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Karyotype of the Red Fox, *Vulpes vulpes* L., in Alaska

Abstract

The chromosomal number in the red fox, *Vulpes vulpes* L., from central Alaska varied from 37 to 39 ($2n=34+3-5\ m$). In cells from bone marrow, macrochromosomes were constant at 34 and microchromosomes ranged in number from 3 to 5, per cell, in the one male and one female studied. Karyograms from both animals are shown. The characteristics of the karyotype were found to correspond closely to those described in the literature about animals from localities in Eurasia and in mideastern North America.

Introduction

The diploid number of chromosomes in the red fox, *Vulpes vulpes* L., has been determined from animals from various localities in Eurasia, but not including the arctic and subarctic regions of Siberia. In North America, the geographic origins of animals studied, when stated, have been within the mideastern part of the continent. A comparison of the chromosomal characteristics of red foxes in northwesternmost North America seemed desirable, not only because of the great distance separating this region from those where foxes have been studied previously, but also because the animals probably are derived from a population that inhabited Beringia during the last (Würm) glacial period. Findings in red foxes from central Alaska are reported here.

Methods and Materials

Two foxes, *Vulpes vulpes alascensis* Merriam, a male and a female, were captured 5 and 11 km northwest of Fairbanks, respectively. An hour after intraperitoneal injection of a 0.05 percent solution of colchicine, marrow was collected from the femur and sternum, held 20 minutes in hypotonic sodium citrate, and fixed and stained in acetic orcein or in Carnoy's solution and Giemsa blood stain. G-banding of chromosomes was obtained following Seabright's (1972) method, using trypsin and Giemsa stain. The chromosomes in 100 cells from the male fox and 50 cells from the female were counted, and idiograms for comparison were prepared from photographs of 8 cells from the male and 6 from the female. Measurements were recorded of the non-banded complements. The banded chromosomes were matched by evident patterns. The Y-chromosome was selected by inspection.

Results

Male. ($2n=34+3-5\ m$). From 37 to 39 chromosomes were present, depending on the variable number of microchromosomes. The number of macrochromosomes was con-

stant at 34. In 100 cells, 12 contained 37 chromosomes (3 microchromosomes + XY + 32 large autosomes); 81 contained 38 (4 microchromosomes + XY + 32); and 7 cells had 39 (5 microchromosomes + XY + 32). The largest autosomes were about $6\mu\text{m}$ in length (metaphase). The X was identified as submetacentric, about $3\mu\text{m}$ long (metaphase), with indistinct banding. The Y-chromosome was subtelo-centric, and not markedly different from some of the microchromosomes. Four of the latter appeared to be subtelocentric, but when five were present in the complement, the odd one had the appearance of a dark dot. G-bands were not distinct or bright in the Y nor in the microchromosomes, but darker areas distally on the long arms were sometimes noted in the best preparations. G-banded chromosomes from the male are shown in Figure 1.

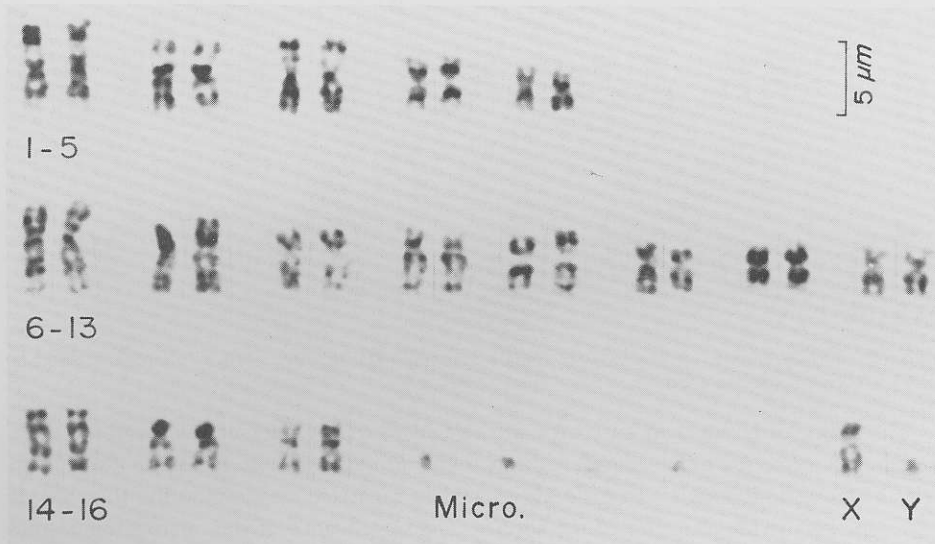


Figure 1. Giemsa-banded chromosomes of *V. vulpes*, male, central Alaska: $2n=34+4$ microchromosomes.

Female. ($2n=34+3-5$ m). As in the male, the diploid number ranged from 37 to 39, with the macrochromosomes constant at 34. In 50 cells, 4 contained 37 chromosomes (3 microchromosomes + XX + 32); 41 contained 38 (4 microchromosomes + XX + 32); and 5 cells had 39 (5 microchromosomes + XX + 32). Figure 2 shows the chromosomes from one cell with 39 chromosomes; the 32 large autosomes have been arranged in three groups, pair-numbers 1-5 with arm-ratios ranging from 1.01 to 1.50, numbers 6-13 with ratios of 1.51 to 2.20, and numbers 14-16 with ratios from 2.70 to 2.90. The arm-ratio of X ranged from 1.60 to 1.80. For convenience, the karyogram follows the arrangement adopted by Lin *et al.* (1972).

Discussion

Comparison of our findings with those of Gustavsson (1964), Moore and Elder (1965), Gustavsson and Sundt (1967), Sasaki *et al.* (1968), Vogt and Arakaki (1971), Low and Benirschke (1972), and Renzoni and Omodeo (1972), and with the quinacrine fluorescent karyograms published by Lin *et al.* (1972), indicates that karyotypic differences among the macrochromosomes are slight and probably reflect methods of prep-

aration. Our karyogram as well as that of Lin *et al.* (1972) would correspond closely to a rearrangement of the karyogram of *V. vulpes* from Iran published by Hsu and Benirschke (1974). Evidently *V. vulpes* [including *V. fulva* (Desmarest)] has a diploid number of 34 macrochromosomes plus a variable number of microchromosomes, with the total count ranging from 34 to 40-41.

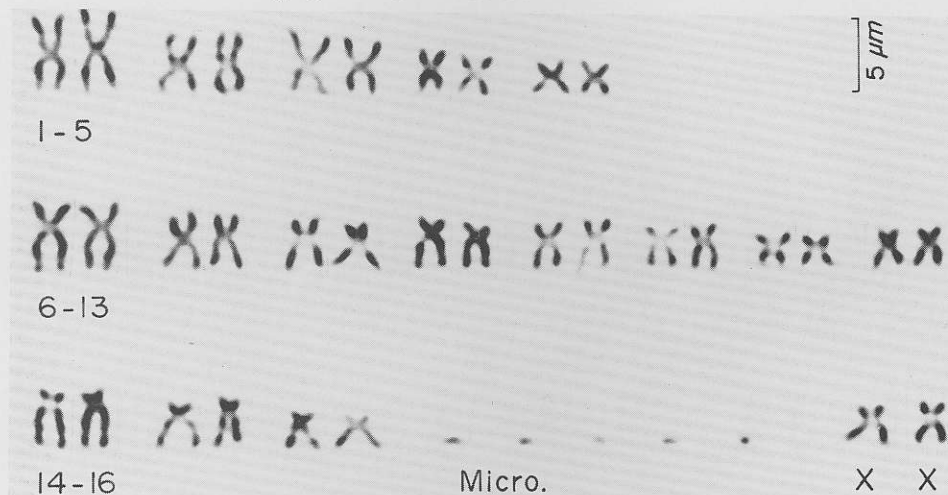


Figure 2. Chromosomes of *V. vulpes*, female, central Alaska: $2n=34+5$ microchromosomes. Giemsa blood stain.

The major differences in karyotype are related to the number of microchromosomes present, but since such elements have been found to vary in most red foxes (within as well as among individuals) from localities widely separated geographically, this, too, is a constant karyotypic character of the species. The significance of the microchromosomes and their variance is unknown. Rather than being in the process of elimination from the genome, as was suggested by Gustavsson and Sundt (1967), the microchromosomes may exert a positive influence (Renzoni and Omodeo, 1972). Ward *et al.* (1972) suggested that the number of micro-elements may be positively correlated with size and vitality of the individual. The foxes that we studied were collected at a time of relatively high species population density in central Alaska.

V. vulpes is one of several species of mammals of palaeartic origin that first appeared in North America during the penultimate (Riss/Saale) glacial period (Kurtén, 1966; Rausch, 1977). Its status as a holarctic species, established on macromorphologic grounds by Churcher (1959) and others, is supported by the karyologic data.

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