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Chromosome Morphology of North American *Rattus rattus* (L.) (Muridae)[1]

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Although the present distribution of *Rattus rattus* is cosmopolitan, the three subspecies reported from North America were introduced by man in recent times. Specimens for our study were collected from feral populations. Karyotypic preparations were by *in vivo* culture of bone marrow, sodium citrate, Carnoy's fixative, blaze dry method ; stain was by Giemsa's blood stain. This process is described by Baker (in press). Subspecific assignment was made on the basis of characteristics of external morphology.

Results and discussion. We have examined the chromosomes of all the North American subspecies (*R. r. rattus*, *R. r. alexandrinus*, and *R. r. frugivorous*) and all specimens revealed a diploid number of 38 and a fundamental number (number of arms of the autosomal complement) of 58. The autosomes consist of a pair of large subtelocentrics, a pair of large and a pair of medium metacentrics, a graded series of eight pairs of small biarmed elements plus a graded series of seven acrocentrics (Figs. 1 and 2). The X is a medium sized acrocentric and the Y is a small acrocentric.

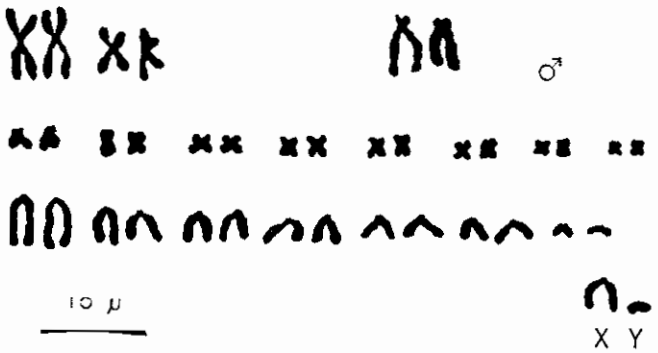

Fig. 1. Representative karyotype of a male *Rattus rattus frugivorous* from Nayarit Mexico.

There are two reports of the chromosomes of North American *R. rattus*. Pincus (1927) reported a diploid number of 40 with three of the larger elements being distinctly biarmed. Cross (1931) also reported a diploid number of 40

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but only one pair of the larger elements was biarmed. Both of these karyotypes differ from our results but their karyotypic preparations were by the older, less reliable squash technique which may account for the differences. Conversely, there may be several different karyotypes found within North American *R. rattus*.

Our specimens came from widely separated geographic localities (see specimens examined) and no karyotypic variation was found. The fact that specimens of three different subspecies had the same karyotype is also of interest. Specimens of two of these subspecies have been studied from the Old World. *Rattus r. alexandrinus* from Japan was studied by Yosida *et al.* (1965) and found to have a diploid number of 42. In their populations a polymorphic system existed that may be established in the North American populations as the large pair of subtelocentrics. The karyotype reported by Yosida *et al.* (1965) also differed from that found in our material by the absence of the two pairs of larger metacentrics, five extra pairs of acrocentrics and one less pair of small biarmed elements. Two Robertsonian fusions plus a pericentric inversion of one of the smaller chromosomes are necessary to relate the two karyotypes. A diploid number of 42 has also been reported by the old section method for some *R. r. rattus* from Hondo and Formosa (Makino 1949, 1951) and also for some *R. r. alexandrinus* (Matthey 1949).

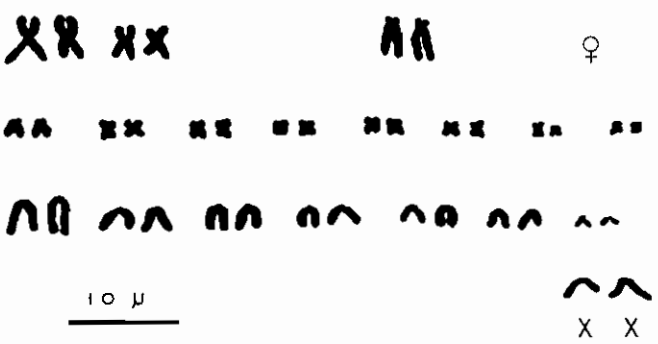

Fig. 2. Representative karyotype of a female *Rattus rattus rattus* from El Yunque Nat'l Forest, El Verde Research Station, Puerto Rico W. I.

Yosida *et al.* (1969) studied the chromosomes of some *R. rattus* (subspecies not determined) from Australia, New Zealand, and New Guinea, and the karyotype of our North American material is similar, if not identical to their results. Bianchi *et al.* (1970) also reported this karyotype (2n=38) from some *R. rattus* (subspecies not determined) from Argentina and Brazil, South America.

All *Rattus rattus* populations having the 38 chromosomal complement share one feature in common. They were all introduced in recent times from the Old World (Simpson 1961, and Miller and Kellogg 1955).

No Old World population has been reported to have a diploid number of 38. Yong (1969) reported a diploid number of 42 for some Malayan *R. r. diardii*. In the Malayan subspecies the pair of large subtelocentrics were

replaced by a large pair of acrocentrics and there were eight pairs of small biarmed elements. With these exceptions the Malayan *Rattus* karyotype was like that reported by Yosida *et al.* (1965). It is reasonable to expect that the karyotype of these introduced populations of *Rattus rattus* is like that of the parental Old World populations. Therefore, intensive karyotypic studies should reveal Old World populations of *R. rattus* with a diploid number of 38. The opposing view that the changes occurred after introduction would require independent changes in the chromosomal complements of populations in widely separated geographic areas.

Since the subspecies of *R. rattus* are described primarily on pelage color, the possibility of convergent evolution in subspecific characteristics remains distinct. Therefore, we question the tentative subspecific identification of introduced forms as indicative of relationship to subspecific Old Word populations.

Another interesting aspect of these data is that *Rattus rattus* is easily bred and raised in large numbers in the laboratory. Crosses between forms bearing different karyotypes have been made by Yosida *et al.* (1969). Meiotic studies on F_1 hybrids can reveal if the proposed mechanisms for the described changes were accurate. The fecundity of this species in the laboratory offers an excellent opportunity to study the degree with which these changes cause genetic isolation.

Specimens examined: *Texas*: Cameron Co., 5 mi. S. Brownswille (1 male, 2 females); Haskell Co., 4.5 mi. W. Rule (2 males, 5 females). *Washington*: vicinity of Seattle (2 males, 1 female). *Puerto Rico*: El Verde Research Station of the Puerto Rico Nuclear Center (1 female). *Mexico*: *Nayarit*: 2 mi. W. Tecuala (5 males, 5 females); *Colima*: 11 mi. E. Manzanillo (1 female). All voucher specimens are deposited in the Collection of Mammals, Department of Biology, Texas Tech University.

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References

Baker, R. J. 1970. Karyotypic trends in bats. In: Biology of Bats. Vol. 1, William A. Wimsatt Editor. Academic Press. New York.

Bianchi, N. O., Paulete-Vanrell, J. and de Vidal Rioja, L. A. 1969. Complement with 38 chromosomes in two South American populations of *Rattus rattus*. Experimentia 25(10): 1111-1112.

Cross, J. C. 1931. A comparative study of the chromosomes of rodents. J. Morph. 52(2): 373-401.

Makino, S. 1949. A chromosomal survey in some Asiatic species of the Muridae, with

special regard to the relationship of the chromosomes upon taxonomy. Cytologia 15: 153-160.

1951. An atlas of the chromosome numbers in animals. 2 ed. The Iowa State College Press. Ames, Iowa.

Matthey, R. 1949. Les Chromosomes Des Vertebres Librairie de L'Universite. F. Rouge, Lausanne.

Miller, G. S., Jr., and Kellogg, R. 1955. List of North American recent mammals. Bull. U. S. Natl. Mus. 205: 1-954.

Pincus, G. 1927. A comparative study of the chromosomes of the Norway rat (*Rattus norvegicus*) and the Black rat (*Rattus rattus*). J. Morph. 44: 515-538.

Simpson, G. G. 1961. Historical zoogeography of Australian mammals. Evolution 15(4): 431-446.

Yong, Hoi Sen. 1969. Karyotypes of Malayan rats (Rodentia-Muridae, Genus *Rattus* Fischer). Chromosoma 27: 245-267.

Yosida, T. H., Nakamura, A. and Fukaya, T. 1965. Chromosomal polymorphism in *Rattus rattus* (L.) collected in Kusudomari and Misima. Chromosoma 16: 70-78.

--, Tsuchiya, K., Imai, H. and Moriwaki, K. 1969. New chromosome types of the Black rat, *Rattus rattus*, collected in Oceania and F_1 hybrids between Japanese and Australian rats. Japanese J. Genetics 44(2): 89-91.