Bull. Natn. Sci. Mus., Ser. A (Zool.), **2** (3), September 22, 1976

Chromosomes of Two Species of Beryciform Fishes from Japan

By

Ryoichi ARAI

Department of Zoology, National Science Museum, Tokyo

and

Kazuo NAGAIWA

College of Agriculture and Veterinary Medicine, Nihon University, Tokyo

Beryciform fishes are structurally the most primitive acanthopterygians and the first to have appeared in time. The Beryciformes are generally considered to be antecedent to the Perciformes (PATTERSON, 1964; GREENWOOD *et al.*, 1966). PATTERSON (1964) discussed polyphyletic evolution of perciform fishes on the basis of morphological characters of living and Mesozoic acanthopterygians, i.e., Menidae, Carangidae, Chaetodontidae and Centrarchidae might be derived from the dinopterygoid stem, and Serranidae, Scorpidae, Monodactylidae and Kyphosidae might have arisen from a polymixioid line.

On the other hand, karyological approach to fish systematics has become more valuable. As regards chromosomes of the Beryciformes, their studies are very few; three species of Melamphaeidae (CHEN, 1969) and two species of Diretmidae (POST, 1973). Moreover, figures of their chromosomes are not always clear.

Recently, we could obtain clear chromosome figures of two species of beryciform fishes from Japan, *Adioryx ruber* in Holocentridae and *Monocentris japonicus* in Monocentridae. The karyotypes of these two species are described in the present paper.

Classification of the order Beryciformes is that by GREENWOOD *et al.* (1966).

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 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.

Adioryx ruber (FORSSKÅL) "Ayame-ebisu"

(Figs. 1 and 3)

Two specimens (Nos. E·73·32 and E·73·48), 98.9 and 99.1 mm in total length,

Table 1. Characters of two species of beryciform fishes.

Species	No. of fish	S.L. (mm)	Dorsal	Anal	Pelvic	VN
Holocentridae						
Adioryx ruber	2	79.0–80.6	XI, 13	IV, 9	I, 7	11+16
Monocentridae						
Monocentris japonicus	1	108.0	V, 12	10	I, 3	12+14

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

Species	2n										Total
	41	42	43	44	45	46	47	48	49	50	
Adioryx ruber			2		3	4	5	25			39
Monocentris japonicus	1				2	3	5	18		1	30

were caught at Kusugô (30°25′N, 130°36′E), Yakushima 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. 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.

Monocentris japonicus (HOUTTUYN) "Matsukasa-uo"

(Figs. 2 and 4)

A specimen (No. E·81·30), 126.0 mm in total length, was collected at Amatsukominato, Awa, Chiba Prefecture (Table 1).

The diploid chromosome number is 48 (Table 2). The karyotype comprises 24 pairs of acrocentric chromosomes. The chromosomes are comparable in size, which makes it impossible to arrange them in size groups. The arm number is 48. The karyotype of this species agrees well with that of *Adioryx ruber*.

Chromosomes of Beryciform Fishes

As shown in Table 3, chromosomes of 7 species of 4 families within the order Beryciformes have been studied and their diploid chromosome numbers range from 42 to ca. 140. However, it is doubtful whether or not the supermacro-chromosomes of the two species of *Diretmus* are chromosomes of each species by the following reasons: 1) supermacro-chromosomes stained differently from other chromosomes, 2) very

Figs. 1–4. Photomicrographs of mitotic metaphase chromosomes and karyotypes from gill epithelial cells of a squirrelfish and a pineconefish. —— 1. *Adioryx ruber*, 2n=48. ×2,200. —— 2. *Monocentris japonicus*, 2n=48. ×1,600. —— 3. *Adioryx ruber*, from Fig. 1, NF=48. ×1,830.—— 4. *Monocentris japonicus*, from Fig. 2, NF=48. ×2,170.

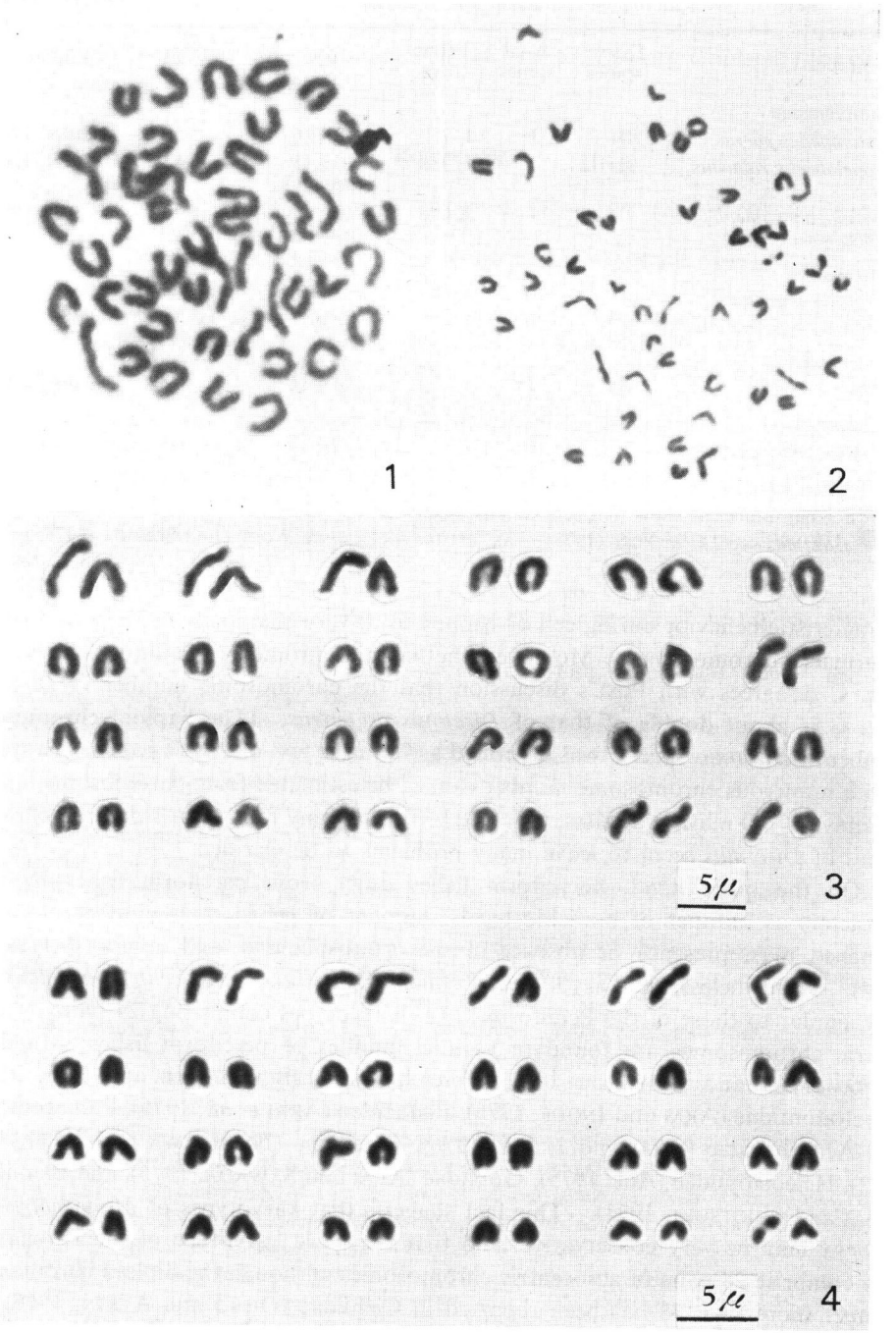
1
2
5μ
3
5μ
4

Table 3. Morphological characters and chromosomes of the order Beryciformes.

Species	Dorsal spines	Anal spines	Pelvic rays	VN	2n	Literature
Melamphaeidae						
Malamphaes parvus	III	I	I, 7	11–12+16–17	50	CHEN, 1969
Scopeloberyx robustus	II–III	I	I, 7–8	10+15 (usually)	42	CHEN, 1969
Scopelogadus mizolepis bispinosus	II	I	I, 6–8	10+15 (usually)	46	CHEN, 1969
Diretmidae						
Diretmus argenteus	0	0	I, 6	13+16*	II+42–44**	POST, 1973
*Diretmus pauciradiatus****	0	0	I, 6	30	ca. IV+136**	POST, 1973
Holocentridae						
Adioryx ruber	XI	IV	I, 7	11+16	48	This paper
Monocentridae						
Monocentris japonicus	V	0	I, 3	12+14	48	This paper

* After ABE (1975).

** Roman numerals show numbers of supermacro-chromosomes.

*** *Diretmus* spec. C in POST (1973). As for this species, see WOODS and SONODA (1973, p. 296).

characteristic behavior during cell division, and 3) very characteristic form and size of supermacro-chromosomes. Moreover, the haploid chromosome number of *Diretmus* spec. C disagrees with POST's discussion that the chromosome number in *Diretmus* spec. C is about double of that of *Diretmus argenteus*. (The haploid chromosome number of *Diretmus* spec. C was described as 70 in the text of POST's paper. However, such a numerous chromosome number cannot be estimated from chromosome figures. Possibly, n=70 may be a misprint for 2n=70.) At any rate, POST's data on chromosomes of *Diretmus* seem to leave many problems to be clarified.

On the other hand, beryciform fishes differ from perciform fishes by such characters as number of branchiostegals, number of pelvic rays, number of caudal branched rays, presence or absence of the orbitosphenoid, and others (PATTERSON, 1964). Nevertheless, the karyotypes of *Adioryx ruber* and *Monocentris japonicus* are very similar to those of the Perciformes, i.e., karyotypes comprising 24 pairs of acrocentric chromosomes are found in various families of perciform fishes; Mugilidae (CATAUDELLA and CAPANNA, 1973), Percichthyidae (BENIRSCHKE and HSU, 1973), Chaetodontidae (ARAI and INOUE, 1975), Platacidae (ARAI *et al.*, 1976), Pomacentridae and Acanthuridae (ARAI and INOUE, 1976), Girellidae (NISHIKAWA and KARASAWA, 1972), Heleostomidae (ABE, 1975), Gobiidae (ARAI and SAWADA, 1975), and Blenniidae (ARAI and SHIOTSUKI, 1973). This fact suggests that karyotypes of *Monocentris* and *Adioryx* may be very conservative, and that the basic karyotype of the Perciformes may comprise 24 pairs of acrocentric chromosomes, although the diploid chromosome number more than 48 has been reported in Cichlidae (OHNO and ATKIN, 1966) and Gobiidae (ARAI and SAWADA, 1974; NISHIKAWA *et al.*, 1974).

Acknowledgment

We wish to express our gratitude to Dr. H. IDA of Kitasato University for collecting specimens of *Adioryx ruber*.

References

ABE, S., 1975. Karyotypes of 6 species of anabantoid fishes. *Chromosome Information Service*, (19): 5–7, figs. 1–5.

ABE, T., 1975. Notes on some fishes collected by the Fisheries Research Vessel "Kaiyômaru" in the South China Sea. III. *Bull. biogeogr. Soc. Japan*, **30**: 31–34, fig. 1.

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.

——— & ——— 1976. Chromosomes of seven species of Pomacentridae and two species of Acanthuridae from Japan. *Ibid.*, (A), **2**: 73–78, pls. 1–4.

———, ——— & H. IDA, 1976. Chromosomes of four species of coral fishes from Japan. *Ibid.*, (A), **2**: 137–142, pls. 1–2.

——— & 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 (I). *Ibid.*, **17**: 97–102, pls. 1–3.

——— & ——— 1975. Ditto. (III). *Ibid.*, (A), **1**: 225–232, pls. 1–7.

——— & K. SHIOTSUKI, 1973. A chromosome study on three species of the tribe Salariini from Japan (Pisces, Blenniidae). *Ibid.*, **16**: 581–584, pl. 1.

BENIRSCHKE, K., & T. C. HSU, 1973. Chromosome Atlas: Fish, Amphibians, Reptiles and Birds. Volume 2. New York, Springer-Verlag.

CATAUDELLA, S., & E. CAPANNA, 1973. Chromosome complements of three species of Mugilidae (Pisces, Perciformes). *Experientia*, **29**: 489–491, figs. 1–3.

CHEN, T. R., 1969. Karyological heterogamety of deep-sea fishes. *Postilla*, (130): 1–29, figs. 1–35.

GREENWOOD, P. H., D. E. ROSEN, S. H. WEITZMAN & G. S. MYERS, 1966. Phyletic studies of teleostean fishes, with a provisional classification of living forms. *Bull. Am. Mus. nat. Hist.*, **131**: 345–455, 9 text-figs., pls. 21–23.

LEVAN, A., K. FREDGA & A. A. SANDBERG, 1964. Nomenclature for centromeric position on chromosomes. *Hereditas*, **52**: 201–220, figs. 1–3.

NISHIKAWA, S., & T. KARASAWA, 1972. A comparative study of the chromosomes in Japanese fishes—I. A study of the somatic chromosomes of three species of scups. *J. Shimonoseki Univ. Fish.*, **20**: 235–240, figs. 1–6. (In Japanese.)

———, K. AMAOKA & K. NAKANISHI, 1974. A comparative study of chromosomes of twelve species of gobioid fishes in Japan. *Jap. J. Ichthyol.*, **21**: 61–71, figs. 1–5.

OHNO, S., & N. B. ATKIN, 1966. Comparative DNA values and chromosome complements of eight species of fishes. *Chromosoma*, **18**: 455–466, figs. 1–9.

PATTERSON, C., 1964. A review of Mesozoic acanthopterygian fishes, with special reference to those of the English Chalk. *Phil. Trans. roy. Soc. London*, (B), **247**: 213–482, figs. 1–103.

POST, A., 1973. Chromosomes of two fish-species of the genus *Diretmus* (Osteichthyes, Beryciformes: Diretmidae). In *Genetics and Mutagenesis of Fish*, ed. by J. H. SCHRÖDER, pp. 103–111, figs. 1–17. New York, Springer-Verlag.

WOODS, L. P., & P. M. SONODA, 1973. Order Berycomorphi (Beryciformes). In *Fishes of the Western North Atlantic*. Part six, pp. 263–396, figs. 1–66. New Haven, Sears Foundation for Marine Research, Yale University.