Karyotypic Diversity in Genus *Mystus* (Bagridae: Pisces)

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Bagrid catfishes are characterized with dorsal fin preceded by a spine and peculiar dorsal adipose fin. Family Bagridae is cytologically known by thirteen species of fishes and the present work further adds information on four species viz., *Mystus bleekeri*, *M. vittatus*, *M. seenghala* and *M. cavasius*. Of these four species, *M. bleekeri* and *M. vittatus* resemble much in their external morphology and can only be distinguished from one another on the basis of the presence of blue longitudinal bands in *M. vittatus* and dark shoulder spot in *M. bleekeri*. These two species, however, have been found to possess different karyotypes and thus can be easily recognized considering their cytological make-up. *M. seenghala* is characterized with the presence of a black spot at the base of the adipose fin, while *M. cavasius* is recognized by its maxillary barbels extending up to its caudal peduncle. Taking into account the morphological closeness, it becomes all the more interesting to explore the karyotypic details of these species to establish their taxonomic status.

Materials and methods

Specimens of *Mystus bleekeri*, *M. vittatus*, *M. seenghala* and *M. cavasius* were collected from different water bodies of Jammu Province, such as Sehi, R. S. Pura, Gho-Manasan, Gadigarh and Chakrohi. The gonads and somatic tissues like kidney and gills of these species were used for the chromosomal studies. Fishes were intraperitoneally injected with 0.5% colchicine solution at the rate of 1 ml/100 g body weight and sacrificed after $1\frac{1}{2}$ to $3\frac{1}{2}$ hr of treatment. Tissues were excised and minced in 0.075 M KCl and fixed in methanol-acetic acid fixative. The routine air drying Giemsa-staining technique was employed for cytological preparations. For nomenclature of the chromosomes, the method put forth by Levan *et al.* (1964) was followed.

Observations

I. *Mystus bleekeri*: Both male and female metaphase complements (Figs. 1, 3) revealed the presence of 56 chromosomes in the diploid set of *M. bleekeri*. The diploid set included 20 meta-, 14 submeta-, 10 subtelo- and 12 telocentric chromosomes with fundamental arm number, $NF=100$. The total complement length (TCL) was found to be $86.8\ \mu$ in the male and $75.7\ \mu$ in case of the female. The 56 chromosomes of the diploid complement formed 28 homomorphic pairs in both the sexes without any evidence of heteromorphic pair or the sex pair (Figs. 4, 5). The first pair of subtelocentric chromosomes has been regarded as the 'marker pair'

on the basis of its being largest pair in the complement.

Spermatocyte metaphase I plates (Fig. 2) revealed the occurrence of 28 dumb-bell shaped bivalents, each having a single terminal chiasma.

II. *Mystus vittatus*: The spermatogonial metaphase plates in the male (Fig. 6) and somatic metaphase complements in the female (Figs. 11, 12) showed the existence of 54 elements in their diploid set. The 54 chromosomes included 22 meta-

Figs. 1-5. *Mystus bleekeri*, $2n=56$, $n=28$. 1, a somatic metaphase complement from kidney of male (arrow exhibiting marker pair). 2, a spermatocyte metaphase-I complement. 3, a somatic metaphase complement from kidney of female (arrow exhibiting marker pair). 4, photokaryotype of male. 5, photokaryotype of female.

20 submeta- and 12 subtelocentrics with $NF=108$. The TCL was found to be 110.56μ and 63.3μ in the male and female respectively. The 54 chromosomes of the diploid set formed 27 homomorphic pairs (Figs. 10, 13) in which the first meta-centric pair has been designated as the 'marker pair' considering its larger size. The

sex-chromosomes could not be distinguished in either sex. The diakinetid and metaphase-I plates (Figs. 7, 8) contained 27 bivalents whereas metaphase II exhibited the presence of 27 chromosomes (Fig. 9).

III. *Mystus seenghala*: The female complement (Figs. 14, 16) showed the ex-

Figs. 6-13. *Mystus vittatus*, $2n=54$, $n=27$. 6, a spermatogonial metaphase complement (arrow exhibiting marker pair). 7, diakinesis. 8, a spermatocyte metaphase-I complement. 9, metaphase-II. 10, photokaryotype of male.

istence of a diploid count of 54 chromosomes which included 28 meta-, 12 submeta-, 8 subtelo- and 6 telocentrics, with $NF=102$. The TCL was found out to be 82.4μ . The first metacentric pair has been demarcated as the 'marker pair'.

IV. *Mystus cavasius*: The sex of the specimens of *M. cavasius* could not be specified due to very immature condition of the gonads. In the somatic metaphase plates of this species, a diploid number of 58 chromosomes was encountered which

Figs. 11–13. 11 and 12, somatic metaphase complements from kidney of female (arrow exhibiting marker pair). 13, photokaryotype of female.

happens to be the highest count recorded in any species of *Mystus*—worked out so far. The diploid set included 18 meta-, 16 submeta, 10 subtelo- and 14 telocentric chromosomes (Figs. 15, 17), with $NF=102$. The TCL was calculated to be 79.0μ .

Discussion

Family Bagridae comprises many genera and numerous species (Nelson, 1976), of which only 6 genera and 13 species have so far been cytologically studied. Karyotypic data are already available on six species of the genus *Mystus* (Nayyar 1966,

Figs. 14–17. 14, a somatic metaphase complement from kidney of female *Mystus seenghala* ($2n=54$) (arrow exhibiting marker pair). 15, a somatic metaphase complement from gill of *Mystus cavasius* ($2n=58$). 16, photokaryotype of female *M. seenghala*. 17, photokaryotype of *M. cavasius*.

Table 1. Chromosomal constitution in the various species of the family Bagridae worked out so far

Species	Chromosome number		Chromosome type				Arm number (NF)	References
	n	2n	m	sm	st	t		
<i>Coreobagrus ichikawa</i>	—	56	—	—	—	—	108	Ojima <i>et al.</i> 1976
<i>Liobagrus reini</i>	—	38	—	—	—	—	76	Ojima <i>et al.</i> 1976
<i>Mystus bleekeri</i>	28	56	20	14	10	12	100	Present work
<i>M. cavasius</i>	—	58	14	26	4	14	102	Khuda-Bukhsh <i>et al.</i> 1980
<i>M. cavasius</i>	—	58	18	16	10	14	102	Present work
<i>M. gulio</i>	—	58	—	—	—	—	98-102	Natarajan and Subrahmanyam 1974.
<i>M. gulio</i>	—	58	—	—	—	—	—	Khuda-Bukhsh and Manna 1974
<i>M. gulio</i>	—	58	30	12	2	14	102	Manna and Khuda-Bukhsh 1978
<i>M. mystus</i>	—	54	—	—	—	—	—	Muramoto <i>et al.</i> 1968
<i>M. seenghala</i>	—	50	30	—	—	20	80	Srivastava, and Das 1969
<i>M. seenghala</i>	—	50	—	—	—	—	—	Das and Srivastava 1973
<i>M. seenghala</i>	—	50	30	—	—	20	80	Srivastava and Das 1969
<i>M. seenghala</i>	—	54	28	12	8	6	102	Present work
<i>M. tengara</i>	27	54	10	—	—	44	64	Nayyar 1966
<i>M. tengara</i> (male)	27	54	10	38	—	6	102	Rishi 1973
<i>M. tengara</i> (female)	—	54	9	38	—	7	101	Rishi 1973
<i>M. vittatus</i>	—	54	22	26	—	6	102	Tripathy, N. K. 1980
<i>M. vittatus</i>	27	54	22	22	2	8	98	Nanda 1973
<i>M. vittatus</i> form A	27	54	20	24	—	10	98	Manna and Prasad 1974
<i>M. vittatus</i> form B	29	58	16	10	20	12	104	Manna and Prasad 1974
<i>M. vittatus</i>	—	50	—	—	—	—	—	Srivastava and Das 1969
<i>M. vittatus</i>	27	54	22	20	12	—	108	Present work
<i>Pelteobagrus nudiceps</i>	28	56	—	—	—	—	56	Nogusa 1960
<i>P. nudiceps</i>	—	56	—	—	—	—	—	Fujioka 1973
<i>Pseudobagrus aurantiacus</i>	—	56	24	12	—20	—	92	Ueno 1974
<i>P. aurantiacus</i>	—	48	20	12	—16	—	80	Ueno 1974
<i>Rita chrysea</i>	—	54	28	6	20	—	102	Das and Kar 1977
<i>R. rita</i>	27	54	16	—	—	38	70	Nayyar 1966

Muramoto *et al.* 1968, Srivastava and Das 1969, Das and Srivastava 1973, Nanda 1973, Rishi 1973, Khuda-Bukhsh and Manna 1974, Manna and Prasad 1974, Natarajan and Subrahmanyam 1974, Manna and Khuda-Bukhsh 1978, Khuda-Bukhsh *et al.* 1980). *M. cavasius* has been reported to have $2n=58$ ($14m+26sm+4st+14t$) and $NF=102$ by Khuda-Bukhsh *et al.* (1980). In the same catfish (*M. cavasius*) a similar chromosome count and arm number has been recorded during the present studies too but with different chromosome morphology ($18m+16sm+10st+14t$) thereby, showing numerical variations in the morphotypes of the banded elements. In *M. tengara*, Nayyar (1966) recorded $2n=54$ ($10m+44r's$), while Rishi (1973) recorded the same number in *M. tengara* worked out by him from Kurukshestra. Rishi (1973) observed a diploid complement composition of $9m+38sm$ or $st+7t$, $NF=101$ in the female and $2n=10m+38sm$ or $st+6t$, $NF=102$ in the male, thereby registering female heterogamety (ZW) with one metacentric less and one telocentric more compared to the homogametic (ZZ) male. Another catfish *M. seenghala* was reported to have a diploid complement of 50 chromosomes ($30m+20r's$) by Srivastava and Das (1969) and Das and Srivastava (1973). But the present investigations on *M. seenghala* from Jammu waters have revealed a diploid set of 54 elements ($28m+12sm+8st+6t$) with $NF=102$. These variations in chromosome number and morphology observed between the present population (Jammu population) and the one (Allahabad population) investigated by Srivastava and Das (1969) and Das and Srivastava (1973) might have occurred due to the chromosomal rearrangements experienced by each population independently during the course of time.

Muramoto *et al.* (1968) exhibited the occurrence of $2n=54$ (acrocentrics) in *M. mystus*. A diploid chromosome count of $2n=58$ has been reported in another congeneric species *M. gulio* by Khuda-Bukhsh and Manna (1974) and Natarajan and Subrahmanyam (1974). Later Manna and Khuda-Bukhsh (1978) worked out the detailed chromosome morphology in *M. gulio* as $30m+12sm+2st+14t$ and $NF=102$. Srivastava and Das (1969) reported the presence of $2n=50$ in *M. vittatus*, while in the same species Nanda (1973) observed $2n=54$ ($22m+22sm+2st+8t$) and $NF=98$. Manna and Prasad (1974) described two forms of *M. vittatus* viz., form 'A' and form 'B' reporting $2n=54$ ($20m+24sm+10t$; $NF=98$) in form 'A' and $2n=58$ ($16m+10sm+20st+12t$; $NF=104$) in form 'B'. These two forms morphologically differ in their colour pattern. The presently explored population of *M. vittatus* with $2n=54$ ($22m+20sm+12st$; $NF=108$) is cytologically more close to *M. vittatus* form 'A' than the form 'B' described by Manna and Prasad (1974).

M. bleekeri has been worked out for the first time in which a diploid count of 56 chromosomes has been recorded which include $20m+14sm+10st+12t$ with an $NF=100$. The various species of the genus *Mystus* worked out so far, possess almost a similar arm number in a narrow range of $NF=102\pm 2$, despite differences in their chromosome number and morphology. The Robertsonian fusions and fissions seem to have played an important role in the karyotypic evolution in the genus *Mystus*. A perusal of literature (Table 1) indicates a diploid count of $2n=56\pm 2$ to be the modal number of the family Bagridae.

Summary

Four species of the genus *Mystus* viz., *M. vittatus*, *M. bleekeri*, *M. cavasius* and *M. seenghala* of the family Bagridae (Pisces) have been cytologically explored. The various cytological parameters such as chromosome number, morphology, fundamental arm number (NF) and total complement length (TCL) have been determined in each species. In these species, the diploid chromosome number has been recorded to vary in the range of $2n=56\pm 2$. The meiotic studies have also been carried out in those cases where mature male individuals were encountered in the collections. The inter- and intraspecific diversity and the possible mode of karyotypic evolution within the genus *Mystus* has been discussed.

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