

**The Karyotype of a Gobiid,  
*Gobiomorus maculatus*,  
from Mexico**

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The genus *Gobiomorus* from the coasts of the Gulf of Mexico is represented by *G. dormitor* and from those of the Pacific by *G. polylepis* and *G. maculatus*. Comparison of the chromosomal complements of these species could throw light on the nature of the chromosomal rearrangements arisen during its evolution.

In a previous study it has been reported that *Gobiomorus dormitor* has a diploid number of 48 chromosomes (Maldonado-Monroy et al., 1985). The fundamental number of this species is 54, and it has only three pairs of biarmed chromosomes. The purposes of the present investigation are to determine the karyotypic structure of *G. maculatus*, to compare it with that of *G. dormitor*, and to try to examine what chromosomal changes have accompanied their evolution.

The geographical distribution of *Gobiomorus maculatus* is very wide, ranging from the Gulf of California to as far as Peru (Miller, 1966; Chirichigno, 1963) and can be collected from coastal lagoons, continental or blue waters.

**Materials and methods**

Four specimens, three females and one male, were collected in the Huizache-Caimanero Lagoon

system, in the state of Sinaloa, Mexico. Six more specimens, four females and two males, were collected in the Tres Palos Lagoon, further south in the State of Guerrero, Mexico. Gill epithelial cells were used for chromosome observation. Methods of chromosome preparation were the same as in Maldonado-Monroy et al. (1985). The chromosomes of at least fifty mitotic fields in every specimen were counted to determine the diploid number and at least two karyotypes were prepared from each specimen and analyzed according to the methods of Levan et al. (1964).

**Results and discussion**

The diploid number found in *Gobiomorus maculatus* is 46, the modal number corresponding to 83% of the mitotic counts (Table 1). All the other numbers are well below the modal diploid number and the variation in the counts in different mitotic fields can be attributed to random chromosome loss during the preparation of slides.

The karyotype is formed by seven pairs of metacentric, four pairs of submetacentric, and twelve pairs of telocentric chromosomes (Fig. 1, Table 2).

The two sample populations were separated by more than 1,000 km of coastline, yet shared the same chromosome number ( $2n=46$ ). At a confidence level of 0.95, no statistical significant differences were found between the relative lengths of each pair of chromosomes nor between the length of the chromosomal arms of both populations.

The fundamental number (NF) was  $NF=68$ . No evidence of heterochromatic bodies similar to Bar's corpuscles was found.

The karyotype of *Gobiomorus maculatus* differs from that of *G. dormitor* which lives in the coasts

Table 1. Chromosome counts in the specimens of *Gobiomorus maculatus* from two collecting sites.

Chromosome counts	Huizache-Caimanero				Tres Palos						Total	Percentage
	1 ♀	2 ♂	3 ♀	4 ♀	1 ♂	2 ♀	3 ♀	4 ♂	5 ♀	6 ♀		
Less than 44	1	0	2	0	2	4	0	1	2	1	13	1.9
44	4	2	5	3	2	1	5	4	0	2	28	4.2
45	6	3	4	9	5	6	9	7	5	7	61	9.3
46	59	45	62	49	48	57	79	47	48	62	556	83
47	2	1	0	1	0	2	2	0	1	2	11	1.6
Total	72	51	73	52	57	70	95	59	56	74	669	100

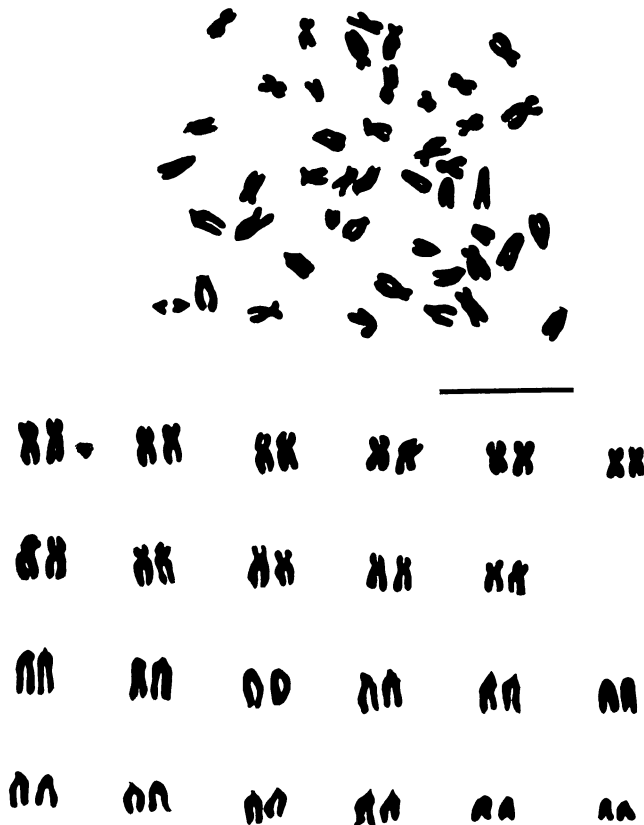


Fig. 1. Mitotic plate of a gill epithelial cell of *Gobiomorus maculatus* and karyotype prepared from it. The bar represents 10  $\mu$ m.

of the Gulf of Mexico. Their diploid numbers are 46 and 48; the fundamental number, 68 and 54, and have 11 and 3 pairs of unarmed chromosomes, respectively.

It is commonly accepted by cytogeneticists that the karyotype formed by acrocentric chromosomes exclusively, is a primitive feature (Ohno, 1969; Arai and Nagaiwa, 1976), and that the increase of biarmed chromosomes indicates evolutionary chromosomal advances. It is noteworthy that, as well as any other phenotypical character, a derived karyotypical trait does not necessarily imply overall evolutionary advancement. The *Gobiomorus maculatus* complement shows traits of evolutionary karyotypical advance since it has 11 pairs of biarmed chromosomes. This karyotype seems to have derived from the one shown in today's populations of *Gobiomorus dormitor* inhabiting the Gulf of Mexico. The decrement of the diploid number from 48 to 46 can be explained

by a centric fusion. To explain the increase of biarmed pairs, it is necessary to call for seven different events of pericentric inversions affecting different chromosomal pairs that have altered the position of the centromere producing biarmed from unarmed elements. An alternative explanation could be the addition of heterochromatic material to acrocentric elements to form second arms, and thus biarmed chromosomes.

The differences found between the karyotypes of *Gobiomorus maculatus* and *G. dormitor* support the current systematics of this group which considers both taxa as different species, since the apparent chromosomal differences found are probably but one of the various specialized biological traits which have derived during their speciation. Meristic studies of the number of anal and pectoral rays of specimens of both species indicate that there exists a clear separation between them (Ginsburg, 1953). Furthermore, another species

Table 2. Relative length and classification of the chromosomes of *Gobiomorus maculatus*.  
 p, short arm; q, long arm; m, metacentric; sm, submetacentric; a, acrocentric.

Chromosome pair	p	q	p+q	Arm ratio	Class
1	2.25±0.30	2.98±0.38	5.23±0.55	1.32	m
2	2.07±0.21	2.70±0.21	4.77±0.28	1.30	m
3	1.92±0.16	2.55±0.22	4.47±0.28	1.32	m
4	1.92±0.15	2.33±0.18	4.25±0.24	1.20	m
5	1.81±0.19	2.23±0.19	4.04±0.29	1.23	m
6	1.67±0.16	2.03±0.16	3.70±0.25	1.21	m
7	1.52±0.30	3.75±0.49	5.27±0.50	2.47	sm
8	1.47±0.19	3.32±0.38	4.79±0.33	2.25	sm
9	1.39±0.22	3.08±0.43	4.47±0.39	2.21	sm
10	1.29±0.20	2.82±0.29	4.11±0.35	2.18	sm
11	1.33±0.13	2.43±0.24	3.76±0.29	1.83	sm
12		5.46±0.53	5.46±0.53	—	a
13		5.06±0.30	5.06±0.30	—	a
14		4.80±0.18	0.80±0.18	—	a
15		4.65±0.16	4.65±0.16	—	a
16		4.50±0.23	4.50±0.23	—	a
17		4.38±0.19	4.38±0.19	—	a
18		4.26±0.20	4.26±0.20	—	a
19		4.15±0.21	4.15±0.21	—	a
20		3.94±0.29	3.94±0.29	—	a
21		3.73±0.32	3.73±0.32	—	a
22		3.37±0.40	3.37±0.40	—	a
23		2.84±0.33	2.84±0.33	—	a

of the genus, *Gobiomorus polylepis*, found sympatrically with *G. maculatus* in a zone of the Pacific Coast, shows meristic characters closer to *G. dormitor*, representing probably intermediate steps between *G. maculatus* and *G. dormitor*.

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#### メキシコ産のハゼ *Gobiomorus maculatus* の核型

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メキシコの太平洋岸に生息するハゼ *Gobiomorus maculatus* の核型分析を行った。鰓の細胞の染色体は46本で、6対の中部着糸染色体、5対の次中部着糸染色体、12対の端部着糸染色体からなり、染色体腕数は68である。雌雄の核型に相異は見られなかった。本種の核型は同属のメキシコ湾産 *G. dormitor* と明瞭に異なり、両種が別種であることを核学的に支持している。