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A STUDY ON THE EFFECT ON RIVER HABITAT CHANGE BY SMALL DAM REMOVAL
- A CASE STUDY OF GOKREUNG 2 & GOTAN SMALL DAM REMOVAL –

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Abstract

About 18,000 small dams are located across the streams in Korea and about 50-150 small dams are abandoned annually. This study is to develop the technology for restoring the stream eco-corridors by removing the small dams whose functions have been lost, and improve the water quality deteriorated by the small dams.

We removed 2 small dams, Gokreung 2 small dam was 76m in length and 1.5m in height and Gotan small dam was 190m in length and 2.8m in height, for demonstration purposes.

We analyzed to physical impacts, such as the change in the river bed, chemical impacts, such as changes in water quality, and biological impacts, such as the changes in the ecological habitats of fish, large benthic invertebrates and vegetation in the upper and lower reaches of the small dams.

Results of a short-period monitoring and analyses of monitored data show some positive effects on stream corridor restoration.

Key Words : small dam removal, habitat change, impact, restoration

1. Introduction

Small and large weirs are installed in the course of a stream for maintaining the water level of the stream or obtaining agricultural water. Currently about 18,000 of them are installed in Korea to supply water. However, the environmental problems of weirs are well known: the interruption of stream eco-corridors, deterioration of water quality in the upper reaches of the weir, changes in the habitats of riparian organisms, damages to the stream scenery.

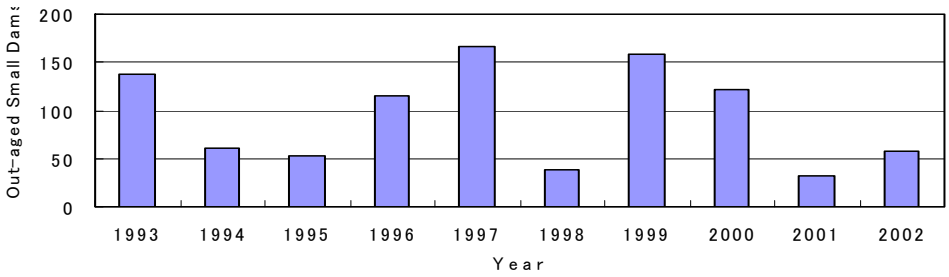
In a very few of these weirs artificial eco-corridors like fishways are installed, but the number is very minimal.

Furthermore, 50~150 weirs are falling into disuse every year owing to the expansion of the urban center due to the concentration of population in cities urbanizes farmland, and changes in farming changed land use, e.g. from rice farming to vinyl house farming, the integration of water intake facilities due to the construction of large reservoirs and installation of pumping stations, and the aging of facilities (agricultural production infrastructure improvement project statistics annual report, Korea Agricultural & Rural Infrastructure Corporation).

Foreign countries are trying to restore the stream and stream eco-corridors by removing some partially functional stream-crossing facilities as well as those small dams whose function are lost.

However, under the local conditions, it will be necessary to restore stream eco-corridors for the purpose of restoring the ecological environment by removing stream-crossing facilities like those weirs whose functions are lost instead of removing facilities still functioning.

Therefore, in this study, we analyzed habitat change(physical, chemical and ecological impacts) by the dam removal.



(Figure 1) Removal of weirs by year (Ministry of Agriculture and Forestry, 2001)

2. River Habitat Change by Dam removal(April 2006 to November 2007)

(1) Analysis of physical impacts (short-term change of riverbed)

we selected Gokreung 2 small dam in the Gokreungcheon stream and Gotan small dam in Hantan river where a demonstration project was conducted in early April 2006 and Jun 2007, and analyzed the data from monitoring.

1) Riverbed variation

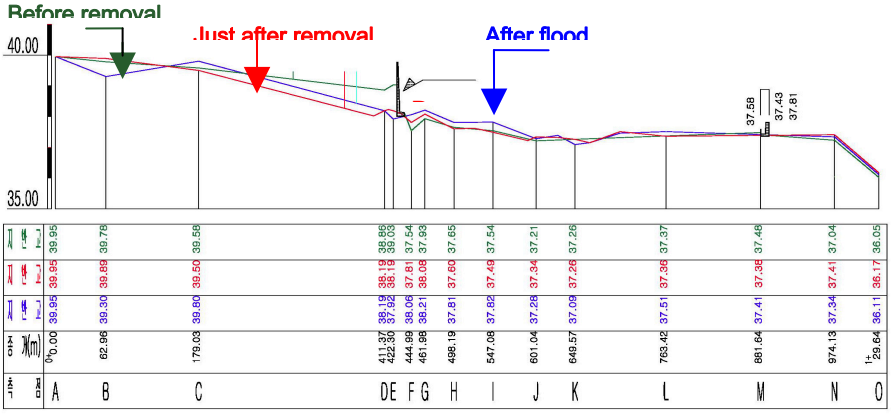
The comparison of the riverbed before and after the flooding showed that the upper reaches of the small dam degraded early after the removal and aggraded again, while sediments continued to accumulate in the immediate lower reaches of the both of dam after the removal and the riverbed continued to aggrade in Gokreung 2 small dam.

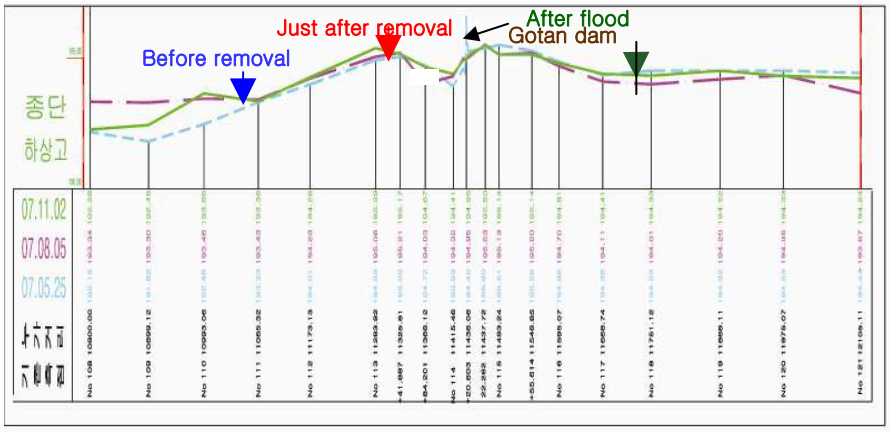
Conversely, although the flooding occurred, there were not any significant changes in the riverbed after the removal of the Gotan small dam in Hantan River. This seems to be the result that the riverbed consists of large particle stones and the change in the riverbed is happening slowly.

2) Grain size distribution of the measured cross section

The analysis of the grain size distribution based on the analysis of the riverbed materials showed that, in the upper reaches of the weir, the grain size of the riverbed materials increased as the riverbed, which used to be a sedimentary layer, was eroded, while in the immediate lower reaches of the weir, sediments accumulated during the removal work was all washed away during the flooding, and the riverbed was full of cobbles, medium-to-fine gravels and coarse sands. In this sector the erosion due to the

flooding abruptly changed the riverbed materials, but is quickly stabilizing and returning to the original riverbed.



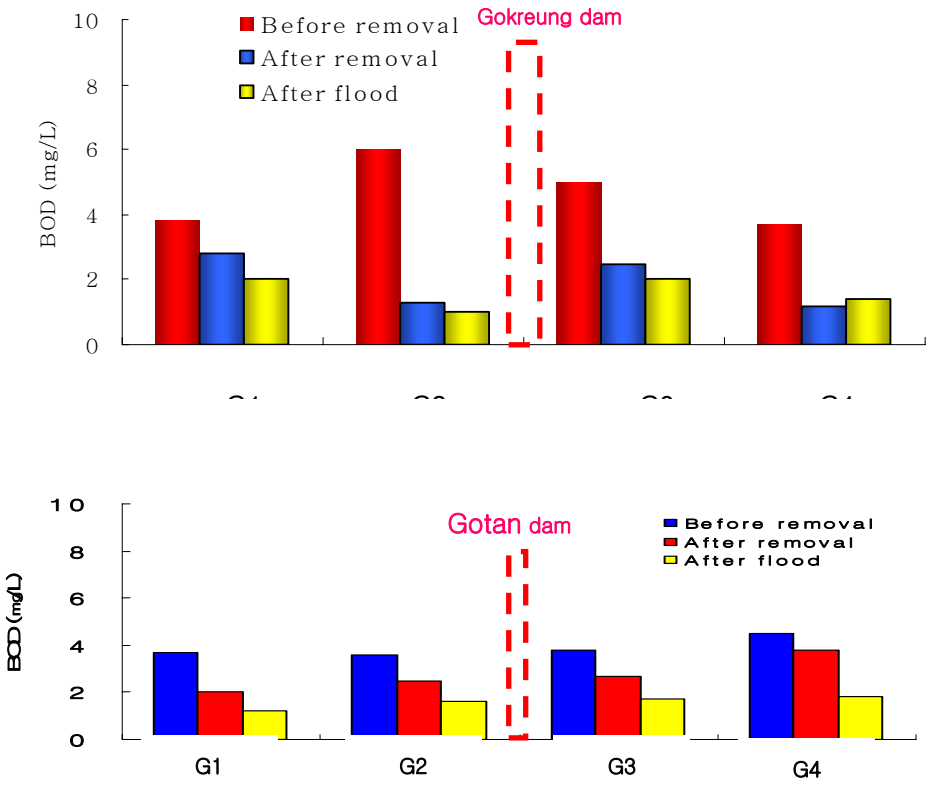


(Figure 2) Vertical changes of the riverbed in Gokreung 2 small dam(up) and Gotan small dam(down)

(2) Analysis of chemical impacts

The analysis of the mean concentration of BOD, SS and TN and TP showed that the concentration of SS was lower after the dam removal than before the dam removal except for in the uppermost reaches of the small dam, and that of BOD had significant lower values of both of the after the dam removal than before the dam removal.

These results indicate that the water quality got better after the weir removal than before the dam removal. However, as the monitoring was conducted over a short period of tine after the dam removal, it is too early to come to any quantitative conclusion, and a longer-term monitoring is in order.

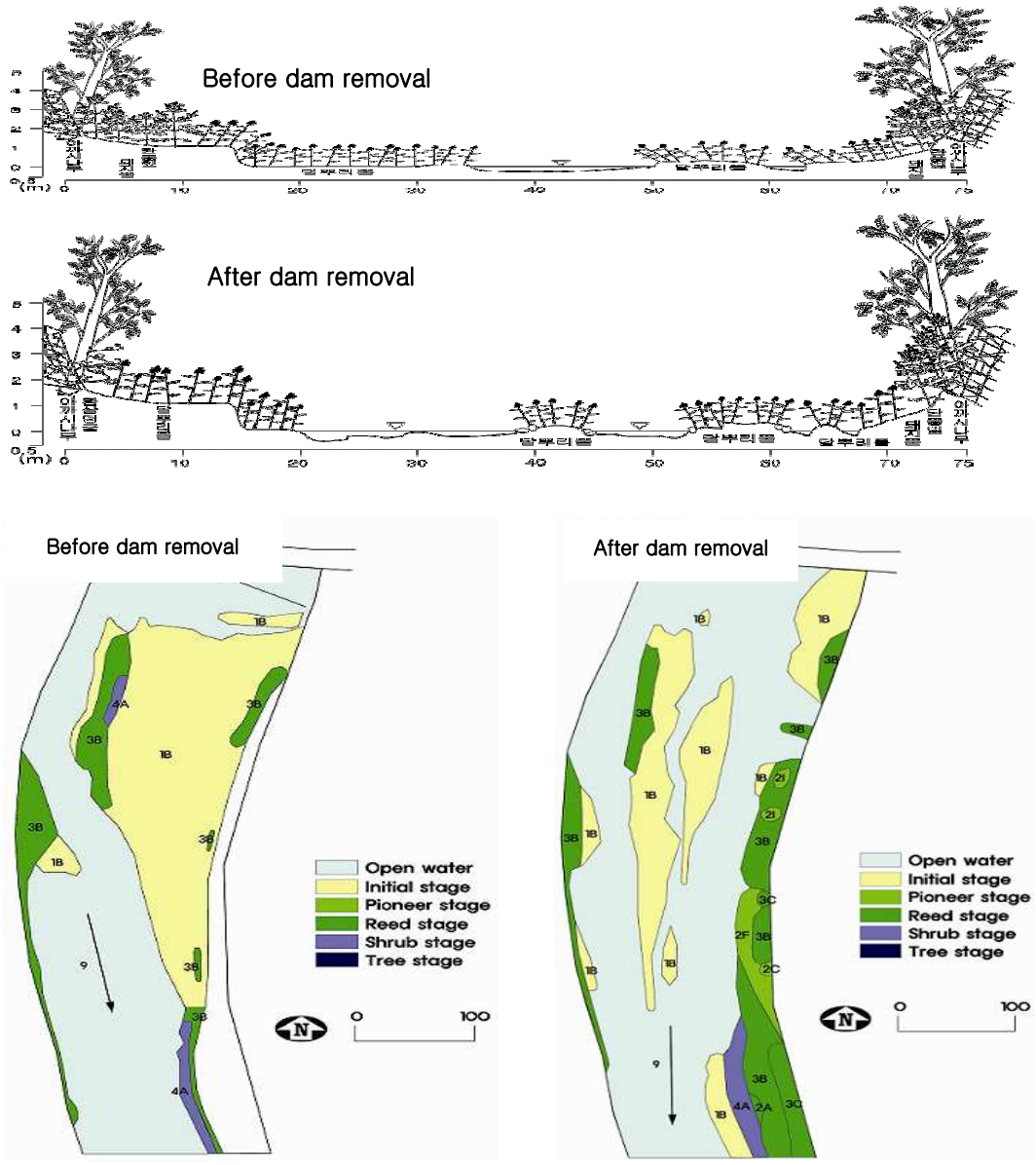


(Figure 3) Changes in BOD and SS concentration of Gokreung 2 small dam(up) and Gotan small dam(down) before and after weir removal

(3) Analysis of ecological characteristics

1) Vegetation

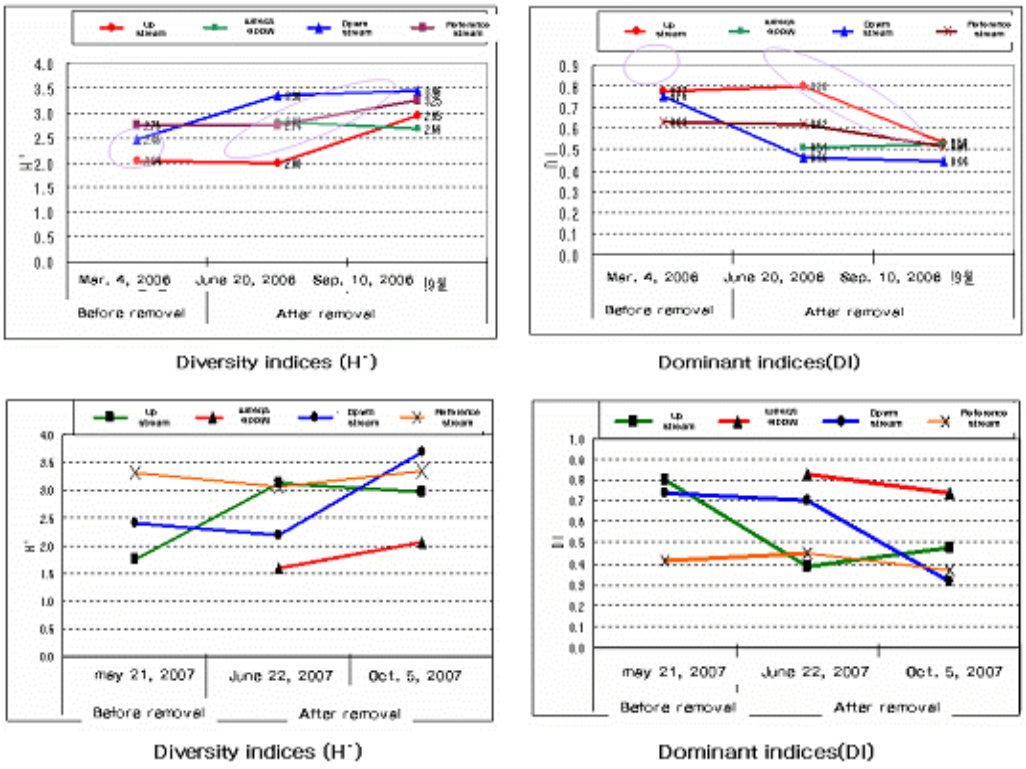
In this area there used to be a swamp in the upstream. What used to be a detention pond before the weir removal showed the characteristics of a detention pond after the weir removal as well. As the water was drained from the ex-detention pond in the upper reaches of the weir, the part newly out of the water became a new habitat for plants, but only pioneer plants inhabit there in the early stage. In July there was a flood after the weir removal, and the topography of the low-flow riparian area was changed a great deal, and the habitat of the water-caltrop, a submerged plant, shrunk. As for new habitats emerging after the weir removal, in the early stage annual zone-of-disturbance vegetation appear in most cases, and as time passes, perennial vegetation is expected to succeed to the annual vegetation.



(Figure 4) Changes of vegetation illustrated in the vegetation cross section after the removal of Gokreung 2 small dam(up) and Gotan small dam(down)

2) Large benthic invertebrates

After the removal the static waters of the upstream changed to flowing waters, and as diverse particles form the riverbed materials, dragonflies and melanian snails, which used to be there, were not discovered, whereas trichoptera, which did not used to be there prior to the weir removal, appeared. There was some change to the species. Before the weir removal chironomids and tubifexes were dominant, but chironomids and mayflies were dominant after the weir removal.



(Figure 5) Comparison of diversity and dominant indeces of large benthic invertebrate after the removal of Gokreung 2 small dam(up) and Gotan small dam(down)

3) Fish

The dominant species was the pale chub, and the next dominant species was the goby minnow. After the weir removal Far Eastern catfish and Chinese mitten crab, which used to be found in the downstream area only, were seen in the upstream area as well. We could confirm the details of the changes in fishes after the weir removal. A look at the changes of the species index before and after the weir removal shows that most indexes rose after the weir removal. As the weir removal secured the eco-corridor, most indexes increased. However, fishes seem to need a longer-term monitoring as well.

<Table 1> Comparison of species diversity indexes before & after the removal of Gokreung weir 2

Fish	Before vs	downstream		upstream	
community patterns	after removal	Gokreung 2 small dam	Gotan Small dam	Gokreung 2 small dam	Gotan Small dam
Species number	Before removal	8	10	8	16
	After removal	9	12	12	26
Species diversity (H')	Before removal	1.53	1.88	1.02	0.98
	After removal	1.97	1.63	1.97	1.97
Evenness (E')	Before removal	0.74	0.90	0.49	0.71
	After removal	0.90	0.67	0.79	0.83
Species richness (R')	Before removal	1.80	1.53	1.49	1.00
	After removal	2.25	1.84	2.55	1.99

(Figure 6) The images of Gokreung weir 2 before (left) and after (right) the weir removal (left bank of the small dam)

(Figure 7) The images of Gotan small dam before (left) and after (right) the dam removal (right bank of the small dam)

3. Conclusions

This study is to analyze the changing phase in the habitat of organisms after the removal of weirs which used to block streams.

For the analysis of the changing phase in the habitat of organisms, the physical impacts such as the changes of the riverbed caused by the removal of the weir, chemical impacts such as changes of the water quality before and after the removal, and biological impacts due to changes in the habitat were examined.

In the Gokreung 2 small dam in the Gokreungcheon whose riverbed was made up with sand, swamps in the upper and lower reaches of the weir quickly changed to rapids after the removal of the weir whereas swamps in the Gotan small dam in the Hantan River whose riverbed consists of gravel is very slowly changing to rapids.

As the density of BOD decreases through the removal of the weirs, the water quality has improved in the two areas.

In terms of biological impacts, there were changes in the habitats as the two streams changed from lentic ones (swaps) to lotic ones (rapids).

These biological changes in the habitats brought the creation of vacant lands right after the removal of the weir and noticeable invasion of introduced plants, but it is likely that the introduced varieties will be succeeded by indigenous ones in the future and caddisfles appeared which had not inhabited in the areas before the removal of the weirs.

Also, fish such as catfish and eels whose movements were obstructed by structures such as weirs before are discovered now in the upper reaches of the weirs.

The result of this study to analyze the changes in organisms' habitats before and after the removal of the two weirs show that the removals were substantially helpful for recovering of ecological functions of rivers.

The analysis of biological impacts, however, seems to need a further long-term monitoring.

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