

## Conference Report:

### Present and future of medaka biology — molecular biology to field surveys — (July 23–24, 1992, held at National Institute of Basic Biology, Okazaki)

Kenjiro Ozato

*Department of Natural Environment Sciences, Faculty of Integrated Human Studies, Kyoto University, Yoshidanihonmatsu, Sakyo-ku, Kyoto 606, Japan*

Small freshwater fish such as medaka and zebrafish have been attracting the recent interest of biologists. Molecular biology, developmental biology, and radiation biology (mutation research) using medaka are entering a new phase of research and being extended to various fields of basic biology, medical science, and fisheries science beyond traditional zoology. Speciation and biogeography of this species have been extensively explored in field surveys and experimental analysis of DNA and chromosomes. In light of these circumstances, a conference was organized to discuss the present and future of medaka biology by Drs. A. Shima (Tokyo Univ.) and K. Ozato (Kyoto Univ.). The conference was supported by “the Cooperative Research Program” of the National Institute of Basic Biology (NIBB) and managed by Dr. Y. Nagahama (NIBB). Fifty-two researchers attended the conference.

Presentations and discussions were carried out in the following seven sessions.

#### *Session 1. Reproduction and development*

Egg maturation in medaka (Y. Nagahama, NIBB)

Fertilization in medaka (T. Iwamatsu, Aichi Univ. of Education)

Structure, synthesis and function of glycopolyprotein in the cortical alveoli granules (hyosophrin) (K. Kitajima and Y. Inoue, Tokyo Univ.)

#### *Session 2. Gene I*

Repetitive sequences as genome markers (K. Naruse, Tokyo Univ.)

Aromatase gene (M. Tanaka, NIBB)

Hatching enzyme cDNA and gene expression (S. Yasumasu and K. Yamagami, Sophia Univ.)

#### *Session 3. Gene II*

Cloning of homeobox genes (S. Takagi and M. Kimura, NTT Basic Research Laboratories and Tokai Univ.)

Early development of zebrafish and POU tran-

scription factors (T. Matsuzaki, Tsukuba Life Sci. Center)

Studies of *Arabidopsis* and medaka (K. Okada, NIBB)

#### *Session 4. Transgenic fish and embryo manipulations*

Transgenic medaka (K. Ozato, Kyoto Univ.)

Expression and germline transmission of the mouse tyrosinase gene in medaka (Y. Taguchi, Natl. Inst. Radiol. Sci.)

Transgenic zebrafish and developmental neurobiology (H. Okamoto, NIBB)

Formation of chimeric medaka (Y. Wakamatsu, Kyoto Univ.)

Approach to sex determination mechanisms of germ cells (T. Hamaguchi, Niigata Univ.)

#### *Session 5. Mutation, systematics, and evolution*

Induction of germ cell mutations (A. Shimada and A. Shima, Tokyo Univ.)

Genetic monitoring of inbred strains of medaka (Y. Taguchi, Natl. Inst. Radiol. Sci.)

Morphological mutants of medaka (Y. Ishikawa, Ryukyu Univ.)

Intraspecific structures of medaka viewed from genetic polymorphism (M. Sakaizumi, Tokyo Metro. Inst. Med. Sci.)

Karyotype and evolution of the medaka fish (H. Uwa, Shinshu Univ.)

#### *Session 6. Medaka viewed from other fields of biology*

*Drosophila* and medaka (Y. Hotta, Tokyo Univ. and NIBB)

Medaka as an experimental animal substituted for mice in cancer research (T. Ishikawa, Tokyo Univ.)

Fisheries science and medaka (K. Aida, Tokyo Univ.)

Marine biology and medaka (T. Hirano, Tokyo Univ.)

#### *Session 7. Research organization of medaka biology*

- a) Production, stock and distribution of experimental fish
- b) Construction of computer networks
- c) Editing of experimental protocols
- d) Republishing of "The Fish Biology Journal MEDAKA"
- e) International cooperation
- f) International Symposium

The conference has revealed that the position of medaka biology is steadily strengthening in several lines of research. Molecular biology on the hatching mechanisms, fertilization, and egg maturation has reached the stage of gene cloning after basic physiological and morphological research for many years. A molecular approach to morphogenesis in development has just begun with the use of probes of homeobox genes and POU transcription factor genes (zebrafish).

Technology of transgenic fish, which first developed in medaka, is now entering the stage of practical use. The mouse tyrosinase gene in transgenic medaka has been transmitted to F<sub>4</sub> generation. The inheritance and expression of genes have been reproducible in each generation. Techniques to trace cell lineage are being developed in zebrafish embryos carrying cells labelled by transgenes. The chimeric medaka has just been produced using inbred strains of the wildtype and some color varieties. Phenotypes of the wildtype were transmitted to the next generation in the pigment and isoenzyme patterns. Currently, gene technology and embryo technology are being linked in various fields of medaka biology.

A new method for induction of mutation has been developed as an application of basic research of radiation biology. The main principle in this method is to use the "tester medaka" which is produced by hybridizations of several mutant strains collected from natural populations by the Laboratory of Freshwater Fish Stock, Nagoya University. Mutations can be induced efficiently in "tester medaka" by exposure to radiation or chemical mutagens.

The medaka has been used as an experimental animal for carcinogenesis for many years and has been known to show high susceptibility to carcinogens. Presently, researchers are rediscovering the usefulness of medaka in cancer research. This tendency is partially encouraged by public interest in the animal rights of experimental rodents.

The genus *Oryzias* is a freshwater fish living specifically in Asia. Ten species are distributed in

a broad area from India to Japan. The genetic approach to speciation of this genus is producing excellent results by international cooperative studies of field surveys and karyotype analysis in Thailand in 1988–1990 and in Indonesia in 1991–1993. Speciation of *Oryzias latipes* distributed in East Asia and Japan has been elucidated precisely in polymorphism of proteins and DNA. A new method for identifying species or varieties is being developed which uses repetitive DNA sequences as the genome marker.

A field of science is often activated by the interchange of ideas with different fields. In sessions 3 (last topics) and 6, biologists not using medaka gave lectures on "medaka viewed from other fields". Drs. K. Okada studying *Arabidopsis* and Y. Hotta studying *Drosophila* talked mainly about the international research organization of these plants and animals. Their talks encouraged participants to consider the foundation of a research organization on medaka biology proposed in session 7.

Medaka is a convenient species for use as an experimental model. However, this point of view is exaggerated and researchers tend to forget that medaka is a type of fish. Dr. Aida, studying fisheries science, talked about regulation of the spawning cycle of fish. Dr. Hirano, studying marine biology, talked about osmoregulation in fish. Their talks threw a new light on extensive diversity and abundance of biological phenomena in fish.

In session 7, action plans promoting research of medaka biology were discussed. The most important and urgent problem is to establish a stock center. Many species or varieties of *Oryzias* are stocked at several laboratories in Japan. A considerable number of mutants collected from natural populations are stocked at the Laboratory of Freshwater Fish Stock, Nagoya University. Several inbred strains are stocked at the National Institute of Radiological Science. *Oryzias latipes*, collected from natural populations in Japan, the Korean Peninsula, and inland China, is stocked at the Laboratory of Radiation Biology, Tokyo University. Various species of *Oryzias* collected from the South and Southeast Asia are stocked at the Department of Biology, Aichi University of Education and the Department of Biology, Shinshu University. However, the range of facilities and manpower to stock and maintain these biologically invaluable stocks are limited, and the system is supported only by the self-

sacrificing efforts of a few researchers. There was much discussion with regard to establishment of a stock center befitting the present state of research, which can supply fish on an international level.

Construction of a computer network is an indispensable requirement for development of a field of science, as pointed out by Drs. K. Okamoto and Y. Hotta. Dr. K. Naruse was nominated to head the development of the network construction.

Many experimental protocols in medaka biology are used privately by individual researchers. There was discussion of obtaining these "hidden" protocols and compiling them for widespread use. This compilation may be assembled by means of the computer network.

The annual journal "MEDAKA", first appeared in 1982 from the Laboratory of Freshwater Fish

Stock, Nagoya University, was published up to Vol. 3 in 1984. Republication of the journal was announced by Dr. H. Fujisawa, director of Laboratory. The announcement was well received and has been materialized as the present issue of MEDAKA. A report on the international cooperative research on field surveys of *Oryzias* with Asian countries was presented by Dr. H. Uwa. Finally, it was proposed to plan an international symposium on small freshwater fish biology.

The conference was ground-breaking in the high quality of papers presented, the wide diversity of the research fields of the participants, and the enthusiasm of discussion. Explosive progress in medaka biology is expected in the near future and will be ensured by the realization of the action plans discussed in session 7.