KARYOLOGY OF FOUR NORTH AMERICAN PERCIDS (PERCIFORMES: PERCIDAE)

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We have examined the chromosomes of four darter species (Percidae) from Texas and Louisiana: *Percina caprodes, P. nigrofasciata, P. sciera* and *Ammocrypta vivax*. All four have diploid complements of 48 chromosomes. Estimates of diploid chromosome arm number among the four species varied from 80 (*P. sciera*) to 92 (*P. caprodes* and *A. vivax*) to 94 (*P. nigrofasciata*); but between two to five chromosome pairs in each species could not be unequivocally classified as either uni-armed or bi-armed. *Percina sciera*, which was scored as having the highest number (16) of uni-armed chromosomes, probably differs in gross karyotype from the other three, but the magnitude of difference may be less than indicated by our measurements.

Nous avons examiné les chromosomes de quatre espèces de percidés (Percidae) du Texas et de la Louisiane: *Percina caprodes, P. nigrofasciata, P. sciera* et *Ammocrypta vivax*. Toutes les quatre espèces sont diploïdes avec 48 chromosomes. Des estimations du nombre des bras chromosomiques diploïdes chez les quatre espèces variaient de 80 (*P. sciera*) à 92 (*P. caprodes* et *A. vivax*) jusqu'à 94 (*P. nigrofasciata*); mais de 2 à 5 paires chromosomiques dans chaque espèce n'ont pas pu être classifiées sans équivoque comme ayant un seul bras ou deux bras. *Percina sciera*, qui fut cotée comme ayant le plus grand nombre (16) de chromosomes d'un seul bras, diffère probablement, quant au caryotype, des trois autres, mais cette différence peut être moindre que ce que nos mesures ont indiqué. [Traduit par le journal]

Introduction

The true perches endemic to temperate North America and Eurasia include a vast array of exclusively freshwater fishes placed in a single family, the Percidae. Within the family, only a few distinct subgroups are recognized, three of which (the darters, pike-perches and yellow perch) are found in North America. The darters, by far the most numerous containing 109 of less than 130 world-wide species, are exclusively North American.

Studies of percid karyology have been practically nonexistant. Ross (1973) karyotyped five darter species from the genus *Etheostoma*. All five had 48 diploid chromosomes, but estimated chromosome arm numbers ranged from 50 to 54. Diploid chromosome numbers of 48 also are reported for the three Eurasian percids, *Perca fluviatilis, Lucioperca lucioperca* and *Acerina cernua* (Nygren *et al.*, 1968). Herein, we describe karyotypes of four additional North American percids, including representatives from the two other darter genera *Percina* and *Ammocrypta*.

Materials and Methods

Fish were collected by seining from the following localities in Texas and Louisiana: *Percina caprodes* (Salado Cr., Bell Co., Tx.); *P. nigrofasciata* (West Fork Chappepela Cr., Tangipahoa Par., La.); *P. sciera* (San Gabriel R., Milam Co., Tx.); and *Ammocrypta vivax* (Sabine R., Newton Co., Tx.). Details of chromosome preparation are in Gold (1974). Relative chromosome lengths were measured using precision calipers; each chromosome was scored by its centromeric index (after Levan *et al.*, 1964). Chromosome pairs were arranged into groups after Bickham (1975): group A chromosomes have centromeres median to submedian (*msm*); group B chromosomes have centromeres subterminal to terminal (*stt*). Fun-

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damental arm numbers were estimated by scoring *msm* chromosomes as bi-armed, and *stt* chromosomes as uni-armed.

Results and Discussion

The chromosome data from each of the four species are shown in Table I. Between 20 and 30 cells were examined from each individual, and counts of $2n = 48$ were obtained in over half of all cells. Most cells not yielding modal counts were short by one or a few chromosomes and probably stemmed from chromosome loss during preparation, overlap, or counting errors. In all well formed spreads, 48 chromosomes were readily apparent. Each of these four percids possesses $2n = 48$ chromosomes. Male and female *P. caprodes* and *P. sciera* were examined, but no sex chromosomes were identified. Modal karyograms of each species are shown in Figs. 1 and 2.

Karyotypes of the four species were highly "asymmetrical" (*sensu* Stebbins, 1958, 1971), and hence were difficult to distinguish from one another. Each contained a graded series of small chromosomes with measured centromere locations ranging from almost median to nearly terminal. Our attempts to classify chromosomes by centromere position within size groupings were unsuccessful. Further, since chromosome arm attenuation and contraction no doubt varied from cell to cell, homologue pairing was at best partially subjective.

Estimates of centromere positions (chromosome formulae) and diploid arm numbers of the four species also are shown in Table I. Differences among the species in the number of *stt* chromosomes were measured, but between two to five chromosome pairs in each species fell close to the *msm* — *stt* border ($r = 3.0$, after Levan *et al.*, 1964) and could not be unambiguously identified. The three species (*P. caprodes, P. nigrofasciata* and *A. vivax*) which differed only by a single *msm* chromosome pair may well have identical gross karyotypes. *Percina sciera*, which was scored as having the highest number (16) of *stt* chromosomes, probably differs in gross karyotype from the other three, but the magnitude of difference may be less than indicated by our measurements.

Our interest in studying percid karyology stemmed from earlier studies on North American minnows (Cyprinidae) where proliferative and rapid speciation apparently has taken place in the absence of extensive gross chromosomal rearrangement (Avise and Gold, 1977; Gold *et al.*, 1978 a, b). Percids in North America represent a highly speciose group of roughly 113 species whose lone fossil dates only from the Pleistocene (Miller, 1965).

The data on percid karyotypes are too incomplete to more than speculate on the involvement of gross chromosomal rearrangement in percid speciation and ev-

TABLE I.

Karyology of four North American percids

Taxon*	Number of cells counted	% modal counts	Modal diploid number	Chromosome formula (A:B)†	Fundamental arm number (diploid)
Percina caprodes (3)	92	71	48	44:4	92
Percina nigrofasciata (2)	45	60	48	46:2	94
Percina sciera (3)	77	53	48	32:16	80
Ammocrypta vivax (2)	54	72	48	44:4	92

*Parentheses refer to number of specimens examined.
†A = *msm* chromosomes; B = *stt* chromosomes.

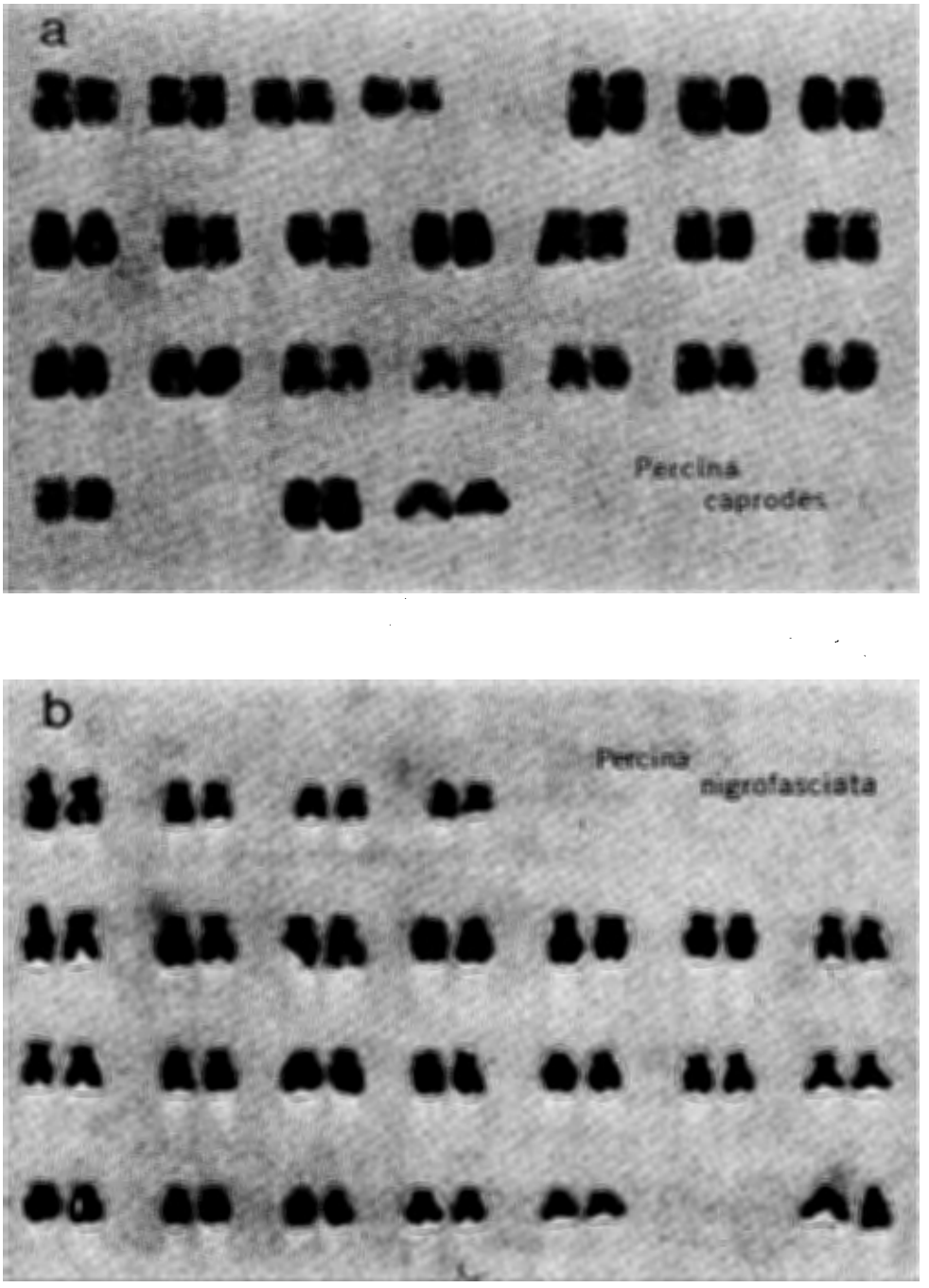

Fig. 1. Kidney metaphase chromosomes of a) *Percina caprodes* and b) *Percina nigrofasciata*. Both species have $2n = 48$ chromosomes.

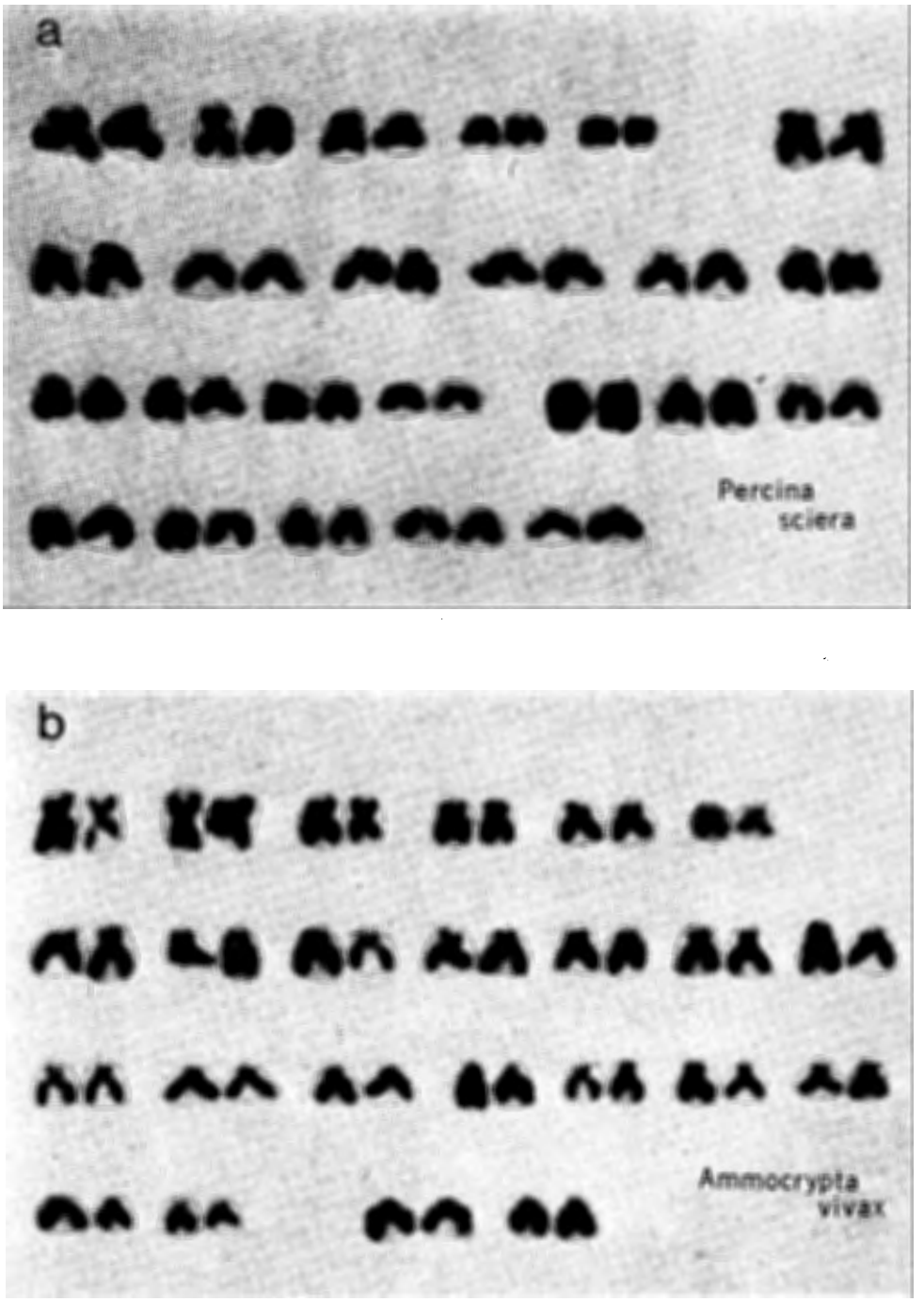

Fig. 2. Kidney metaphase chromosomes of a) *Percina sciera* and b) *Ammocrypta vivax*. Both species have $2n = 48$ chromosomes.

olution. The nine darters karyotyped to date, including representatives from all three darter genera have 48 chromosomes (Ross, 1973; this note). The Eurasian percids karyotyped by Nygren *et al.* (1968) also had 48 diploid chromosomes, and included species from the pike-perch and yellow perch subgroups. Chromosome number changes in percids may occur much less frequently than might be expected on the basis of their proliferative speciation.

Chromosome arm number changes are more difficult to evaluate. Ross's (1973) estimates of arm numbers for five *Etheostoma* species ranged from 50 to 54, whereas our estimates for the four species examined here ranged from 80 to 94. Ross's hand-drawn karyograms, however, show that most of the chromosomes in all five species he examined have appreciable second arms that we might have scored as *msm* or bi-armed. This underscores the difficulty in using chromosome morphometric measurements in organisms with asymmetric chromosomes of small size, and should lead to conservative interpretations of chromosome arm number data. For this reason, we prefer to examine additional percid species before fully considering the extent of chromosome arm evolution in these fishes.

Acknowledgments

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