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Karyotypes of six species of African Cichlidae (Pisces: Perciformes)[1]

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Summary. Diploid numbers of 40–46 were found among the 6 species of African Cichlidae included in this karyotypic study. More species must be studies before any generalized conclusions regarding correlations between karyotypic morphology and phylogeny can be made.

Recent major taxonomic revisions of the African Cichlidae have resulted in extensive rearrangements of the genera within this very speciose family[3,4]. The osteologically based *Haplochromis-Tilapia* dichotomy of Regan[5] was invalidated by Greenwood[6]. It was indicated that, based on the structure of the pharyngeal apophysis, there may be 4 or more major generic groupings within the African cichlids. Trewavas[3] divided the large genus *Tilapia* into 2 genera, *Tilapia* and *Sarotherodon.* This split was based on both morphology and reproductive behavior. Karyotypes for a considerable number of neotropical cichlids have been published[7] but are available for only a few of the numerous African species[8–11]. Karyotypes for 5 species of African cichlids representing both of Trewavas' *Tilapia*-like genera and 2 of Greenwood's apophyseal types, *Haplochromis (Astatotilapia)* and *Tilapia (Tilapia, Sarotherodon)* are presented. Additionally, a species not discussed by Greenwood but probably of the *Haplochromis* type, *Melanochromis auratus,* is included.

Materials and methods. Somatic C-metaphase karyotypes were constructed from gill epithelial squash preparations according to Thompson[7]. All preparations were stained with acetic orcein.
Colchicine treatment of small chromosomes often results in very condensed preparations for which accurate arm ratio measurements are difficult. Thus, some chromosomes may be assigned to different categories by different workers[7]. Consequently, to allow for easier comparison with the results of others, the probable range of the arm or fundamental number (FN) is given rather than an absolute number.
Nomenclature is that of Levan et al.[12]. Metacentric-submetacentric chromosomes (msm) are those with arm ratios less than or equal to 3 and subtelocentric-telocentric (stt) are those with arm ratios greater than or equal to 3. Those in which ratios were 3 were assigned at the discretion of the observer. To calculate FN the msm chromosomes are counted as 2 while all stt chromosomes contribute but 1 to

Diploid chromosome numbers and material examined

	Specimens examined	Chromosomes per cell 37	38	39	40	41	42	43	44	45	46	Total cells
Astatotilapia burtoni	2 males	3	3	2	16	1						25
	4 females	3	1	2	17	4						27
Melanochromis auratus	2 females				1			2	4	3	10	20
Sarotherodon mossambica	2 males						2	2	17			21
	1 female						2	1	8	1		12
Sarotherodon aureus	5 males		1	1	1	4	6	5	33	1		52
	5 females	2			1	1	5	7	39	1		56
Tilapia sparrmanii	7 males	3	1	1	6	9	64	8	3			95
	3 females	4	1		3	1	28	2	1			40
Tilapia mariae	5 males		2	8	41	2						53
	3 females	3	3	2	19	2		1				30

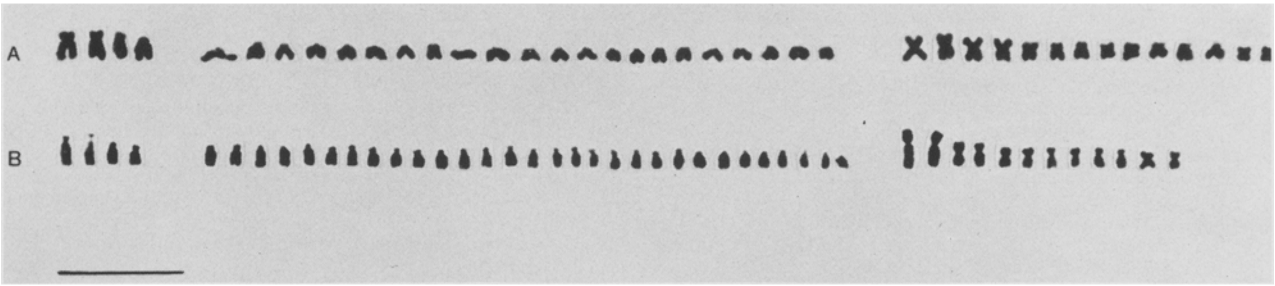

Fig. 1. Karyotypes for: *A Astatotilapia burtoni,* male, 2N = 40; *B Melanochromis auratus,* female, 2N = 46. Bar 10 μm.

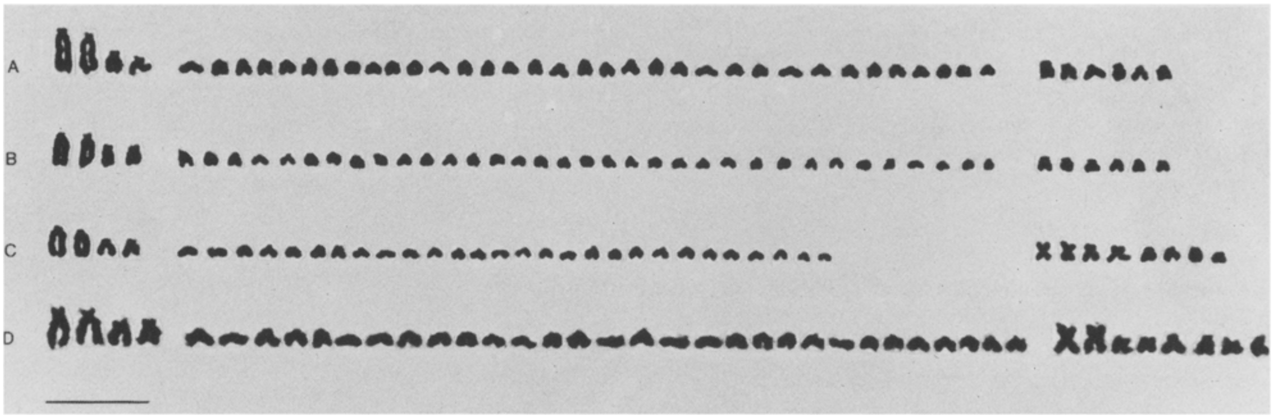

Fig. 2. Karyotypes for: *A Sarotherodon aureus,* male, 2N = 44; *B S. mossambica,* male, 2N = 44; *C Tilapia mariae,* male, 2N = 40; *D T. sparrmanii,* male, 2N = 42. Bar 10 μm.

the total FN. To facilitate comparisons, the photo-karyotypes were arranged according to Kornfield et al.[11].
With the exception of 1 female *Astatotilapia burtoni* collected from Lake Tanganyika[13] all specimens were obtained from commercial sources. Identification specimens of *Tilapia sparrmanii* were placed in the Musée Royal de l'Afrique Central, Tervuren, Belgium (acquisition Nos. 74-35-P-1,2). Specimens of all other species were placed in the Texas Memorial Museum, Austin, Texas, USA (acquisition Nos. 8494-96, 8499, 8500).

Results. Diploid count data are indicated in the table. Representative karyotypes are presented in figures 1 and 2. No apparent sexual dimorphism was noted for any of the species represented by both sexes.

Both species of *Sarotherodon* have diploid counts of 44 (FN = 44-50). By comparison, the 2 included species of *Tilapia* have fewer than 44 chromosomes. *T. sparrmanii* has 2N of 42 (FN = 46-50) and *T. mariae* has 2 N of 40 (FN = 44-48). The karyotypes of both the species of *Tilapia* include 4 metacentric chromosomes which set them apart from those of *Sarotherodon.* However, all 4 of these species have 2 stt chromosomes that are very long with respect to the rest of the chromosome complement. These marker chromosomes are a trait common to most of the species of the *Tilapia-Sarotherodon* lineage for which chromosome morphology is available[9-11].

The included species from the *Haplochromis* lineage tend to have more msm chromosomes than either *Tilapia* or *Sarotherodon. A. burtoni* has 2N of 40 with 14-16 msm chromosomes, at least 10 of which appear to be metacentrics. *Melanochromis auratus* has 2N of 46 (FN = 56-58). Many of the msm chromosomes of this species are also metacentric. The 2 largest stt chromosomes of these 2 species do not present as great a size dichotomy as that seen in *Tilapia* and *Sarotherodon.*

Discussion. Kornfield et al.[11] felt that the 2 largest stt chromosomes were homologous or partly homologous in all of the species that they examined, including one *Haplochromis.* While the data presented here (figure 2) support the hypothesis that these chromosomes may be present in all members of the *Tilapia* lineage the evidence for homology with the largest 2 stt chromosomes in karyotypes among the *Haplochromis* lineage is less than conclusive (figure 1). Ultimate conclusions should not be made until a much greater percentage of the know species have been karyotyped. It is also premature to speculate on the presence of metacentrics in *Tilapia* with respect to their absence in *Sarotherodon* karyotypes.

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