

### 3. The specific relations of *Rattus tiomanicus* (Miller)

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#### INTRODUCTION

RATS OF THE subgenus *Rattus* are endemic on many of the islands off the coast of Malaya. In most cases each population is recognisably distinct from other island forms, and from related rats on the Malayan mainland. Many island forms have been described, including *R. tiomanicus* (Miller) the ecology of which has already been discussed (Medway, this *Bulletin*, p. 20). On the mainland three ecologically separated forms occur (Chasen, 1933), namely, the Malaysian House Rat, *diardii*<sup>11</sup> Jentink, the Malaysian Field Rat, *jalorensis* Bonhote, and the Ricefield Rat, *argentiventer* Robinson and Kloss. These three, together with all island forms, were listed by Chasen (1940) as subspecies of *R. rattus* (Linn.) However, Harrison (1961) has surveyed the distribution of these and related rats throughout Eurasia and adjacent regions, and has suggested that the three forms are best regarded as distinct species of *Rattus*, "each of which is a commensal with man, which have been separately introduced into Malaysia, and which have not yet wholly occupied the area" (Harrison, 1961: 23). Independently, Dhaliwal (1962 & 1963) has undertaken a detailed morphological comparison of series of *jalorensis* and *diardii* from two Malaysian localities, and has shown statistically that the two taxa are distinguished by differences of species rank. Both Harrison (1961) and Dhaliwal (1962) have also noted that several of the island forms are little differentiated from *R. jalorensis*, and are better considered races of this species rather than of *R. rattus*.

On the other hand, on Singapore Island (where *argentiventer* is unknown) *jalorensis* occurs only in a very restricted area, probably having been absent until recently (Searle and Dhaliwal, 1961). On the Malayan mainland, in localities where they are sympatric, *jalorensis*, *argentiventer* and *diardii* are separated by habitat preference; but if one or more is absent, the remaining species characteristically expands to occupy the vacant niches (Harrison, 1957). Similarly in Singapore *diardii* occurs in a wide range of habitats, including not only houses but also field and fringe habitats that on the mainland are occupied by *jalorensis* (Dhaliwal, 1961).

*R. argentiventer* is the more highly specialised rat, and its distribution is limited by its relatively stringent ecological demands. But it is clear that either of the more adaptable *diardii* or *jalorensis* may occur on islands, and that in the absence of competition either may exploit an equally wide range of habitats. Consequently the ecology of an island form is no indication of its taxonomic relations.

It appears from the distribution of *jalorensis* on Singapore Island that the species has entered only recently. By inference, the narrow sea barrier of the Straits of Johore had hitherto effectively prevented the spread of this rat. *R. jalorensis* is probably the older commensal rat in mainland S.E. Asia and *diardii* a more

11. The emended spelling *diardi* is preferable to the original *diardii*, (which was used by Chasen, *loc. cit.*), see the *International Code of Zoological Nomenclature* (1961 edition), Article 31, Article 32 (c), and Appendix D (III) 16 (b).

recent introduction (Harrison, 1957). But the case of Singapore Island stresses that it is not possible to assume on theoretical grounds that an island form such as *tiomanicus* is a race of the more ancient species. In fact it is clear that under modern conditions the cosmopolitan *diardii* is better equipped than *jalorensis* to cross the relatively broad sea barrier.

It is characteristic of island situations of this sort, where one of two closely related and normally exclusive species is absent, that the population of the species that is represented should be intermediate in character (e.g., also among Muridae, Cranbrook, 1957). This is true of *tiomanicus*, and it is by no means clear on superficial inspection to which species this island rat should be ascribed. In the present contribution we have attempted to assess the specific relations of *tiomanicus* by detailed comparison of morphological characters.

#### MATERIALS

Measurements of *tiomanicus* are taken from a series of 28 adults of both sexes collected by us from the main island; we have also included 9 adults of both sexes from P. Tulai. For *diardii* and *jalorensis*, where we have not made use of Dhaliwal's published measurements, our figures are based on a series of 17 *diardii* and 18 *jalorensis*, adults of both sexes, collected from Selangor.

The preserved material is divided among the collections of the Institute for Medical Research and the Department of Zoology, University of Malaya.

#### COMPARISON OF CHARACTERS

##### EXTERNAL CHARACTERS

The dorsal pelage of *R. jalorensis* is brown, and relatively sleek with only a slight admixture of soft spines; the venter is white to greyish white. The dorsal pelage of *R. r. diardii* is also brown, but is coarser and harsher; the venter on the mainland is usually brownish grey, but among the population on Singapore Island varies in colour from this shade through grey to nearly white. Dhaliwal (1963), by microscopic study of the hair types, has shown that auchenes and zigzags of the ventral pelage are always unpigmented in *jalorensis*, and always pigmented in even the palest *diardii* and in hybrids between the two forms. Topotypes of *tiomanicus* resemble *jalorensis* dorsally, but ventrally vary like *diardii* from brownish grey through grey to greyish white; both auchenes and zigzags of the venter may be pigmented. The population on Tulai is distinguished by a pure white venter.

Where the two forms are sympatric, *diardii* and *jalorensis* are also readily distinguished by measurement. In Table 1 the principal dimensions in the flesh of two populations of *diardii* and *jalorensis* (from Dhaliwal, 1962) and of our series from Tioman and Tulai are compared. The mean head and body length of *tiomanicus* topotypes is within the total range of variation of *jalorensis* from the two localities; it is also not significantly different from the mean head and body length of Singapore *diardii*. The mean head and body length of the series from Tulai is larger, although not significantly larger than that of Singapore *jalorensis*. In both series the tail is generally longer than the head and body, a characteristic of *diardii* rather than of *jalorensis* (mean  $\frac{T}{HB}\%$  is  $101.5 \pm 1.3\%$  for *tiomanicus* topotypes,  $106.5 \pm 2.1\%$  for the Tulai series). The hind feet are intermediate in length. The ear is within the range of variation of *diardii*, and significantly larger than the ear of *jalorensis*.

TABLE 1.  
Principal measurements of *diardii*, *tiomanicus* and *jalorensis*, in mm given as means  $\pm$  S.E. of mean. Figures for *diardii* (Singapore and Selangor) from Dhalwal (1962).

	<i>diardii</i> (Singapore)	<i>diardii</i> (Selangor)	<i>tiomanicus</i> (Tioman)	Tulai rat	<i>jalorensis</i> (Selangor)	<i>jalorensis</i> (Singapore)
Head and body	184.4 $\pm$ 1.7	170.8 $\pm$ 3.1	170.8 $\pm$ 2.0	178.3 $\pm$ 2.8	167.7 $\pm$ 1.3	176.9 $\pm$ 2.6
Tail	186.9 $\pm$ 1.9	180.5 $\pm$ 4.2	174.1 $\pm$ 2.1	189.3 $\pm$ 5.4	160.6 $\pm$ 1.3	158.8 $\pm$ 4.3
Hind foot	35.2 $\pm$ 0.2	35.0 $\pm$ 0.4	33.3 $\pm$ 0.2	34.4 $\pm$ 0.1	31.7 $\pm$ 0.2	32.7 $\pm$ 0.3
Ear	20.4 $\pm$ 0.2	21.3 $\pm$ 0.3	20.7 $\pm$ 0.1	20.6 $\pm$ 1.0	19.4 $\pm$ 0.1	19.8 $\pm$ 0.3
Occipitonasal length of skull	41.5 $\pm$ 0.2	41.6 $\pm$ 0.3	41.9 $\pm$ 0.9	41.3 $\pm$ 0.1	40.2 $\pm$ 0.4	40.6 $\pm$ 0.9
Length of right anterior palatal foramen	7.7 $\pm$ 0.05	7.7 $\pm$ 0.1	6.8 $\pm$ 0.1	7.0 $\pm$ 0.7	6.8 $\pm$ 0.05	7.1 $\pm$ 0.1
Maxillary toothrow	7.1 $\pm$ 0.05	7.1 $\pm$ 0.04	6.7 $\pm$ 0.04	6.6 $\pm$ 0.1	6.8 $\pm$ 0.04	6.7 $\pm$ 0.05

The hindfoot of *diardii* as well as being absolutely longer is also proportionately longer than the hindfoot of *jalorensis*; in this character *tiomanicus* is again intermediate. The proportions *length of hind foot: length of head and body*, expressed as the mean of the percentages  $\pm$  S.E., are as follows: *diardii* (Selangor)  $19.8 \pm 1.3\%$ , *jalorensis* (Selangor)  $18.8 \pm 0.8\%$ , *tiomanicus* (topotypes)  $19.5 \pm 0.6\%$ , from P. Tulai  $19.3 \pm 0.2\%$ .

#### SKULL CHARACTERS

Skull measurements are also given in Table 1. It is seen that the skull of *tiomanicus* is larger, in occipitonasal length comparable to *diardii* and not *jalorensis*. On the other hand certain important features of the skull, notably the small anterior palatal foramen and the short toothrow, are closely compatible with *jalorensis*, and significantly different from *diardii* of all localities.

Dhaliwal (1962) has suggested that the foramen magnum of *jalorensis* tends to be more ventrally placed than that of *diardii*. Any significant difference in this character between the two taxa should be revealed by the ratio *basal length: occipitonasal length*, where basal length is measured from the anterior margin of the foramen magnum. We have analysed both this ratio from measurements of *diardii* and *jalorensis* from Selangor, and the ratio *condylobasal length: occipitonasal length*, from Dhaliwal's original measurements of his series from Singapore and Selangor. We find that there is wide individual variation within both taxa, without significant difference between the means. We conclude that this character cannot be used to distinguish between the species.

There is one other important skull character that cannot be reduced to metrical terms. This is the degree of development of the supraorbital ridges, which are more pronounced in *diardii* than in *jalorensis* (Dhaliwal, 1962). We find that in *diardii* these ridges extend forward distinctly to the base of the zygomatic arch on the jugal, whereas in *jalorensis* they terminate at a point posterior to the posterior suture of the jugal behind the base of the zygomatic arch. Using this character we are able to pick out skulls of *diardii* and *jalorensis* from mixed collections with very few mistakes. In this character too, the skull of *tiomanicus* is not intermediate but is decidedly of the *jalorensis* type, readily distinguished from that of *diardii*.

#### DISCUSSION

In Table 2, the principal characters of *R. tiomanicus* are summarised, and the relations that they suggest are indicated. It is seen that there is a predominance of characters indicating affinity with *jalorensis*. Moreover three of these characters relate to the anatomy and proportions of the skull rather than to absolute size. Discussion of the mammalian fauna of Tioman (Medway, this *Bulletin*, p. 24) has already shown that the endemic subspecies of rats and other rodents on the island may be distinguished from their mainland congeners by appreciable variations both in pelage coloration and in body size and proportion (particularly in the length of the tail). By inference, affinities indicated by characters of this nature are significant only at the subspecific level, and are not reliable indicators of specific relationship.

We therefore attach considerably more importance to the three skull characters listed, all of which are noted by Dhaliwal (1962: 258) among the essential differences between *jalorensis* and *diardii*. On the basis of these characters, we suggest that *tiomanicus* should be regarded as conspecific with *jalorensis* rather than with *diardii*<sup>12</sup>.

12. Attempts to produce hybrids with other forms were not successful. Sixteen *tiomanicus* were brought back from the island and paired as follows: 4 with *jalorensis*, 4 with *diardii*, and 8 with *jarak* Bonhote, the form endemic on P. Jarak in the Straits of Malacca, which has crossed freely with *jalorensis* in captivity at the I.M.R. We have no evidence of fertile matings from any of these pairs.

TABLE 2

Affinities of the principal characters of toptotypical *tiomanicus* (measurements in mm.)

Resembling <i>diardii</i>	Intermediate	Resembling <i>jalorensis</i>
Ventral pelage grey-brown to pale grey; achenes and zigzags both pigmented		Dorsal pelage relatively sleek.
Tail generally greater than 100%HB	Mean head and body length $170.8 \pm 2.0$	
	Mean hindfoot length $33.3 \pm 0.2$ →	
	← Mean ear length $20.7 \pm 0.1$	
Occipitonasal length of skull $41.9 \pm 0.9$		Length of anterior palatal foramen $6.8 \pm 0.1$
		Length of maxillary toothrow $6.7 \pm 0.04$ .
		Supraorbital ridges relatively weakly developed.

The variation in ventral coloration is probably related to habit (cf. Harrison, 1961). The venter of the house and town dwelling *diardii* of mainland Malaya is greyish brown, but on Singapore Island where this form occupies a wide range including field and fringe habitats, the ventral coloration is very variable, from greyish brown to pale grey (Dhaliwal, 1963). Conversely *tiomanicus*, although apparently descended from a white-bellied form, shows considerable darkening in ventral coloration in accordance with its range of habitats including close commensal situations. On P. Tulai only the field habitat is available, and the rat population is, like mainland *jalorensis*, white bellied. The rat of Tulai is significantly larger than *jalorensis* and is as distinct as many of the island forms that have been described as separate subspecies. Its affinity with *tiomanicus* and *jalorensis* is again indicated by the skull characters discussed.

The name *tiomanicus* dates from 20th August, 1900 (*Proc. Wash. Acad. Sci.*, 2: 209), and is in fact the oldest name available for the pale-bellied field rats of Malaysia. The name *tiomanicus* was used by Sody (1941) to designate this group, although subsequent authors have preferred to preserve the epithet *jalorensis*. It is an unfortunate result of the international rules of nomenclature that the older name, albeit applied only to an island population, must take precedence, so that the name *jalorensis* is superseded as specific epithet for the Malaysian Field Rat.

Harrison (1961) has discussed the white-bellied forms occurring outside this region. From India the oldest name available appears to be *brunneusculus* Hodgson 1845; this in turn is antedated by *frugivorus* Rafinesque 1814, the white-bellied form of the Mediterranean region (Ellerman and Morrison-Scott, 1951). However, in view of the obvious plasticity of the group, the demonstrated unreliability of ecology as a taxonomic indicator, and the probable relationship between ecology and ventral coloration, we hesitate to suggest that these may all be conspecific. We do not have material available to assess the wider relations of the *tiomanicus* group, but we suggest that the most profitable approach is likely to be based on the features of skull anatomy discussed above, rather than on other morphological characters.

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