

Chromosomes of Seven Species of Pomacentridae and Two Species of Acanthuridae from Japan

By

Ryoichi ARAI

Department of Zoology, National Science Museum, Tokyo

and

Masayuki INOUE

College of Agriculture and Veterinary Medicine, Nihon University, Tokyo

From a phylogenetic point of view, we have studied comparative karyology of shore fishes from Japan, i. e., Gobiidae (ARAI and KOBAYASI, 1973; ARAI and SAWADA, 1974, 1975; ARAI *et al.*, 1974), Blenniidae (ARAI and SHIOTSUKI, 1973, 1974), Chaetodontidae and Scorpidae (ARAI and INOUE, 1975), Scorpaenidae and Congiopodidae (ARAI and KATSUYAMA, 1973), and Balistidae, Tetraodontidae, Diodontidae and Ostraciontidae (ARAI and KATSUYAMA, 1973; ARAI and NAGAIWA, 1976).

Recently we had the chance to examine chromosomes of seven species of Pomacentridae including four genera, *Pomacentrus*, *Abudefduf*, *Dascyllus* and *Amphiprion*, and two species of Acanthuridae including two genera, *Prionurus* and *Acanthurus*, and the results of the observation are described in the present paper.

Method of chromosome preparation is the same as that of ARAI and KATSUYAMA (1973). Classification of chromosomes is adopted from LEVAN *et al.* (1964). Metacentrics and submetacentrics are described as two-arm chromosomes, and subtelo-centrics 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.

Pomacentrus coelestis JORDAN et STARKS "Sora-suzume-dai"

(Plate I, figs. 1 and 4)

A specimen, 61.0 mm in total length, was collected from Shimama (30°28'N, 130°52'E), Tanegashima Island, off southern Kyushu (Table 1).

As shown in Table 2, we could not obtain clear chromosome figures sufficient for determining the karyotype of this species. However, considering karyotypes of the other species of the family Pomacentridae, it seems reasonable to report it as follows. The diploid chromosome number is 48, and the karyotype comprises 24 pairs of acrocentric chromosomes. The arm number is 48.

Table 1. Characters of seven species of Pomacentridae and two species of Acanthuridae.

Species	No. of fish	S.L. (mm)	D	A	VN
Pomacentridae					
<i>Pomacentrus coelestis</i>	1	46.0	XIII, 14	II, 14	11+15
<i>Abudefduf leucozonus</i>	2	42.3-47.5	XII, 15-16	II, 12	11+15
<i>A. notatus</i>	2	40.2-49.3	XIII, 13	II, 13	11+15
<i>A. vaigiensis</i>	5	34.1-39.2	XIII, 13	II, 12-13	11+15
<i>A. sordidus</i>	1	40.4	XIII, 15	II, 15	11+15
<i>Dascyllus trimaculatum</i>	1	38.2	XII, 15	II, 14	11+15
<i>Amphiprion clarkii</i>	3	43.1-52.0	X, 16-17	II, 14-15	11+15*
Acanthuridae					
<i>Prionurus microlepidotus</i>	3	40.9-46.4	IX, 22-23	III, 22	9+13
<i>Acanthurus triostegus</i>	1	47.1	IX, 22	III, 22	9+13

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

Abudefduf leucozonus (BLEEKER) "Hakusen-suzume-dai"

(Plate 1, figs. 2 and 5)

Two specimens, 55.5 and 61.0 mm in total length, were caught at Kusugô (30°25' N, 130°36' E), Yakushima Island, off southern Kyushu (Table 1).

The diploid chromosome number is 48 (Table 2). The karyotype comprises two pairs of subtelocentric, and 22 pairs of acrocentric chromosomes. 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. The karyotype of this species is similar to that of *Pomacentrus coelestis*.

Abudefduf notatus (DAY) "Iso-suzume-dai"

(Plate 1, figs. 3 and 6)

Two specimens, 57.5 and 69.5 mm in total length, were collected from Shimama, Tanegashima Island (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype comprises a pair of metacentric, a pair of subtelocentric, and 22 pairs of acrocentric chromosomes. The arm number is 50. The karyotype of this species differs from that of *A. leucozonus* in the arm number.

Abudefduf vaigiensis (QUOY et GAIMARD) "Oyabitcha"

(Plate 2, figs. 1 and 3)

Five specimens, 46.4 to 57.5 mm in total length, were caught at Amatsu-kominato, Awa, Chiba Prefecture (Table 1).

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

Species	2n											Total
	41	42	43	44	45	46	47	48	49	50	51	
<i>Pomacentrus coelestis</i>								2				2
<i>Abudefduf leucozonus</i>		1		1	1	1	8	19	2			33
<i>A. notatus</i>				1		2	4	17				24
<i>A. vaigiensis</i>		1		1	2	3	8	23	2			40
<i>A. sordidus</i>			1		1	2	4	28	6	1		43
<i>Dascyllus trimaculatum</i>				2		2	9					13
<i>Amphiprion clarkii</i>				1	1	2	5	13	1			23
<i>Prionurus microlepidotus</i>		1	4	1	1	6	7	26	5	1		52
<i>Acanthurus triostegus</i>						2	5	12	1			20

The diploid chromosome number is 48 (Table 2). The karyotype comprises a pair of metacentric, a pair of submetacentric, a pair of subtelocentric, and 21 pairs of acrocentric chromosomes. The arm number is 52. The karyotype of this species differs from those of *A. leucozonus* and *A. notatus* by the arm number.

***Abudefduf sordidus* (FORSSKÅL) “Shima-suzume-dai”**

(Plate 2, figs. 2 and 4)

A specimen, 55.0 mm in total length, was collected at Shimama, Tanegashima Island (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype comprises a pair of metacentric, a pair of submetacentric, a pair of subtelocentric, and 21 pairs of acrocentric chromosomes. The arm number is 52. The karyotype of this species is similar to that of *A. vaigiensis*.

***Dascyllus trimaculatum* (RÜPPELL) “Mitsuboshi-kurosuzume-dai”**

(Plate 3, figs. 1 and 3)

A specimen, 51.0 mm in total length, was caught at Shimama, Tanegashima Island (Table 1).

The diploid chromosome number is 47 (Table 2). The karyotype of this species comprises a large metacentric, and 23 pairs of acrocentric chromosomes. Sex of material is unknown, but the large metacentric chromosome seems to be sex chromosome. This large chromosome is about twice as long as or a little longer than any other chromosome, hence it seems to be formed by centric fusion. Such karyotypes were reported in a Mexican cyprinodontid fish, *Megupsilon aporus*, and a goby, *Gobiodon citrinus* (MILLER and WALTERS, 1972; ARAI and SAWADA, 1974).

Amphiprion clarkii (BENNETT) "Kumanomi"

(Plate 3, figs. 2 and 4)

As ALLEN (1972) synonymized *A. xanthurus* with *A. clarkii*, we followed his classification.

Three specimens, 55.0 to 64.0 mm in total length, were collected from Shimama, Tanegashima Island (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype comprises 7 pairs of metacentric, 8 pairs of submetacentric, and 9 pairs of subtelocentric-acrocentric chromosomes. The arm number is 78. The karyotype of this species agrees with those of *Pomacentrus* and *Abudefduf* in the diploid chromosome number, but differs by numerous arms. Karyologically, *Amphiprion* may be considered as the most specialized of four genera in Pomacentridae.

Prionurus microlepidotus LACEPÈDE "Niza-dai"

(Plate 4, figs. 1 and 3)

Three specimens, 49.5 to 58.0 mm in total length, were caught at Amatsu-kominato, Awa, Chiba Prefecture (Table 1).

The diploid chromosome number is 48 (Table 2). The karyotype of this species comprises 24 pairs of acrocentric chromosomes. The chromosomes are comparable in appearance and show a gradation in size that makes it impossible to arrange them in size groups. The arm number is 48.

Acanthurus triostegus (LINNAEUS) "Shima-hagi"

(Plate 4, figs. 2 and 4)

A specimen, 57.7 mm in total length, was collected at Kusugō, Yakushima Island (Table 1).

As shown in Table 2, the diploid chromosome number is 48. The karyotype comprises 24 pairs of acrocentric chromosomes. In size, the chromosomes show a gradation from largest to smallest, hence cannot be easily divided into size groups. The arm number is 48. The karyotype of this species is similar to that of *Prionurus microlepidotus*.

Various Karyotypes in the Genus *Abudefduf*

With the exception of those which have sex chromosomes, marine acanthopterygian fishes belonging to a genus nearly always have the same karyotype. Cases where congeneric species have different karyotypes have been reported in *Gillichthys* and *Chaenogobius* of Gobiidae (CHEN and EBELING, 1971; ARAI and SAWADA, 1975), *Istiblennius* and *Blennius* of Blenniidae (ARAI and SHIOTSUKI, 1974; CATAUDELLA and

CIVITELLI, 1975), *Tetraodon* of Tetraodontidae (ARAI and NAGAIWA, 1976), and *Pollachius* of Gadidae (NYGREN *et al.*, 1974).

Present results show that the genus *Abudefduf* also has at least three different karyotypes. The arm number is 48 in *A. leucozonus*, 50 in *A. notatus*, and 52 in *A. vaigiensis* and *A. sordidus*. We tried to find morphological characters which reflect different karyotypes, and summarized them in Table 3 on the basis of AOYAGI (1941) and others. However, we could not find such correlation except for the scales of suborbital ring, i. e., the arm number seems to increase as the suborbital scales become less developed. When skeletons are examined more carefully, further evidence could be found.

Table 3. Comparison of characters on four species of the genus *Abudefduf*.

	<i>leucozonus</i>	<i>notatus</i>	<i>vaigiensis</i>	<i>sordidus</i>
Dorsal spines	12	13	13	13
Dorsal soft-rays	15-16	13	13	15
Anal soft-rays	12	13	12-13	15
Scales in suborbital ring	two rows	one row	one row	none
Scales in longitudinal series	26-28	ca. 26	23-29	26-28
Gill-rakers	16-20	ca. 26	24-28	22-23
Teeth	uniserial	uniserial	uniserial	uniserial
Dark crossbands	absent	absent	present	present
Diploid chromosome number	48	48	48	48
Arm number (NF)	48	50	52	52

Acknowledgments

We wish to express our gratitude to Dr. H. IDA, Kitasato University, and Messrs. Y. SAWADA and A. ÔSATO for collecting material.

References

- ALLEN, G. R., 1972. The Anemonefishes: their Classification and Biology. 1-288 pp., 140 figs., Neptune City, New Jersey, T. F. H. Publications.
- AOYAGI, H., 1941. The damsel fishes found in the waters of Japan. *Trans. biogeogr. Soc. Japan*, **4**: 157-279, text-figs. 1-52, pls. 11-23.
- ARAI, R., & M. INOUE, 1975. Chromosomes of nine species of Chaetodontidae and one species of Scorpidae from Japan. *Bull. Natn. Sci. Mus., Tokyo*, (A), **1**: 217-224, pls. 1-4.
- & I. KATSUYAMA, 1973. Notes on the chromosomes of three species of shore-fishes. *Ibid.*, **16**: 405-408, pl. 1.
- , — & Y. SAWADA, 1974. Chromosomes of Japanese gobioid fishes (II). *Ibid.*, **17**: 269-274, pls. 1-5.
- & H. KOBAYASI, 1973. A chromosome study on thirteen species of Japanese gobiid fishes. *Jap. J. Ichthyol.*, **20**: 1-6, figs. 1-15.
- & K. NAGAIWA, 1976. Chromosomes of tetraodontiform fishes from Japan. *Bull. Natn. Sci. Mus., Tokyo*, (A), **2**: 59-72, pls. 1-6.

- ARAI, R., & Y. SAWADA, 1974. Chromosomes of Japanese gobioid fishes (I). *Bull. Natn. Sci. Mus., Tokyo*, 17: 97-102, pls. 1-3.
- & ——— 1975. Chromosomes of Japanese gobioid fishes (III). *Ibid.*, (A), 1: 225-232, pls. 1-7.
- & K. SHIOTSUKI, 1973. Chromosome study on three species of the tribe Salariini from Japan (Pisces, Blenniidae). *Ibid.*, 16: 581-584, pl. 1.
- & ——— 1974. Chromosomes of six species of Japanese blennioid fishes. *Ibid.*, 17: 261-268, pls. 1-3.
- CATAUDELLA, S., & M. C. CIVITELLI, 1975. Cytotaxonomical consideration of the genus *Blennius* (Pisces-Perciformes). *Experientia*, 31: 167-169, figs. 1-4.
- CHEN, T. R., & A. W. EBELING, 1971. Chromosomes of the goby fishes in the genus *Gillichthys*. *Copeia*, 1971: 171-174, 2 figs.
- LEVAN, A., K. FREDGA & A. A. SANDBERG, 1964. Nomenclature for centromeric position on chromosomes. *Hereditas*, 52: 201-220, figs. 1-3.
- MILLER, R. R., & V. WALTERS, 1972. A new genus of cyprinodontid fish from Nuevo Leon, Mexico. *Nat. Hist. Mus. Los Angeles County, Contr. Sci.*, (233): 1-13, figs. 1-5.
- NYGREN, A., G. BERGKVIST, T. WINDAHL & G. JAHNKE, 1974. Cytological studies in Gadidae (Pisces). *Hereditas*, 76: 173-178, figs. 1-13.

Explanation of Plates 1-4

Plate 1

- Figs. 1-3. Photomicrographs of mitotic metaphase chromosomes from gill epithelial cells of damselfishes. — 1. *Pomacentrus coelestis*, $2n=48$. $\times 1,820$. — 2. *Abudefduf leucozonus*, $2n=48$. $\times 1,310$. — 3. *A. notatus*, $2n=48$. $\times 1,830$.
- Figs. 4-6. Karyotypes of damselfishes. — 4. *Pomacentrus coelestis*, from Fig. 1, $NF=48$. $\times 2,170$. — 5. *Abudefduf leucozonus*, from Fig. 2, $NF=48$. $\times 1,690$. — 6. *A. notatus*, from Fig. 3, $NF=50$. $\times 2,430$.

Plate 2

- Figs. 1-2. Photomicrographs of mitotic metaphase chromosomes from gill epithelial cells of *Abudefduf*. — 1. *A. vaigiensis*, $2n=48$. $\times 1,270$. — 2. *A. sordidus*, $2n=48$. $\times 2,430$.
- Figs. 3-4. Karyotypes of *Abudefduf*. — 3. *A. vaigiensis*, from Fig. 1, $NF=52$. $\times 1,270$. — 4. *A. sordidus*, from Fig. 2, $NF=52$. $\times 2,430$.

Plate 3

- Figs. 1-2. Photomicrographs of mitotic metaphase chromosomes from gill epithelial cells of a damselfish and an anemonefish. — 1. *Dascyllus trimaculatum*, $2n=47$. $\times 2,640$. — 2. *Amphiprion clarkii*, $2n=48$. $\times 1,800$.
- Figs. 3-4. Karyotypes of a damselfish and an anemonefish. — 3. *Dascyllus trimaculatum*, from Fig. 1, $NF=48$. $\times 3,010$. — 4. *Amphiprion clarkii*, from Fig. 2, $NF=78$. $\times 1,800$.

Plate 4

- Figs. 1-2. Photomicrographs of mitotic metaphase chromosomes from gill epithelial cells of surgeonfishes. — 1. *Prionurus microlepidotus*, $2n=48$. $\times 2,580$. — 2. *Acanthurus triostegus*, $2n=48$. $\times 1,720$.
- Figs. 3-4. Karyotypes of surgeonfishes. — 3. *Prionurus microlepidotus*, from Fig. 1, $NF=48$. $\times 2,580$. — 4. *Acanthurus triostegus*, from Fig. 2, $NF=48$. $\times 1,720$.







