of the shell, measured in tenths of a millimeter, reduced to mm., and tabled in classes the indicated means of which differ by 3 mm. (e. g., 18 = 16.5 to 19.5 mm.).

BL = the maximum breadth, expressed in percent of the length.

DL, DC = the closeness of the labial and columellar teeth respectively, expressed by letters (earlier letters of the alphabet indicate less numerous teeth than later letters; see Schilder, 1958).

DF = the number of real denticles on the inner border of the fossula.

Co = the color of the dorsum expressed by two letters, the first of which indicates the prevalent shade. As in previous papers, we have distinguished: a = white; b = brown; f = fulvous; g = grey; l = orange; n = black; v = green (see Schilder, 1952). In summarizing, the prevalent color has been considered of double the value of the accessory shade.

Oc = the development of lilac grey ocelli within the white dorsal spots (the lateral ones excluded), expressed by the letters: i = absent; v = pale or scarce; and n = well developed (see Schilder, 1952).

In the tables the sign "0" indicates rare frequency in less than 0.5 percent, whereas the sign "-" indicates total absence.

LENGTH

The following table illustrates the variation in size, expressed in classes of 3 mm. (see above); the figures indicate percent of 143 I (including the data published in the diagram by Griffiths, 1956), 284 R, and 126 A.

	18	21	24	27	30	33	36	39	42	45	48	51
I	1	1	10	21	27	21	10	7	2	-	-	-
R	-	0	4	11	36	27	14	6	1	0	-	-
A	-	-	-	1	5	14	24	18	20	13	4	1

The exact means are: I = 30.6; R = 31.9; and A = 38.6 mm. The difference between I and A is mathematically significant, but R is similar to I instead of to A as one would expect on the basis of geographical reasons. The median length in large areas is as follows:

No.	I	mm.	No.	A	mm.
66	Penang (Griffiths)	29	16	Natal	39
			23	Mozambique	37
25	Mergui — Bombay	34	46	No locality	40
			30	Zanzibar, etc.	39
19	No locality	30			
28	Karachi	31	11	Madagascar	35
5	Lemuria	30			

The 28 I shells from Karachi were erroneously credited to Aden by Schlesch (see Schilder, 1931).

The medians of I (29 to 34) distinctly differ from those of A (37 to 40), the dwarf A of Madagascar excluded.

BREADTH

The relative breadth varies considerably. The mean and the range (in brackets) of 90 percent of the least unusual shells (see Schilder, 1961) are as follows:

I = 65.9 (60-71)
R = 67.6 (62-73)
A = 64.4 (59-70)

Therefore, the average shells of R seem to be broader than both I and A. But there is a distinct correlation between length and relative breadth, as larger shells usually are more slender than small shells, so that the mean index BL of shells of 25 30 35 40 mm.

	25	30	35	40
is, in I:	70	66	63	59
in R:	73	69	65	62
in A:	-	72	68	64.

These rough figures prove R to be intermediate between I and A with regard to its relative breadth.

DENTITION

There is no difference between I and A with regard to the closeness of the teeth on both lips, and R also agrees with both. The median of labial:columellar teeth is in each group l:k, the range of 90 percent of 441 shells is (i-n):(h-m).

FOSSULA

The number of the fossular denticles varies from 1 to 5; the average number and the range (in brackets) of 90 percent of the shells are as follows:

I = 2.0 (1-3)
R = 2.1 (1-3)
A = 2.8 (2-5)

But as larger shells show, on an average, more denticles than smaller shells of the same race, these figures exaggerate the larger figure in A: according to the regression line one must expect in A of a length comparable to I and R (32 mm.) at most 2.5 fossular denticles, so that the general increase from I over R to A becomes less distinct.

COLOR

The occurrence of the various shades explained above is as follows (expressed in percent of 69 I, 272 R, and 78 A):

	a	v	f	l	b	s	g	n
I	0	14	64	2	14	5	0	-
R	0	8	24	1	57	7	2	0
A	0	8	23	1	56	6	5	1

There is a striking similarity of R to A, whereas I is quite different: the paler shades (f, v, a) amount to less than one-third only in A and R, but to more than three-quarters in I.

OCELLATION

The distribution of the three varieties in dorsal markings, called i:v:n, has been expressed in percent of 69 I, 272 R, and 78 A, as follows:

I = 94:4:2
R = 32:28:40
A = 5:23:72

Therefore, I and A are contrary, and R evidently is intermediate between the white spotted I and the ocellated A.

Summary

There is a distinct statistical difference between the eastern Erosaria l. redimita (I) and the western E. l. lamarckii (A) concerning the length of the shells, the general color of their dorsum, and the ocellation of the white dorsal spots; the differences in the relative breadth and in the denticulation of the fossula are less obvious, and in the closeness of the teeth along the aperture there is no difference at all.

The population living in an isolated area at Port Reitz near Mombasa, i. e., on the northern limit of the East African Erosaria l. lamarckii, agrees with the latter in the brown dorsal color only; its size and fossula rather agree with E. l. redimita, which spreads from Malacca to the Seychelles not too far from the Kenya coast, so that one could suspect genetical influence; the breadth and the dorsal markings are intermediate. Therefore, the population of Port Reitz is exactly intermediate between the widely distributed Indian and African races, both geographically and morphologically.

The few shells coming from Madagascar seem to connect the two races in another way.

APPENDIX

Among 75 specimens from Port Reitz which were examined also anatomically, there were 34 females and 41 males (sex ratio: females = 45 percent). The average length of the shells, the animal of which could be examined, is 32.68 mm. in females and 31.95 mm. in males; the relative breadth is 68.47 and 67.46, respectively. Therefore, the females seem to be slightly larger and broader (especially in view of the fact that larger shells generally are more slender); but the difference is by no means significant mathematically. In the other characters there is evidently no sexual difference at all. The radula will be discussed in another paper.

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