Research Square

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Frequency-Dependent Seedling Predation by Rodents: Growth and Survival of *Quercus Wutaishanica* in Two Habitats

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Research

Keywords: Quercus wutaishanica, Rodents, Prey on, Frequency of large seeds and small seeds (FLSD), Habitats, Seedling growth, and survival

Posted Date: May 5th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-437784/v1

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Abstract

Background: The preference of a predator for a certain type of prey affects the fitness of species in nature, the optimal foraging theory predicted that prey density may change the predator's selection preferences, furthermore, predation on prey may be frequency-dependent. However, there are few studies demonstrate that how such frequency-dependent selection influences predator-prey dynamics, especially in plants.

Methods: We tested the frequency-dependent preying on Quercus wutaishanica seedlings by rodents and seedlings' survival and growth in different habitats. We transplanted seedlings with five frequency of large and small seed (FLSD) (9:1, 7:3, 5:5, 3:7, 1:9) in the forest gap and under the canopy in a warm temperate forest in the Liupan Mountains, northwest, Ningxia, China.

Results: (1) Rodents prefer the cotyledon of seedlings established from large seeds with more nutrients in the early stage of transplanting. Nonetheless, we found the net effect of rodent predation to be positively frequency-dependent, and this predation effect should function as a species coexistence promoting mechanism. (2) The seedling cotyledon retention rate has the maximum fitness when the FLSD was almost the same, which can provide energy for the growth of seedlings of different phenotypes and ensure their survival as much as possible. (3) Only the cotyledons were preyed on, the apical buds were bitted off, and the whole seedling was uprooted, which mostly occurred under the forest canopy, but the survival rates of cotyledon-predated seedling, apical bud-predated seedling, and intact seedling in the forest gap were higher than those under the canopy, indicating rodents prefer to active or prey under the hidden forest canopy, but the forest gap can provide suitable light for seedling growth and survival. (4) If only cotyledons were preyed on, the growth of Q. wutaishanica seedling would not be affected. Although it is not fatal to bite off the seedling apical bud, the growth is still hindered.

Conclusion: These results of this experiment enrich the theory of "frequency dependence", and provide new insights into the coexistence between rodents and seedlings established different seed phenotypes. Furthermore, it also better reveals the ecological characteristics of deciduous Quercus regeneration.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

Rodent dig a hole and prey on cotyledon

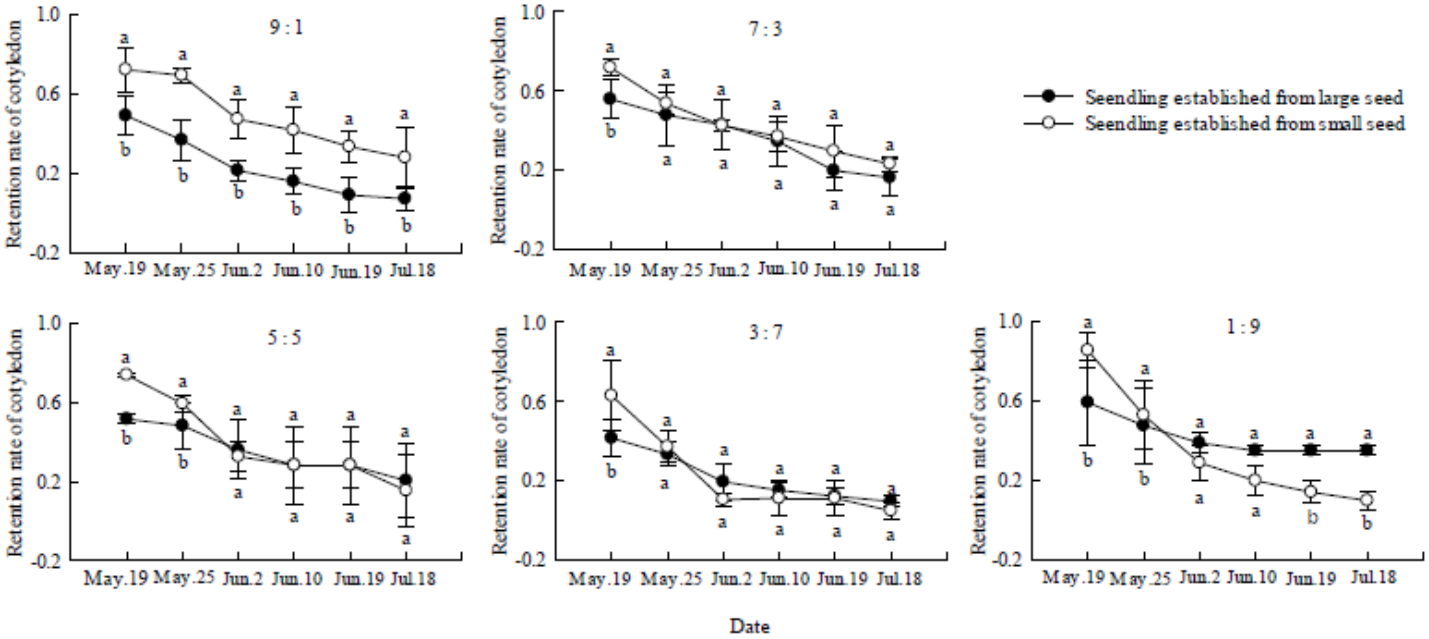

Figure 2

Cotyledon retention rates and its dynamics of Quercus wutaishanica seedlings established from different size seeds (mean ± SD). Different small letters indicate the significant differences of seedlings

established from different size seeds at 0.05 level.

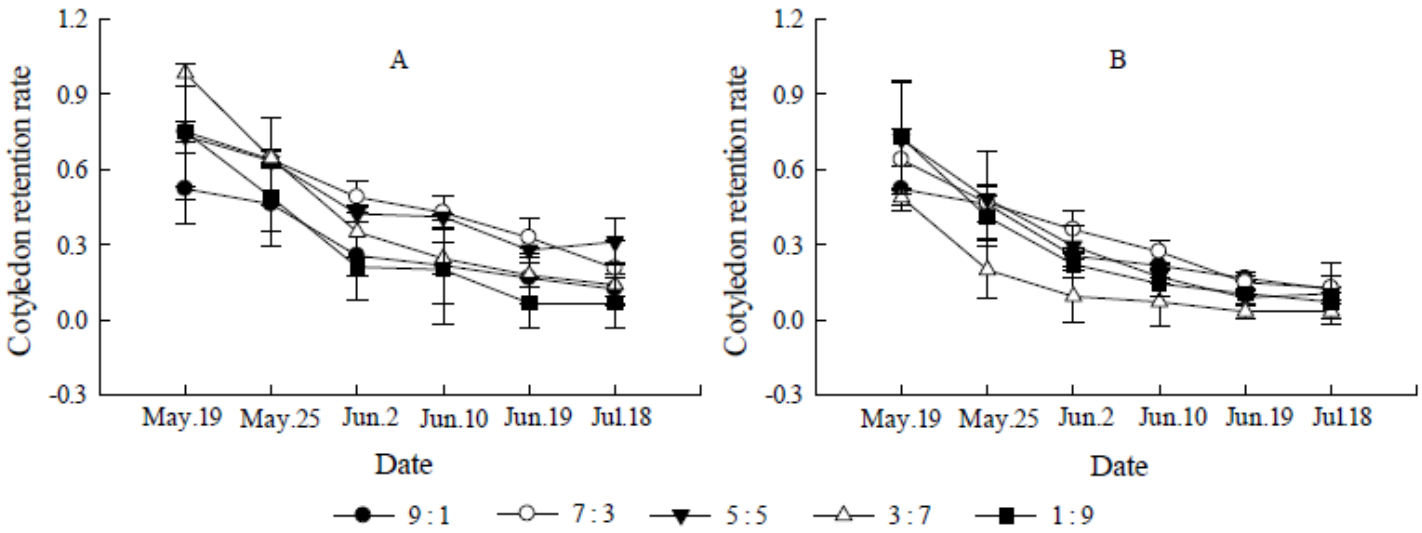

Figure 3

Cotyledon retention rates and its dynamics of Quercus wutaishanica seedlings with different FLSD in forest gap (A) and under the canopy (mean ± SD) (B).

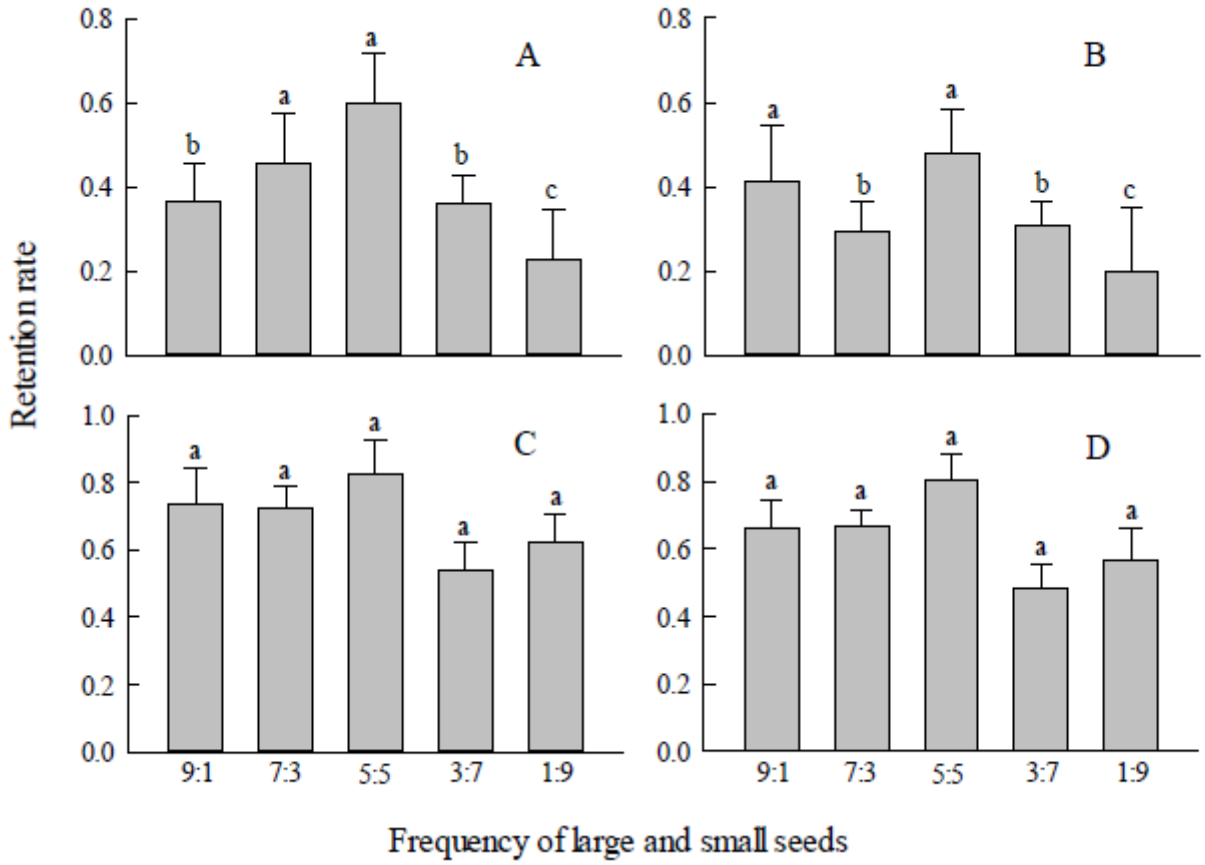

Figure 4

Retention rates of apical bud and taproot of Quercus wutaishanica seedlings with different FLSD in forest gap and under the canopy (mean ± SD). A: apical bud retention rates in forest gaps, B: apical bud retention rates under canopies. C: taproot retention rates in forest gaps and D: taproot retention rates under canopies. Different small letters indicate the significant difference among different FLSD at 0.05 level.

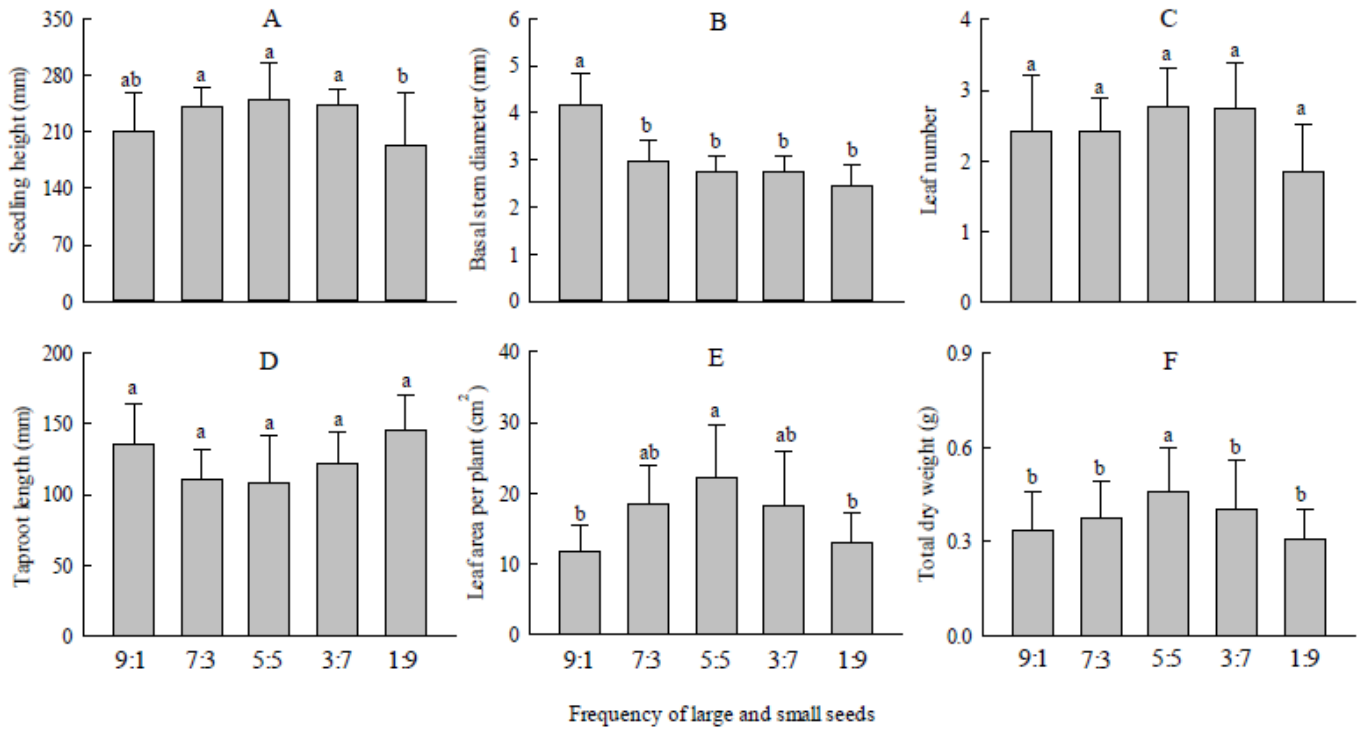

Figure 5

Growth characteristics of Quercus wutaishanica seedlings at different FLSD treatments (mean ± SD). A, B, C, D, E, and F represent the seedling height, basal stem diameter, leaf number, taproot length, leaf area per plant, total dry weight at the end of a growth cycle. Different small letters indicate the significant difference between different FLSD at 0.05 level.

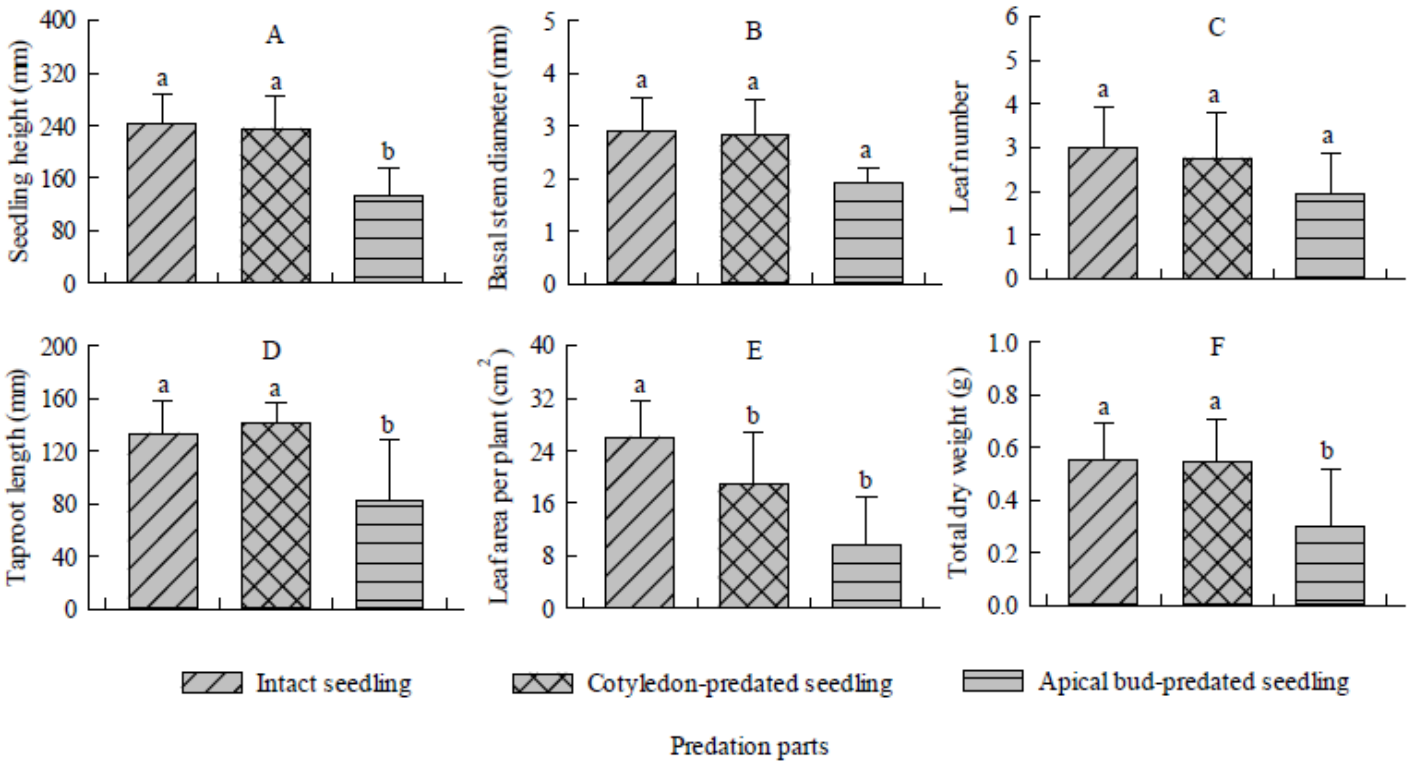

Figure 6

Growth characteristics of Quercus wutaishanica seedlings preyed on different parts by rodents (mean ± SD). A, B, C, D, E, and F represent the seedling height, basal stem diameter, leaf number, taproot length, leaf area per plant, total dry weight after preyed on different parts by rodents at the end of a growth cycle. Different small letters indicated a significant difference among different parts of seedings after being preyed on at 0.05 level.