44 ENVIRONMENTAL ANALYSIS OF SOME MODEL AREAS IN THE UPPER UONOGAWA WATERSHEDS FROM THE VIEWPOINT OF NATURAL TORRENT CONTROL ENGINEERING

Klaus Rosino, Universität für Bodenkultur Wien / Austria, Research Institut for Hazards in Snowy Areas, University of Niigata / Japan

Ass. Prof. DDr. Hideaki Marui, Research Institut for Hazards in Snowy Areas, University of Niigata / Japan

1. Introduction and the aim of the research:

Ecologically, a river has various functions such as the selfcleaning ability, the ecological system of the aquatic fauna and flora, the interaction of surface water and ground water, the formation of a special climate caused by higher evaporation, the effect on the landscape, the recreational function etc. .... These factors have to be taken into consideration in watershed management and torrent control engineering.

Therefore, the construction methods in watershed management and torrent control engineering should be evaluated according to the effects which these methods have for preserving these functions.

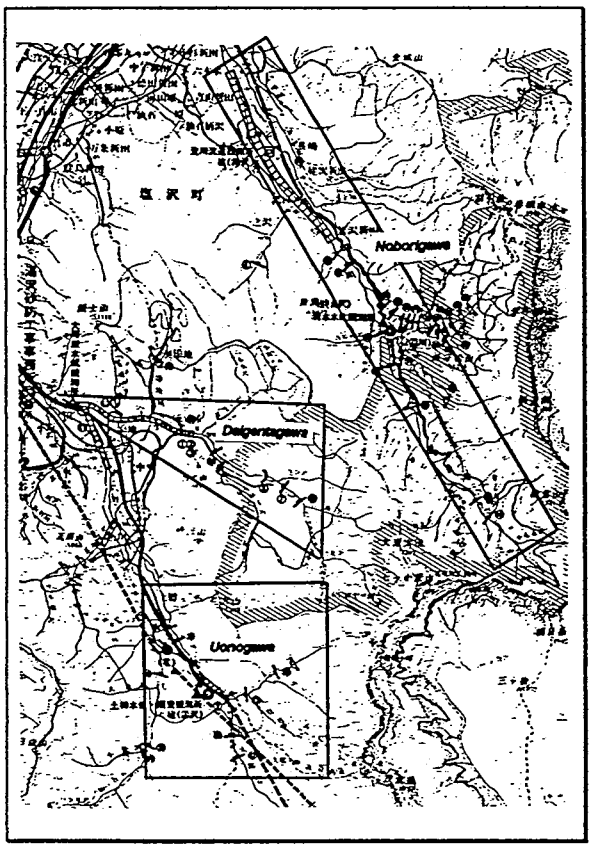


FIG. 1. 1.: Survey Area in the upper Uonogawa watersheds

This research is an attempt to analyze how nature friendly the torrent control engineering applied in Japan is. This analysis was performed by collecting basic data on rivers located in an alpine area in Yuzawa. Actually, the survey area locates in the upper Uonogawa watersheds and includes the upper course of Uonogawa itself, Daigentagawa and Noborigawa (see Fig. 1. 1.). The surveyed distance of these river courses extends to 7.500 m, 8.000 m and 12.000 m, respectively.

2. Social demands and ecological aspects:

Generally speaking torrents are characterized by short river courses with rather steep slopes which have a high relief energy and constitute a high potential of danger in case of heavy rainfalls. There are different approaches of controlling these torrents. Conventionally, more attention was paid to the safety of not only the people's life but also of their property and of important infrastructures than to ecological aspects. Recently, the uniform construction methods of watershed management and torrent control engineering that

often have a negative influence to the flood discharge are under the cross - fire of criticism, especially in the age in which the value of an original nature is increasing. Nowadays, the challenge for torrent control engineering is to find individual compromises between the social demands (safety, cultivation,...) and the ecological aims.

3. Method:

For the purpose of evaluating an ecosystem in torrents a suitable method has to fulfill the following requirements:

- SIMPLICITY
- UNIFORMITY
- COMPREHENSIBILITY AND VARIABILITY
- DISTINCTNESS
- PRACTICABILITY

Specifically, the **Method of *Werth*** was selected for this study.The parameters of the in - the - field evaluation are as follows (Fig. 3. 1.).

SURVEY OF THE FOLLOWING PARAMETERS

1. FORMATION OF THE WATERCOURSE
- Watercourse (Ground plan)
- Longitudinal section of the river
- Transverse section of the river

2. RIVERBED
- Substratum of the riverbed
- Relief of the river
- Contact of the riverbottom with the part of high biological activity
- Important aspects for the fish population

3. INTERLOCKING OF THE WATER AND THE BANK
- Interlocking of the water and the bank

4. SLOPE OF THE BANK
- Shape of the slope
- Material of the slope

5. VEGETATION
- Vegetation
- Area close to the river
- Area within a wider radius

FIG. 3. 1.: Evaluation parameters

According to the extent of deviation of these evaluation parameters from the conditions of the original ecosystem of a torrent, they are classified into 7 condition categories (see Fig. 3. 2.). This classification can point out the sections of the rivers which are preserved in a natural condition. At the same time it stresses the necessity of improving the unnatural status of the sections with bad ecological conditions.

CONDITION CATEGORIES

These Categories describe the deviation of the parameters from the conditions of the original ecosystem of a torrent.

Condition category 1:	***Natural***
Condition category 1 - 2:	***Close to nature***
Condition category 2:	***Ecomorphologically little effected***
Condition category 2 - 3:	***Ecomorphologically distinctly effected***
Condition category 3:	***Ecomorphologically severely effected***
Condition category 3 - 4:	***Far from nature***
Condition category 4:	***Unnatural***

FIG. 3. 2.: Condition Categories which are used to describe the closeness to nature of each of the evaluation parameters

A standardized survey procedure is applied to record the evaluated values. Depending on the actuel circumstances (e. g. small or wide river, bank protection only on one side, etc. ...) the evaluation applies to only one or both sides of the river starting at the source of the river and following downstream to its confluence.

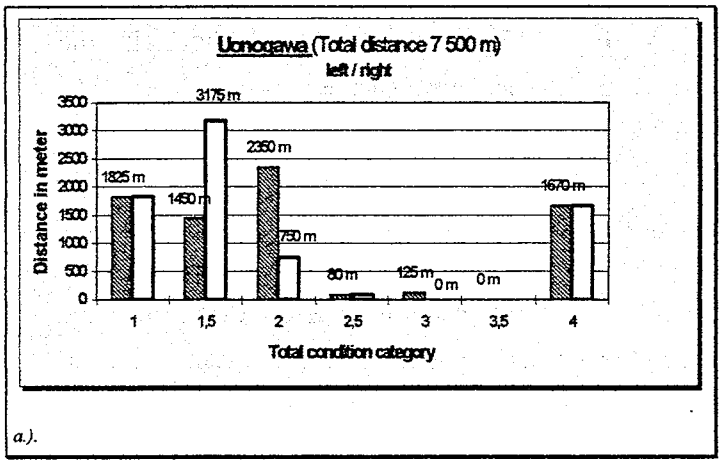
Depending on the extension of the river, the survey should be performed with a 1 : 25.000 or 1 : 50.000 map.

The results of the evaluation of the right and the left bank are shown in a carthographic illustration on the map that points out significant objects - like check dams or other constructions.

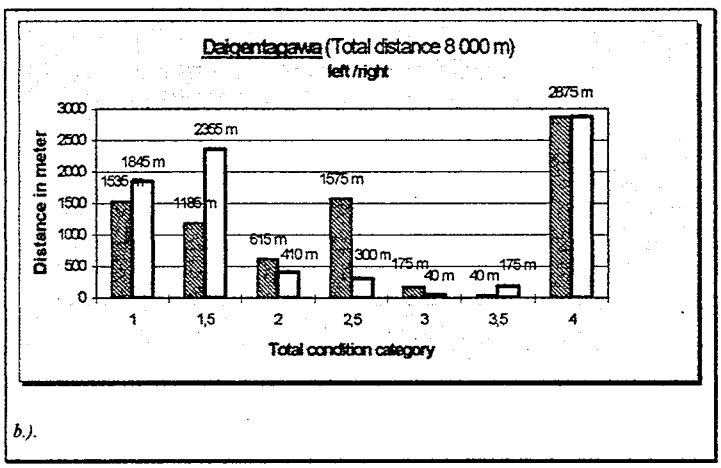
If further information on any parameter is needed, this will be expressed in a more detailed map.

4. Results:

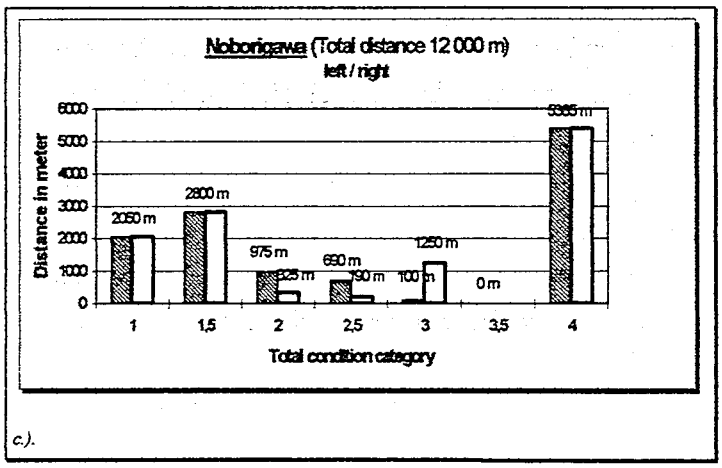
A preliminary analysis of the data shows extreme differences in river conditions.



a.).



b.).



c.).

FIG. 4. 1. a., b., c.: Total length of the river sections characterized by each of the 7 different condition categories

On the one hand very natural sections with high ecological value were observed, on the other hand, very "unnatural" sections with a lot of various constructions and poor ecological quality were detected (Fig. 4. 1. a / b / c.). Obviously, there is a lack of sections with intermediate condition categories at all three rivers.

Figure 4. 1. shows the total length of the river sections characterized by each of the 7 different condition parameters.

At Uonogawa the total percentage of the condition categories 1, 1.5 and 4 amount to 65 %. The unnatural section with category 4 accounts for 22 %. For Daigentagawa these two percentages total 69 % and 35 %, respectively. This ratio of percentages is more significant at Noborigawa. The percentage of all three categories amounts to 85 %, namely the natural section with category 1 accounts for 17 %, the section that is close to nature with category 1.5 totals 23 % and the unnatural section with category 4 amounts to 45 %.

Furthermore, Uonogawa and especially Daigentagawa show different evaluation values between their left and right bank. Generally speaking, the right side is in better condition than the left side.

In addition, it has to be pointed out that the total condition category in the upper course of all three rivers is mainly influenced by the following parameters: the "Formation of the water course" and the "Riverbed"; whereas the "Interlocking of the water and the bank", the "Slope of the bank" and - specifically at Daigentagawa - the "Vegetation" are responsible for poor ecomorphological circumstances.

5. Discussion:

At first, the standardized viewpoint upon the different threats in the upper -, middle -, and lower courses has to be stressed as a reason for the lack of intermediate condition categories at all three rivers. Besides that, the uniformity of construction methods and construction materials reduce the ecological variety. The reason for the higher percentage of intermediate condition categories at Daigentagawa is the attemt of torrent control engineering to decrease this uniformity. In that case, the slope constructions in the middle course are not so steep, and instead of concrete natural stones are used as a material for increasing the interlocking of the water and the bank.

Next, the domination of certain parameters at the various sections of the rivers is also caused by the uniformity mentioned above. On the one hand, check dams for retaining debris are responsible for the overweight of the following parameters: "Formation of the watercourse" and "Riverbed"; on the other hand, these two parameters loose importance in the middle course and lower course, and in the same section the "Interlocking of the bank", the "Slope of the bank" and the "Vegetation" are placed into the foreground by uniform bank protections.

Finally, the protection of important infrastructure, such as the highway - and the shinkansen track at Uonogawa and of private property such as cultivation areas and one family houses at Daigentagawa, mainly lead to the different values between the left and the right condition of the bank.

6. Conclusions:

Firstly, to reduce the number of check dams for retaining debris, open dams in combination with countermeasures against erosion are recommended for reducing the quantity of debris in the upper course of the rivers. Of course, this will slightly deteriorate the ecological value of the river in this area, but it will also contribute to a higher flexibility of choosing different construction methods in the middle and lower course.

Secondly, this flexibility in choosing different construction methods and - materials will have a positive effect especially on the "Slope of the bank" and on the "Interlocking of the water and the bank". Actually, this will enhances the variety of the rivers and thus the value of their ecosystem.

In the future, the task of natural torrent control engineering in the survey area should be the improvement of the ecological conditions in the middle and lower course of the rivers without decreasing the protection level from floods and debris flows, according to the results of the research.

Ultimately, it can be said that the natural torrent control engineering depends upon the public environmental consciousness that demands for a higher ecological standard. And the task of torrent control engineering is to react on such requirements. The application of an uniform method for all these various problems will not be able to satisfy the demand for an natural environment.

Key words: Condition Categories, Ecomorphology, Environmental consciousness, Natural torrent control engineering, Werth;