

Flow rate changes, dynamism of streams, and restoring habitats

Controlling the flow rates of streams

Various roles of a flood

Increasing flow rates

A flood triggers fish to swim up streams and lay eggs.

In the Shin-Sakai Stream (a branch of the Kiso River), a large number of mature-sized carp swam up the stream and laid eggs on the streambanks and in the creeks on the day following a flood (April 18, 2002), suggesting a close relationship between floods and egg-laying behavior.



School of carp swimming up the stream



Eggs laid on water grass in a creek

Connecting isolated backwater areas to streams

During floods, otherwise isolated backwater areas are connected to the stream. When major beds are flooded, fish enter into the beds and lay eggs there, thus floods are important events in the life of fish.

Disturbing water

Improving the streambed by washing out fine soil particles

Floods wash out fine soil particles accumulated between the streambed rocks and improve streambed conditions. It also prevents stones from being buried.

Renewing algae growing on stones

When the algal layer is thin, algae will grow fast on stones using rich nutrient salts in stream water, but basic production drops when the layer thickens because less light penetrates through the layer and photosynthesis decelerates. Therefore, exfoliation of alga layers from stones (Photograph A) increases the production of algae and improves their quality as fish food.



Photograph A
Streambed before and after a flood

Maintaining spaces between streambed stones

When the streambed is disturbed, spaces are formed between streambed stones to which stream water containing dissolved oxygen is constantly supplied. These spaces provide habitats for aquatic insects.

Forming stream channels and micro-landforms

In large-scale rivers of Japan, the size of low-water channels and sand bars are believed to correlate to the mean annual maximum discharge (large-scale floods that occur once every two to three years). Floods move sandbars downstream, changes the distribution of rapids and pools, and are involved in the formation of micro-landforms.

These study topics are only parts of or studies. Please refer to "Roles of discharge changes on stream environments and experimental investigations" (in Japanese), Civil Engineering Journal, Vol. 44, No. 10, pp. 32-37, for details.

Keeping and controlling streamside vegetation

The stability of streamside vegetation is maintained by repeated destruction caused by flooding and subsequent restoration, which suppresses vegetation transition. At the Center, streamside vegetation was compared between a stream, along which a flood was artificially produced, and a stream in which the flow was kept constant. Plants grew tall, almost covering the entire water surface along the constantly flowing stream, while growth was inhibited along the flooded stream (Photograph B).



Constant flow stream (Left) and stream with flooding



Formation of sites where seeds can settle and dispersion of seeds

For example, the seeds of *Chosenia arbutifolia* are the first to acquire sites on sandy and bare, gravelly land formed by flood disturbance to settle down on.

Reproduction of stream beaches

Floods wash out plants in alluvial fans, move sand bars, and reproduce bare stream beaches. This enables organisms that depend on stream beaches to survive (such as *Aster kantoensis* and *Euphonia japonicus*) (Photograph C).

Along the Chikuma Stream, a large-scale flood, which probably occurs once every 30 years, occurred in August 1999, and increased the percentage of bare land from 2.3% to 15.2% in a 96 to 98 km section from the stream mouth. This seven-fold increase caused bare-land stream beaches to appear.

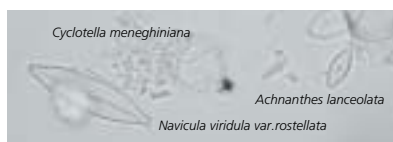


Photograph C: Disturbance during flood (reproduction of stream beaches in the alluvial fan of a stream)

Flood tests suggested the relationship between changes in discharge and organisms

Experiment on flooding and the exfoliation and removal of algae

Algae that grow on the surface of riverbed stones, such as diatoms, *Cynophyceae*, and *Chlorophyceae*, are the primary producers in the river ecosystems. Exfoliation and renewal of these algae during floods are believed to maintain their production and quality as fish food. Recent stabilization and reduction of discharge have caused



fine sand to accumulate on the riverbed, thus affecting the photosynthetic activities of the algae. The Aqua Restoration Research Center has investigated the effects of floods on primary production in rivers and has analyzed the flood conditions needed to remove layers adhering to riverbed stones (consisting of algae and fine soil). This report describes several experiments on the latter topic.

Methods

This experiment was conducted in the upstream section of stream A. The discharge through a flat section of approximately 1/500 (0.2%) in bed slope, which had been kept low (0.05 m³/s) over a long period, was increased in stages from 0.05 to 0.1, 0.25, and 0.5 m³/s, in order to investigate the relationship between floods and exfoliation of algae layers. The discharge was maintained at each rate for 24 hours. Table 1 shows the discharge conditions for each flow level.

Algae were collected from ten rocks 3, 6, and 24 hours after the start