EFFECT OF DIFFERENCE IN SHAPE OF STEPPED FISHWAY ON FLOW STRUCTURE

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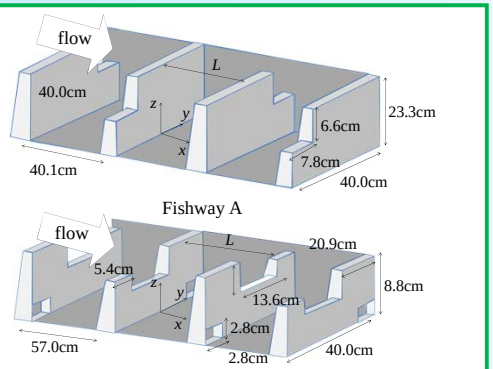
INTRODUCTION

There are various structures such as the step type and the ice harbor type in the fishway, and the flow situation changes greatly depending on the structure, and it has a great influence on the habitat of fish. In this study, we focus on stepped fishways existing in the middle and downstream of real rivers, and examine how the difference in the structure of the fishway affects the turbulent structure.

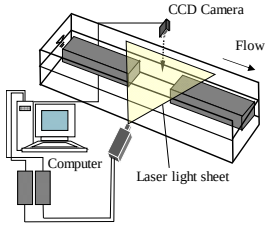
APPARATUS AND EXPERIMENTAL METHOD

〈APPARATUS〉

A model of the existing stairway type Fishway A and Fishway B is installed in an open channel in a room. The Fishway B has a latent hole at the bottom of the partition wall.



Fishway model used for hydraulic experiments



PIV sistems

〈EXPERIMENTAL METHOD〉

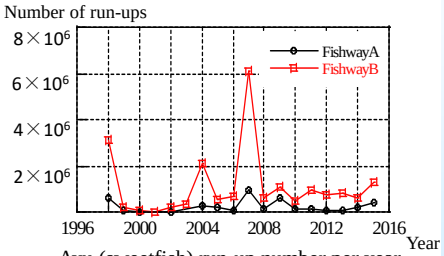
- Point measurement of flow velocity: Electromagnetic current meter
- Simultaneous measurement of flow velocity: PIV (particle image velocimetry) method

Experimental Conditions

Case	Flow discharge Q (l/s)	Bed slope I	Downstream length of pool L (cm)	Model scale
Fishway A	6	1/40	40	1/2.6
Fishway B			56	1/7.4

NUMBER OF RUN-UPS IN ACTUAL RIVERS IN EACH FISHWAY

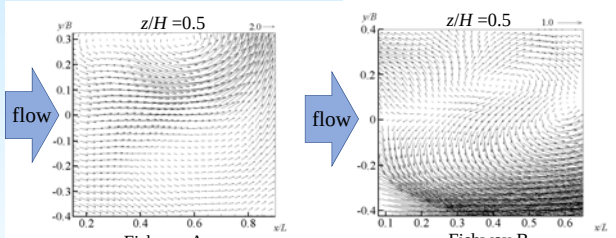
Step type in the fishway



Ayu (sweetfish) run-up number per year

Fishway A is 4 km upstream from Fishway B. The run-up number of sweetfish changes every year, and the change is similar in both fishways. However, the number of Fishway B was large in all years, especially in 2007, Fishway B showed 6.4 times the number of Fishway A.

VELOCITY VECTOR DISTRIBUTION IN HORIZONTAL PLANE



Fishway A Fishway B

Velocity vector distribution in horizontal plane

Fishway A

Circulating flow is occurring on the left bank side of the pool.

Fishway B

Two circulating flows are observed downstream of the left bank, and the velocity vector shows a large value on the right bank.

MAIN FLOW VELOCITY CONTOURS IN CROSS SECTION

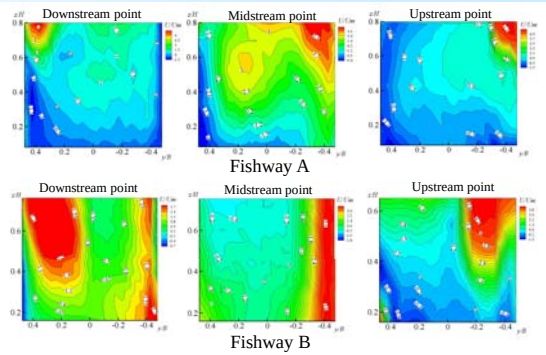
Fishway A

In each case, the main flow velocity is small near the bottom, which is considered to be a rest space for fishes.

Fishway B

At the downstream point, it can be seen that the influence of the submerged mouth is on the right bank side, and the effect of the upstream notch remains near the water depth.

Compared with the Fishway A, it was clarified that there was no clear space for the fish to take a break because the sections where the flow velocity was small were different in each section.



Main flow velocity U/U_m contours in cross section

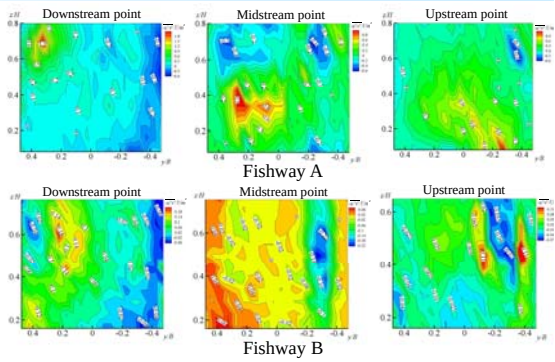
TRANSVERSE REYNOLDS STRESS DISTRIBUTION IN CROSS SECTION

Fishway A

At midstream point, the Reynolds stress shows a positive extreme value below the half water depth on the left bank side from the center of the channel, and it can be confirmed that the three-dimensionality of the flow is strong.

Fishway B

At the midstream point, it can be confirmed that the right bank shows negative values in the vertical direction due to the effects of the notch on the upstream side and the submergence on the downstream side.



Transverse Reynolds stress distribution in cross section

CONCLUSIONS

- It was found that a complicated flow occurred especially in the horizontal plane in the fishway with a structure with a submerged hole, and there was no clear place to rest for the fish going up.
- Due to the flow velocity distribution in the cross section, Fishway A showed a stronger three-dimensionality of the flow than Fishway B, especially at the center of the pool. Furthermore, it became clear that the distribution tendency of the turbulent structure differs greatly depending on the installation position of the notch.

As a result, it became clear that it was important to carefully consider not only the presence or absence of a submerged opening but also the location of the notch.