# Quantitative evaluation of water temperature change on cold water fish habitat in snowy cold river

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## Introduction

The possibility of loss of habitat of cold water fish due to water temperature rise with climate change is reported by evaluating water temperature dependence of fish. Salmonid fish are representative species and valuable fishery resource that supports the local economy in snowy cold regions, such as Hokkaido. In the future, habitat for salmonid fish and the local economy of Hokkaido may be affected by climate change. Therefore, it will be necessary to evaluate quantitatively the effects on climate change.

We focused on regional characteristics of snowy cold regions, which is scale of approximately 10km or less. This paper aims to consider adaptation measures to climate change and evaluate quantitatively the effects on river water temperature and habitat for salmonid fish, by using climate change prediction data.

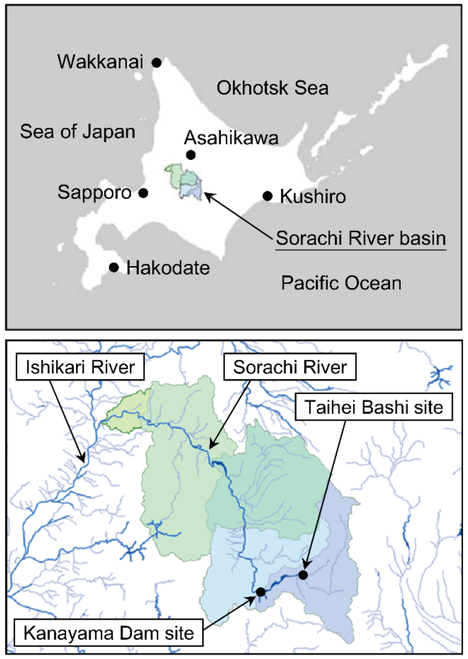


Figure 1. Location of Sorachi River and Kanayama Dam basin

## Model

- We adopted climate change data (MRI-NHRCM20), which is regional climate model provided by Japan Meteorological Agency and based on RCP emission scenario.
- We built the analytical model to calculate river water temperature by dividing flux on the arbitrary mesh upstream of Taihei Bashi site by runoff and performed river flow tracking calculation of flux upstream of Taihei Bashi site.
- We considered the shielding rate of solar radiation by riparian trees based on LAI.
- We examined the optimal water temperature days and range during the spawning period (from April to May) of *Hucho perryi*.

Table 1. Analysis case

| Case no. | Analysis period | RCP emission scenario | Sea surface water temperature |
|---|---|---|---|
| Case-1 | 9/1/1984 ~ 8/31/2004 | — | HadISST |
| Case-2 | 9/1/2080 ~ 8/31/2099 | RCP8.5 | CMIP5-SST1 |
| Case-3 | | | CMIP5-SST2 |
| Case-4 | | | CMIP5-SST3 |

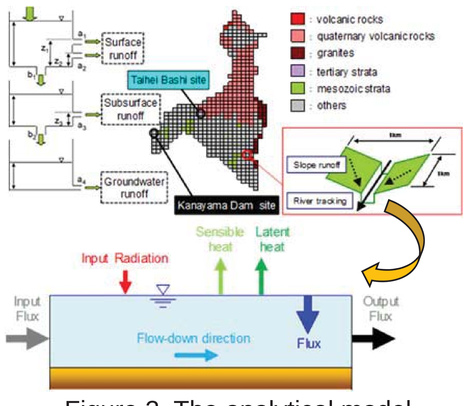


Figure 2. The analytical model

## Results

- Monthly average water temperature might increase by approximately 4.7 ℃ in March and by approximately 3.6 ℃ in July with climate change in the future.
- River water temperature might rise to approximately 8.1 °C and exceed the optimum water temperature during the spawning season with climate change, also number of days in optimum water temperature range might decrease.
- The range of optimum river water temperature area suitable for spawning of *Hucho perryi* scattered in the middle reaches of Taihei Bashi site might move near the upper reaches.

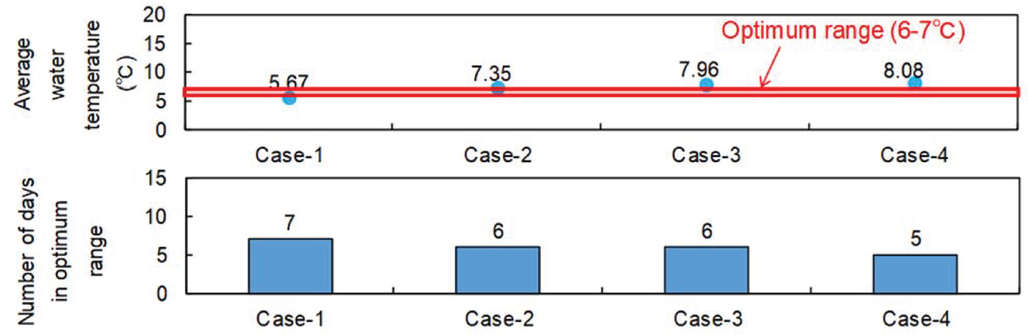


Figure 3. Changes in river water temperature and optimal- water temperature days during the spawning period

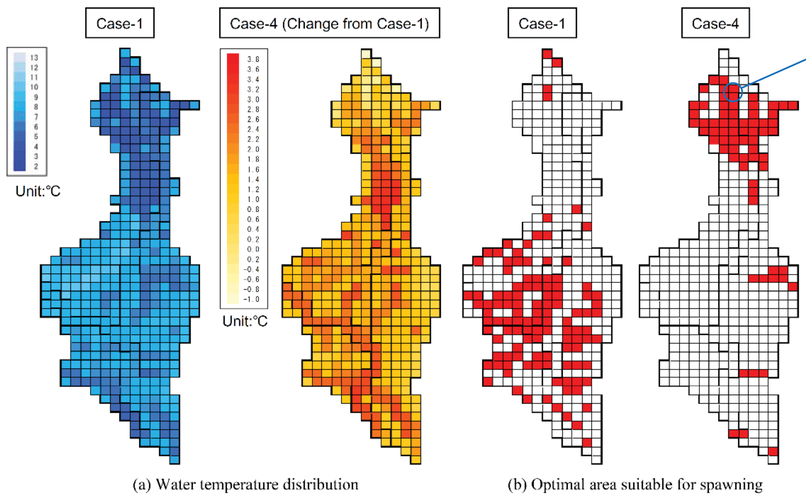


Figure 4. River water temperature distribution and the area of optimal water temperature range

Figure 5. The upper reaches of Sorachi river

Figure 6. *Hucho perryi*

## Conclusion

- It was shown that the results of river water temperature simulation indicated that climate change is expected to raise river water temperature in March, also river water temperature area suitable for spawning of *Hucho perryi* might be limited.
- The quantitative evaluation method will be used for formulating effective and efficient adaptation plans based on characteristics of snowy cold regions, such as Hokkaido.
- The analysis model will be further developed for evaluating the influence of climate change accurately and the water environmental management.