VARIATION IN SIZE AND WEIGHT IN FIVE SPECIES OF HOUSE-RATS (RODENTIA: MURIDÆ), IN RANGOON, BURMA.

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INTRODUCTION.

The "average" length of the body-parts is frequently used as a specific or subspecific character. Yet, the average or mean lengths of most animals are rarely known with accuracy. Take, for example, the following key for the bandicoots, condensed form Wroughton (1919) :—

Size larger, head and body more than 250 mm ; mammae 3+3=12 . . .	*Bandicota.*
Size smaller, head and body at most 225 mm.—	
Mammae 16 to 18	*Gunomys.*
Mammae 2+2=8	*Nesokia.*

What, then, is our specimen No. 23.7.11 of length 190 mm., mammæ 14 ; or No. 6. 23. 10 of length 240 mm., mammæ 17; or No. 4. 1. 11, a. of length 270 mm. ? Clearly, there is need for more information about the range of variation of our commonest animals—variation both of individuals in the same population and of communities in different districts. Huxley (1940, p. 39) points out the importance of measurements of a few characters on a reasonably long series of animals.

In Rangoon, during 1945, rat control measures gave us the opportunity of examining some thousands of bodies of rats of five species. Some standard measurements were made and the statistical results are given here.

Summarizing such results presents a difficulty. The "average" so often quoted, may imply arithmetic or geometrical mean, mode median, or more doubtful statistics. The "range", which is even more often used, depends so much on the number of specimens examined and the chance occurrence of extremes that it is of little value and may indeed mislead. The arithmetic mean with the standard deviation is the best way of expressing results which are distributed normally, and it is the method suggested by Huxley, but is not suitable for skew distributions, and most of our results show marked negative skewness. The method adopted, therefore, has been to give the arithmetic mean, the range and an abbreviated frequency table showing the percentage of measurements in each group to the nearest one per cent.* indicates that observations occured in that group, but with a frequency of less than 0·5%.

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OBSERVATIONS.

The following measurements were recorded :—(1) Length of head-and-body (in mm.) measured from the tip of the nose to the anus. (2) Length of tail (in mm.), measured with the tail in line with the body, from the anus to the tip, excluding hairs. This is expressed here as a percentage of the head-and-body length. (3) Length of hind-foot, excluding claws (in mm.). (4) Weight in grams.

These are tabulated for all apparently adult rats (see below) in Tables 2 to 7, while the mean values for the members of the youngest litter which had been obtained for each species are given in Table 1. Such litters were newly born or a few hours old. The sexes have been tabulated separately where a sufficient number of specimens were available.

The species of rats dealt with, together with some additional observations on each, are summarized below. The nomenclature is as given in Ellerman (1941 ; 1947).

1. **Bandicota bengalensis** (Gray and Hardwicke).

Syn.—*Nesocia bengalensis* of Blanford and *Gunomys bengalensis* of Wroughton.

This species was one of the most abundant. The number of mammæ recorded was variable and frequently asymmetrical. The frequency of the various totals in 281 females examined were :—

No. of mammae	12	13	14	15	16	17	18	19	20
Frequencies	3	2	10	33	96	68	44	21	4

The number of embryos in 33 visibly pregnant females varied from 2 to 13, with no marked mode.

2. **Rattus norvegicus** (Berkenhout).

This species was of limited distribution and less than 100 adults were examined. The mammary formula was uniformly 3+3=12. In 9 visibly pregnant females the number of embryos varied from 3 to 9.

3. **Rattus rattus** (Linné).

The Rangoon form of this species appears to be allied to *R. r. khyensis* Hinton and *R. r. tikos* Hinton. There appears to be a cline in this species from *R. r. khyensis* in the Chin Hills to *R. r. jalorensis* in Malaya (Chasen, 1933). Of 154 specimens seen only 3 tended towards the grey bellied cosmopolition form, and two more showed a dark streak down the centre of the underside ; the remainder were bright brown above and brilliant white below. The number of mammæ was variable. In 79 females, the frequencies were :—

Mammæ 2+3=10	8 rats
Mammæ 11	5 rats
Mammæ 3+3=12	66 rats

The number of embryos in 15 visibly pregnant females varied from 3 to 8.

4. **Rattus exulans concolor** (Blyth).

This was the commonest rat. The number of mammæ was uniformly 2+2=8. The number of embryos in 62 visibly pregnant females varied thus :—

2 embryos in each of 4 rats

3 embryos in each of 17 rats

4 embryos in each of 22 rats

5 embryos in each of 14 rats

6 embryos in each of 5 rats

5. **Mus musculus** Linnè.

The number of mammæ was uniformly 3+2=10. Only 2 pregnant females were seen, each with 5 embryos.

General Remarks.

" Apparently adult " is a rather vague classification. In the absence of detailed investigation of the gonads, the final criterion used was that the length of the hind-foot should be less than 25 per cent. of the body-length. This rather arbitrary criterion seemed to work fairly well with *Rattus* spp., but not so well with *Bandicota* in which the hind-feet are shorter in relation to the body.

The numbers of rats on which Table 4 (tail-length) is founded are in each species less than those of other dimensions. This is due to the discarding of rats with damaged tails. If longer tails are more likely to be damaged, the Table will be biased for shorter tails. The proportions of rats with damaged tails in different species throws some light on this, as will be seen from the following data regarding the percentage of specimens with damaged tails :—

Percentage of specimens with damaged tails.

	♂	♀
B. bengalensis	18	10
R. norvegicus	21	17
R. rattus	24	21
R. e. concolor	13	12

The three larger species show a decided increase of damage with tail length, but *R. e. concolor*, with a tail of great relative length (although small absolute length) upsets the series. It is noticeable that 25% of specimens of *R. norvegicus* had tails as long as or longer than the body. In Europe, " tail shorter than the body " is a usual diagnostic character of this species. Perhaps this is an example of " Allen's rule " that the relative size of exposed portions of the body decreases with a decrease of mean temperature.

Fuller statistics of the data presented here have been deposited in the Library of the University of London (Woodville, 1947).

SUMMARY.

1. The measurements of the length of head-and-body, tail, hind-foot, and weight of some thousands of house rats belonging to 5 species, killed in Rangoon in 1945, are summarized. The species were: *Bandicota bengalensis* (G. & H). *Rattus norvegicus* (Berk.), *R. rattus* (L.), *R. exulans concolor* (Bly.) and *Mus musculus* L.

2. The frequency distributions of measurements are negatively skew; so the results are expressed as abbreviated frequency tables.

3. Some notes are given on number of mammæ and embryos, and on the size of young at birth.

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TABLE 1.

Dimensions, etc. of new born rats (youngest litter seen).

Species.	No. of litters seen.	No. of individuals in each litter.	Head and body (mm.).	Tail as % of H. & B.	H. Foot (mm.).	Weight (gm.).
B. bengalensis	3	7, 7, 11	47	49	18·7	5·8
R. norvegicus .	2	5, 6	52	34	8·8	5·6
R. rattus	5	4, 4, 4, 4, 5	45	34	8·2	4·0
R. e. concolor .	11	2-5	37	38	6·0	2·0
M. musculus .	1	6	22	45	5·0	0·8

TABLE 2.

Length of head-and-body, by 25 mm. groups.

Length (mm.).	B. bengalensis. ♂	B. bengalensis. ♀	R. norv.	R. rat.	R. e. concolor. ♂	R. e. concolor. ♀	M. mus.
50—74	0	0	0	0	0	0	53
75—	0	0	0	0	12	17	46
100—	2	1	0	5	70	74	1
125—	8	5	6	28	18	10	0
150—	6	7	17	47	0	0	0
175—	16	28	26	19	0	0	0
200—	32	43	47	1	0	0	0
225—	29	16	3	0	0	0	0
250—	5	0*	1	0	0	0	0
275—299	1	0	0	0	0	0	0
Range	112—290	115—260	130—250	114—200	82—140	82—145	60—100
Mean	207	202	190	158	113	109	77
No. of specimens	391	336	98	154	414	493	80

*See text.

TABLE 3.

Length of head-and-body, in the smaller species, by 10 mm. groups.

Length (mm.).	R. rattus.	R. e. concolor. ♂	R. e. concolor. ♀	M. mus.
60—69	0	0	0	17
70—	0	0	0	49
80—	0	3	3	20
90—	0	9	14	13
100—	0	24	30	1
110—	3	35	36	0
120—	5	21	15	0
130—	9	7	2	0
140—149	16	1	1	0
150 and over	67	0	0	0

TABLE 4.

Length of tail, given as percentage of head-and-body.

Percentage.	B. bengalensis. ♂	B. bengalensis. ♀	R. norv.	R. rat.	R. e. concolor. ♂	R. e. concolor. ♀	M. mus.
60—69	1	1	0	0	0	0	0
70—	32	27	1	0	0	0	0
80—	56	60	39	0	0	0*	0
90—	10	13	35	3	1	1	13
100—	0	0	20	28	18	15	24
110—	0	0	4	36	40	38	41
120—	0	0	1	27	33	33	16
130—	0	0	0	6	7	10	5
140—149	0	0	0	0	1	2	0
Range	68—96	69—99	72—125	90—153	93—143	87—143	92—137
Mean	82	83	95	115	117	119	113
No. of specimens	319	303	80	121	359	435	75

*See text.

TABLE 5.

Length of hind-foot by 2 and 4 mm. groups.

Length (mm.).	B. bengalensis. ♂	B. bengalensis. ♀	R. norv.	R. rat.	R. e. concolor. ♂	R. e. concolor. ♀	M. mus.
12—13	0	0	0	0	0	0	3
14—15					0	0	20
16—17	0	0	0	0	0	0*	50
18—19					0	1	8
20—21	0	0	0	1	10	13	11
22—23					52	66	9
24—25	2	1	2	3	33	19	0
26—27					4	0*	0
28—31	7	3	2	49	0	0	0
32—35	15	30	13	44	0	0	0
36—39	51	64	37	3	0	0	0
40—43	25	3	41	0	0	0	0
44—47	1	0	5	0	0	0	0
Range	24—44	25—42	25—46	21—37	20—30	16—27	13—23
Mean	37	36	38	31	23	23	17
No. of specimens	391	336	98	154	414	493	80

* See text.

TABLE 6.

Body-weight by 50 and 100 gm. groups.

Weight (gm.).	B. bengalensis. ♂	B. bengalensis. ♀	R. norv.	R. rat.	R. e. concolor. ♂	R. e. concolor. ♀	M. mus.
0—49	10	5	10	9	85	91	100
50—				35	15	9	0
100—	16	17	33	55	0	0	0
150—199				5	0	0	0
200—299	18	33	44	0	0	0	0
300—	20	37	13	0	0	0	0
400—	22	7	0	0	0	0	0
500—	12	1	0	0	0	0	0
600—699	3	0	0	0	0	0	0
Range	40—650	55—560	42—375	40—190	12—71	15—71	8—27
Mean	326	279	214	104	39	38	15
No. of specimens	391	336	98	154	414	493	80

TABLE 7.

Body-weight, in the small species, by 5 and 10 gm. groups.

Weight (gm.).	R. e. concolor. ♂	R. e. concolor. ♀	M. mus.
5—9	0	0	8
10—14	3	3	47
15—19			32
20—24	16	13	8
25—29			5
30—39	30	39	0
40—49	36	36	0
50—59	13	7	0
60 and over	2	1	0