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Sheep herbivory within grassland patches: The potential cost of food item discrimination

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Abstract

Large mammalian herbivores are key drivers of grazed community structure especially through their selective grazing which requires animals to discriminate between food items. The impact of local plant diversity on selective grazing is however largely unknown. We investigated the ability of sheep to discriminate between plant species within a patch (feeding station level) using sown plant mosaics involving up to four grassland species: perennial ryegrass (*Lolium perenne*), tall fescue (*Festuca arundinacea*), narrow-leaf plantain (*Plantago lanceolata*) and yarrow (*Achillea millefolium*). This made it possible to vary two factors likely to decrease sheep discrimination ability: plant species richness and degree of resemblance. Patch species richness only slightly decreased sheep selectivity for ryegrass. Sheep preferred plantain and avoided yarrow relative to ryegrass, confirming that they can discriminate these species at a fine scale. Contrary to previous surveys, sheep did not select ryegrass over fescue, which suggests that species resemblance impaired within-patch discrimination. The degree of species similarity would thus interact with the local distribution of resources so that either positive or negative effects of neighbouring plants can be observed on selection for a focal plant species. This highlights the importance of improving our knowledge of how grazers discriminate plant species for predicting their susceptibility to herbivory.

Zusammenfassung

Pflanzenfressende Großsäuger sind wichtige Steuerfaktoren für die Struktur beweideter Gemeinschaften, insbesondere durch ihr selektives Weiden, welches die Tiere zwingt, zwischen Nahrungsarten zu unterscheiden. Der Einfluss der lokalen Pflanzendiversität auf das selektive Weiden ist indessen weitgehend unbekannt. Wir untersuchten die Fähigkeit von Schafen, zwischen Pflanzenarten in einem Patch zu unterscheiden (Futterstationsebene), indem wir ausgesäte Pflanzenmosaike benutzten, die aus bis zu vier Grasland-Arten bestanden: Deutsches Weidelgras (*Lolium perenne*), Rohr-Schwingel (*Festuca arundinacea*), Spitzwegerich (*Plantago lanceolata*) und Schafgarbe (*Achillea millefolium*). Dies

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machte es möglich, zwei Faktoren, die wahrscheinlich die Unterscheidungsfähigkeit der Schafe verringern, zu variieren: Artenreichtum der Pflanzen und den Grad der Ähnlichkeit. Der Artenreichtum im Patch verringerte die Selektivität der Schafe für das Weidelgras nur geringfügig. Die Schafe bevorzugten Wegerich und mieden Schafgarbe verglichen mit dem Weidelgras, was zeigt, dass sie diese Arten auf kleinem Raum unterscheiden können. Im Gegensatz zu früheren Untersuchungen bevorzugten die Schafe das Weidelgras nicht gegenüber dem Rohr-Schwingel, was nahelegt, dass die Ähnlichkeit dieser Arten die Fähigkeit der Schafe, sie innerhalb des Patches zu unterscheiden, beeinträchtigte. Der Grad der Ähnlichkeit zwischen Arten würde somit mit der lokalen Verteilung der Ressourcen interagieren, mit dem Ergebnis, dass positive oder negative Nachbarschaftseffekte beobachtet werden können. Dies unterstreicht, wie wichtig es ist, unsere Kenntnis zur Unterscheidungsfähigkeit von Weidetieren zu verbessern, um die Empfindlichkeit von Pflanzenarten gegen Herbivorie vorherzusagen.

Keywords: Grazer; Diet selection; Neighbouring effect; Plant–herbivore interaction; Plant species richness; Plant species resemblance

Introduction

Large mammalian herbivores are key drivers of grassland community structure. Their selective grazing shapes sward structure (Adler, Raff & Lauenroth 2001) as well as pasture diversity, with contrasting effects of herbivore species according to their grazing style (Öckinger, Eriksson, & Smith 2006; Dumont et al. 2011). A key process at the basis of any active selection is the animal's ability to discriminate between food items. Beyond the animal's ability to sort elements within swards and its willingness to do so considering foraging costs relative to benefits, there cannot be any active selection as long as there is no discrimination. Discrimination implies a perceived contrast between a focal plant and its neighbours, which highlights the importance of local plant community composition for diet selection (Baraza, Zamora, & Hodar 2006). The neighbouring effect can be either positive (protection) or negative (vulnerability) for a focal plant depending on the degree of selectivity of the herbivore (generalist vs specialist, sorting ability), the spatial scale at which selectivity operates (between- or within-patches), and relative plant palatability. This has led to two ecological hypotheses whose assumptions in terms of focal plant vulnerability to herbivory radically differ (Hjälten, Danell, & Lundberg 1993). Hence, a palatable plant will gain protection from less palatable neighbours when the herbivore expresses between-patch selectivity ('repellent-plant hypothesis'; Tahvanainen & Root 1972; Hay 1986) but will face more herbivory when the herbivore expresses within-patch selectivity ('attractant-decoy hypothesis'; Atsatt & O'dowd 1976).

For any grazer, discrimination ability and associated selectivity will depend on the complexity of the foraging challenge (Bergvall, Rautio, Siren, Tuomi, & Leimar 2008), and so on the number, palatability and contrast between neighbouring plants, as highlighted by the previously mentioned hypotheses. Here, our objective is to investigate discrimination abilities of a large generalist herbivore, sheep (*Ovis aries*), facing tasks with contrasting costs of grazing selectively within fine-grained patches. Previous results indicate that ruminants, including sheep, are grazing more selectively when preferred plant species are aggregated into large patches (Dumont, Carrère, & D'hour 2002), and less selectively at small spatial scales (Edwards, Newman, Parsons, & Krebs 1994; Bergvall et al. 2008). However, other surveys have revealed that sheep, while being generalists, are also highly selective and consistently sort the best quality components within multi-species swards (Garcia, Carrère, Soussana, & Baumont 2003). Sheep have also been shown to express within-patch selectivity in a grazing experiment where resource distribution was manipulated by using bowls of food pellets (Hewitson, Dumont, & Gordon 2005). However, little is known on their ability to discriminate between food items within-patches (i.e. at feeding station scale, sensu Bailey et al. 1996), though it could explain sheep selectivity and their impact on plant communities.

We therefore recorded sheep selectivity at the within-patch scale on sown fine-grained plant mosaics with different plant species richness and contrasting morphological characteristics between neighbouring plant species. We hypothesized that these two factors are likely to affect sheep discrimination between food items and consequently plant vulnerability to herbivory.

Materials and methods

The study was conducted indoors, between mid-August and mid-October 2008, in the facilities of the UE1354 Experimental Unit of INRA Clermont-Ferrand/Theix in central France (45°42′N, 03°30′E). Animals were handled by specialized personnel who took care of animal welfare in accordance with European Union Directive No.609/1986.

Experimental setup

We used eight dry Romane ewes aged 2–4 years (mean live weight 54.5 kg, S.D. = 7.2), chosen from an initial batch of 12 ewes based on their habituation to isolation in the test arena. Outside the tests, ewes grazed a cocksfoot (*Dactylis glomerata*) pasture with free access to water and salt blocks. On test days, tests occurred between 1345 and 1515 h. The ewes were turned out from pasture at 0900 h and kept in a