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More case studies from around the globe
Edited by Pritpal S. Soorae

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Translocation and re-introduction project of striped bitterling in Lake Biwa and neighboring areas, Japan

Junya Kitazima[1], Shigeru Takeda[2], Masanari Matsuda[3], Shotaro Nishida[4] & Seiichi Mori[5]

[1] - Graduate School of Environmental Studies, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8601, Japan kazetoge@gmail.com
[2] - Botejyako Trust,23-6 Tsurunosato, Kusatsu, Shiga 520-0826, Japan uotakeda@fine.ocn.ne.jp
[3] - Lake Biwa Museum, 1091 Oroshimo, Kusatsu, Shiga 525-0001, Japan matsuda@lbm.go.jp
[4] - Central Japan Bitterling Research Association,7-178-2-203 Hayashimachi, Ogaki, Gifu 503-0015, Japan totakekespi@gmail.com
[5] - Biological Laboratory, Gifu-keizai University, 5-50 Kitagata, Ogaki, Gifu 503-8550, Japan smori@gifu-keizai.ac.jp

Introduction

The striped bitterling (*Acheilognathus cyanostigma*) is a Japanese endemic freshwater fish belonging to the carp family. The natural region of distribution of this fish is considered to be Kinki District and the central region of mainland Japan, and a large number used to live on the coast and lagoons called “naiko” around Lake Biwa in Shiga Prefecture. Although scattered occurrences of individuals thought to have originated from Lake Biwa have been confirmed across Japan, the number of individuals in Lake Biwa has decreased sharply from the 1990s and no records exist for the last ten years. Owing to its nearly complete extirpation around Lake Biwa, this species has been designated as Critically Endangered by the Ministry of the Environment. It has also been designated as Critically Endangered and in Shiga Prefecture, where Lake Biwa is located and collection of bitterlings is forbidden by the prefectural ordinance.

Lake Biwa where the project is being undertaken is the only ancient lake dating back well over 4 million years in Japan. To speak only of the lake’s fish, about 15 endemic species are found here and therefore is an important water area for biodiversity conservation. It is also important for Japanese culture because Lake Biwa appears in classical Japanese literature and artwork. However, much of the wildlife of

***Acheilognathus cyanostigma* bred in Lake Biwa**

the lake, including the striped bitterling, has been affected adversely in recent years by the invasion of alien species, the disappearance of "naiko", and the fragmentation of the wildlife habitat network formerly provided by rice fields. In this project, we started to produce a number of striped bitterling habitats in ponds and biotopes around Lake Biwa, which works as a means of securing the continued existence of this fish and preparing for the re-introduction of founder stocks into Lake Biwa.

Goals

- Goal 1: Continuation of striped bitterling populations in the wild in Shiga Prefecture.
- Goal 2: Establishment of a management approach for striped bitterlings released into ponds.
- Goal 3: Elucidation of the genetic localization of the surviving population and development of a release plan for Lake Biwa based on these findings.
- Goal 4: Establishment of striped bitterling populations in Lake Biwa.
- Goal 5: Generalization of the progress of freshwater fish conservation and the experience of this project as a role model.

Success Indicators

- Indicator 1: Breeding multiple successive generations of striped bitterling in the release ponds.
- Indicator 2: Breeding multiple generations of mussels as the spawning hosts for striped bitterling and also breeding host fish in the release ponds.
- Indicator 3: Obtaining the agreement to re-introduction and co-operation with the project by various stakeholders.
- Indicator 4: Producing the required number of founders for re-introduction of striped bitterling into Lake Biwa.
- Indicator 5: Confirmation of a large number of surfacing larvae of striped bitterling around the shores of Lake Biwa.

Project Summary

Feasibility: As the core breeding stock for the project, the wild population in a pond in northern Shiga Prefecture and a breeding population maintained in captivity in the Lake Biwa Museum were used.

Northern pond population - The northern pond is the only habitat of striped bitterling which is confirmed in Shiga Prefecture. The result of the investigation shows that since 2005, individuals <50 mm long, have not been sighted and shows no breeding has occurred for one or two years. As a result of the pond mud which is 70 cm thick there are no freshwater mussels that serve as the spawning hosts of bitterlings could not be confirmed there. The number of striped bitterling was presumed to be 57 (±14 SD) individuals. On the basis of further investigations, Miyadame Pond in the upper reaches of an inflowing stream of Lake Biwa was chosen as a candidate for fish translocation trials. Miyadame pond is equipped with drain pipes, so water management can be conducted easily. The likelihood of obtaining local residents' cooperation seemed high, because the

pond is located within the ground of a communally maintained shrine devoted to the area's guardian Gods.

The pond of a traditional Japanese garden at a shrine in Kyoto where striped bitterlings have survived

Moreover, fish poaching hardly occurs because poachers must pass through the village settlement to reach the pond. In order to release striped bitterlings into Miyadame pond, we secured the release founders, to increase the individuals in the northern pond. At the same time, we carried out the draining and drying of a pond called "Ikehoshi", in the northern pond and to improve the habitat.

Breeding population in the Lake Biwa Museum - In 2005 we captured 63 individuals from the pond of a shrine in Kyoto where there is a piped headrace channel to Lake Biwa. We investigated in the southern Shiga where a headrace gate is placed and based on the results we planned the re-introduction to the adjacent pond of Lake Biwa. Moreover, in order to secure a number of founders to release to Lake Biwa which is the biggest lake in Japan, we propagated the breeding population in Lake Biwa Museum and planned the translocation of them to the ponds and biotopes of elementary schools and various companies in southern Shiga. Furthermore, we started the research of the relation between each source and other prefectures, and each group's genetic diversity by molecular genetics investigation.

Implementation:

Northern pond population - In 2007, we prepared founder stocks bred by 22 individual captured striped bitterlings (11 male:11 female) and *Anodonta lauta* as spawning hosts in a concrete pool. Miyadame pond for the translocation was drained and dried by our team and the local residents to exterminate the alien fish such as *Lepomis macrochirus*. Then, we took measures to prevent escape of released individuals and released 100 individual striped bitterlings and 100 individual *Anodonta lauta* to Miyadame pond. Also, 100 individual *Rhinogobius* sp. as hosts of mussels were released there.

Breeding population in Lake Biwa Museum - In 2009, habitat maintenance of the adjacent pond of Lake Biwa was performed the same way as Miyadame pond. Then, 750 individual striped bitterlings propagated by 100 individuals the breeding population in Lake Biwa Museum, were re-introduced into this pond. In

Releasing founder stocks into a biotope at a semiconductor factory (OMRON Corporation)

addition, to produce the founder, the increased individuals propagated from the breeding population in the Lake Biwa Museum, were used for the translocation to a satoyama garden of a Japanese confectionary company (Kanou Shoujuan Sunainosato, 2008), a biotope at a semiconductor factory (OMRON Corporation, 2011), and biotopes and ponds at two elementary schools (Tanakami Elementary School and Ousaka Elementary School, 2010).

Post-release monitoring: Particular researches have been conducted in all released areas. They are the confirming of breeding striped bitterling by observation of mussels molluscan tissue, the counting surfacing larval fish, the investigation of fish species, and the regular research of individual mussels. The management has been conducted based on the result of the investigation. In 2009, it was confirmed the propagation of *Trapa japonica* covered on the water surface of Miyadame pond where the population of the northern pond was translocated. Also the mortality of the *Anodonta lauta* was confirmed there. Therefore we got rid of *Trapa japonica*. Then, additional 50 individual *Anodonta lauta* and 50 individual *Rhinogobius sp* were released from the downstream of Miyadame pond. The breeding striped bitterlings have been confirmed in every year for four years there. On the other hand, new enrollments of *Anodonta lauta* have not been confirmed. The adjacent pond of Lake Biwa where the founder propagated by the breeding population in Lake Biwa Museum was re-introduced, was invaded by a number of alien species. Moreover, it was confirmed the mass mortality of mussels and the decrease of striped bitterling.

We conducted a draining and drying pond and another investigation. As the result, it was confirmed the alien species of *Lepomis macrochirus* (1,560 individuals), *Rhodeus ocellatus ocellatus* (394 individuals), *Rana catesbeiana* (1,996 individuals) and *Procambarus clarkii* (about 10,000 individuals). The striped bitterlings confirmed were only 5 individuals, and most re-introduction individuals have been lost. Many of mussels mortality individuals marked the predation by *Procambarus clarkii*. We believe that the decrease in numbers of *Anodonta lauta* and striped bitterlings was a result of the influence of these alien species. It confirmed the breeding every year in the ponds and biotopes managed at the elementary schools and the company, into which founders propagated by

the breeding population in the Lake Biwa Museum were translocated. Their population have been increasing and amounted to about 2,000 individuals in total in 2011.

"Ikehoshi" (the draining and drying of a pond) with help from local firefighters washing out the mud

Major difficulties faced

- It is an important issue to construct a long-term management role to conserve the translocated or re-introduced water areas.
- Illegal fish poaching from translocated area and sales have been conducted.
- It was a few number of the founder stocks, so that authors are estimating the genetic diversity of both the population of the northern pond and the breeding population in the Lake Biwa Museum.
- There are a lot of stakeholders such as fishermen and many endemic species inhabit Lake Biwa. To discuss the influence by releasing with multidiscipline group of professionals and consensus-building is also a issue though a procedural justice for re-introduction are also important difficulties.
- It is necessary to clarify genetically the relation between the population of the northern pond and the breeding population in the Lake Biwa Museum, and develop a release plan in Lake Biwa.
- Alien species such as *Micropterus salmoides* still inhabit Lake Biwa now.
- It is necessary to investigate their effect on re-introduction and establish the method to reduce this effect.

Major lessons learned

- We showed that striped bitterlings prefer large size individuals which are in a group of Anodonta, and *Cristaria plicata* as spawning hosts. They do not use *Unio douglasiae biwae* which are family of mussels, and there are most numbers of individuals in the lake coast. It is important the fundamental ecological study about Japanese bitterlings for the project.
- It was important that the participation of children in the activity in terms of increasing the number of available hands and thus the work that could be accomplished.
- It is important for the success of the project that encouraging collaborators understand that the re-introduction is a long-term issue.

Success of project

Highly Successful	Successful	**Partially Successful**	Failure
		√	

Reason(s) for success/failure:

- The population of striped bitterling has been increased to breed multiple generations in translocated ponds. However, mussel breeding has not been confirmed which are the spawning hosts.
- Released striped bitterlings were lost as a result of the invasion of many alien species into the pond adjacent to Lake Biwa. Re-introduction into this pond failed because the administrator decided to abandon the effort.
- A project team consisting of specialists from various fields was formed, and various subjects such as an administration, NGO, museum, have cooperated to the re-introduction into Lake Biwa.

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