

## アユの染色体研究

誌名	日本水産學會誌
ISSN	00215392
巻/号	378
掲載ページ	p. 707-710
発行年月	1971年8月

農林水産省 農林水産技術会議事務局筑波事務所  
Tsukuba Office, Agriculture, Forestry and Fisheries Research Council Secretariat



## A Chromosome Study of the Ayu, a Salmonoid Fish

Fumio YAMAZAKI\*

(Received February 19, 1971)

The present study was carried out to clarify the morphology and the number of chromosomes that the ayu represents. The material, *Plecoglossus altivelis*, was obtained from Lake Biwa, a lake in the main island of Japan. The air drying technique was used to obtain chromosome preparations of kidney tissues after injection of 0.5% colchicine. The diploid number of chromosomes in the ayu amounted to 56, including 12 biarmed and 46 telo- or acrocentric chromosomes. The number of arms was 68. Four pairs of small dot like chromosomes were also observed.

The ayu, *Plecoglossus altivelis* TEMMINCK et SCHLEGEL classified as belonging to Plecoglossidae related to Salmonidae is the most productive species in the fresh water fisheries in Japan. However, recent pollution of the river yields the serious suspense in the ayu fisheries. This suggests the necessity of the studies of improvements of ayu breeding on the basis of the cytogenetics. Some serious abnormality and pathological condition in fish may also be induced by karyotypic changes as in human.<sup>1)</sup>

Current advances in cytogenetic techniques in teleost fish such as tissue cultures<sup>2)</sup>, squashes of the testis<sup>2,3)</sup> haematopoietic tissues or embryological material<sup>4,5)</sup>, smear of gill epithelium<sup>6,7)</sup> or air drying technique<sup>8-11)</sup> after treatment of colchicine have facilitated karyological studies in teleost fishes.

The morphology and the number of the chromosomes of the ayu have not been reported yet. The author could have a chance to observe the number of chromosomes and karyotypes of the ayu by air drying techniques. The results are reported here.

### Material and Methods

The ayu, *Plecoglossus altivelis* used in the present study had been caught at Yasugawa, Lake Biwa, main island. About two thousand fish had been transferred alive to Shikabe near Hakodate, Hokkaido Island. Ten fish were taken up by a hand net from a fish transport tank equipped in the truck in the way of transportation at the campus of Fisheries School Hokkaido University on June 15, 1970. The average size of the fish used was 5.6 cm in body length. They were kept in a well aerated aquarium of 30×45×30 cm size and fed with pellets.

After one week rearing, they were injected with 0.02 ml of 0.5% colchicine solution and kept for 3 to 4.5 hours after the injection. Then the injected fish were killed by de-

\* Faculty of Fisheries, Hokkaido University, Hakodate, Hokkaido, Japan. (山崎文雄: 北海道大学水産学部)

capitation. Kidney tissues were removed and minced with scissors, treated with 0.075 M KCl hypotonic solution for 40 minutes at room temperature, then fixed with 3:1 methyl-alcohol acetic acid mixture. Chromosome slides were made according to the usual air-drying method and stained with Giemsa solution. The sex of the fish could not be determined by dissection.

### Results and Discussion

The results of chromosome counts are shown in Table 1. It was shown that the diploid number of the present species so far examined in four specimens was 56 in the somatic metaphase (Figs. 1, 2).

Detailed karyotype analysis revealed that the 56 chromosomes comprised of 12 biarmed chromosomes and 44 telo- or acrocentric elements (Figs. 1, 2). The 12 biarmed elements were matched into 6 supposed homologous pairs on the basis of their size and centromeric position. While 44 telo- or acrocentric elements showed a difficulty in the identification of homologous partners (Figs. 3, 4). There were the four pairs of characteristic small dot-like chromosomes among these telo- or acrocentric element (Figs. 3, 4). The number of arms is 68. No metacentric chromosomes could be observed.

**Table 1.** Distribution of chromosome numbers in somatic cells of the ayu, *Plecoglossus altivelis*

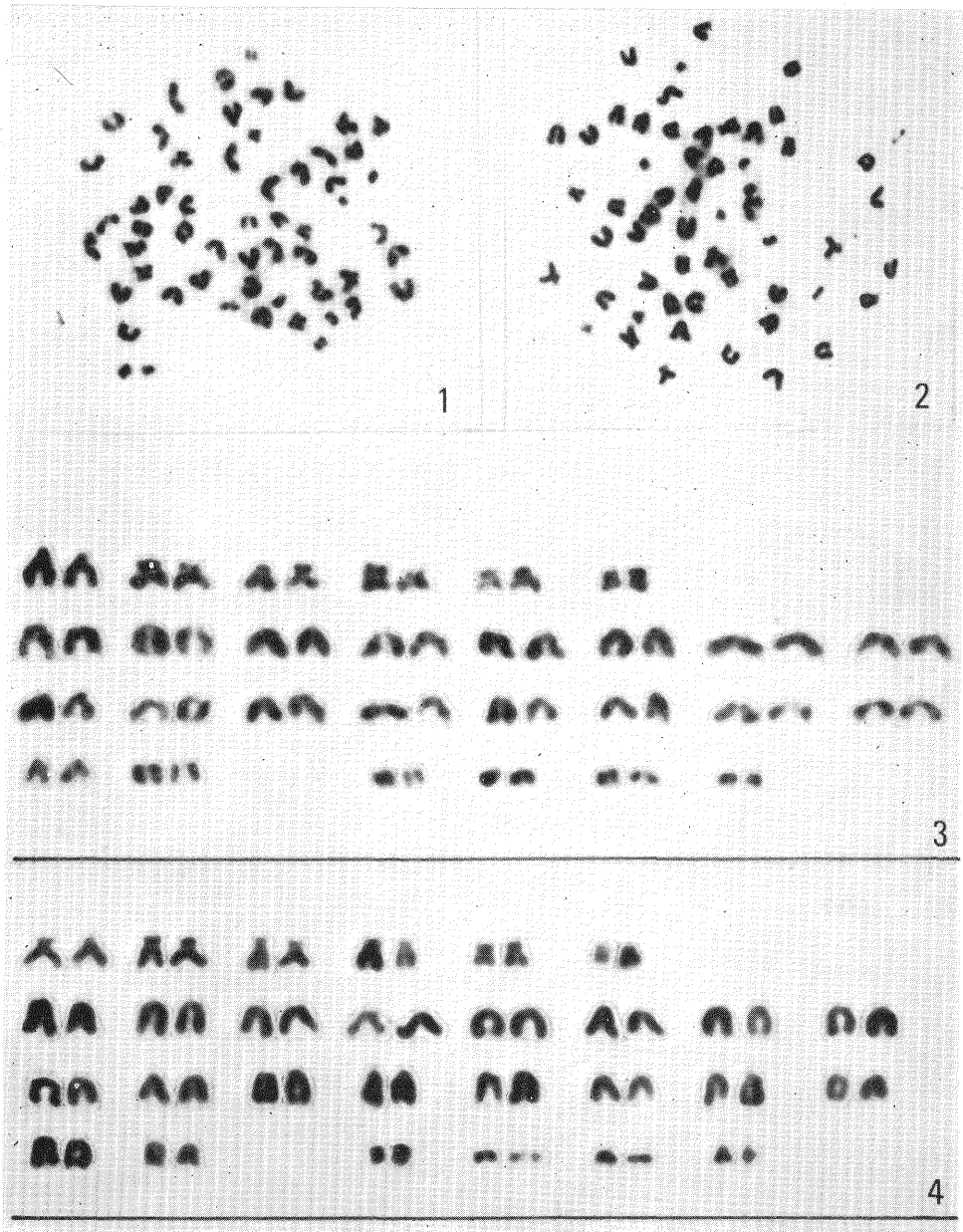
Specimen No.	Time of colchicine treatment (hours)	Chromosome number										Total No. of cells observed		
		51	52	53	54	55	56	77	91	94	104		112	
1	3		1		4	1	14							20
2	3.5			1		1	11	1		1		1		16
3	4		1	1			7		1		1			11
4	4.5			2	2	1	12							17
Total		1	2	3	6	3	44	1	1	1	1	1		64

. Approximate number

Large variations in the chromosome number were found in some cells of two fish killed at 3.5 and 4.0 hours after the colchicine injection, but not in fish killed at 3 and 4.5 hours after the colchicine injection (Table 1). No consistent morphological differences were observed which might suggest sex chromosomes.

The chromosome number of the ayu is the same as those of *Oncorhynchus nerka*<sup>4)</sup> and *Salmo salar*<sup>12,13)</sup> in the family Salmonidae.

These two Salmonids have been studied with early embryo. Roberts<sup>14)</sup> has pointed out that the chromosomes in the blastomere preparations tend to be elongated which often makes the counting and determination of centromere position very difficult. A chromosome figure of *Salmo salar* obtained from the cell culture shows sixteen biarmed chromo-



#### Explanation of the Plate

Figs. 1 and 2. Somatic metaphase figures with 56 chromosomes  $\times 1700$

Figs. 3 and 4. Serial alignments of somatic metaphase chromosomes. Biarmed elements are aligned at the upper row then telocentric elements are placed in order of size. Fig. 3 is from Fig. 1 and Fig. 4 from Fig. 2.  $\times 2960$

somes which are matched into eight supposed homologous pairs among 40 telo- or acrocentric chromosomes.<sup>14)</sup> Some of them are typical metacentric and the number of arms is 72.

There exist differences in the karyotypes between the present species and *Salmo salar* in despite of the same chromosome number of  $2n=56$ . The numbers of arms of genus *Oncorhynchus* is ranged from 102 to 112<sup>4)</sup> and is considerably greater than that of the present species.

Recent studies in human chromosomes reveal the close associations between karyotypic changes and various kinds of neoplasms<sup>15-17)</sup> and abnormality<sup>1)</sup>. This associations may also be present in fish. Studies in fish chromosomes were assumed to be extremely difficult. But now adequate and simple techniques are available in fish. Studies of the some abnormality or neoplasms of fish will possibly be benefited by chromosome studies.

#### Acknowledgements

Present author expresses hearty thanks to professor Hidejiro Niiyama, Faculty of Fisheries Hokkaido University, who read and commented on the manuscript. The author is also very grateful to Mr. Awakura, Hokkaido Salmon Hatchery for providing the material.

#### References

- 1) A. LIMA-DE-FARIA: Handbook of Molecular cytology. Part IX chromosome abnormalities and other pathological condition, North-Holland Publishing Co. Amsterdam, 688-834 (1969).
- 2) F. L. ROBERTS: *J. Morph.*, **115**, 401-418 (1964).
- 3) S. OHNO, C. STENIUS, E. FAISST, and M. T. ZENZES: *Cytogenetics*, **4**, 117-129 (1965).
- 4) R. C. SIMON: *J. Morph.*, **112**, 77-97 (1963).
- 5) J. YAMADA: *Bull. Fac. Fisheries Hokkaido Univ.*, **18**, 183-187 (1967).
- 6) J. D. MCPHAIL and R. L. JONES: *J. Fish. Res. Bd. Canada*, **23**, 767-769 (1966).
- 7) K. W. STEWART and C. B. LEVIN: *J. Fish. Res. Bd. Canada*, **25**(5), 1091-1093 (1968).
- 8) E. M. EICHER: *Stain technology*, **41**, 317-321 (1966).
- 9) Y. OJIMA, S. HITOTSUMACHI, and S. MAKINO: *Proceed. Jap. Acad.*, **42**, 62-66 (1966).
- 10) S. HITOTSUMACHI and M. SASAKI: Chromosome Information Service No. 8, 19-20 (1967).
- 11) H. FUKUOKA: Masters thesis, Fac. Fisheries Hokkaido Univ. (1970).
- 12) E. R. BOOTHROYD: *Proceedings, Genetic Society of Canada*, **2**, 41 (1957).
- 13) E. R. BOOTHROYD: *Can. J. Genetics. Cytology* **1**, 161-172 (1959).
- 14) F. L. ROBERTS: *Prog. Fish-culturist* **29**, 75-83 (1967).
- 15) K. BAYREUTHER: *Nature*, **186**, 6-9 (1960).
- 16) J. LEJEUNE: Ninth International Cancer Congress (Tokyo) Abstracts, 5-6 (1966).
- 17) K. ICHINOE: Chromosomal abnormalities in gynecological neoplasms. Invited lecture commissioned by Jap. Obst. Gynec. Soc., 1-285 (1970).