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World Medaka Aquarium in Nagoya Higashiyama Zoo

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Introduction

Small in size but unique, "World Medaka Aquarium" was established in Nagoya Higashiyama Zoo on October 7, 1993. A zoo should fulfill four major functions: recreation, social education, research and preservation of species. The World Medaka Aquarium was designed to meet these four requirements as one part of the zoo. Particular emphasis has been placed on environmental problems that had previously not been given adequate consideration but are now contemporary issues in social education. The preservation of species is another issue of emphasis. There were restrictions on the size of the aquarium since it is only one facility of the zoo, but the designers strove to create an attractive, natural aquarium with a distinctive flavor all its own. After much discussion, it was decided to set up an aquarium collecting a certain group of fish (a kind of aquarium which had not existed before). The special group chosen to be represented mainly includes the *Oryzias* (medaka); it is classified as suborder *Cyprinodontoidei.* These fishes were considered to be the most appropriate kinds to accomplish the mission of the aquarium. Furthermore, the nearby presence of Nagoya University, which has played an important role in the study of medaka in Japan, including the work of the late Professor Tokio Yamamoto — an expert on medaka who was affectionately referred to as "Dr. medaka" — contributes to enhancing the significance of the new aquarium.

Size of the facility

The aquarium is small compared with other new aquariums established recently, since it is one facility of the zoo.

Site area: 2,700 m^2.

Building area: 1,116 m^2. Reinforced concrete, partly two-storied.

Total floor area: 1,424 m^2.

Number of water tanks for exhibition: 208.

Number of nonexhibition water tanks: 668 (for breeding and reproduction).

Fig. 1. Front view of World Medaka Aquarium in Nagoya Higashiyama Zoo.

Total water volume used:
water for exhibition; 67.0 t.
nonexhibition water; 35.0 t.
Fish being bred:
six families, 57 genera, 241 species, and approximately 14,000 items.

Oryziatidae	1 genus, 11 species
Cyprinodontidae	13 genera, 39 species
Aplocheilidae	18 genera, 141 species
Anablepidae	1 genus, 1 species
Goodeidae	8 genera, 8 species
Poeciliidae	16 genera, 41 species

Outline of the Facility

The main building contains six zones that are designed to faciliate the visitors' understanding of the ecology, physiology, living environment and variety in species of medaka and its relatives, while renewing interest in medaka which was, for a long time, the most familiar fish in Japan but is not often seen these days. Overall, the facility is intended to help visitors understand the close relationship between these fish and plants, together with the importance of the ecosystem. The aquarium also strives to promote awareness of environmental problems.

Zone 1: Natural living environment of medaka

A water tank [L: 15 m, W: 1.0 m, D: 0.5 m (average)] in the main building represents the natural environment that medaka inhabits. The natural environment of this species and the ecology therein can be observed. Approximately 20 species of small fish and crustaceans are kept in the tank that share the water environment inhabited by medaka in nature, as well as approximately 10 species of water plants. On the land, approximately 30 species of trees and plants are planted, recreating the appearance of natural streams and ponds in the aquarium.

Zone 2: Medaka learning corner

Here visitors can enjoy themselves learning about the birth, physical structure, living environment, behavior, habits and characteristics of medaka by means of a micro-TV scope, video, magic vision, panels, and exhibitions in the water tanks. In the water tank, six mutant species of medaka (*O. latipes*) and seven species of *Oryziatidae* are kept for exhibition.

Zone 3: Vivarium

This room is filled with tropical flora, creating a spectacle which makes the visitors feel as if they

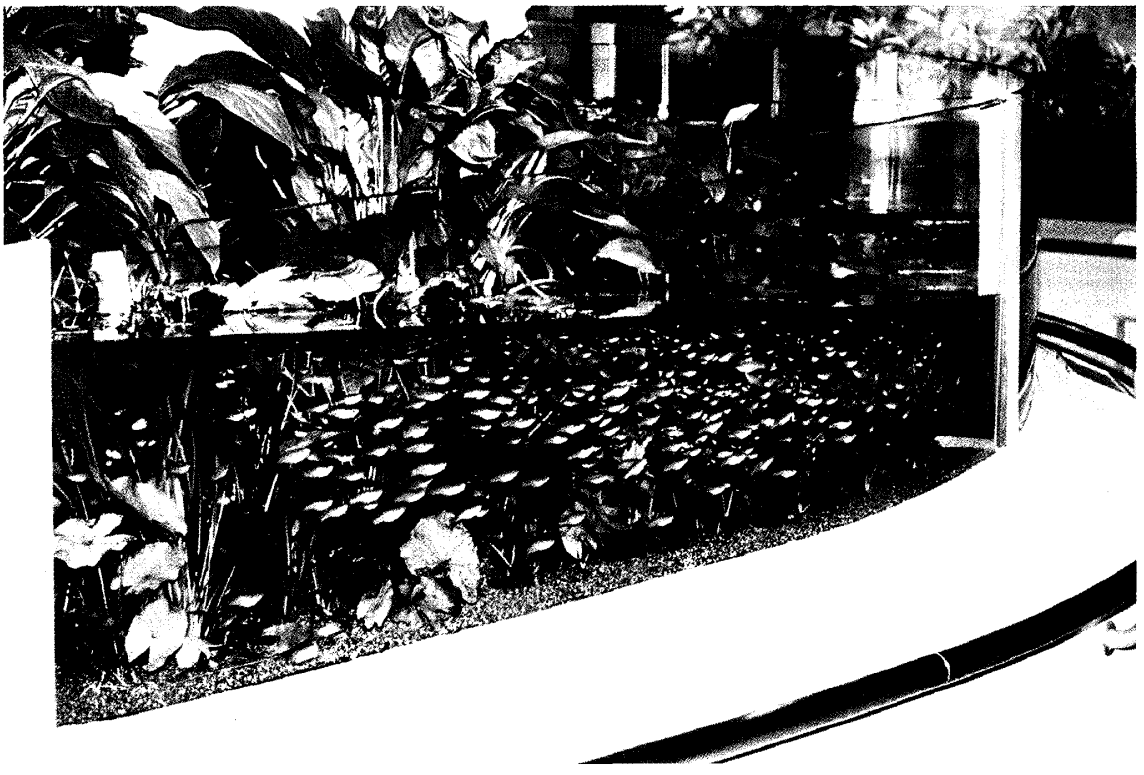

Fig. 2. Natural environment tank.

are viewing rivers and ponds in tropical rain forests. In particular, numerous water plants are grown in the water tank so that the visitors can observe the close relationship between water plants and fish, as well as every kind of fish behavior, including breeding.

Zone 4: Exhibition of small water tanks

There are three exhibition rooms containing small water tanks. The first room exhibits 20 species of viviparous fish (*Poeciliidae* and *Goodeidae*), and the second room exhibits 20 oviparous species (*Cyprinodontidae* and *Aplocheilidae*). In these two rooms, particular emphasis is placed on the beautiful arrangement of water plants, in addition to showing fish with distinctive characteristics in these two groups. Visitors will gain a sense of satisfaction from simply viewing the beautifully arranged and well-tended water plants. In the third exhibition room, there are 128 small water tanks (W: 30 cm, D: 45 cm, H: 30 cm) built into the wall, and two columnar water tanks in the corridor for visitors. Here, especially beautiful *Cyprinodontidae* fish are exhibited. The *Cyprinodontidae* fish, relatives of medaka, are all very small but rich in variety, with forms and colors varying subtly depending on the species. Therefore, they are exhibited in a number of small water tanks so that the visitors can observe the water tanks at close range.

Zone 5: 3D Hi-Vision theater

A three-dimensional Hi-Vision theater, "Medaka Hall", is constructed on the second floor, and an original software produced by us is shown. Visitors are introduced to environmental problems while enjoying beautiful three-dimensional video images with narrative. The software runs for approximately ten minutes and is shown every twenty minutes. The hall is also used for lectures.

Zone 6: Nature observation zone

Three small ponds and a river linking these ponds are arranged outside the building. Of course, these are artificial, but are created so as to resemble the natural environment as closely as possible, reproducing streams and ponds that used to be familiar to us until some time ago. The greatest emphasis has been placed on the arrangement of the plants growing in the water, in the area leading from water to land, and on the land itself, with the aim of facilitating the understanding of the close connection between medaka and the environment (especially plants).

Specific features that cannot seen in other aquariums

The major features specific to the World Medaka Aquarium are as follows.

1. The range of fishes for exhibition has been determined on the basis of taxonomy. There are aquariums which exhibit fishes inhabiting specific locations and environment, but there is no other aquarium exhibiting only specific taxonomical groups.
2. Water plants are arranged in all the water tanks. Plants provide safe ground for spawning, delivery and shelter, contributing to reducing stress in the fish. Therefore, natural breeding, behavior and ecology of fishes can be observed. Additional effects include the supply of oxygen (aeration is not necessary) due to the metabolism of the plants, and water purification. These exhibits promote the understanding of the close relationship between fish and plants.
3. Most of the water tanks are the open type. Since fish are in the same open space as visitors, visitors can observe the fish easily and feel close to them.
4. All the fish for exhibition are bred in-house. Fish for supplementing stock are always kept in the nonexhibition breeding facility, so there is no need to catch wild fish.
5. Basic knowledge of medaka can be obtained in the learning corner. Here, the different stages of development can also be observed using a micro-TV scope.
6. Outside the building, there are streams and ponds inhabited by medaka providing an opportunity for field observation.
7. Strains of medaka are stocked to use for scientific research. Eleven species of *Oryzias* collected from various areas of Asia and 28 mutants of *Oryzias latipes* are maintained.

Conclusions

The World Medaka Aquarium represents an innovative concept, and therefore, at present, the staff is fully occupied with basic management, such as maintenance of facilities and establishment of breeding technology. In the future, however, we hope to cooperate with elementary schools (in Japan, children learn about medaka in

the fifth grade), universities and research laboratories to contribute to education and research.

In establishing the aquarium, we received advice, suggestions and assistance from many people. We would like to thank Dr. Hideo Tomita of Nagoya University, Dr. Takashi Iwamatsu of Aichi University of Education, the late Dr. Hiroshi Uwa of Shunshu University, Dr. Kunisuke Takeuchi of Aichi Gakuin University and Dr. Teruya Ueno of the National Science Museum for their help.