

**Global Warming Impacts on
GIAHS "Ayu of the Nagara River System" and
Adaptation Measures
- through joint monitoring by local government,
researchers and fishermen**

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Self-Introduction

Morihiro HARADA Dr. Eng., P.E. Jp (Civil)

Consultant Engineer for Public Works Sector (- 2012)

Postdoctoral fellow at the Public Works Research Institute (2012 - 2014)

Associate Professor, River Basin Research Center, Gifu Univ. (Dec. 2014 – Mar. 2024)

Director, Regional Adaptation Research Center, Gifu Univ. (Feb. 2020 – Mar. 2024.3)

Associate Professor, Deputy Director, Center for Environmental and Societal Sustainability(CENSS) (Apr. 2024 –)



■ Research Areas

✓ River Engineering / Ecological Engineering

■ Research interests

- ✓ Methods for assessing flood disturbances and in-channel physical habitats
- ✓ River morphology and physical habitat formation processes induced by sediment transport during floods
- ✓ Climate change impacts on river flow regime and water temperature regime

■ Current Role in the Gifu University

✓ Responsible for climate change adaptation actions by Gifu University and Gifu Prefecture

Adaptation to Climate Change Impacts in Japan and Actions of Gifu University

Global

Japan National

Local (Gifu)

2013

2014

2015 IPCC AR5

“There is a clear human influence on the climate.” “It is important to start adaptation”

2016

2017

2018

2019

2020

2021

2022

2023

2024-



Signing Ceremony between Former President of Gifu University and Governor of Gifu Prefecture

- SI-CAT program (FY2015-2019) by MEXT



Gifu University and Gifu Prefecture jointly promote climate change adaptation efforts at the local level as a model municipality.

- Gifu Climate Change Adaptation Center established between Gifu Prefecture and Gifu University (Apr. 2020)

Japan's first case of joint establishment by a university and local government

- A new research center will be established at Gifu University through reorganization. (Apr. 2024)

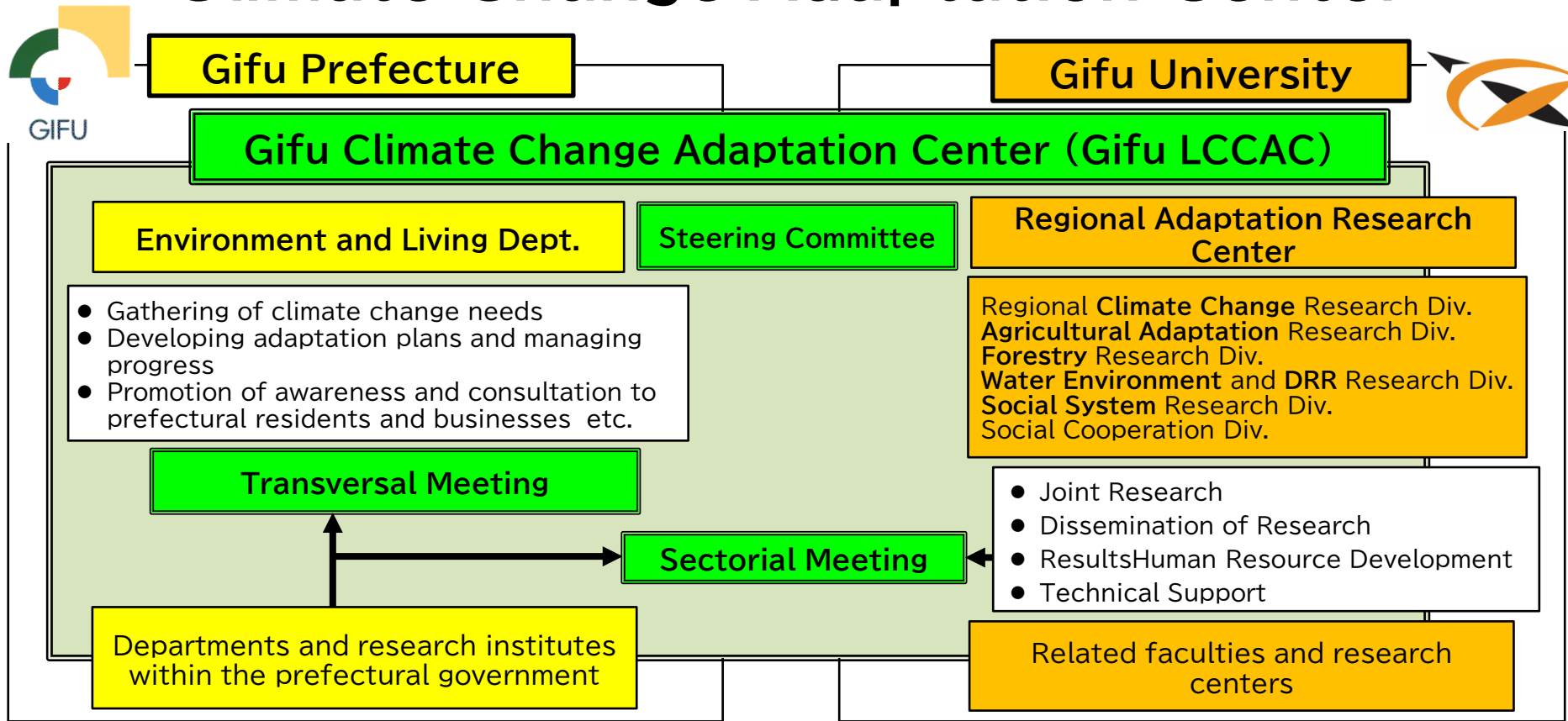


国立大学法人 東海国立大学機構 岐阜大学

環境社会共生体研究センター

Center for Environmental and Societal Sustainability

Framework and Features of the Gifu Climate Change Adaptation Center

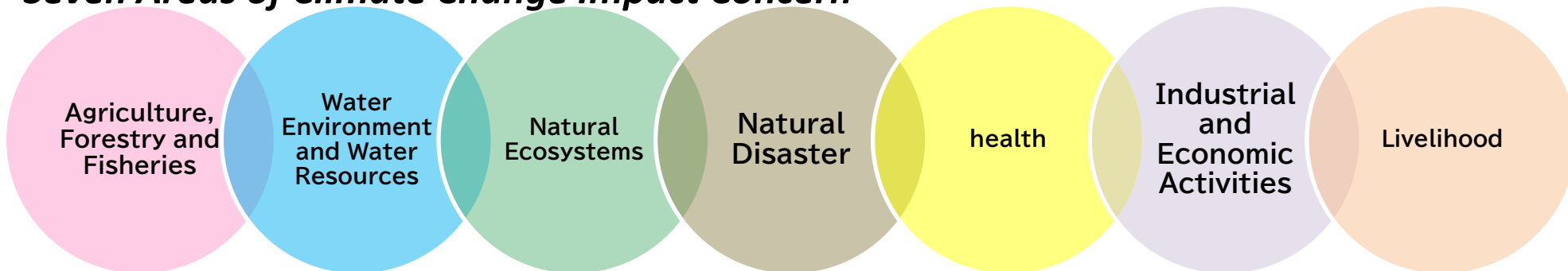


Features of the Gifu LCCAC

- University researchers, county administrative officials, and prefectural researchers will conduct joint research.
- Data held by prefectural administrative agencies and research institutes can be used for joint research.
- On-the-ground information from the past few decades will enhance the reliability of the analysis of climate change and the social environment.
- Information on climate change impacts is **shared speedily with county administrative measures and stakeholders**, shortening the time frame for implementation of adaptation measures

Corroborative Research Themes focused on by the LCCAC in Gifu

Seven Areas of Climate Change Impact Concern



Major joint research theme groups in recent years in Gifu LCCAC

- Supporting science-based decision-making in the field of flood risk management
- Assessing climate change impacts and co-creating adaptation measures in the agriculture and fisheries sectors
- Supporting forest management that contributes to carbon fixation, water cycle, biodiversity conservation, etc. with scientific knowledge
- Assessment of risk of heat stroke and other health hazards and countermeasures

Global Warming Threat to Ayu in Nagara River, a World Agricultural Heritage Site

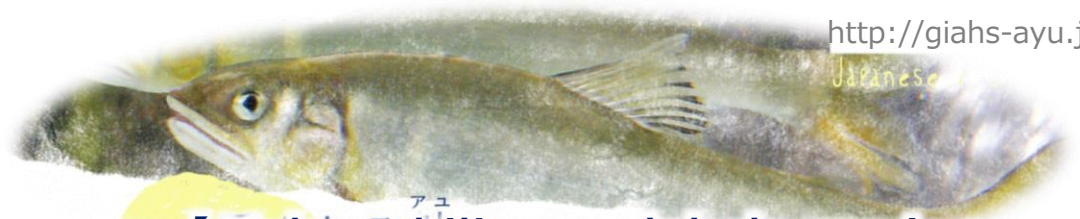


- The Nagara River is recognized not only for its ayu, but also for the beauty of its waters and ecosystem, the headwater forests that nurture the water, and the traditional culture and way of life of the people living in the watershed who live with the water.
- The Nagara River system is highly regarded for its deep intertwining of agriculture, forestry, inland fisheries, commerce, and tourism, with "Satogawa" as the keyword.



【 Ecosystem services that local communities receive from ayu 】

- Ayu, a symbolic fish loved by the people of Gifu
- Major fisheries species, target of recreational fishing (fishery resources)
- Cormorant fishing on the Nagara River is a major tourism resource and has a large economic impact on the local tourism industry.



【 Vulnerability to global warming due to ayu ecology 】

- An amphidromous (bilateral migratory) fish that lives its entire life in one year
- Grows in middle and upper watersheds and is susceptible to disturbances such as **floods and droughts** in a given year.
- **Water temperature** is deeply intervened in the life history of upwelling, growth, and spawning.

Ayu, Sweetfish (*P. Altivelis*), Commercial freshwater fish species representing Japan



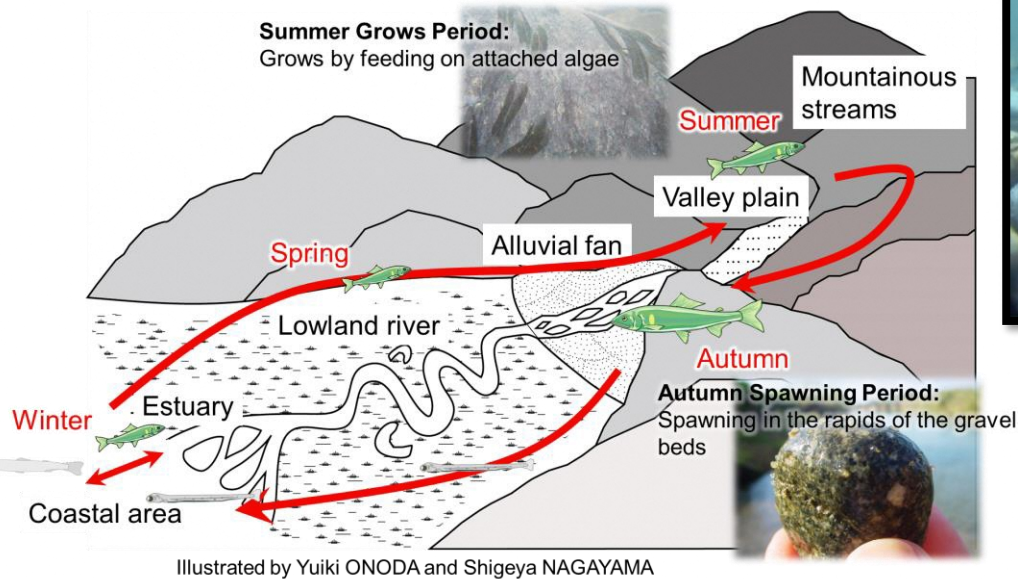
Sweetfish (*Plecoglossus altivelis*) is known as a one of the most valuable species for commercial and recreational fisheries in Japan. Not only is it a very well-known fishing target, it is also a very tasty fish.

All images were taken in Gifu.

Ecology of Sweetfish

Fish species with a one-year lifespan and adapted to flood disturbance regimes: **Sweetfish** (*Plecoglossus altivelis*)

An amphidromous autumn-spawning annual fish species.



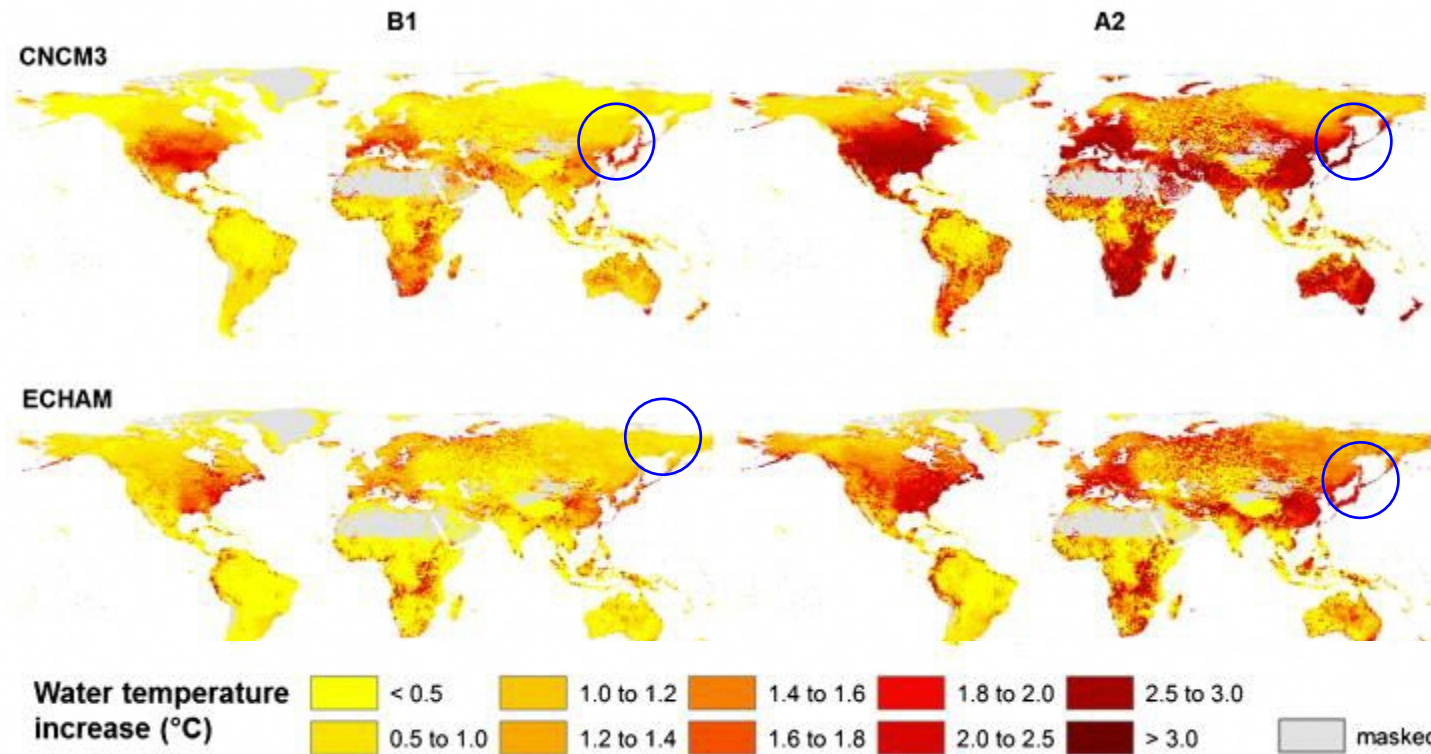
Breeding behavior of Sweetfish

- In autumn, mature ayu migrate downstream to the middle part of the river (mainly in Gifu City) to spawn.
- Nuptial coloration of many males swim and settle in suitable spawning areas.
- Near dusk, females waiting in the pool downstream of the rapids join in the spawning behavior.
- Spawning grounds are often created in rapids where unstable gravels are deposited.

P. altivelis can significantly alter its distribution within a river basin during the summer growing season, depending on water temperature and flood disturbances (Nagayama et al. 2022, Harada & Nagayama 2022)

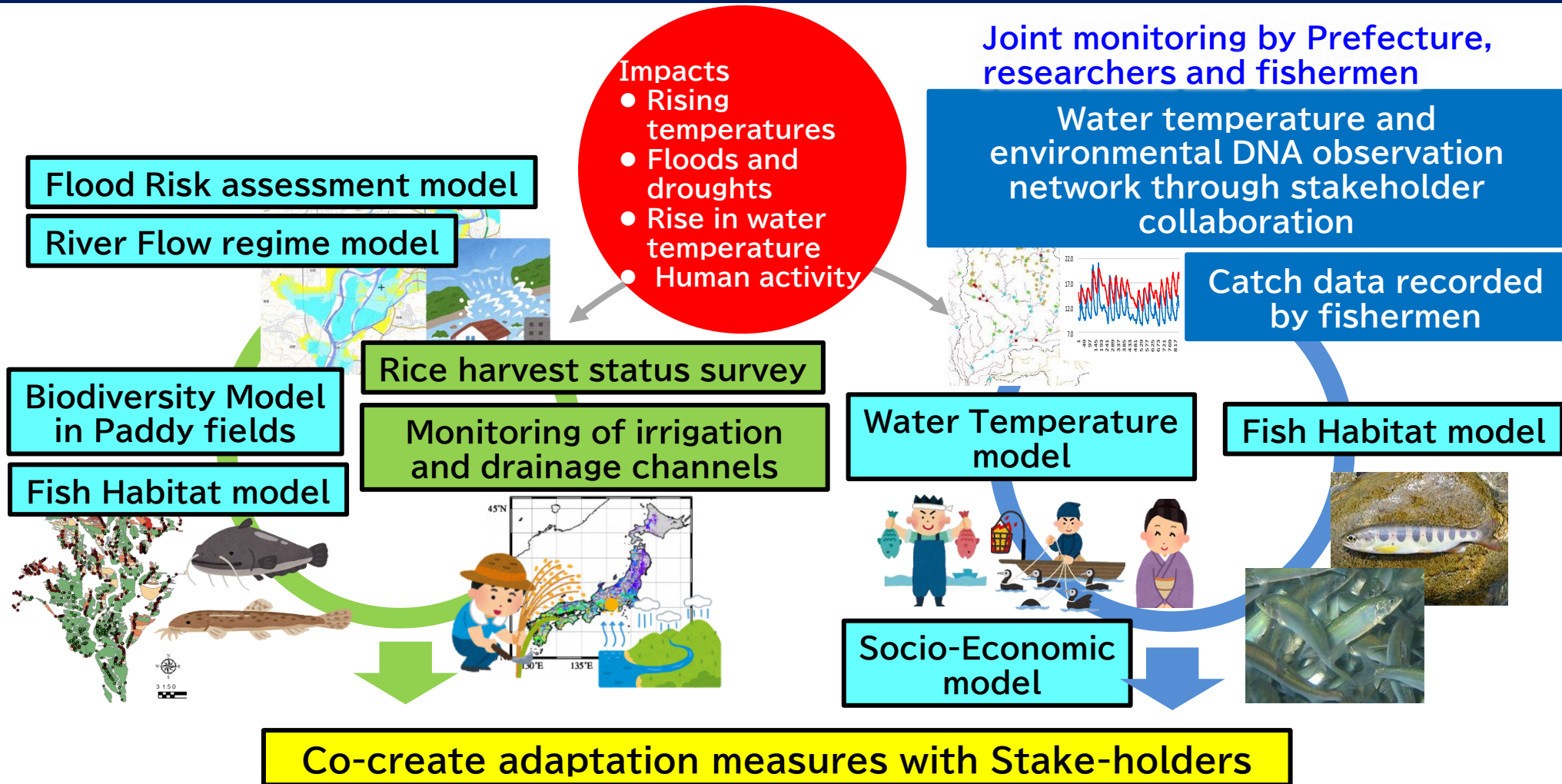
Examples of predicted increases in water temperature in rivers and lakes due to global warming.

Projected water temperature increase from 2071-2100 relative to 1971-2000. Depending on GCMs and warming scenarios, an increase of 1.5°C to 3°C is expected.



- Japan is projected to experience high water temperature increases under all model scenarios!
- According to the Ministry of the Environment, a rise in water temperature of about 1°C has already been observed in Japan over the past 30 years.

Joint Research Project to clarify the effects of global warming on ayu (sweetfish) in the Nagara River and co-create adaptation measures



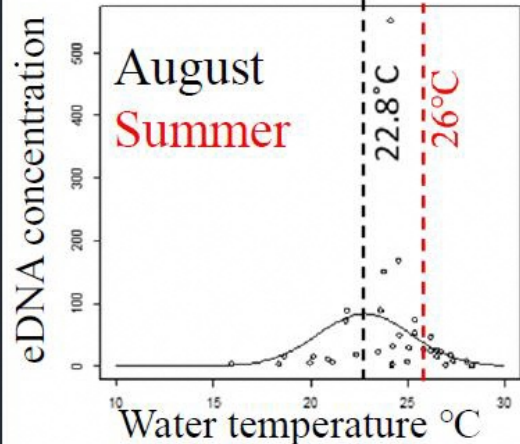
Main Stakeholders:
Rice farmers and farmers' associations,
water managers
Prefectural government, Local governments

Main Stakeholders:
Fishermen and fishing cooperatives,
tourism businesses
Prefectural government, Local governments

Key findings revealed by joint monitoring and data analysis

① Limited Summer Distributions

Ayu disappeared from the downstream reach of the Nagra River where the mean daily water temperature exceeded 26 °C.

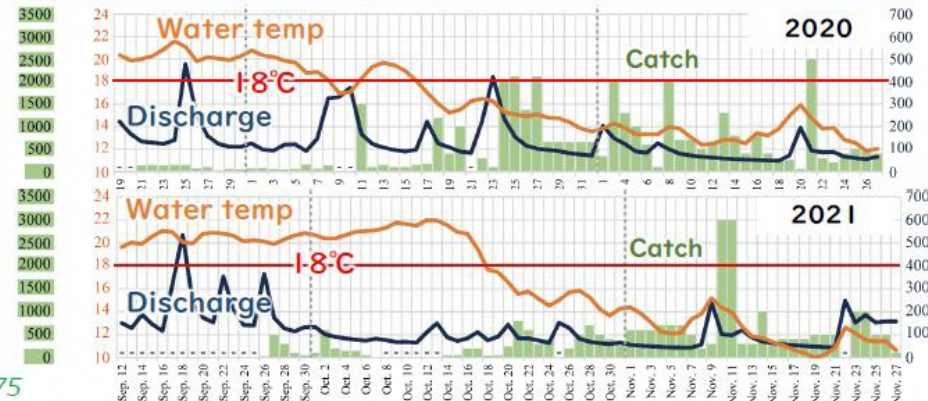


Tributaries and upper main reaches with low water temperatures provide **summer refuge habitat** under climate warming trend.

From the poster presentation by Nagayama et al.

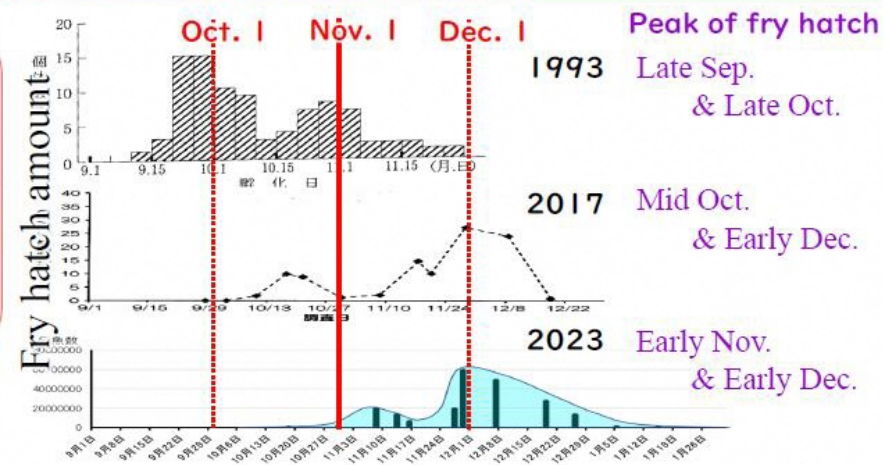
② Delayed Autumn Spawning Migration

The downstream spawning migration of ayu was triggered by **two factors**: mean daily water temperature **below 18 °C** and **water discharge increase**. The downstream migration have been delayed by about one month over the last half century due to rising water temperature.



③ Delayed Hatching in late autumn

The peak hatch dates for ayu fry have been gradually delayed over the last 30 years. The first peak has become smaller.



Information Dissemination and Dialogue with Stakeholders



Communication with tourism operators



Communication with fishermen

Adaptation options proposed by stakeholders

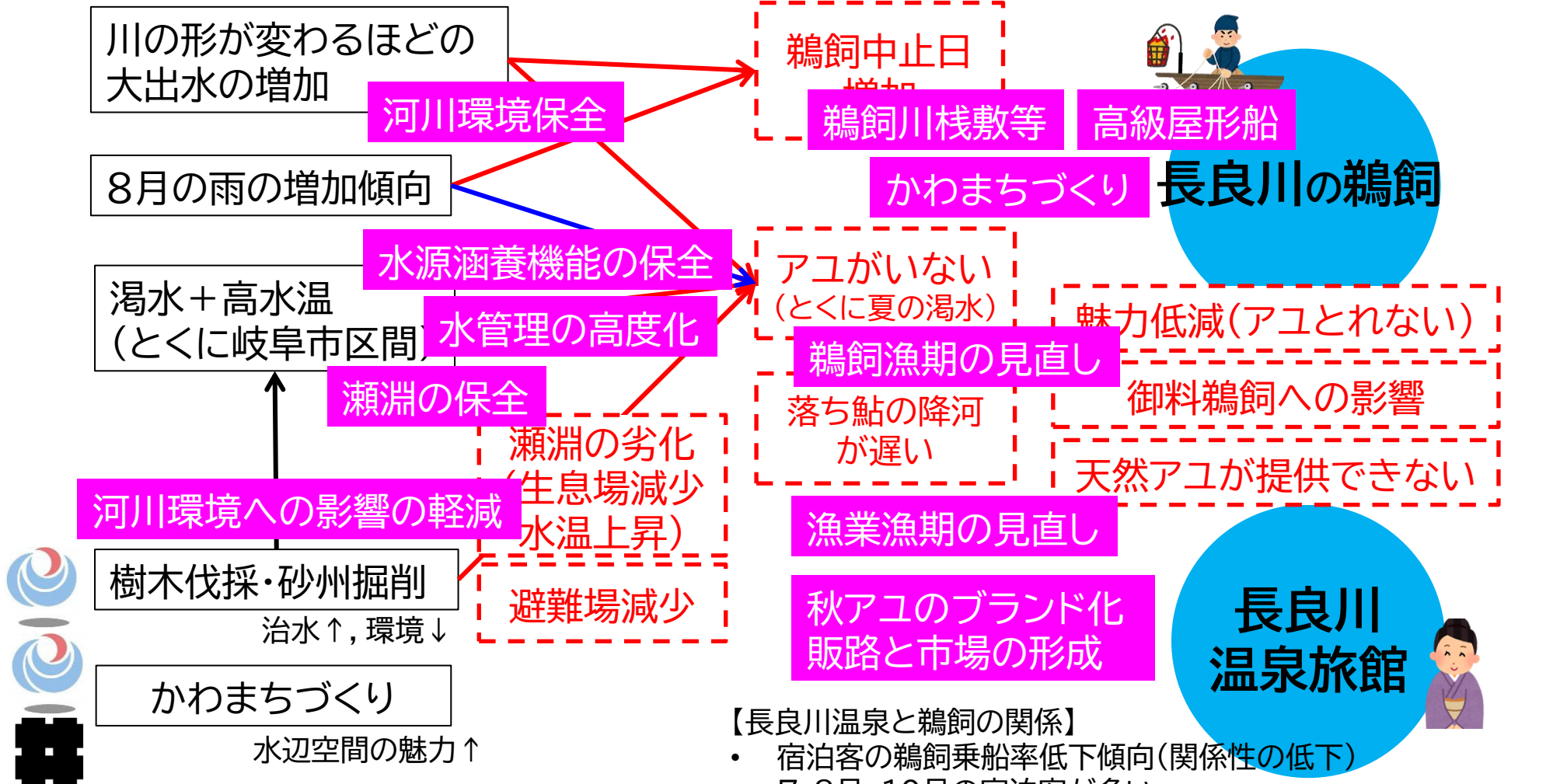
- Revise fishing regulations (fishing season, fishing methods)
- Increase the extra value of ayu, which is caught in large numbers in autumn
- Create places where "natural ayu from the Nagara River" can be easily eaten (expansion of sales channels)

Information from anglers

- Upstream, the fishing season is about a month longer.
- Ayu used to spawn more than a month earlier than before.
- The number of fish other than ayu has also decreased considerably.



Promising measures and adaptation options



【長良川温泉と鵜飼の関係】

- 宿泊客の鵜飼乗船率低下傾向(関係性の低下)
- 7-8月, 10月の宿泊客が多い
- 旅行コストは, 4月, 9-10月が高い(鵜飼とあまり関係ない?)

Information sharing with local governments / Information dissemination to stakeholders

Review of urban planning and site selection plans, etc.



local governments (City, Town, Virage)



Stakeholders (industry and local residents)

Individual behavior change

provision of information

Creation of promotional and educational media
Provision of information

Climate Change Information including population dynamics
Analysis and Research



地域環境変動適応研究センター



Gifu University

Other Youtube videos presenting research results in an easy-to-understand manner 15

Impact on persimmon, a specialty of Gifu Prefecture

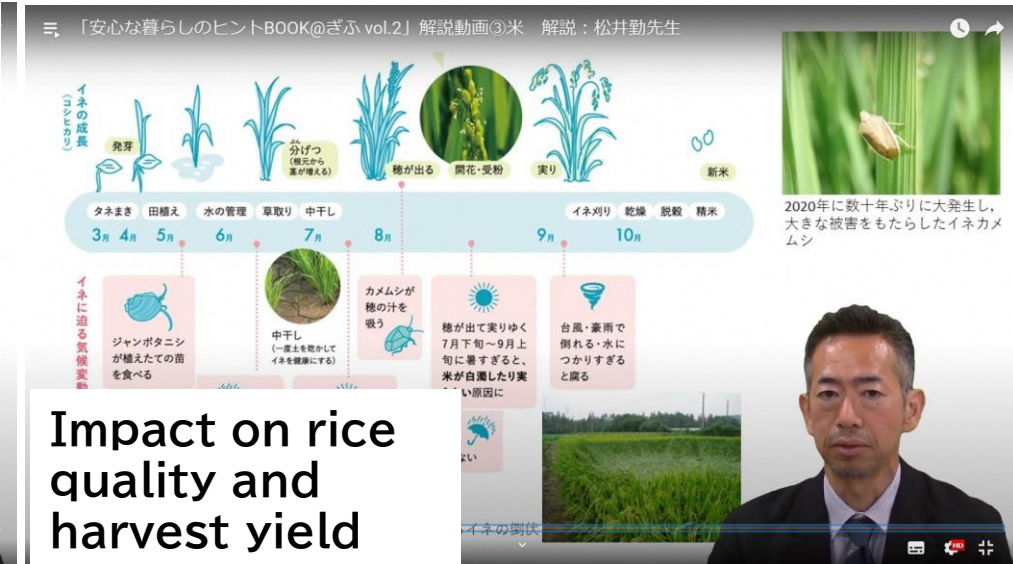


十分色づいた 富有柿 (Fully colored Fuyu persimmon)

近年の 色が薄い富有柿 (Recent thin-colored Fuyu persimmon)

富育特産(イネカ)

『安心な暮らしのヒントBOOK@ぎふ vol.2』より



「安心な暮らしのヒントBOOK@ぎふ vol.2」解説動画③米 解説：松井勤先生

イネの成長 (Rice growth stages: 発芽, 分けつ, 穂が出る, 開花・受粉, 実り)

タネまき 田植え 水の管理 草取り 中干し 稲刈り 乾燥 脱穀 精米

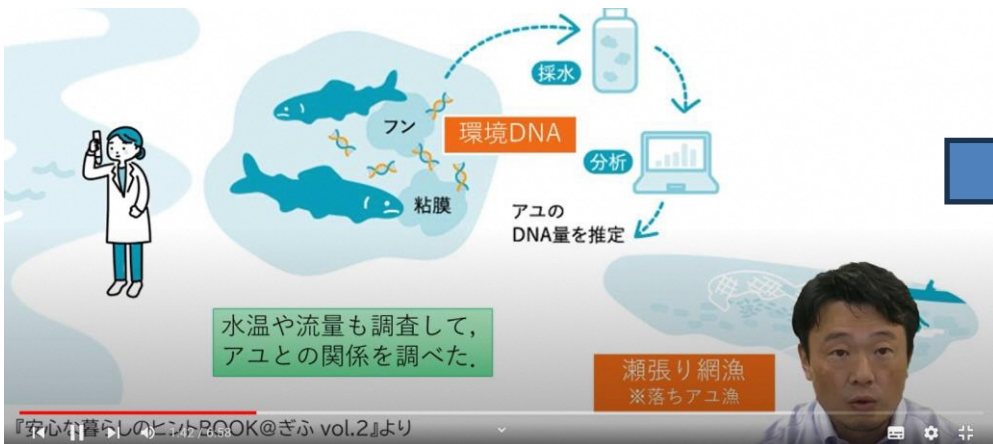
3月 4月 5月 6月 7月 8月 9月 10月

2020年に数十年ぶりに大発生し、大きな被害をもたらしたイネカムシ (2020 saw a major outbreak of rice weevils, causing significant damage)

Impact on rice quality and harvest yield

『安心な暮らしのヒントBOOK@ぎふ vol.2』より

Effects of river warming on fisheries fish species, Ayu



採水 (Water sampling)

環境DNA (Environmental DNA)

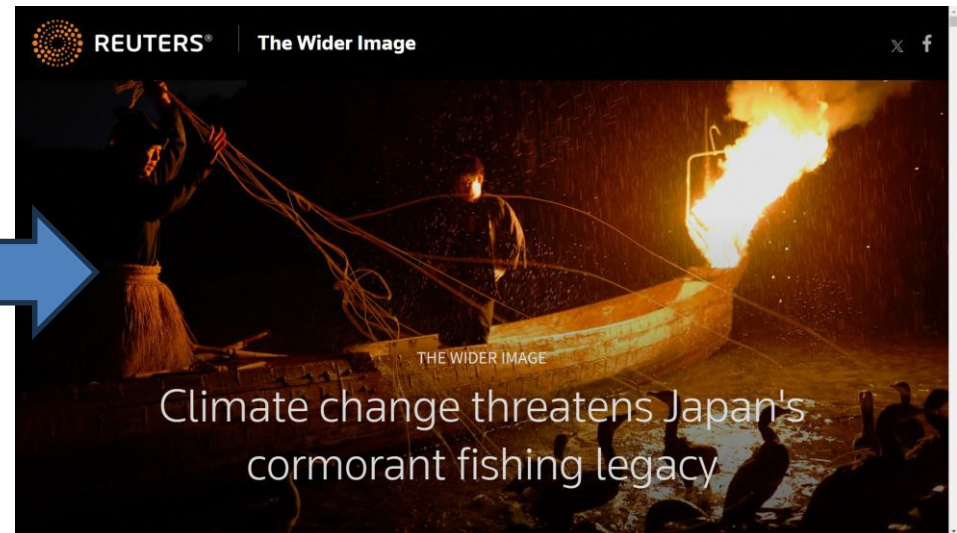
分析 (Analysis)

アユの DNA量を推定 (Estimate Ayu DNA quantity)

水温や流量も調査して、アユとの関係を調べた。 (Also investigated water temperature and flow rate to study the relationship with Ayu.)

瀬張り網漁 ※落ちアユ漁 (Riverbank net fishing ※ falling Ayu fishing)

『安心な暮らしのヒントBOOK@ぎふ vol.2』より



REUTERS® The Wider Image

Climate change threatens Japan's cormorant fishing legacy

THE WIDER IMAGE

Summary

- Strong partnerships between university researcher and local government have a number of advantages in promoting climate change adaptation actions.
 - On-the-ground data held by local government agencies over the past several decades is a powerful weapon in the analysis of climate change and social environmental variability.
 - Common understanding between decision makers and stakeholders will accelerate its implementation in social policies.
- Joint monitoring of global warming impacts on ecosystems with stakeholders can be effective in accelerating action.
 - For industries with strong regional characteristics, such as agriculture, forestry, and fisheries, it is necessary to promote regional initiatives through individual projects.

Thank you for your attention!