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Chromosomes of Labroid Fishes from Japan

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Labroid fishes from Japan consist of the family Labridae and the family Scaridae. The family Labridae is one of the most diversified of all fish families in shape and size. They are one of the commonest inhabitants in coral reef areas, and the most species bury themselves in sand at night. Fifty-eight genera with perhaps about 400 species have been reported in the world (NELSON, 1976). From Japan, 28 genera and 124 species of labrid fishes have been collected. They are so various in osteological and ethological characters as well as coloration that the phylogeny of labrid fishes is very difficult.

On the other hand, karyological approach to fish systematics has become more important. However, chromosomes of only thirteen species of Labridae in the world have been studied, i.e., *Thalassoma lunare*, *T. lutescens*, *Pseudolabrus japonicus*, *Labroides dimidiatus*, *Stethojulis interrupta*, *Halichoeres prosopeion* (=*H. melanochir*), *H. tenuispinis*, *Coris multicolor*, *Cirrhilabrus temmincki*, *Hemipteronotus dea* and *Cheilinus bimaculatus* from Japan and *Crenilabrus melops* and *Coris julis* from the Mediterranean Sea (NOGUSA, 1960; CATAUDELLA *et al.*, 1973; OJIMA & KASHIWAGI, 1979).

The family Scaridae is also one of the most familiar coral reef fishes, and some of them secrete mucus to envelope themselves while resting. Eleven genera and 68 species have been reported in the world (SCHULTZ, 1969; NELSON, 1976), and 6 genera and 40 species from Japan. Phylogenetic study based upon osteology was done by SCHULTZ (1958), but no karyological data have been reported.

In this paper, karyotypes of 11 species of the family Labridae and 2 species of the family Scaridae are described, and the relationships between their karyotypes and some morphological characters are discussed.

Method of chromosome preparation is the same as that of ARAI (1973). Classification of chromosomes is adopted from LEVAN *et al.* (1964). Metacentrics and submetacentrics are described as two-arm chromosomes, subtelocentrics and acrocentrics as one-arm chromosomes. The definition of the new arm number (NAN) is referred to ARAI and NAGAIWA (1976).

Table 1. Characters of 13 species of material fishes.

Species	No. of fish	S.L. (mm)	D.	A.	VN
Labridae					
Choerodon azurio	1	195.0	XIII, 7	III, 10	10+17
Cheilio inermis	1	70.5	IX, 12	III, 12	9+16
Thalassoma cupido	10	50.9– 88.9	VIII, 13	III, 11	9+16
T. lutescens	1	71.3	VIII, 13	III, 11	9+16
Stethojulis interrupta	9	41.0– 80.4	IX, 11	III, 11	10+15
Halichoeres poecilopterus	4	72.6–100.5	IX, 14	III, 14	10+17
H. binotopsis	1	79.5	IX, 11	III, 11	9+16
H. tenuispinis	1	81.1	IX, 12	III, 12	9+16
H. melanochir	1	79.3	IX, 12	III, 12	9+16
Pseudolabrus japonicus	2	85.7– 95.5	IX, 11	III, 10	9+16
Pteragogus flagellifera	3	94.9–103.4	IX, 11	III, 9	9+16
Scaridae					
Calotomus japonicus	1	58.6	IX, 10	III, 9	9+16
Scarus rhoduropterus	2	53.6– 72.0	IX, 10	III, 9	10+15

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

Family Labridae

Choerodon azurio (JORDAN et SNYDER) "Ira"

(Figs. 1 A, C)

A specimen (No. E·98·78), 230.8 mm in total length, had been kept at the Aquarium of Seto marine biological Laboratory, Kyoto University, Shirahama, Wakayama Prefecture (Table 1).

As shown in Table 2, we could not obtain clear chromosome figures sufficient for determining the karyotype of this species. In this paper we describe it as preliminary report. The diploid chromosome number is 48. The karyotype comprises 3 pairs of metacentric, a pair of submetacentric, and 20 pairs of subtelocentric-acrocentric chromosomes. The arm number is 56.

Cheilio inermis (FORSSKÅL) "Kamasu-bera"

(Figs. 1 B, D)

A specimen (No. E·73·25), 84.1 mm in total length, was caught at Kusugô, Yakushima Island, off southern Kyushu (Table 1).

The diploid chromosome number of this species is 48 (Table 2). The karyotype comprises 2 pairs of metacentric, a pair of submetacentric, and 21 pairs of subtelocentric-acrocentric chromosomes. The arm number is 54. The karyotype of this

Table 2. Frequency distributions of diploid chromosome counts in Japanese labroid fishes.

Species	2n													Total
	38	39	40	41	42	43	44	45	46	47	48	49	50	
Labridae														
Choerodon azurio										1	1			2
Cheilio inermis				1		1	1	1		1	6			11
Thalassoma cupido				1	3	1	2	1	3	8	41	3	2	65
T. lutescens						2		1		3	4			10
Stethojulis interrupta				1		1		2	3	6	21	1		35
Halichoeres poecilopterus					1			4	7	5	18	3	1	39
H. binotopsis											4			4
H. tenuispinis											1			1
H. melanochir									1	1	4			6
Pseudolabrus japonicus	1	1			11	1								14
Pteragogus flagellifera						2	15		1					18
Scaridae														
Calotomus japonicus						1					10			11
Scarus rhoduropterus	1		1		1		1	1	1		3			9

species agrees with in the diploid chromosome number, but differs from that of *Choerodon azurio* in the arm number.

Thalassoma cupido (TEMMINCK et SCHLEGEL) "Nishiki-bera"

(Figs. 2 A, C)

Ten specimens (Nos. E·69·8–E·69·10, E·69·17, E·81·20, E·81·36, E·81·37, E·81·43, E·81·57 and E·81·58), 63.5 to 104.6 mm in total length, were collected from Amatsu-kominato, Awa, Chiba Prefecture (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype comprises 24 pairs of subtelocentric-acrocentric chromosomes. The chromosomes are comparable in appearance and show a gradation in size which makes it impossible to arrange them in size groups. The arm number is 48. Karyologically this type of karyotype is considered as the most basic one.

Thalassoma lutescens (LAY et BENNETT) "Yamabuki-bera"

(Figs. 2 B, D)

A specimen (No. E·73·63), 85.5 mm in total length, was caught at Kusugô, Yakushima Island, off southern Kyushu (Table 1).

The diploid chromosome number is 48 (Table 2). The karyotype comprises 24 pairs of subtelocentric-acrocentric chromosomes. The chromosomes show a gradation from largest to smallest, hence cannot be easily divided into size groups. The

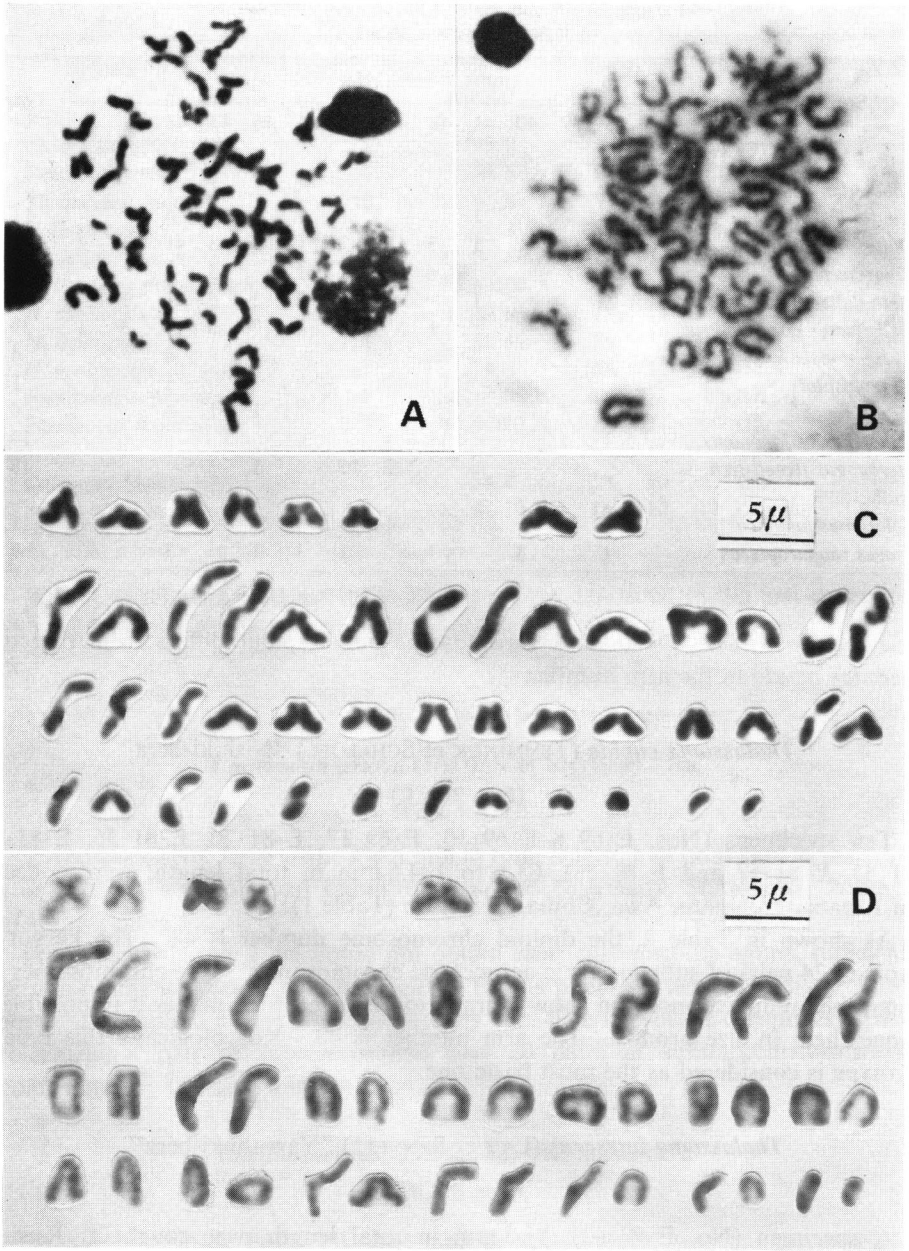

Fig. 1. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of *Choerodon azurio* and *Cheilio inermis*. —— A, *Choerodon azurio*, 2n=48, ×1,670; B, *Cheilio inermis*, 2n=48, ×1,880; C, *Choerodon azurio*, from Fig. A, NF=56, ×2,550; D, *Cheilio inermis*, from Fig. B, NF=54, ×2,250.

Fig. 2. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of two species of the genus *Thalassoma*. —— A, *Thalassoma cupido* (No. E·69·8), 2n=48, ×1,930; B, *T. lutescens* (No. E·73·63), 2n=48, ×1,530; C, *Thalassoma cupido*, from Fig. A, NF=48, ×2,180; D, *T. lutescens*, from Fig. B, NF=48, ×2,280.

arm number is 48. The present study confirmed the report by OJIMA and KASHIWAGI (1979). The karyotype of this species is very similar to that of *Thalassoma cupido*.

Stethojulis interrupta (BLEEKER) "Kaminari-bera"

(Figs. 3 A, C)

Seven specimens (Nos. E·69·11–E·69·14, E·81·19, E·81·42 and E·81·56), 50.1 to 97.7 mm in total length, were collected from Amatsu-kominato, Awa, Chiba Prefecture, a specimen (No. E·98·70) of 94.1 mm in total length from Shirahama, Wakayama Prefecture, and a specimen (No. E·73·9) of 54.4 mm in total length from Kusugô, Yakushima Island, off southern Kyushu (Table 1). Body color of all material fishes was "*kalosoma*" pattern (KISHIMOTO, 1974).

As shown in Table 2, the diploid chromosome number of this species is 48. The karyotype comprises a pair of submetacentric and 23 pairs of subtelocentric-acrocentric chromosomes. The arm number is 50. This result is the same as that by OJIMA and KASHIWAGI (1979). The karyotype of this species agrees with in the diploid chromosome number, but differs from those of *Thalassoma cupido* and *T. lutescens* in the arm number.

Halichoeres poecilopterus (TEMMINCK et SCHLEGEL) "Kyûsen"

(Figs. 3 B, D)

Four specimens (Nos. E·99·3, E·99·7, A·4·17 and A·4·18), 84.8 to 119.3 mm in total length, were caught at Amatsu-kominato, Awa, Chiba Prefecture (Table 1).

The diploid chromosome number is 48 (Table 2). The karyotype comprises 2 pairs of metacentric and 22 pairs of subtelocentric-acrocentric chromosomes. The last pair (Fig. 3D) of one-arm chromosomes are very small in size. The arm number is 52.

The karyotype of this species agrees with in the diploid chromosome number, but differs from those of three species of *Thalassoma* and *Stethojulis* in the arm number.

Halichoeres binotopsis (BLEEKER) "Ami-bera"

(Figs. 4 A, C)

A specimen (No. E·73·5), 96.5 mm in total length, was collected from Kusugô, Yakushima Island, off southern Kyushu (Table 1).

As shown in Table 2, the diploid chromosome number of this species is 48. The karyotype comprises 24 pairs of subtelocentric-acrocentric chromosomes. Each chromosome is comparable in appearance and shows a gradation in size which makes it impossible to arrange them in size groups. The arm number is 48.

The karyotype of this species is similar to those of two species of *Thalassoma*, but differs from that of *Halichoeres poecilopterus* in the arm number.

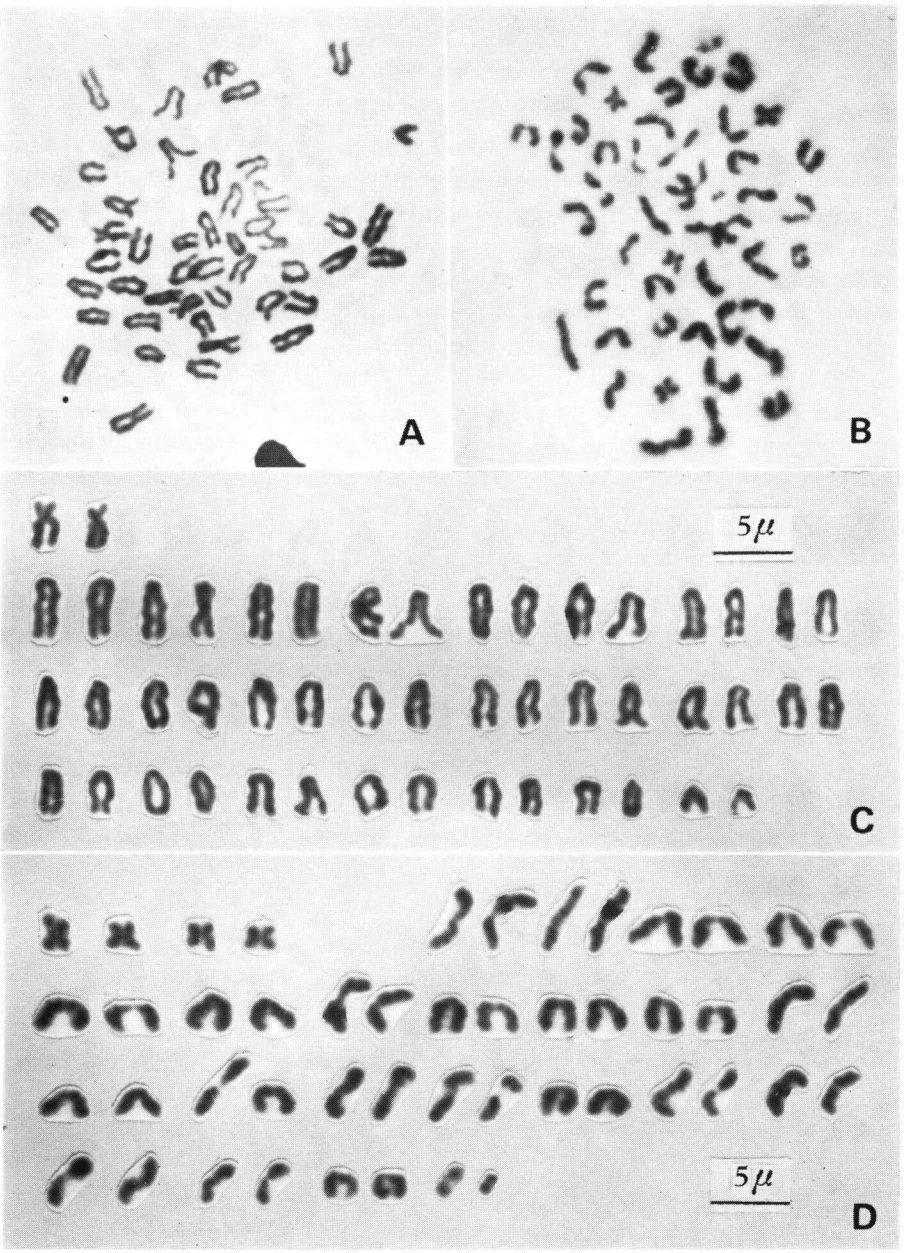

Fig. 3. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of species of *Stethojulis* and *Halichoeres*. —— A, *Stethojulis interrupta* (No. E·81·19), 2n=48, ×1,640; B, *Halichoeres poecilopterus* (No. E·99·7), 2n=48, ×1,610; C, *Stethojulis interrupta*, from Fig. A, NF=50, ×2,130; D, *Halichoeres poecilopterus*, from Fig. B, NF=52, ×2,120.

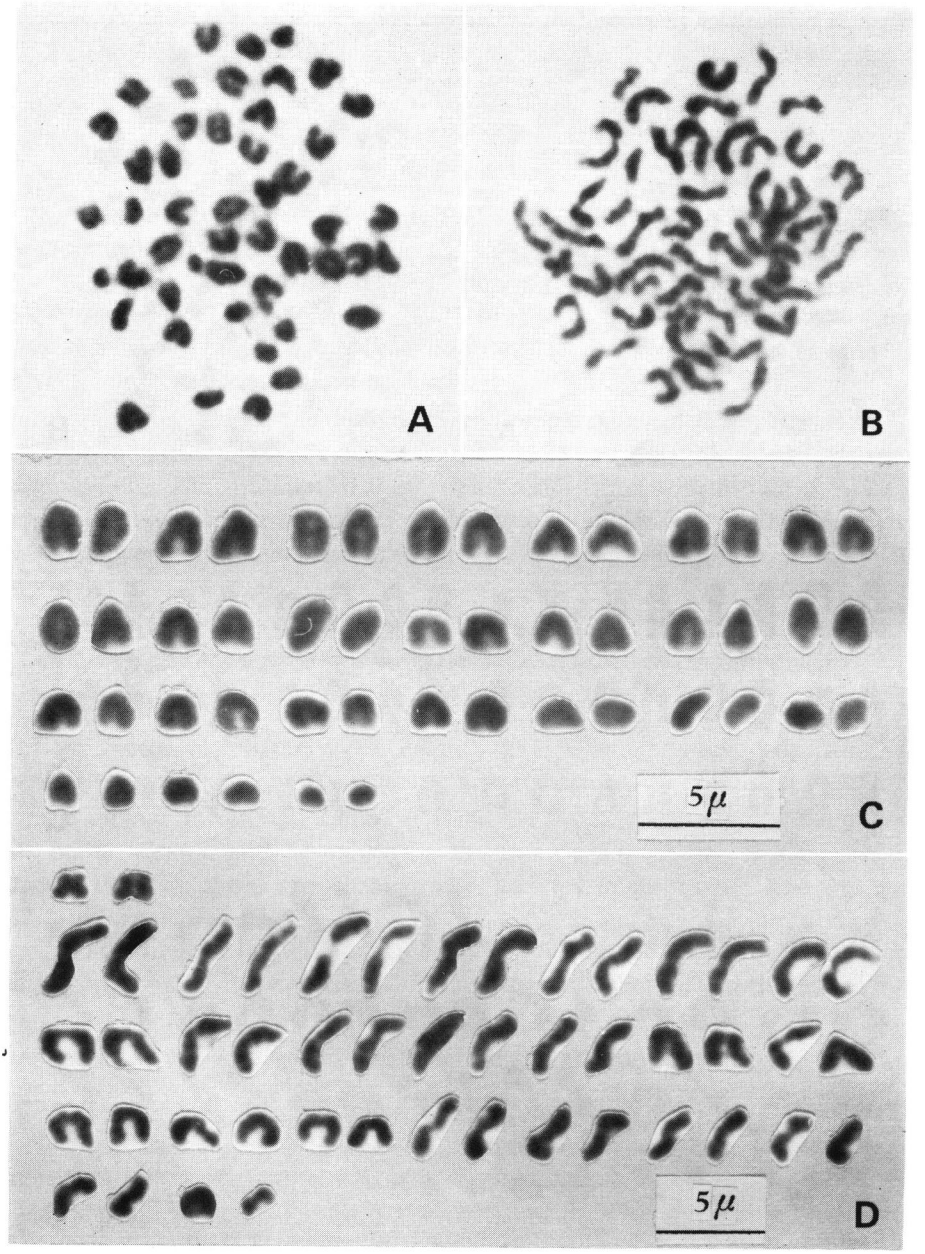

Fig. 4. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of two species of *Halichoeres*. —— A, *Halichoeres binotopsis* (No. E·73·5), 2n=48, ×2,690; B, *H. tenuispinis* (No. A·4·24), 2n=48, ×2,540; C, *H. binotopsis*, from Fig. A, NF=48, ×3,760; D, *H. tenuispinis*, from Fig. B, NF=50, ×2,920.

Halichoeres tenuispinis (GÜNTHER) "Hon-bera"

(Figs. 4 B, D)

A specimen (No. A·4·24), 95. 2 mm in total length, was caught at Amatsu-kominato, Awa, Chiba Prefecture (Table 1).

We could not obtain clear chromosome figures sufficient for determining the karyotype of this species (Table 2). However, considering karyotypes of the other species of the genus *Halichoeres*, we consider it reasonable to report as follows.

The diploid chromosome number is 48. The karyotype comprises a pair of metacentric and 23 pairs of subtelocentric-acrocentric chromosomes. The arm number is 50. OJIMA and KASHIWAGI (1979) considered a pair of two-arm chromosomes as submetacentrics.

The karyotype of this species is similar to that of *Stethojulis interrupta*, but differs from those of *Halichoeres poecilopterus* and *H. binotopsis* in the arm number.

Halichoeres melanochir FOWLER et BEAN "Munaten-bera"

(Fig. 5)

A specimen (No. E·73·61), 94.5 mm in total length, was collected from Shimama, Tanegashima Island, off southern Kyushu (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype comprises a pair of metacentric and 23 pairs of subtelocentric-acrocentric chromosomes. The arm number is 50. A pair of two-arm chromosomes were classified into submetacentrics by OJIMA and KASHIWAGI (1979).

The karyotype of this species is very similar to that of *Halichoeres tenuispinis*, but differs from those of *H. binotopsis* and *H. poecilopterus* in the arm number.

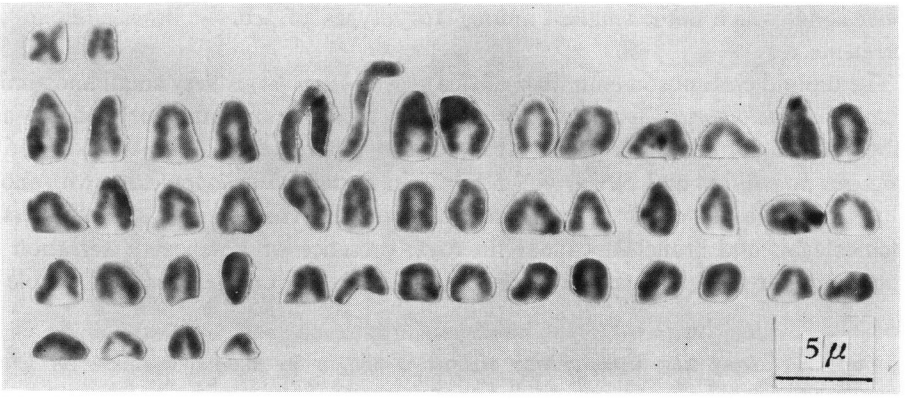

Fig. 5. The karyotype from the gill epithelial cell of *Halichoeres melanochir*. 2n=48, NF=50, ×2,580.

Pseudolabrus japonicus (HOUTTUYN) "Sasanoha-bera"

(Figs. 6 A, C)

A specimen (No. E·30·8), 103.0 mm in total length, was caught at Arasaki, Miura Peninsula, Kanagawa Prefecture and another specimen (No. E·98·73), 113.2 mm in total length, at Shirahama, Wakayama Prefecture (Table 1).

The diploid chromosome number is 42 (Table 2). The karyotype comprises 10 pairs of metacentric, 4 pairs of submetacentric and 7 pairs of subtelocentric-acrocentric chromosomes. The arm number is 70. The first 4 large metacentrics seem to be formed by centric fusion. The new arm number (NAN) may be 46.

The karyotype of this species is very characteristic, i.e., the diploid chromosome number is smaller than that of any other labroid species used in our experiments.

The diploid chromosome number in this study (2n=42) does not agree with those reported by other workers, i.e., 2n=46 in NOGUSA (1960) and 2n=48 in OJIMA and KASHIWAGI (1979). Such differences found in karyotypes may reflect the possibility of sibling species, or the intrapopulation chromosome polymorphism as in the case of the rainbow trout (THORGAARD, 1976).

Pteragogus flagellifera (VALENCIENNES) "Ohaguro-bera"

(Figs. 6 B, D)

A specimen (No. E·98·58), 116.1 mm in total length, was collected at Shirahama, Wakayama Prefecture and two specimens (Nos. A·2·3 and A·2·5), 130.0 mm and 117.2 mm in total length, from Tsumekizaki, Shimoda, Izu Peninsula, Shizuoka Prefecture (Table 1).

As shown in Table 2, the diploid chromosome number is 44. The karyotype of this species comprises a pair of metacentric, 5 pairs of submetacentric and 16 pairs of subtelocentric-acrocentric chromosomes. The arm number is 56. The new arm number is 44, which is the smallest among karyotypes of labroid fishes used in our experiments.

The diploid chromosome number of this species (2n=44) is very small and similar to that of *Pseudolabrus japonicus* (2n=42), but the new arm number and the arm number of the former differ from those of the latter, i.e., NAN=44, NF=56 in *Pteragogus flagellifera* and NAN=46, NF=70 in *Pseudolabrus japonicus*. Morphologically, they are much different from each other in such characters as the numbers of branchiostegals and branched caudal fin rays, presence or absence of serration on the preopercular edge, and size of scales on the cheek and on the caudal fin (Table 4).

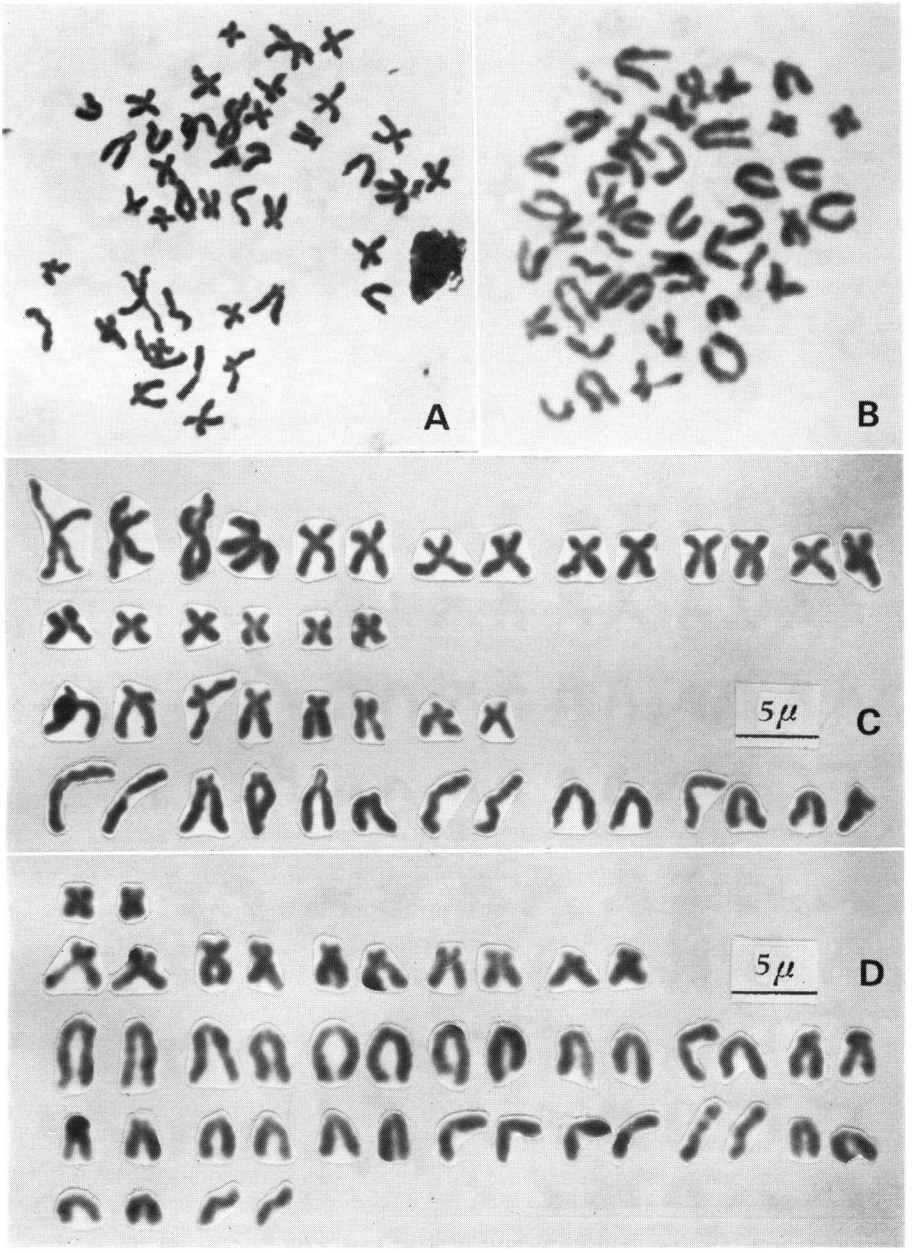

Fig. 6. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of species of *Pseudolabrus* and *Pteragogus*. —— A, *Pseudolabrus japonicus* (No. E·30·8), 2n=42, ×1,500; B, *Pteragogus flagellifera* (No. A·2·3), 2n=44, ×1,980; C, *Pseudolabrus japonicus*, from Fig. A, NF=70, ×2,200; D, *Pteragogus flagellifera*, from Fig. B, NF=56, ×2,280.

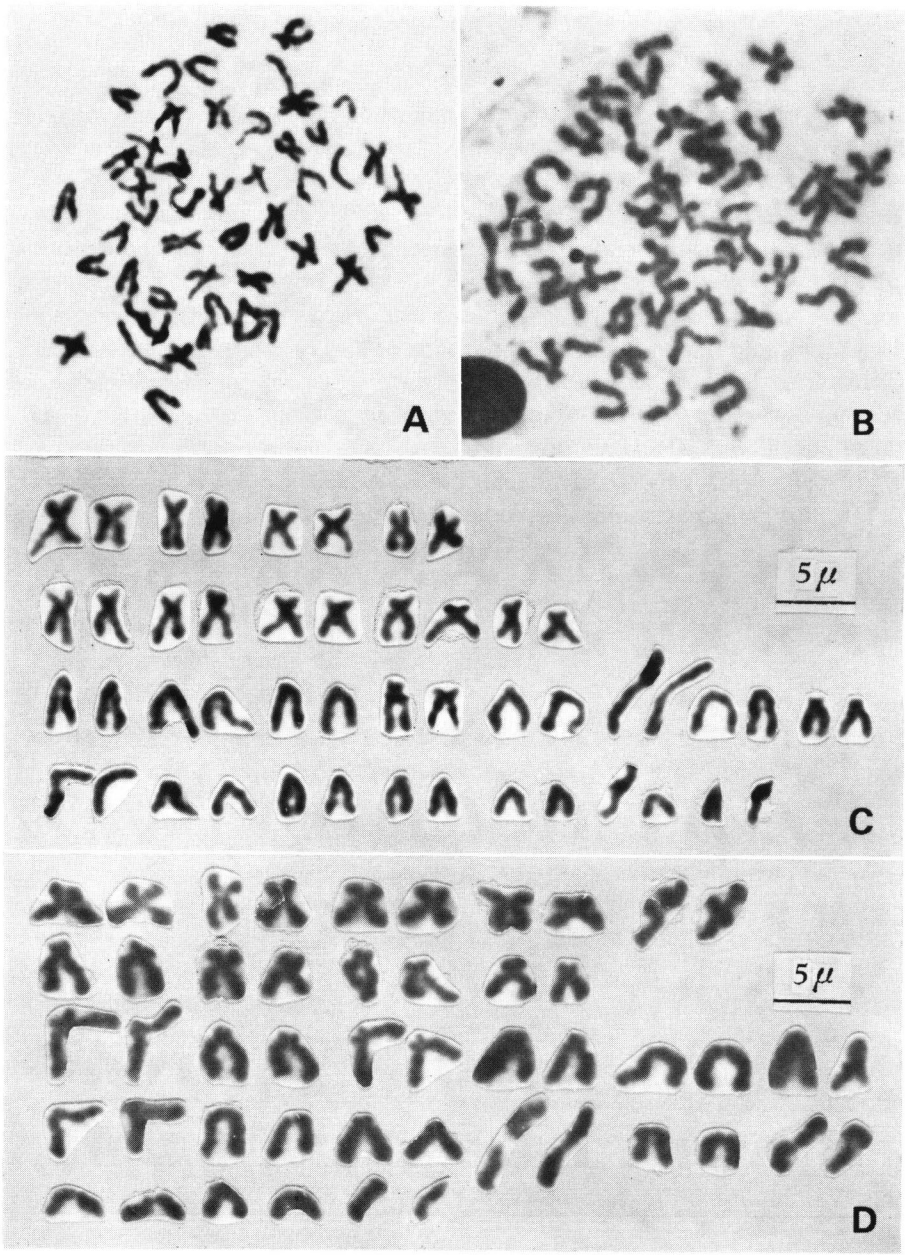

Fig. 7. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of two species of parrotfishes. —— A, *Calotomus japonicus* (No. E·81·35), 2n=48, ×1,620; B, *Scarus rhodouropterus* (No. E·87·22), 2n=48, ×1,720; C, *Calotomus japonicus*, from Fig. A, NF=66, ×2,110; D, *Scarus rhodouropterus*, from Fig. B, NF=66, ×2,050.

Family Scaridae

Calotomus japonicus (VALENCIENNES) "Bu-dai"

(Figs. 7 A, C)

A juvenile specimen (No. E·81·35), 70.9 mm in total length, was collected from Amatsu-kominato, Awa, Chiba Prefecture (Table 1).

The diploid chromosome number is 48 (Table 2). The karyotype comprises 4 pairs of metacentric, 5 pairs of submetacentric and 15 pairs of subtelocentric-acrocentric chromosomes. The arm number is 66. The karyotype of this species agrees with in the diploid chromosome number, but differs from those of labrid fishes in the arm number.

Scarus rhoduropterus (BLEEKER) "Akaguchi-bu-dai"

(Figs. 7 B, D)

Two juvenile specimens (Nos. E·87·21 and E·87·22), 86.5 and 65.5 mm in total length, were caught at Chichijima Island, Bonin Islands (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype comprises 5 pairs of metacentric, 4 pairs of submetacentric and 15 pairs of subtelocentric-acrocentric chromosomes. The arm number is 66.

The karyotype of this species is similar to that of *Calotomus japonicus* in 48 chromosomes with numerous arm number, which may be the specific character to scarid fishes.

Discussion

Table 3 shows chromosomes of the suborder Labroidei. As regards their karyotypes, the diploid chromosome number ranges from 32 to 48. The arm number (NF) ranges from 36 to 70. The new arm number (NAN) ranges from 44 to 48.

The karyotypes of *Halichoeres* are polymorphic, i.e., NF is 48 in *H. binotopsis*, 50 in *H. tenuispinis* and *H. melanochir*, and 52 in *H. poecilopterus*. With respect to other labroid species, there are no genera in which chromosome polymorphisms have been reported. These facts seem to show that *Halichoeres* consists of taxonomically heterogeneous fish groups.

The karyotype of *Pteragogus flagellifera* is very characteristic in the small number of the diploid chromosomes and the small new arm number. Among labrid fishes used in this study, this species is peculiar in morphological characters such as 5+5 branched caudal fin rays, 9 anal soft rays, a non-branched pectoral ray, 5 branchiostegals, and large scales on the cheek and on the caudal fin. The specialized karyotype of *Pteragogus flagellifera* may relate with these peculiar morphological characters. The diploid chromosome number of *Pseudolabrus japonicus* is smaller than that of *Pteragogus flagellifera*. However, the new arm number of *P. japonicus* is 46, which

Table 3. Karyotypes of labroid fishes.

Species	2n	Two arm	One arm	NF	NAN	Literature
Family Labridae						
Choerodon azurio	48	8	40	56	48	This paper
Cheilio inermis	48	6	42	54	48	This paper
Thalassoma cupido	48	0	48	48	48	This paper
T. lunare	48	0	48	48	48	OJIMA & KASHIWAGI, 1979
T. lutescens	48	0	48	48	48	OJIMA & KASHIWAGI, 1979
〃 〃	48	0	48	48	48	This paper
Stethojulis interrupta	48	2	46	50	48	OJIMA & KASHIWAGI, 1979
〃 〃	48	2	46	50	48	This paper
Halichoeres poecilopterus	48	4	44	52	48	This paper
H. binotopsis	48	0	48	48	48	This paper
H. tenuispinis	48	2	46	50	48	OJIMA & KASHIWAGI, 1979
〃 〃	48	2	46	50	48	This paper
*H. melanochir**	48	2	46	50	48	OJIMA & KASHIWAGI, 1979
〃 〃	48	2	46	50	48	This paper
Pseudolabrus japonicus	48	4	44	52	48	OJIMA & KASHIWAGI, 1979
〃 〃	42	28	14	70	46	This paper
〃 〃	46					NOGUSA, 1960
Pteragogus flagellifera	44	12	32	56	44	This paper
Coris multicolor	48	14	34	62	48	OJIMA & KASHIWAGI, 1979
C. julis	45	5	40	50	46	CATAUDELLA *et al.*, 1973
Crenilabrus melops	46	10	36	56	48	CATAUDELLA *et al.*, 1973
Labroides dimidiatus	48	0	48	48	48	OJIMA & KASHIWAGI, 1979
Hemipteronotus dea	44	0	44	44		OJIMA & KASHIWAGI, 1979
Cirrhilabrus temmincki	34	12	22	46	46?	OJIMA & KASHIWAGI, 1979
Cheilinus bimaculatus	32	4	28	36		OJIMA & KASHIWAGI, 1979
Family Scaridae						
Calotomus japonicus	48	18	30	66	48	This paper
Scarus rhodouropterus	48	18	30	66	48	This paper

* Reported as *Halichoeres prosopeion* (see OJIMA and KASHIWAGI, 1979).

is larger than that of *P. flagellifera*. This suggests that the karyotype of *P. flagellifera* is more specialized than that of *P. japonicus* (see ARAI & NAGAIWA, 1976). The diploid chromosome numbers of *Cirrhilabrus temmincki* and *Cheilinus bimaculatus* are also very small (OJIMA & KASHIWAGI, 1979). However, descriptions about their chromosomes are so short that we cannot discuss about their karyotypes in this paper.

On the other hand, we have tried to find out the relationship between the comparative morphology and karyotypes in butterflyfishes (ARAI & INOUE, 1975), pomacentrid fishes (ARAI *et al.*, 1976) and tetraodontiform fishes (ARAI & NAGAIWA, 1976). In the following lines, the relationship between morphological characters and karyotypes is discussed.

From the viewpoint of comparative anatomy, the directions of differentiation of branchiostegals and branched caudal fin rays are considered to be from large to small

Table 4. Comparison between 7 types of levator posterior (LP), a muscle of the head (YAMAOKA, 1978) and morphological characters in labroid fishes from Japan.

Species	Serration on preopercular edge	Branched caudal rays	Pectoral rays	Branchio-stegals	Type of LP
Family Labridae					
Choerodon azurio	present	6+6	ii, 14	6	PA
Cheilio inermis	absent	6+6	ii, 10		PA
Thalassoma cupido	absent	6+6	ii, 13	6	Bb
T. lutescens	absent	6+6	ii, 14	6	Ba
Stethojulis interrupta	absent	6+6	ii, 11	6	C
Halichoeres poecilopterus	absent	6+6	ii, 11	6	PA
H. binotopsis	absent	6+6	ii, 12	6	
H. tenuispinis	absent	6+6	ii, 11	6	PB
H. melanochir	absent	6+6	ii, 12	6	
Pseudolabrus japonicus	absent	6+6	ii, 11	6	PB
Pteragogus flagellifera	present	5+5	i, 12–ii, 11	5	PB
Anampses caeruleopunctatus	absent	6+6	ii, 11	6	PC
Labroides dimidiatus	absent	6+6	ii, 11	5	D
Cirrhilabrus temmincki	present	6+5	ii, 13	5	
Cheilinus bimaculatus	absent	6+5	ii, 10		PB
C. rhodochrous	absent	6+5	ii, 10	5	
Family Scaridae					
Calotomus japonicus	absent	6+5	ii, 11	5	
Scarus rhoduropterus	absent	6+5	ii, 13	5	

in number (MCALLISTER, 1968). The comparative karyology of the family Labridae seems to support these directions in both characters because the karyotype of *Pteragogus flagellifera* is more specialized than that of any other species used in our experiments (Tables 3 & 4).

With respect to anal fin rays, 9 soft rays may be the most specialized character state in labrid fishes whose caudal vertebrae are 16 in number (Tables 1 & 3). Eight anal soft rays in *Cheilinus* (2n=32) are also considered to be very specialized character state. In this case, however, the number of caudal vertebrae of *Cheilinus* is 14. As the number of anal soft rays is highly correlated with that of caudal vertebrae, the number of anal soft rays of *Pteragogus* cannot be easily compared with that of *Cheilinus*.

YAMAOKA (1978) classified 21 genera and 44 species of labrid fishes into 7 types according to the degree of the developing state of the levator posterior (LP) which is one of the muscles of the head, and discussed the interrelationships among these 7 types.

According to YAMAOKA (1978), the most basic type is Type PC, which contains *Pseudolabrus gracilis*, *Halichoeres marginatus*, *Anampses caeruleopunctatus*, *A. meleagris*, *Coris awayai* and *Hologymnosus semidiscus*, and Types Ba and Bb are more advanced than Type PB.

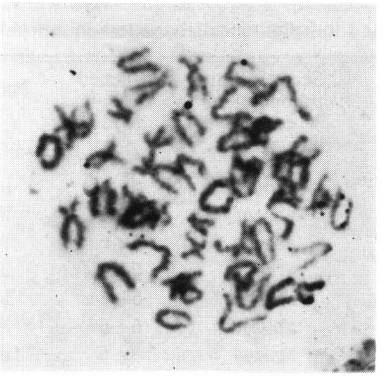

Fig. 8. A photomicrograph of mitotic metaphase chromosomes from the gill epithelial cell of *Anampses caeruleopunctatus* (No. E·73·38).

We could not obtain clear chromosome figures of the species belonging to Type PC. As shown in Fig. 8, however, *Anampses caeruleopunctatus* has at least 9 two-arm chromosomes. This shows that the karyotype of *A. caeruleopunctatus* is more specialized than that of *Halichoeres tenuispinis* (Type PB), whose karyotype is more specialized than those of *Thalassoma cupido* (Type Bb) and *T. lutescens* (Type Ba). These facts seem to show that the direction of differentiation of LP by YAMAOKA (1978) conflicts with that of karyotypes in labrid fishes.

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