

Chromosomes of Four Species of Coral Fishes from Japan

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In a previous paper, we found a characteristic karyotype of *Amphiprion* in the family Pomacentridae (ARAI and INOUE, 1976), i.e., the arm number of *Pomacentrus*, *Abudefduf* and *Dascyllus* ranges from 48 to 52, but that of *Amphiprion clarkii* is 78. Then we tried to check whether or not so numerous arm number is a general character of the genus *Amphiprion*.

Recently, we had a chance to examine chromosomes of four species of coral fishes including two species of *Amphiprion*, a species of *Platax*, and a species of *Plesiops*. As far as we know, karyotypes of *Platax orbicularis* and *Plesiops coeruleolineatus* are the first report in the family Platacidae and the family Plesiopidae, respectively.

Method of chromosome preparation is the same as was given in ARAI and KATSUYAMA (1973).

Classification of chromosomes is adopted from LEVAN *et al.* (1964). Metacentrics and submetacentrics are described as two-arm chromosomes, and subtelocentrics and acrocentrics as one-arm chromosomes.

All the specimens used for the experiments are deposited in the fish collection of the Department of Zoology, National Science Museum, Tokyo.

Amphiprion frenatus BREVOORT "Hama-kumanomi"

(Plate 1, figs. 1 and 3)

A specimen, 88.2 mm in total length, was caught at Kabira Bay, Ishigaki Island, southern Ryukyus (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype comprises 7 pairs of metacentric, 11 pairs of submetacentric, 5 pairs of subtelocentric, and a pair of acrocentric chromosomes. The arm number is 84. The karyotype of this species is similar to that of *A. clarkii* (see ARAI and INOUE, 1976).

Table 1. Characters of four species of material fishes.

Species	No. of fish	S.L. (mm)	D	A	VN
Pomacentridae					
<i>Amphiprion frenatus</i>	1	70.9	X, 17	II, 14	11+15*
<i>A. ocellaris</i>	3	40.4-54.4	XI, 13-14	II, 11-12	11+15
Platacidae					
<i>Platax orbicularis</i>	1	52.0	V, 38	III, 27	10+14
Plesiopidae					
<i>Plesiops coeruleolineatus</i>	3	43.4-58.6	XI, 7-8	III, 8	10+15

* AOYAGI (1941) reported vertebral number of this species as 12+15, but we have not seen such vertebrae.

Table 2. Frequency distributions of diploid chromosome counts in material fishes.

Species	2n										Total
	42	43	44	45	46	47	48	49	50		
<i>Amphiprion frenatus</i>	2		1	1	2	7	18	1		32	
<i>A. ocellaris</i>		1	1		2	5	19	1		29	
<i>Platax orbicularis</i>			2	2	1	4	17	4	1	31	
<i>Plesiops coeruleolineatus</i>	1		1	1	1	4	12			20	

Amphiprion ocellaris CUVIER “Kakure-kumanomi”

(Plate 1, figs. 2 and 4)

The scientific name of the material fish is *Actinicola percula* in AOYAGI (1941) and MATSUBARA (1955), but *Amphiprion ocellaris* in ALLEN (1972) and MASUDA *et al.* (1975).

Three specimens, 51.4 to 66.0 mm in total length, were collected at Kabira Bay, Ishigaki Island (Table 1).

The diploid chromosome number is 48 (Table 2). The karyotype comprises 7 pairs of metacentric, 11 pairs of submetacentric, and 6 pairs of subtelocentric-acrocentric chromosomes. The arm number is 84. The karyotype of this species agrees well with that of *A. frenatus*.

Platax orbicularis (FORSSKÅL) “Tsubame-uo”

(Plate 2, figs. 1 and 3)

Material fish is identified with *P. pinnatus* by MATSUBARA (1955), but with *P. orbicularis* by MASUDA *et al.* (1975).

A specimen, 68.8 mm in total length, was caught at Shimama (30°28' N, 130°52' E), Tanegashima Island, off southern Kyushu (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype of this species comprises 24 pairs of acrocentric chromosomes, a pair of which seem to

possess satellites. In size, one-arm chromosomes show a gradation from largest to smallest, hence cannot be easily divided into size groups. The arm number is 48.

***Plesiops coeruleolineatus* RÜPPELL "Tanabata-uo"**

(Plate 2, figs. 2 and 4)

Scientific name of the material fish is *P. melas* by MATSUBARA (1955), but *P. coeruleolineatus* by MASUDA *et al.* (1975).

Two specimens, 56.4 and 67.0 mm in total length, were collected from Chichijima Island, Bonin Islands, and a specimen of 74.6 mm in total length from Kabira Bay, Ishigaki Island (Table 1).

The diploid chromosome number is 48 (Table 2). The karyotype comprises a pair of metacentric, and 23 pairs of subtelocentric-acrocentric chromosomes. The arm number is 50.

**Karyological Characteristics of the Genus *Amphiprion*
within the Family Pomacentridae**

Although we have not known whether or not diagnostic characters within a family are directly related with different karyotypes, we have tried to find morphological characters which may reflect different karyotypes in Chaetodontidae, Balistidae and Pomacentridae (ARAI and INOUE, 1975, 1976; ARAI and NAGAIWA, 1976).

In the present and previous reports (ARAI and INOUE, 1976), karyotypes of 9 species including 5 genera of Pomacentridae have been described; classification of Pomacentridae follows that of ALLEN (1975) here, hence *Abudefduf leucozonus* in the previous report is changed into *Plectoglyphidodon leucozonus*. Then, morphological characters were listed up in Table 3, data of which were derived from AOYAGI (1941), ALLEN (1972, 1975) and others. As shown in Table 3, *Amphiprion* differs from the other genera by dorsal spine number, number of scales in longitudinal series, many spines of opercle, squamation of the area around eyes, and the arm number in the karyotype.

Karyologically, it is suggested that the direction of differentiation of the arm number (NF) is small to large in the karyotype with the same number of the diploid chromosome number and the new arm number (ARAI and NAGAIWA, 1976).

When we consider the direction of differentiation of characters which separate *Amphiprion* from the other genera, with consideration of karyological analysis, their directions may be discussed as follows.

Dorsal spines. The number of dorsal spines of *Amphiprion* ranges from 8 to 11, and those of the other genera, 12 to 15. Decrease of dorsal spine number may reflect numerous arm number, but such tendency is not found in Chaetodontidae.

Scales of longitudinal series. Scale numbers in longitudinal series range from 47 to 66 in *Amphiprion*, and ca. 20 to ca. 30 in the other genera. This fact suggests that the direction of differentiation of scale numbers is small to large in number, but such

Table 3. Comparison of characters of 6 genera within Pomacentridae.

	Amphiprioninae		Pomacentrinae			Chrominae	
	<i>Amphiprion</i>	<i>Abudefduf</i>	<i>Plectoglyphidodon</i>	<i>Pomacentrus</i>	<i>Dascyllus</i>	<i>Chromis</i>	
Morphological characters							
Vertebrae (AV+CV)	11+15	11+15	11+15	11+15	11+15	11+15	
Dorsal rays							
spines+soft-rays	24-28	25-29	26-32	25-29	24-28	22-28	
spines	VIII-XI	XIII	XII	XIII-XIV	XII	XII-XV	
soft-rays	13-20	12-16	14-20	12-16	12-16	10-15	
Anal spines	II	II	II	II	II	II	
soft-rays	11-15	11-15	11-18	12-16	12-16	10-14	
Pectoral rays	15-21	18-20	18-21	16-19	17-20	15-22	
Scales in longitudinal series	47-66	20-30	24-28	20-30	20-30	24-28	
Gill-rakers	15-22	22-30	10-23	18-30	21-28	21-39	
Teeth	uniserial	uniserial	uniserial	biserial	multiserial	multiserial	
Spines of opercle	12-24	2	2	2	2	2	
Serration of							
suborbital	present	absent	absent	absent	present	absent	
preopercle	present*	absent	absent	present	present	absent	
opercle	present	absent	absent	absent	absent	absent	
Squamation of							
preorbital	naked	naked	naked	naked	scaled	scaled	
suborbital	naked	naked-scaled	scaled	naked-scaled	scaled	scaled	
interorbital	naked-scaled	scaled	scaled	scaled	scaled	scaled	
Karyological data**							
Diploid chromosome number	48	48	48	48	47	?	
Arm number (NF)	78-84	50-52	48	48	48	?	
New arm number (NAN)***	48	48	48	48	48	?	

* Except for *Amphiprion ocellaris* and *A. percula*.
** As for karyotypes, *Amphiprion* from three species, *Abudefduf* from three species, *Plectoglyphidodon* from a species, *Pomacentrus* from a species, and *Dascyllus* from a species. *Plectoglyphidodon leucozonus* was reported as *Abudefduf leucozonus* in ARAI and INOUE (1976).
*** Total of the diploid chromosome number and large chromosome number. As for detail, see ARAI and NAGAIWA (1976).

tendency is not found in Chaetodontidae.

Spines of opercle. Opercle, subopercle and interopercle of *Amphiprion* have many spines, but in the other genera the opercle usually has two spines, and subopercle and interopercle have no spines. Hence each of the opercle, subopercle and interopercle with many spines may be considered as specialized one.

Squamation around eyes. Interorbital, preorbital and suborbital of *Amphiprion* are naked or scaled (usually naked), but interorbital of the other genera is covered

with scales. Squamation of *Plectoglyphidodon* and *Dascyllus* is more developed than that of *Abudefduf* and *Pomacentrus*. Hence the arm number seems to increase as squamation around eyes becomes less developed.

As far as we know, chromosome information on *Chromis* has not been reported. If the discussion described above is reasonable, *Chromis* will be more basic than *Amphiprion* in such characters as two spines of opercle, no spines of subopercle and interopercle, and squamation around eyes. Reversely, it may be suggested that the karyotype of *Chromis* differs from that of *Amphiprion*, but resembles those of *Abudefduf*, *Pomacentrus* and *Plectoglyphidodon*.

As the results, from the comparative karyological point of view, *Amphiprion* may be the most specialized fish genus, among at least six genera discussed here, of the family Pomacentridae.

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Explanation of Plates 1-2

Plate 1

Figs. 1-2. Photomicrographs of mitotic metaphase chromosomes from gill epithelial cells of anemonefishes. — 1. *Amphiprion frenatus*, $2n=48$. $\times 1,580$. — 2. *A. ocellaris*, $2n=48$. $\times 1,580$.

Figs. 3-4. Karyotypes of anemonefishes. — 3. *Amphiprion frenatus*, from Fig. 1, $NF=84$. $\times 2,400$. — 4. *A. ocellaris*, from Fig. 2, $NF=84$. $\times 1,650$.

Plate 2

Figs. 1-2. Photomicrographs of mitotic metaphase chromosomes from gill epithelial cells of Platacidae and Plesiopidae. — 1. *Platax orbicularis*, $2n=48$. $\times 2,170$. — 2. *Plesiops coeruleolineatus*, $2n=48$. $\times 2,170$.

Figs. 3-4. Karyotypes of *Platax* and *Plesiops*. — 3. *Platax orbicularis*, from Fig. 1, $NF=48$. $\times 2,170$. — 4. *Plesiops coeruleolineatus*, Fig. 2, $NF=50$. $\times 2,170$.



