Forest Tree Genetic Resources Information
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Forest Tree Genetic Resources Conservation Stands of Japanese Larch (*Larix kaempferi* (Lamb.) Carr.)

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1 Introduction

The species of genus *Larix* widely distribute in subarctic and arctic zone. The number of species is estimated as ten or more, only one of which distributes in Japan. This species, Japanese Larch (in Japanese, **Karamatsu**), is endemic in Japan, and its distribution area is mainly central mountainous regions (fig. 1). The northern and eastern limit is Mt. Zao in Miyagi Prefecture, the western limit is Mt. Hakusan, and the southern limit is Mt. Tengu and Mt. Yamazumi of Akashi Mountain Range. The eight provenances, known to be representative, are named as follows: Kawakami-Higashiyamanashi, Yatsugatake, Asama, Fuji, Minami-Alps (The South Japan Alps), Nikko, Kita-Alps (The North Japan Alps), and Kiso.

The species grows very well not only in central Japan but also in eastern and northern Japan, where it does not naturally distribute. Therefore, it has been an important forestry species of the boreal zone in Japan. The Forest Tree Breeding Center (FTBC) has engaged in selection and progeny testing of plus trees, selection and determination of trees that have few spiral grains, artificial crossing, and selection of recommended varieties and development of new varieties.

Japanese Larch has also been widely evaluated internationally, and an international provenance test has been implemented by use of seeds collected in 1956 from 25 natural forests. The participating countries number more than ten, and include Japan, the USA, New Zealand, and several European countries.

The information above emphasizes the importance of widely conserving natural genetic resources that are the base and source of forestry varieties and breeding material.

2 The Present Status of Forest Tree Genetic Resources Conservation Stands in Japanese Larch

The Forest Tree Genetic Resources Conservation Stand (FTGRCS) is an *in situ* conservation forest established in a national forest. The objective of this forest is to conserve genetic variation within species in the form of natural forest. The species to be conserved are important species, in terms of forestry, and endangered species. In each conservation stand, one or more species for conservation are specified. In the stands, operations to conserve genetic variation or promote regeneration of the species are permitted and/or recommended. According to the objectives, although the size of each stand is rather small, the number of stands is large. Statistics in the end of FY 2003 showed 329 places and 9,211 ha in total for 105 species.

The number and area of FTGRCS of Japanese Larch are shown in table 1, the location of them in figure 1.

The number of stands is six, which is relatively small, but the locations belong to six provenances, Yatsugatake, Asama, Fuji, Minami-Alps, Nikko and Kita-Alps, among the eight main provenances. The area size of the stands ranges widely, from 6 ha to 250 ha.

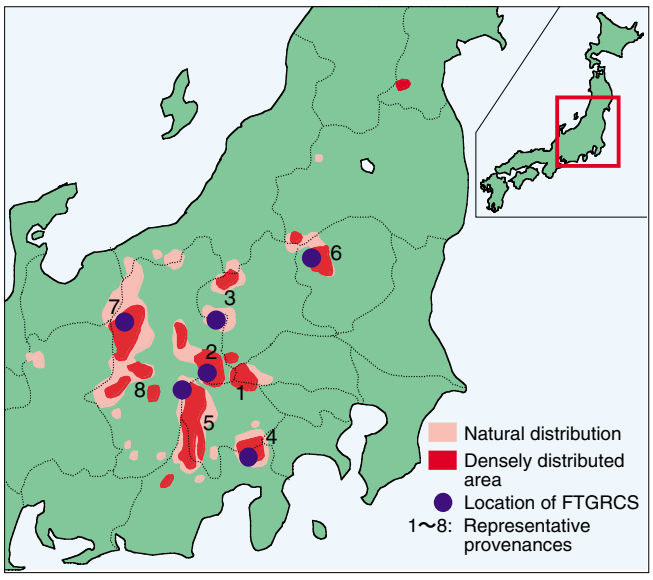

Fig. 1 Natural distribution and location of FTGRCS in Japanese Larch
1: Kawakami-Higashiyamanashi, 2: Yatsugatake, 3: Asama, 4: Fuji, 5: Minami-Alps, 6: Nikko, 7: Kita-Alps, 8: Kiso (distribution map is mainly after Hayashi 1960, Taxonomical and Phytogeographical Study of Japanese Conifers)

Table 1 Number and area of FTGRCS in Japanese Larch

Breeding Region	Regional Forest Office	Number	Area (ha)
Kanto	Kanto	2	265.37
	Chubu	4	152.73
Total		6	418.10
Proportion among whole stands		1.8%	4.5%

3 Representative FTGRCS of Japanese Larch

The representative FTGRCS are introduced as follows. The name of each FTGRCS is composed of the name of the regional forest office, the species name for conservation in Japanese (if the species names are more than one, they are combined by hyphens), and consecutive numbers among regional forest offices.

[Tokyo Karamatsu-Iramomi-Urajiromomi 10]

The provenance is Fuji. Average tree height is not so large (14m), but DBH is relatively thick: the average size is 32cm, the largest tree up to 72cm (fig. 2).

Location	Fujinomiya-shi, Shizuoka Prefecture 35 °21 ′N, 138 °43 ′E
Land description	Area: 252.39ha, altitude : 1,560m～2,780m Warmth Index: 43, annual precipitation: 2,573mm
Stand description	DBH: 32cm, height: 14m Stand density: 200, volume: 133m^3/ha, Number of seedling and sapling: 0/ha

Fig. 2 Tokyo Karamatsu-Iramomi-Urajiromomi 10

[Nagano Karamatsu-Shirabe 9]

The provenance is Minami-Alps. The average DBH and tree height are 62cm and 31m, respectively. These are the largest of this species among FTGRCSs. The volume is also large (289m^3/ha). However, the proportion of trees (their actual number) is as small as 7%, reflecting the fact that the species is mixed with other species such as Shirabe (*Abies veitchii*) and Kometsuga (*Tsuga diversiflora*) (fig. 3).

Location	Hase-mura, Kamiina-gun, Nagano Prefecture 35 °45 ′N 138 °11 ′E
Land description	Area: 53.48ha, altitude: 1,650m～2,200m Warmth Index: 32.8, annual precipitation: 1,570mm
Stand description	DBH: 62cm, height: 31m, Stand density: 65, volume: 289m^3/ha, Number of seedling and sapling: 0/ha

Fig. 3 Nagano Karamatsu-Shirabe 9

[Nagano Kitagoyomatsu-Karamatsu-Kometsuga 19]

The provenance is Kita-Alps. The proportions of number of trees and volume are 69% and 81%, respectively. These trees are relatively large among trees of this species in FTGRCS (fig. 4).

Location	Omachi-shi, Nagano Prefecture 37 °24 ′N 137 °41 ′E
Land description	Area: 41.71ha, altitude: 1,400m～1,840m Warmth Index: 39.3, annual precipitation: 2,800mm
Stand description	DBH: 27cm, height: 19m Stand density: 387, volume: 280m^3/ha Number of seedling and sapling: 0/ha

Fig. 4 Nagano Kitagoyomatsu-Karamatsu-Kometsuga 19

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Forest Tree Superior Genes Conservation Stands of Japanese Larch (*Larix kaempferi* (Lamb.) Carr.)

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1 Introduction —What is a Forest Tree Superior Genes Conservation Stand—

A Forest Tree Superior Genes Conservation Stand (FTSGCS) is an *ex situ* conservation system that conserves superior genes of breeding species such as *Cryptomeria japonica* and *Chamaecyparis obutusa* in the form of man-made forests. After collecting seeds from excellent man-made or natural forests that are selected for aspects of growth such as tree height or diameter or straightness of trunk, seedlings are grown from the seeds and man-made forests (FTSGCS) are established with the seedlings. The process of seed selection allows these man-made forests to inherit superior genes.

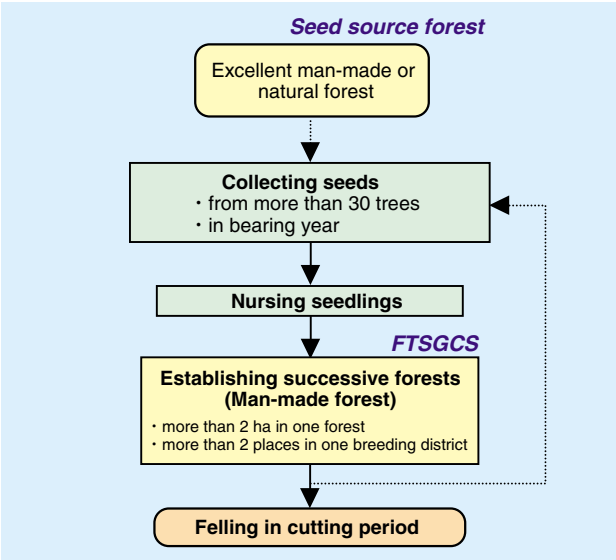

Fig. 1 Outline to establish FTSGCS

The outline to establish FTSGCS (fig. 1) was determined by the Forestry Agency of MAFF in 1964 and finally reviewed in 2001 as follows.

First, select the seed source forest among excellent man-made or natural forests of breeding species such as *Cryptomeria japonica* and *Chamaecyparis obutusa*, and collect the seeds in a bearing year from more than 30 individuals in the forest; at least 30 individuals are needed as a seed source, and genetic diversity is more assured in a bearing year than in a poor crop year. In a bearing year, most adult trees bear flowers and disperse pollen, and the trees receive pollen from various trees; thus, various genes can be collected in the form of seeds.

Next, we sow the seeds, nurse the seedlings, and establish more than two successive forests from one seed source forest. These successive forests are established at different places in one breeding district, and the area size of each successive forest is more than 2 ha. These successive forests are called "Forest Tree Superior Genes Conservation Stands (FTSGCS)". This type of forest is classified as an *ex situ* conservation forest, given that the genes derived from seeds are conserved in a site remote from that where the seeds were originally collected.

Seed source forests were designated in 18 species of needle-leaved trees such as *Cryptomeria japonica*, *Chamaecyparis obutusa*, *Pinus densiflora, P. thunbergii, Larix kaempferi*, *L. gmelinii, Picea glehnii*, and *Abies sachalinensis*, and also in 18 species of broad-leaved trees such as *Betula maximowicziana*, *B. ermanii*, and *Populus sieboldii*. Successive FTSGCS for these species have been established.

In FY 2003, 359 places and 1,003.2 ha of FTSGCS had been established from 246 seed source stands. The average area of each FTSGCS is 2.8ha.

2 The difference between a FTSGCS and an *in situ* conservation stand

With regard to other methods to conserve genetic resources of forests, there are three types of in situ conservation forests in Japan's national forest. Among them is the Forest Tree Genetic Resources Conservation Stand (FTGRCS), which is characterized and explained in special issue no. 1 of this series.

In table 1, a comparison of the features of FTSGCS (*ex situ*) and those of FTGRCS (*in situ*) is shown. The objective of FTSGCS is limited to conservation of superior genes, whereas that of FTGRCS is conservation of a wide variety of genes. Thus, the forest that is selected as a seed source

stand in FTSGCS is excellent man-made forest or excellent natural forest. This criterion differs from that of FTGRCS; in FTGRCS, natural forest that contains abundant individuals of the species to be conserved is preferable. Moreover, in FTSGCS, final felling can be done in an adequate cutting period, after seeds have been collected for establishing successive FTSGCS (fig. 1 and table 1). This is a sustainable system for both genetic resources conservation and production activities.

Table 1 Comparative features of FTSGCS and FTGRCS

	FTSGCS	FTGRCS
Objective	To conserve superior genes of excellent forest in the forms of successive forest	To conserve genetic diversity within species
Target forest	Excellent man-made or excellent natural forest, as seed source forest	Natural forest abundant in individuals of the species to be conserved
Target species	Breeding species	Forestry species and endangered species
Method	*Ex situ*	*In situ*
Management	Felling is available, after seeds for successive FTSGCS have been collected in the forest	Operations for promoting regeneration are available

3 Natural distribution and FTSGCS in Japanese Larch

Number and area of FTSGCS of Japanese Larch are listed in table 2, locality of FTSGCS and seed source forest of the species in figure 2.

Table 2 Number and area of FTSGCS in Japanese Larch

Breeding region	Regional Forest Office	No. of seed source forest (natural forest)	FTSGCS	
			No. of establishments	Area (ha)
Tohoku	Tohoku	2(1)	3	4.2
Kanto	Kanto	3(3)	9	21.7
	Chubu	8(6)	14	32.1
Total		13(10)	26	57.9
Proportion among whole stands		5.3%	7.2%	5.8%

The number of seed source forests is 13. Of those, 3 forests are man-made forest and 10 natural. The number of FTSGCS established is 26 and their total area is 57.9 ha. The average number of stands in one seed source forest is two and the average area of a stand is 2.2 ha (table 2).

Of the natural forests, one or two seed source forests are designated in each of 8 representative provenances (fig. 2). Among them, Kawakami-Higashiyamanashi and Kiso are provenances where FTGRCS (*in situ* conservation stands) have not yet been established. The northern limit population at Mt. Manokami is also designated as a seed source forest. Of the man-made forests, three forests have been designated as seed source forests.

The sites for FTSGCS are selected after due consideration of later growth, because they are in the natural distribution area and/or a prosperous area of plantation of Japanese Larch (fig. 2). These FTSGCS were established predominantly between 1966 and 1978, and are consequently 26~38 years past the date of establishment. The average tree height within a population at 15 years after planting ranges from 6 to 10m, and 10 to 16m at 25 years after planting. The growth rate in these FTSGCS is relatively good.

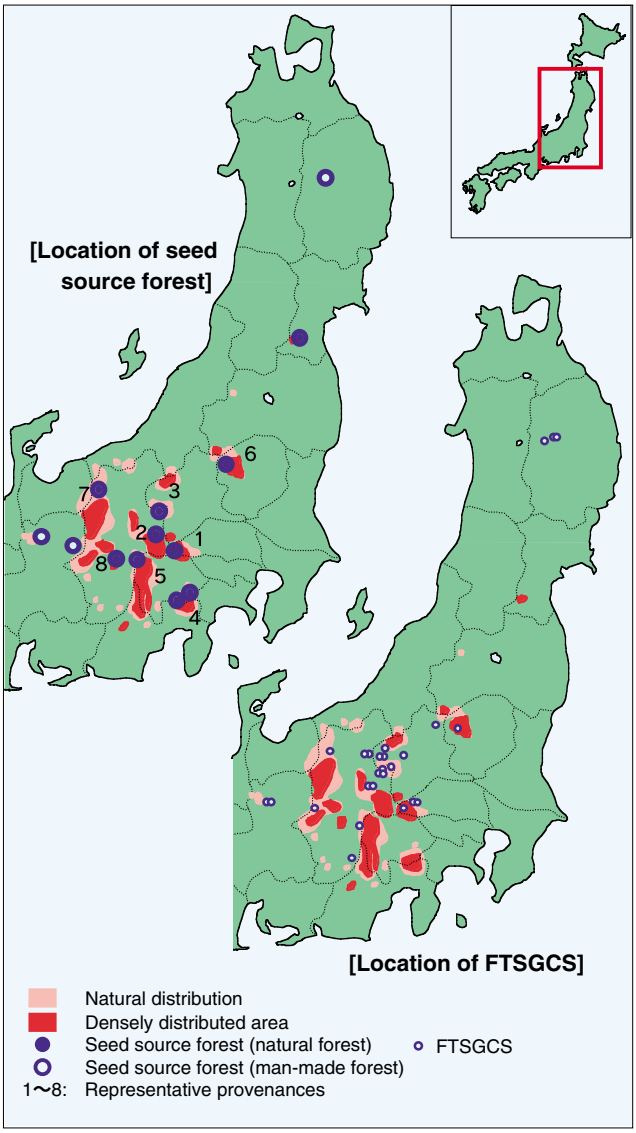

Fig. 2 Natural distribution of Japanese Larch and location of seed source forest (upper) and location of FTSGCS (lower)
1: Kawakami-Higashiyamanashi, 2: Yatsugatake, 3: Asama, 4: Fuji, 5: Minami-Alps, 6: Nikko, 7: Kita-Alps, 8: Kiso (distribution map is mainly after Hayashi 1960, Taxonomical and Phytogeographical Study of Japanese Conifers)

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