Stream-edge vegetation, creates habitats for aquatic organisms.

Objectives
In the aquatic-terrestrial ecotone, stream-edge vegetation has an important role for the maintenance of aquatic and terrestrial organisms. Most stream-banks are naturally covered by plants, except for streams whose banks have been strengthened with concrete. Such bank protection works have induced stream-edge plants to also aquatic and terrestrial organisms. Functions that were lost when concrete banks replaced the natural vegetation should be understood in order to improve and restore the habitats of stream organisms. The effects of wadisides plants covering the ground and stream surface on aquatic organisms have been inves-
tigated since fiscal 2002 at the Aqua Restoration Research Center in partnership with the Chubu Technical and Engineering Office of the Ministry of Land, Infrastructure and Transport.

Methods
Surveys
Experiments were conducted along experimental stream A at the Aqua Restoration Research Center. The experimental stream A is straight, approxi-mately 800m long, and about 3m wide. Surveys were conducted in late September and October and involved the following: 1) collection of fish and crustaceans by applying electric shocks in order to determine the quantity of these organisms, 2) measurements of physical variables (water depth, current velocity, substrate composition, and areas shaded by plants), 3) determining the amount of food for these organisms (algae, benthic invertebrates, particulate organic matter, and drifting organic matter), and 4) investigating the contents of the collected fish's stomachs. This report describes the differences in the quantity of fish and crustaceans and physical conditions between the treated and control sections.

Design of experiment
Five kinds of sections were established along experimental stream A, as shown in Figure 1. Each section was 15m long. Class A sections were vegetated banks where stream-edge plants (plants that grow in water) and plants on the ground, were left intact. In Class B sections, stream-edge plants were left intact (in-stream cover), but plants growing on the ground were cut down. In Class C sections, stream-edge plants were cut down, but plants on the ground were left intact (over-hanging cover). In Class D sections, both stream-edge and ground plants were cut down (no plants). Class E sections were covered by concrete revetment. There were four sections for each class (A to D), and two Class E sections. During the experiment, concrete blocks were placed at the end of each section, allowing the fish to move through, so as to control the uniformity of the water’s depth in all sections. It was confirmed in advance that the quantity of fish and crustaceans, physical conditions, and the amount of food in the water were equivalent in Class A to D sections before the plants were cut down.

Physical conditions change as a result of plants being cut down.

The physical conditions of each section class are summarized in Table 1. The current velocity near the bank was slow. In Classes C and D, the current velocity near the banks was faster than in Classes A and B, as a result of there being no in-stream cover in C and D. In Class E (concrete revetment), the current velocity near the bank was fast due to the surface of the concrete banks being smoother than that of other kinds of banks.

In-stream covers affect the distribution of aquatic organisms.

Result 1
The type of stream-edge structure was closely correlated to the biomass of fish (Figure 2). In the figure, the quantity of fish is the total of three traits. The quantity differed by class, and was the largest in A (vegetated bank), followed by B (in-stream cover), C (over-hanging cover), D (no plants), and E (concrete revetment). In order to determine the effect of in-stream cover, the quantity in B, which lacked overhanging cover, was smaller than that in A. This difference was not as notable as that between A and the other sections. The quantity of fish and crustaceans in stream-edge cover nearly approached that of the vegetated bank, followed by B (in-stream cover), C (over-hanging cover), D (no plants), and E (concrete revetment). The difference in the quantity of fish (Figure 4). The amount did not differ greatly between A (vegetated bank) and B (in-stream cover), but dropped dramatically in C (over-hanging cover) and D (no plants). There were very few crustaceans living in Class E sections with concrete revetment. This study showed that in-stream cover is essential for crustaceans to live.

Discussion
The experiment showed that disappearance of plants from the water’s edge affected the distribution of aquatic organisms even when plants still remained on the ground. Stream-edge plants slow down the speed of flow near banks, create cover over stream-edge water, affect other physical conditions, and thus affect the distribution of aquatic organisms. When banks were covered by concrete, the current velocity was as fast as in the middle of the stream, and such conditions inhibited crustaceans from living in that area.

Restoring stream-bank functions
As a part of activities to reform streams into multi-natural forms, plants are being actively planted along streams, especially in the ground. In order to improve the living conditions of aquatic organisms, plants should also be planted in the water, and stream-edges should be improved into a space where plants can grow. Stream-edge plants not only change the physical conditions in water but also save in vari-ous other ways, such as providing food and shade from sunlight. Plants should be kept along the water’s edge in a manner appropriate to each stream and stream section.

Column
Fish use stream-edge plants in various ways. Some species of fish use pieces of plants to make nests, while some fish (small fish in general) need the slow-moving waters created by plants to live. There are fish that feed on insects that fall from stream-edge plants, and those that shelter among plants to escape from predatory birds. Understanding these functions of stream-edge plants will enable us to improve habitats for fish. It is therefore important to understand the functions of plants in each stream environment.