Maintaining stream beaches
Streamside plants and alien plants

Gravel stream beaches are widely found along the middle reaches of Japanese streams, which are generally steep. Gravel stream beaches are severe places for most plant species to grow due to strong solar radiation and high temperatures, but there are plants that have adapted to such a severe environment, e.g. Artemisia capillaris, Aster kantoensis, Lactuca tamagawaensis. These plants, called “stream beach plants”, grow in a relatively scattered fashion over the gravel stream beaches and constitute ecosystems specific to gravel stream beaches. However, stream beach plants are declining and many species are even in danger of extinction. One of the principal causes of this decline is alien plants. Among plants introduced from abroad, there are many species that grow vigorously in gravel stream beaches, and these plants increasingly occupy stream beaches, taking over the habitats of native stream beach plants.

In order to conserve stream beach plants and ecologically sound stream beach vegetation, the effects of selective removal of alien plants on stream beach vegetation must be evaluated. As a fundamental study, we conducted a selective removal experiment at the Aqua Restoration Research Center.

Methods

The experiment was conducted at the center’s Riverside Plant Protection Research Zone. Twenty square quadrats (2m x 2m) were established in the zone, over which, on March 15, 2000, Potentialla chinensis, Artemisia capillaris, Dianthus superbus, Galium verum, and Anaphalis yedoensis seeds (native stream beach plants) were uniformly sown. The seeds had been collected in the previous year on stream beaches near the center along the Kiso River. In 10 of the twenty quadrats, all alien plants were removed once a month from April to August 2000 (removal quadrats) (Figure 1). The other 10 quadrats were left intact and used as the control (Figure 1). Almost no new alien plants were observed during and after September.

Alien plants become dominant unless they are selectively removed.

From April to August 2000, 21 species of alien plants grew in these quadrats, including: Diodia tona, Eragrostis curvula, Coreopsis lanceolata, and Dianthus superbus. In October 2000, vegetation in the removal quadrats was significantly taller and sparser than in the control quadrats (Figure 2, t-tests, P<0.05). This should be mainly attributable to the difference in species composition of the vegetation. In order to investigate the abundance of each species, the quadrats were divided into grids of 20 cm intervals, plant species that grew at the intersections were recorded, and the number was totaled for each plant species. The selective removal caused a clear difference in species composition. In the control quadrats, Diodia tona, an alien plant, dominated (Figure 3). On the other hand, in the removal quadrats, Artemisia capillaris was relatively abundant, although Diodia tona was most dominant (Figure 3).

Alien plants are a major cause of the decline in native plants inhabiting stream beaches. We investigated the effect of experimental selective removal of alien species from stream beaches on the number and growth of native species. The results of the experiment showed that alien plants became dominant without the selective removal, and that native plants, such as Artemisia capillaris and Galium verum, recovered just by removing the nearby alien plants. These results suggest that the selective removal of alien plants is an effective method to conserve native vegetation.

\begin{table}[h]
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\begin{tabular}{|c|c|c|c|c|}
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Species & Treatment & Number of quadrats & Mean & Minimum & Maximum \\
\hline
Artemisia capillaris & Removal & 10 & 90.8 & 26 & 210 \\
 & Control & 10 & 43.5 & 4 & 108 \\
Potentialla chinensis & Removal & 10 & 0.8 & 0 & 3 \\
 & Control & 10 & 0.2 & 0 & 3 \\
Galium verum & Removal & 10 & 14.3 & 0 & 68 \\
 & Control & 10 & 3.6 & 0 & 24 \\
Dianthus superbus & Removal & 10 & 0.4 & 0 & 2 \\
 & Control & 10 & 0 & 0 & 0 \\
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\end{tabular}
\caption{Number of stream beach plants per quadrat}
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Colum

In the middle reaches of the Kinugawa River, an invasive alien grass Eragrostis curvula has flourished as sand has accumulated on gravelly stream beaches, and native plant species inhabiting gravelly sand beaches, such as Aster kantoensis, are rapidly dwindling. As part of conservation efforts, Eragrostis curvula vegetation that had established on the stream beaches of the Kinugawa River was removed using heavy machines, the fine sand on stream beaches was removed by water jets to restore the gravelly stream beaches, and the seeds of Aster kantoensis, which were collected from remnant populations, were sown to conserve the species.

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Photograph by Jun Miyazaki

Native plants

Native plants such as Potentialla chinensis, Artemisia capillaris, Dianthus superbus, Galium verum, and Anaphalis yedoensis grow on stream beaches.

Native plants

Various species have been brought from foreign countries and their distributions have expanded as a result of growing projects and the urbanization of streamside areas. There are thirty species that can grow well even in sandy and gravely stream beaches unless they are removed, and 2) selective removal of alien plants from areas where seeds of stream beach plants exist may restore the original stream beach vegetation. The results of this study suggest that removal of alien plants is an effective measure in the protection of natural streamside environment.

Larger-scale experiments will be conducted to investigate methods of removing alien plants that can be used in stream management.