



Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Post-dispersal fate of hazel (*Corylus avellana*) nuts and consequences for the management and conservation of scrub-grassland mosaics

Javier Laborde*, Ken Thompson

Department of Animal and Plant Sciences, University of Sheffield, Western Bank, Sheffield S10 2TN, UK

ARTICLE INFO

Article history:

Received 19 August 2008

Received in revised form 7 January 2009

Accepted 13 January 2009

Available online 3 March 2009

Keywords:

Calcareous grassland

Scatter hoarding

Sciurus carolinensis

Scrub encroachment

Secondary succession

Seed removal

ABSTRACT

Granivorous rodents and birds are both predators and dispersers of the nuts produced by many woody plants. This study examines the role of granivores as predators and dispersers of *Corylus avellana* L. and the consequences of this interaction for *Corylus* regeneration and scrub encroachment into grassland. In the Cressbrook Dale nature reserve (Derbyshire, UK), *Corylus* nuts were buried in the grassland at two distances (<15 and >70 m) from scrub vegetation (the main source of nuts, and habitat of the granivores) to estimate the rate of seed removal over 3 years, assessing also the success of dispersal and seedling establishment in the grassland. The rate of nut removal at close sites (<15 m from scrub) was consistently higher than at far sites (>70 m) over the 3 years. All sown nuts were removed over 2 years at close sites, while at the far sites around 20% of the sown nuts were still present the following spring. Grassland close to the scrub had the highest intensity of nut predation but also had the highest density of *Corylus* seedlings. *Sciurus carolinensis* was the most important disperser of hazelnuts into the grassland. This squirrel scatter-hoarded 10–12 thousand hazelnuts in 1.5 ha of grassland adjacent to scrub. In this reserve, two vertebrates – both non-native – are largely responsible for maintaining the dynamic balance between the scrub and grassland habitats. American grey squirrels disperse hazelnuts into the grassland and sheep slow the encroachment of scrub by repeated browsing.

© 2009 Elsevier Ltd. All rights reserved.

1. Introduction

Like many nut-bearing trees and shrubs, *C. avellana* maintains a risky liaison with the animals that consume its nuts. Some animals destroy all nuts immediately and are therefore harmful to the plant (e.g. pheasants, pigeons, deer). Other animals eat as many nuts as they can during autumn, but also store large numbers for consumption during winter (e.g. mice, squirrels, jays). These nut hoarders can take a heavy toll on the annual crop, but not all hoarders are harmful to the plant. Those that occasionally fail to retrieve all cached nuts are doubtless formidable nut predators, but they are also valuable dispersers of nuts (Bossema, 1979; Price and Jenkins, 1986; Vander Wall, 1990, 2001).

Different animals select different sites to cache their harvest. Granivorous small rodents, particularly mice, are reluctant to leave the cover of woody plants because in open areas they themselves are vulnerable to predation (Price and Jenkins, 1986; Hulme, 1993; Manson and Stiles, 1998; Gómez et al., 2008). In contrast,

tree squirrels and granivorous birds are quite bold and frequently hoard nuts in non-wooded areas (Vander Wall, 1990; Hulme and Kollmann, 2005). Squirrels will usually scatter-hoarded nuts just a few metres away from the wood margin, mostly within 30 m (Stapanian and Smith, 1986; Gurnell, 1987; Steele et al., 2005), while birds may scatter-hoarded dozens of metres away from it, frequently as far as 100 m or even further into open areas (Bossema, 1979; Kollmann and Schill, 1996; Gómez, 2003; denOuden et al., 2005; Pons and Pausas, 2007). Nuts that remain where they were produced (i.e. in woodland or scrub) are exposed to extremely intense removal and predation, whereas nuts taken out into non-wooded habitats such as grasslands have a much higher probability of going undetected by other seed eaters (Bossema, 1979; Vander Wall, 2001). Removal is further reduced if the nuts are hoarded far from wooded areas (Stapanian and Smith, 1986; Manson and Stiles, 1998; Myster and Pickett, 1993; Meiners and LoGiudice, 2003). Nuts from trees and shrubs which are hoarded in non-wooded habitats and later forgotten, promote the encroachment of woody vegetation over open habitats; hence the outcome of the interaction between nut-producing woody plants and animal nut-hoarders plays a significant role in plant succession. Even though there are plenty of studies on this interaction in temperate ecosystems (see reviews by Price and Jenkins, 1986; Vander Wall, 1990, 2001; Hulme and Kollmann, 2005), there are

* Corresponding author. Present address: Instituto de Ecología, A.C., km 2.5 Carretera Antigua a Coatepec # 351, Congregación El Haya, Xalapa 91070 Veracruz, Mexico. Tel.: +52 228 8421800x4205; fax: +52 228 842 1800x4222.

E-mail addresses: javier.laborde@inecol.edu.mx (J. Laborde), ken.thompson@sheffield.ac.uk (K. Thompson).