

Using scats of a generalist carnivore as a tool to monitor small mammal communities in Mediterranean habitats

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Abstract

Owl pellets have long been used to analyze communities of small mammals, while analogous analyses of faeces of mammal carnivores are not available. We demonstrate that common genet (*Genetta genetta*) scats can be used as a reliable method to sample small mammal communities and to monitor their variations. We have compiled data on 6350 small mammal remains of 18 species found in scats from 51 different latrines in a 1200 km² area of northeastern Spain. Genet scats sampled effectively 95.6% of the small mammal species ranging in size from 2.7 to 385 g. Spatial patterns of diet composition along environmental gradients of elevation, climate and land-use matched expected changes in small mammal communities along these gradients according to ecological requirements of prey species. Frequencies of occurrence of prey in genet scats were strongly correlated with frequencies of occurrence in barn owl (*Tyto alba*) pellets. Genet scats included two forest species not preyed upon by owls, whereas only one species was not preyed upon by genets. Forest species were more frequent in genet than in barn owl diets after correcting for environmental effects, whereas the opposite was true for open-habitat and synanthropic species. Scats of generalist carnivores can be used to estimate the spatial patterns of distribution and abundance of small mammal communities. Genet scats in fact overcome some of the limitations of more traditional sampling methods (live-trapping and owl diets), as genets were less selective and their diets reflect more accurately changes in community composition.

Zusammenfassung

Eulengewölle werden seit langem genutzt, um die Gemeinschaften von Kleinsäugetern zu analysieren, während analoge Analysen des Fäzes von räuberischen Säugetern fehlen. Wir zeigen, dass der Kot der Europäischen Ginsterkatze (*Genetta genetta*) genutzt werden kann, Kleinsäugetergemeinschaften verlässlich zu beproben und ihre Veränderungen zu verfolgen. Wir trugen Daten zu 6350 Überresten von Kleinsäugetern aus 18 Arten zusammen, die im Kot von 51 Latrinen in einem 1200 km² großen Gebiet im Nordosten Spaniens gefunden wurden. Der Ginsterkatzenkot wies effektiv 95.6% der Kleinsäugeterarten nach, deren Gewicht zwischen 2.7 und 385 g betrug. Die räumlichen Muster der Nahrungszusammensetzung entlang von Umweltgradienten (Höhenlage, Klima, Landnutzung) entsprachen den Änderungen der Kleinsäugetergemeinschaften entlang dieser Gradienten, die aufgrund der Umweltansprüche der Beutearten erwartet wurden. Die Häufigkeit der Beutearten im Ginsterkatzenkot war eng mit ihrer Häufigkeit in den Gewöllen von Schleiereulen (*Tyto alba*) korreliert. Ginsterkatzenkot enthielt zwei Waldarten, die nicht von den Schleiereulen gejagt werden, während nur eine Art nicht von den Ginsterkatzen erbeutet worden war. Waldarten waren im Ginsterkatzenkot häufiger als in Schleiereulengewöllen, nachdem Umwelteffekte herauskorrigiert waren, während

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das Gegenteil auf Offenland- und synanthrope Arten zutraf. Kot von generalistischen Räubern kann genutzt werden, um die räumlichen Verteilungsmuster und die Abundanz von Kleinsäugergemeinschaften abzuschätzen. In der Tat überwindet die Ginsterkatzenkot-Methode einige Einschränkungen traditioneller Probemethoden (Lebendfang, Eulengewölle), weil die Ginsterkatzen weniger selektiv sind und ihre Nahrungsspektren genauer Änderungen in der Gemeinschaftszusammensetzung widerspiegeln.

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Keywords: Diet analyses; Environmental gradients; *Genetta genetta*; Small mammal communities; Spatial variation

Introduction

Obtaining accurate data on present small mammal species distribution is necessary for establishing conservation priorities, since this information is crucial to understand what will happen with species ranges in the near future in the face of different threats like climate change. There is increasing evidence that range boundaries of small mammals are suffering significant displacements tracking changes in temperature, at least along altitudinal gradients (Rowe, Finarelli, & Rickart, 2010). The Mediterranean basin is considered a hotspot for small mammal diversity (Krystufek & Griffiths, 2002), but is also one of the regions that will face largest changes in climate (Maiorano et al., 2011, and references therein). Within this zone, the transitional areas between biogeographic Regions can be especially vulnerable in the face of climate change, as small mammal communities will theoretically be affected by reorganization processes caused by range shifts and extinctions (Moritz et al., 2008).

Spatial scale has been considered a source of variation in determining patterns of small mammal diversity across spatial and environmental gradients (Rowe & Lidgard, 2009). When a coarse grain approach is used (grids >100 km² or higher), spatial patterns of diversity are not affected since broad geographic patterns are not sensitive to grid square size (Krystufek & Griffiths, 2002, and references therein). Nonetheless, grain size can affect at smaller spatial scales (Rowe & Lidgard, 2009). Traditionally, studies on patterns of small mammal diversity along environmental gradients are based on collections of museum specimens and recent faunal surveys at small spatial scales in order to obtain alpha diversity data, and these data are then combined to obtain gamma diversity values for larger areas (bins or ranges; Rowe & Lidgard, 2009). Information on species occurrences and diversity at high spatial scales is dependent on information at smaller spatial scales, so that sampling methods at smaller spatial scales need to be comprehensive. However, sampling thoroughly across environmental gradients is often impractical if not impossible (Rowe & Lidgard, 2009), and trapping methods usually gave incomplete small mammal inventories due to sampling biases due to trap types and baits (O'Farrell et al., 1994).

The diet of nocturnal raptors can be an alternative to trapping for estimating small mammal communities and their responses to habitat change. Barn owl (*Tyto alba*) pellets have been especially used due to the generalist diet of owls

and its close foraging ranges (2–5 km²; Bunn, Warburton, & Wilson, 1982). Barn owl diet usually reflects real changes in availability of small mammals (Clark & Bunck, 1991; Love, Webbon, Glue, & Harris, 2000). Barn owls may even be more efficient in detecting some small mammal species when compared to conventional live-trapping techniques, but diet of barn owls can overestimate the small mammal fauna of open landscapes (grasslands and crops) and underestimate the fauna of wooded landscapes (Torre, Arrizabalaga, & Flaquer, 2004).

Alternative generalist predators of small mammals would then be needed to document community changes in forest habitats. Here we propose using the diet of common genets (*Genetta genetta*) for large-scale tracking of changing small mammal communities. Genets are considered generalist predators with a euryphagous diet (Larivière & Calzada, 2001), and seasonal or geographic changes in the diet seem to reflect changes in the availability of food resources (Le Jacques & Lodé, 1994). Nonetheless, this assumption is based mostly on the variability of the diet along the geographical range of genets, and some authors (e.g. Virgós, Llorente, & Cortés, 1999) even consider genets as facultative specialists rather than generalists. Genets show a marked latitudinal trend in stenophagy, with decreasing specialization southwards in Europe (Virgós et al., 1999). In fact, the diet of genets of montane and forested areas of NE Spain showed the highest presence of small mammals compared to other areas in south Western Europe, with frequencies being higher than the 90% of all the vertebrates consumed (Torre, Ballesteros, & Degollada, 2003). This high frequency of occurrence of small mammals in the diet allowed us to use the frequencies of remains in genet latrines to analyze the distribution and abundance of small mammal communities.

We analyze for the first time the efficiency of the diet of the genet as a source of information on the distribution and abundance of small mammals by testing (1) whether the species of small mammals found in the area were also found in diets; (2) whether genets behave as generalist predators of small mammals in the study area. A generalist predator should include species in its diet at frequencies correlated with the profile of species' abundances in the field (Jacksic 1989). This behaviour would translate into diet changes along environmental gradients consistent with expected changes of prey abundances along these gradients according to prey ecological requirements; and (3) whether frequencies of occurrence of small mammal species in genet diets were

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