The “Yurikago Suiden” project: Has this effort to revive Paddy fields as fish nurseries succeeded?

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Introduction

Different sorts of fish passes, intended to provide access to paddy fields, have been installed in recent years in many areas of Japan. In Shiga Prefecture, such fish passes have been devised since 2001, and the so-called Shiga-model system, consisting of a flashboards cascade constructed in a drainage canal, was established in 2004. This system has been increasingly installed in Shiga Prefecture, and the area of paddy fields involved was 1.11 km^2 in 2009.

In the present report, we introduce the “Yurikago Suiden” project, or Project for Fish Breeding Mechanism Restoration in Paddy Fields around Lake Biwa, which made us of this device in Yasu city, Shiga, and evaluate its effects.

Overview of the “Yurikago Suiden” project and its practice in Yasu

The “Yurikago Suiden” project aims at restoring the paddy field environment in the paddies around Lake Biwa, to the extent that fishes can again spawn and reproduce. This project enables fish to enter paddies by means of fish ladders in the form of flashboard cascades constructed in drainage canals.

The study fields belong to four villages in Yasu city, southwest of Lake Biwa, and comprise an area of 0.322 km^2 in total. All the main drainage canals connect with Lake Biwa directly or by way of a marshy satellite lake. Six fish pass ladders were set up there.

A fish ladder constructed in a drainage canal.

Characteristics of the project

1. One fish ladder enables fish to run into many paddies, i. e., all the paddies above its upper end. It is thus efficient, both technically and economically. It is, however, “socially” difficult because it requires acceptance by all the involved farmers, unified farming methods and calendar, and consensus in the community.

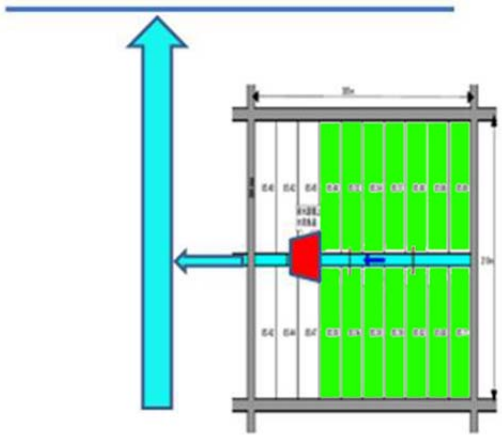

Diagram of a fish ladder (red) set in a drainage canal (blue). Fish can run into all the paddies above the flashboard cascade (green).

2. This project has been undertaken chiefly by farmers. Since 2007, farmers in southern part of the Lake Biwa Basin have improved the device in terms of ease of construction and cost performance.
3. The frequency of rainy days in May influences the fish-run into paddies, because fish usually run during or after precipitation.
4. Both adult and juvenile fish enter the paddies. In the case of juvenils, water-level control is very important because only a small difference in the water level can constitute an important obstacle for juve-

A Far Eastern catfish, *Silurus asotus,* entering a paddy field (upper), and a pair spawning within a paddy (lower).

nile fish.

5. The management of rice farming, especially rice transplanting period, affects the fish run into paddies.
6. Fish immigration can be enhanced by adequate maintenance of the fish ladder and a drain outlet of the paddy. Construction of a fish pass from a drainage canal to a paddy is also effective.
7. In conclusion, this project is multilaterally good for villages, farmers, children, aquatic organisms, and Lake Biwa!

Evaluation of the project: a case study

In 2009, a scoop net was set over each drain outlet at the time of the mid-season drainage to catch all fishes exiting from the "Yurikago Suiden" paddies in Yasu into drainage canals. The fish caught were identified and counted, although these numbers were underestimates because some fishes were left stranded in the paddies.

Fish juveniles bred in a paddy field, mainly crucian carp *Carassius auratus* and Far Eastern catfish *Silurus asotus*

In total, about 10,000 individuals of fish larvae/juveniles and 2,600 individuals of adult fish were caught. Among them, seven species of fish were identified: crucian carps *Carassius auratus* (including subsp. *langsdorfii* and *grandoculis*), weather loach *Misgurnus anguillicaudatus* (probably including *Paramisgurnus dabryanus*), Far Eastern catfish *Silurus asotus*, "kanehira" *Acheilognathus rhombeus*, Japanese rice fish *Oryzias latipes*, common carp *Cyprinus carpio*, and topmouth gudgeon *Pseudorasbora parva*. The first three listed were dominant.

Fish ran down from 94% of the paddies connected to fish ladders; the proportion ranged from 80% to 100% depending on site. These high success rates demonstrate that the objective of the project, the enhancement of fish spawning/breeding in paddies otherwise inaccessible to fish was largely accomplished.

Many fish larvae/juveniles were also recovered from the drainage canals upper the fish ladder or in the ladders' compartment themselves. This suggests that the stagnant water there also provided an effective fish nursery. Abundant zooplankton from the connected paddies may serve as food to enhance fish growth there. In addition, when the water level of the dammed-up drainage canal was equal to that of the connected paddies, fish juveniles could come and go freely between the canal and the paddies. From these observations, we conclude that leveling drainage canal and its paddies forms a connected suite of "Fish Nursery Paddy Areas", with an increased effect due to the expanded the area available for fish spawning/breeding.