

DYNAMICS OF *QUERCUS CRISPULA* (JAPANESE OAK) POPULATIONS IN NATURAL MIXED FORESTS UNDER A SELECTION CUTTING REGIME IN NORTHERN JAPAN

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PURPOSE AND SCOPE

In Japan, the demand for broadleaf trees, especially oak, has increased significantly due to the limited supply of logs from overseas and the increasing preference for domestic timber. Japanese oak (*Quercus crispula*) exists as a dominant species in natural mixed forests, but its sustainable management has not been established. In this study, I describe the long-term dynamics of Japanese oak under a selection system over a 40-year period. In the target experimental stand (37 ha in area), single-tree selection with a 10-year rotation has been continued since the 1970s based on an intensive tree survey. A previous study (Yoshida et al. 2006), covering the first 20 years, showed that Japanese oak was gradually increasing. Furthermore, additional investigations of natural regeneration (Miya et al. 2009, Noguchi and Yoshida 2007) have shown that Japanese oak saplings are predominantly found under a closed canopy, where dwarf bamboo, a major inhibitor, was less abundant on the forest floor. The aim of this study was to determine whether this trend continued over a 40-year period. I investigated factors related to long-term dynamics and clarify the conditions that will lead to the sustainable production of Japanese oak in the long term.

METHODS AND APPROACH

A long-term, wide-scale experiment was conducted in a natural mixed forest in Hokkaido, northern Japan. The dominant tree species were *Abies sachalinensis*, *Acer mono*, *Quercus crispula*, *Tilia japonica*, and *Betula ermanii*, and the forest floor was densely covered with dwarf bamboo. The predominant natural disturbance was windfall. The targeted experiment stand was 37 ha. From the 1970s, all living trees (diameter at breast height [d.b.h.] >12.5 cm) with individual identification have been measured, and selection cutting with a cutting rate of 10 to 20 percent by volume has been conducted every 10 years. Changes in volume over 40 years and demographic parameters (diameter-class promotion, recruitment, and survival rate) were calculated. In addition, for a 6.7-ha area where spatial data of individual tree location was available, I used a generalized linear model to analyze factors related to these parameters.

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FINDINGS AND IMPLICATIONS

The volume recovery of Japanese oak under selection cuttings was remarkable compared to the other tree species. It also showed a slight increase even in the period when a windfall disturbance occurred. The recruitment rate of Japanese oak was high, second only to birch species. The number of small-diameter trees increased significantly over time, and as a result, the frequency distribution, which had a mode around 20 cm, changed to a reverse J-shape (fig. 1). The growth rate of Japanese oak decreased with local crowding and increased with the intensity of selection cutting in the surrounding area. On the other hand, new recruitment around mother oak trees increased with the initial local crowding (possibly due to negative effect on dwarf bamboo), and increased with the intensity of selection cutting.

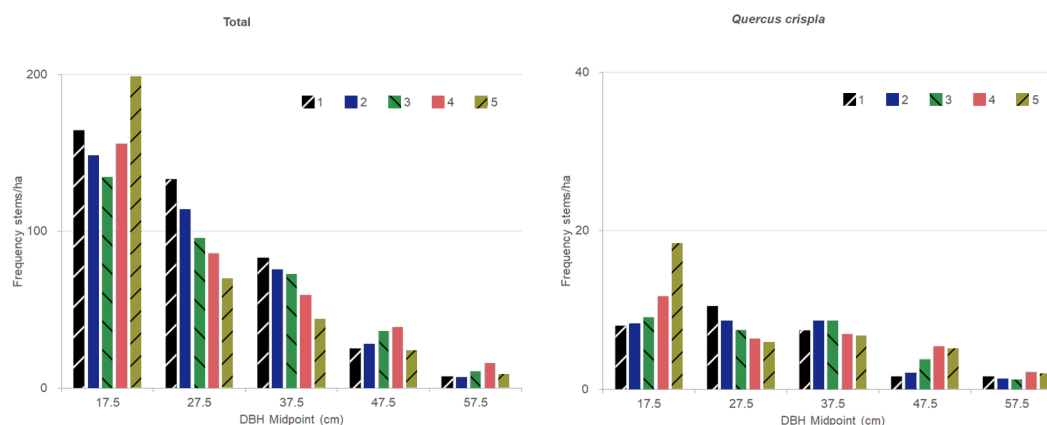


Figure 1—Diameter-class distribution of the 37-ha experimental stand over 40 years. All species combined (left); *Quercus crispula* (right). Surveys were conducted at 10-year intervals, at the beginning of rotations (numbers in legend).

Thus, in this forest, Japanese oak responded favorably to the stand changes. The increase in growth rate, especially in the latter period, may also be influenced by climate change. As for the high recruitment rate, it is possible that management operations significantly contributed to newly established individuals. Japanese oak could be a major target species, along with early successional species such as birch, for the selection system in this type of mixed stand. In order to make the system more sustainable, it is essential to carry out regeneration assistance in conjunction with single-tree cutting, and to periodically open the canopy to enhance growth of remaining trees.

LITERATURE CITED

- Miya, H.; Yoshida, T.; Noguchi, M.; Nakamura, F. 2009.** Individual growing conditions that affect diameter increment of tree saplings after selection harvesting in a mixed forest in northern Japan. *Journal of Forest Research*. 14: 302–310.
- Noguchi, M.; Yoshida, T. 2007.** Regeneration responses influenced by single tree selection harvesting in a mixed-species tree community in northern Japan. *Canadian Journal of Forest Research*. 37: 1554–1562.
- Yoshida, T.; Noguchi, M.; Akibayashi, Y. [et al.]. 2006.** Twenty years of community dynamics in a mixed conifer-broad-leaved forest under a selection system in northern Japan. *Canadian Journal of Forest Research*. 36: 1363–1375.

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