IMPACTS OF SABO DAM ON PHYSICAL AND GEOMORPHIC ENVIRONMENTS AS HABITAT IN THE MOUNTAIN STREAMS

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1. INTRODUCTION

The river is one continuum and is balanced on stream size and ecosystem structures from head water to downstream according to the river continuum concept (R.L.Vannote et al., 1980). Input of riparian vegetations from around stream is importance source as food supply for underwater creatures in the mountain streams. The big particles are disassembled into small and find organic matters by insects like benthic invertebrates, these are became nutrients for living things in the downstream. However natural flow is interrupted by structures such as dam in the middle of stream, even environments around dam change. Sabo dam, which is one of structure in the head water, were built to accumulate sediment and defense natural disaster like sudden debris flow. However it makes the flows of the river and sediment delay or cut. The water flow is related with energy for substrate's movement, if sabo dam is constructed, first physical and geomorphic environments change. They are basic parameters to compose ecosystem, and these diversities are acknowledged as one indicator of stream health(Norris and Thomas, 1999). According to, we need to know the physical characteristics of streams before research about river ecosystem.

2. SUTDY AREA AND METHOD OF ANALYSIS

(1) Study areas

Study areas are up and downstream of 5 sabo dam in the two streams, totally 10 sites(fig 1). One river, Oisawa stream, is second order and flows 7.2km with 1.3 sinuosity, 0.030m/m slope and 21.8km^2 catchments. There are three sabo dam and of them two dams from downside were slit. The other, Wasada stream, is also second order and flows 8km with 1.2 sinuosity, 0.034m/m slope and catchment area is 25.6km^2, and has two sabo dams. In field, current velocity, particle size of substrate as physical factors and gradient, depth to calculate geomorphic diversity were measured at reach scale.

(2) Method of Analysis

Each physical factor is affected from catchments' various environments like elevation, catchment area, article impacts. Owing to two streams are located in different catchments, general factors are needed with

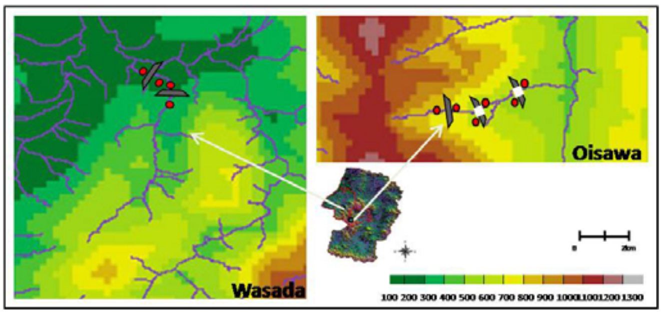

Fig. 1 Study sites in the Yamagata Prefecture

data to compare. First, the value of velocity x depth, which is flow, from concept of *Reynolds number* as urbulent flow was calculated to consider erosion processes that change the characteristics of the stream(1).

$$N_R = \frac{\rho v d}{\mu} \qquad (1)$$

Where, v is velocity, d is depth. μ and ρ are viscosity and density but was not consider on the supposition that these values are same in the fresh water. Next, thalweg, cross-section calculated as geomorphic diversity.

Gradient of thalweg which is the deepest path of water, cross section shape as geomorphic factor were measured in reach scale. The 10 points of gradients were measured with 5m interval and 5 cross-sections were done with 10m interval. The diversities of parameters were calculated with field data. There are several methods to calculate diversities of parameters. Among of them, the method of 'sum of squared height differences' was selected to calculate thalweg and cross-section diversity (2), (3) because that method is good for evaluating the smaller scale habitat changes across a river (Bartly R. and Rutherfurd I., 2005).

$$\text{Thalweg diversity} = \Sigma dh^2 \qquad (2)$$

Where, dh is the difference of height from one point to next point.

$$\text{Cross-section diversity} = \frac{\sum dh^2}{n} \qquad (3)$$

Here, n is the number of height.

3. RESULTS AND DISCUSSION

Velocity exhibited trends that were faster on the

Key words: River ecosystem, Sabo dam , Dam slit, Physical environment, Geomorphic diversity
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downstream, and velocities of each point were slower in the upstream than the downstream of dam. Spatially, velocities on upsides of full sabo dams were slower than other sites because water flow may be reduced by full structure. Velocities of each points were difference but we could find the trend that the higher the values of flow is, the bigger the particle size is(Fig 2). Gradients were decline from upside to downside at the reach scale of slit

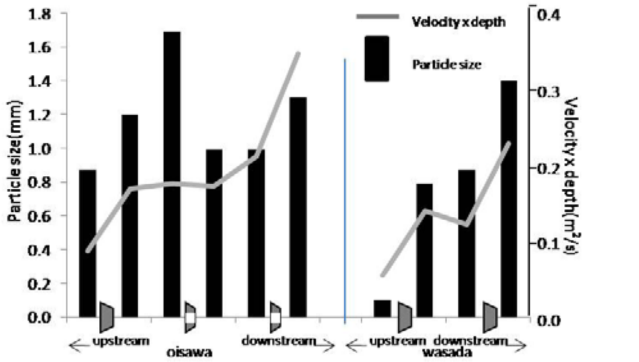

Fig. 2 The trends of velocity x depth and particle size on the each site

dam. However, gradients on upside of full dam became higher as 0.0032m/m, 0.0316m/m. The one of roles of sabo dam is to make steep gradient into mild one as accumulate sediment. In the Wasada river, owing to debris is accumulated up to limit of dam nearly on these two sites, gradients also increase. While, in the Oisawa river, after slit construction, sediment was able to flow to downstream and the slopes were recovered original ones, we could guess. As an exception, the upper dam of Oisawa river is keeping full dam, gradient does not increase. This may because the dam is located in the toe of meandering channel, sediment which is just upside of dam is being scoured by current that flows from but bank. The geomorphic characteristic also may influences on formation of various habitats, while upstream of dam, in which straight river is simple. Therefore, we pay attention to research a relationship habitat with dam and biological factors.

The results of geomorphic diversities, thalweg diversity and cross-section diversity, were calculated that those of Wasada river were lower than Oisawa river(average; Oiwasa talweg diversity=1.34, cross-section=1.38, Wasada thalweg=0.55, cross-section=0.12). And then the diversities were related with flow and had positive correlation(fig 3, 4). Of two streams, Oisawa river has more various diversity according to flow. Despite similar flow, diversity of Wasada river is low. This means that geomorphic diversity is affected from other factors besides flow. Two mountain streams are same order rivers and has similar whole river bottom gradient. However owing to accumulated sediment by two full sabo dams on the wasada river, slope is mild on upside of dam. In addition, width of river becomes wide as much as that of dam. Stream, which is being flowed on mild bottom slope and wide river channel, lost current energy. Accordingly, sedimentation become main work and then diversity also become simple in these places.

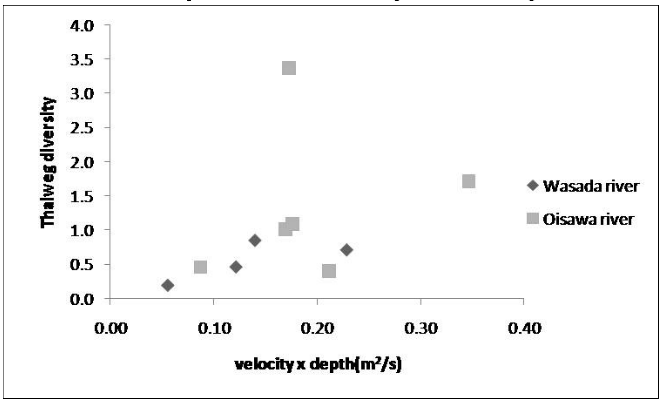

Fig. 3 Correlation graph between water flow and thalweg diversity

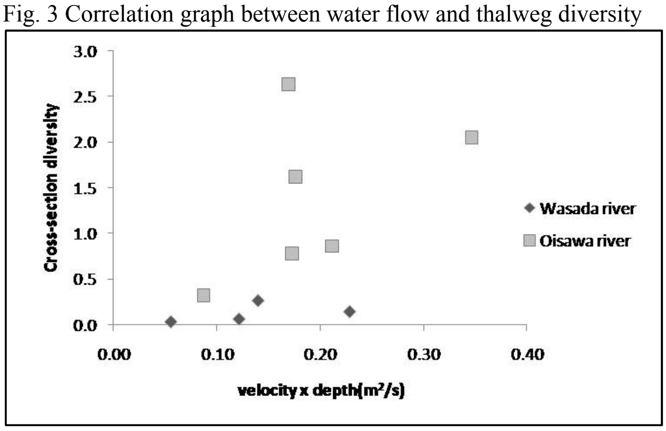

Fig. 4 Correlation graph between water flow and corss-section diversity

4. CONCLUSIONS

In this research, physical environments were analyzed in stream with full and slit sabo dams for next work which is relationship between physical environment and aquatic organism. In two streams which have similar surroundings, flow, particle size and geomorphic diversity were different according to the situation of full dam or slit dam. We could confirm the recovery of bottom gradient and geomorphic diversity in Oisawa river with slit dam. On the other hand, in Wasada river, low geomorphic diversities and simple habitat were confirmed because sedimentation is occurred generally by current velocity decrease.

REFERENCES

(1) Bartley, R. and Rutherfurd, I., 2005, Measuring the reach-scale geomorphic diversity of streams: Application to a stream disturbed by a sediment slug, *River res. Applic*., 21: 39-59.

(2) Norris, R.H., Thoms, M.C., 1999, What is river health?, *Freshwater Biology*, 41:97-209.

(3) Vannote, R.L., G.W. Minshall, K.W.Cummins, J.R. Sedell and C.E. Cushing, 1980, The river continuum concept, Can. J. Fish. Aquat. Sci. 37, 130-137.