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Attack of wood-borer insects to *Quillaja saponaria* (Rosaceae): a human-modulated relationship?

Ataque de insectos taladradores a *Quillaja saponaria* (Rosaceae): ¿una relación modulada por el hombre?

JAVIER A. SIMONETTI and AUDREY A. GREZ

Departamento de Ciencias Ecológicas, Facultad de Ciencias, Universidad de Chile.
Casilla 653, Santiago, Chile

ABSTRACT

We report the relationship between *Rhyephenes*, a wood-borer insect, and *Quillaja saponaria*, its host tree, in central Chile. *Rhyephenes* attacks to *Q. saponaria* are restricted to debarked areas of the trunk and branches. Debarked areas result from the human exploitation of the bark for extracting saponins. Therefore, we advance the hypothesis that humans have an indirect effect on the *Rhyephenes-Quillaja* relationship.
Key words: Indirect effects, human disturbance, Chile.

RESUMEN

En esta nota describimos la relación entre *Rhyephenes*, un insecto taladrador y *Quillaja saponaria*, su árbol huésped, en Chile central. Los ataques de *Rhyephenes* a *Q. saponaria* están restringidos a áreas del tronco y ramas a las cuales se le ha removido la corteza. Dichas áreas resultan de la explotación humana de la corteza para extraerle saponinas. Nosotros especulamos que el hombre tendría un efecto indirecto sobre la relación *Rhyephe-Quillaja* en el matorral de Chile central.
Palabras claves: Chile, efectos indirectos, perturbación humana.

INTRODUCTION

Human subsistence activities such as food harvesting and land clearing may have indirect effects on individual, population, and community attributes (Simonetti & Cornejo 1990). Human activities may modify species relationships by harvesting strong interactors, either predators or competitors, and may also alter the resource base for non-target, unexploited wild species (*e.g.*, Godoy & Moreno 1989, Simonetti 1988). Here, we communicate a case of indirect effect of humans on species interactions in the shrublands of central Chile, related to the resource base for wood-boring insects.

Quillaja saponaria (Rosaceae) is a common tree of the scrublands of central Chile (Rundel 1981). The bark of *Q. saponaria* has been exploited for saponins from colonial times. Strips of bark are removed from branches and stems, leaving the wood exposed (Cunill 1971). Observations of live trees suggested that borer-insect attacks could be associated with human debarking of trees. Some trees however, also exhibited evidence of branch cutting and fire scars, which could also facilitate the attack by wood-boring insects (Knight & Heikkenen 1980). In order to explore the role of these disturbances in favoring the attack by borer-insects, we investigated the degree of association of both the frequency and location of the attacks with the type of disturbance suffered by *Q. saponaria* trees.

METHODS

Live *Q. saponaria* trees were censused primarily at a shrubland area of San Carlos de Apoquindo (33°23'S, 70°31'W; 20 km E of Santiago) and additionaly at Lampa

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(33°20'S, 70°47'W; 60 km NW of Santiago). The climate of the area is of mediterranean type, with hot-dry summers and moist-cold winters (di Castri & Hajek 1976). Censuses at San Carlos de Apoquindo were carried out during the summer (January-February) 1985 and fall (May) 1987. Vegetation was a typical scrubland, with shrubs covering from 41% to 56% of the ground. *Lithraea caustica* (Anacardiaceae) and *Q. saponaria* were the dominant evergreen species, accounting for over 83% of the shrub cover (Simonetti 1989a). At Lampa, censuses were conducted during the winter (June-August) 1986. Vegetation was a shrubland dominated by *Colliguaya odorifera* (Euphorbiaceae) and *Q. saponaria*.

At San Carlos de Apoquindo, 44 trees were censused in an area of 5 ha in order to determine the number of them with strips of bark removed, presence of fire scars, evidence of branches being cut off, and the frequency and location of the attack by wood-borer insects. At Lampa, only the frequencies of debarking and insect attack, and its location on the tree were recorded. Twenty-five trees were censused in an area of 2 ha.

RESULTS

Eighteen percent for the trees (26 out of 69) had some bark stripped. Debarked trees were larger (DBH = 197.7 ± 32.0 cm; mean ± 2SE; n = 26) than those with intact barks (DBH = 122.9 ± 18.6 cm; n = 39, Mann Whitney two-tailed test $Z = 2.58$, $P = 0.01$). Bark was found to be removed primarily from the trunk, and secondarily from the branches (84% versus 16%, respectively). There was usually one stripping per tree (88% of the cases); in few instances there were two and four stripped areas in a given tree (8% and 4%, respectively). On the average, 1,842 cm^2 of bark were removed per tree, ranging from 240 to 10,068 cm^2. Total area of bark removed was unrelated to tree size ($r = 0.27$; $P = 0.10$).

Insect attack was strongly associated with the stripping of bark ($X_c^2 = 49.9$, $P << 0.001$). Eighty percent (21 out of 26) of the trees with stripping on their barks were attacked by borer insects. In contrast, no tree without removal of bark exhibited such an attack (n = 43). The attacks were independent of both the presence of fire scars and branch cutting ($X_c^2 = 1.8$ and 0.3, $P > 0.17$, respectively).

All galleries were confined to the stripped areas. The number of insect galleries was positively correlated to debarked area ($r = 0.52$, $P < 0.003$; n = 30). The diameter of the insect hole was 1.0 ± 0.1 cm (n = 102), and the borer-insects were tentatively identified as a snout beetle, *Rhyephenes* sp (Curculionidae).

DISCUSSION

The bark acts as a physical and chemical barrier against wood-borer insects and associated pathogens, like fungi (Knight & Heikkenen 1980). When trees are dead or otherwise debilitated, wood-borer insects can successfully attack them (Knight & Heikkenen 1980). Therefore, the removal of bark seems to be one of the factors that renders *Q. saponaria* a suitable target for *Rhyephenes*, which is known to attack debilitated trees in Chilean forests (Gara *et al.* 1980; see also González 1989).

Rhyephenes appears restricted to bore on debarked areas of *Q. saponaria*. Further, its population size, expressed as the number of galleries per tree, is positively associated with the amount of bark removed. Consequently, while collecting the bark of *Q. saponaria* for saponins, humans indirectly increase the resource base for *Rhyephenes*. On this regard, the relationship between humans, *Q. saponaria* and *Rhyephenes* falls within the trophic linkage type of indirect effects (Miller & Kerfoot 1987). Here, humans affect *Rhyephenes* by modulating the abundance of its resource (i.e., debarked trees).

Wood-boring insects may reduce the survivorship and fitness of the infested trees, affecting the population demography and structure of the forests (Harris 1974, Morrow & LaMarche 1978). Although the actual impact of the infestation by *Rhyephenes* on *Q. saponaria* is yet to be eva-

luated, we hypothetized that a human subsistence activity may have indirect effects upon the *Q. saponaria – Rhyephenes* interaction. This supports our previous contention (Simonetti 1988, 1989a, b) that indirect effects of human subsistance activities may be more widespread than previously recognized and that these type of interaction should be adequately considered while attempting to understand population and community structure and dynamics.

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