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THREE METHODS FOR ASSESSING RICHNESS AND COMPOSITION OF SMALL MAMMAL COMMUNITIES

IGNACIO TORRE,* ANTONI ARRIZABALAGA, AND CARLES FLAQUER

Museu de Granollers-Ciències Naturals, Francesc Macià 51, 08400 Granollers, Spain

Analysis of pellets of *Tyto alba* and scats of *Genetta genetta* and Sherman livetrapping were compared to assess richness and composition of small mammal communities in a Mediterranean area (NE Spain). Owl pellets provided 17 small mammal species (17,232 individuals), genet scats 14 species (2,145 individuals), and livetrapping 9 species (1,488 individuals). Owl pellets oversampled insectivores and grassland rodents and undersampled tree-dwelling and woodland rodents. Genet scats and livetrapping oversampled woodland rodents and undersampled insectivores and grassland rodents. After controlling for sample size and elevation differences between methods by means of analysis of covariance (ANCOVA) and rarefaction, owl pellets contained higher richness for small samples (<50 individuals), and scats contained higher richness for large samples (>100 individuals), both having higher richness than livetrapping regardless of sample size. We concluded that both indirect methods provided complementary information of small mammal communities, detecting the 19 small mammal species known to be present in the study area.

Key words: barn owl pellets, communities, composition, elevation, genet scats, *Genetta genetta*, livetrapping, richness, small mammals, *Tyto alba*

Assessing patterns of richness and composition of animal communities through ecological gradients such as latitude and elevation has been one of the most recurrent issues in geographical ecology during the past decades (review in Rahbek 1995). Regardless of taxa studied (invertebrates or vertebrates), the decline of species richness with latitude and elevation seems to be a widely accepted pattern throughout tropical and temperate biomes (Kaufman and Willig 1998; Rahbek 1995; Rosenzweig 1992). Transects through significant gradients of latitude or elevation also indicate declines in richness and abundance in small mammal communities (Clark and Bunck 1991; Järvinen 1978; McCoy and Connor 1980; Patterson et al. 1989). Otherwise, this generalized pattern is not always found in the small mammal communities of the Mediterranean basin, where a general increase of richness can be found with increasing elevation or latitude (Moreno and Barbosa 1992; Orsini 1990; Torre 2001; but see Alcántara 1989; Delibes 1985; and Torre et al. 1996 for opposite results). This pattern can be explained by the significant impoverishment of Mediterranean communities relative to mid-European or transitional zones (Fons et al. 1980; Gosàlbez and López-Fuster 1985) because of the role played by high mountains (i.e., Pyrenees, Alps) as reservoirs of the northern fauna following glacial retreats of their distribution areas (Blondel and Aronson 1999).

Trapping is the most common method used to study small mammals (Gurnell and Flowerdew 1990) and has been successfully used to detect patterns of richness, composition, and abundance of small mammal communities through ecological gradients (Kelt 1996; Patterson et al. 1989; Yu 1994). However, trapping exhibits biases according to traps and baits used (O'Farrell et al. 1994) and is sensitive to sampling effort (Yu 1994). Indirect approaches, such as examining remains in pellets of the barn owl (*Tyto alba*), have been extensively used in studies of small mammal distribution through geographical gradients (Alegre et al. 1989; Clark and Bunck 1991; Moreno and Barbosa 1992; Torre 2001; Torre et al. 1996) owing to the generalized habits of this predator (Díaz et al. 1996). Scats of the common or small-spotted genet (*Genetta genetta*), a small generalist carnivore whose main prey are small mammals (Rosalino and Santos-Reis 2002; Torre et al. 2003; Virgós et al. 1999), have not been previously used to study small mammal distribution. However, preliminary observations showed that remains in scats are valid for detecting patterns of small mammal richness and community composition.

Nonetheless, assessing richness is not a simple matter since controlling for many factors such as sample size, sampled area, or adequate replicated sampling (both at spatial and temporal scales) is necessary to achieve a significant picture of richness (Gotelli and Colwell 2001; Lomolino 2001; Rahbek 1995; Yu 1994). Hence, different patterns of richness found throughout

* *Correspondent: m.granollers.cn@diba.es*

elevation or latitude in the same area could simply reflect sample biases related to different methods used (Rahbek 1995; Torre 2001). For example, cold temperatures limit barn owls, and pellets are found throughout open landscapes at moderate elevations in Spain (<1,380 m—Alegre et al. 1989). Patterns of small mammals distribution can be studied via barn owl pellets only below this elevation. The same pattern is found for the genet, a species also restricted by temperature (Virgós et al. 2001). Genet feces also contain small mammal remains, but latrines are always found at elevations below 1,400 m, and most of them below 1,000 m in wooded landscapes (Virgós et al. 2001). Furthermore, if owl pellets are studied, small mammal fauna living in forest habitats would be undersampled, and fauna associated with open habitats such as grasslands and agriculture land would be oversampled. A contrary pattern would be found in genets scats as a result of the forest habits of that species (Ruiz-Olmo and López-Martín 2001; Virgós et al. 2001).

The objectives of this study are to assess advantages and deficiencies of 3 methods for assessing patterns of richness and composition of small mammal communities: Sherman live-trapping, barn owl pellets and genet scats. The study took place along a gradient of elevation (about 1,000 m) by using both published and unpublished information gathered in the same area of northeastern Spain.

Materials and Methods

Study area.—The study was carried out in the Montseny-Montnegre Mountains and surrounding plains (Barcelona and Girona, Catalonia, NE Spain; 41°50–41°33′N, 2°39′–2°06′W; an area of 1,250 km^2). Topography and climate vary markedly. Two main orographic units are found in the study area: the Montseny massif, a Mediterranean mountain with a moderate elevation (elevation 1,714 m), and the Montnegre-Corredor massif, a low mountain range (elevation 657–773 m) lying near the Mediterranean Sea. Both mountain ranges have topographic and climatic characteristics of biogeographic interest, with the presence of well-established mid-European vegetational (De Bolós 1983) and animal communities (Rocamora 1987; Torre et al. 1996). These mountains are mainly covered by evergreen (*Quercus ilex* and *Q. suber*) and deciduous (*Q. petraea*, *Fagus sylvatica*) forests, with small patches devoted to grasslands or agriculture. The surrounding plains are mainly cultivated, with a prevalence of human settlements. Average rainfall varies from 600 mm in the lowest and driest Mediterranean localities to 1,200 mm at the top of the Montseny mountains.

Sampling of small mammals.—We sampled richness and abundance of small mammals (Insectivora and Rodentia, excluding bats and hedgehogs) by means of 3 different approaches along a gradient of elevation (elevation 119–1,450 m). We established 7 trapping stations from the Mediterranean lowlands to mid-European woodlands ($\bar{X}$ elevation sampled ± *SE:* elevation 918 ± 354 m; elevation range 540–1,450 m). Mediterranean lowlands were sampled by 3 independent 7-by-7 trapping grids (*Q. suber*, *Q. ilex*, and *Alnus glutinosa* forests, respectively), with 49 live traps (Sherman folding small animal trap; 23 × 7.5 × 9 cm) spaced 15 m apart that were left open for 3 consecutive nights from February 1995 to July 1997 (11 trapping sessions, collectively lasting 33 days) and that were placed at Montseny Natural Park (Barcelona, Spain). Mid-European woodlands were sampled by 4 independent grids, 1 each in forests dominated by *Abies alba*, *F. sylvatica*, *Q. petraea*, and *Populus nigra*, with the same trapping effort expended as in Mediterranean lowlands and at the same mountain range. In every area, we sampled different and contrasting habitats to increase the likelihood of trapping different species.

Traps were baited with a mixture of tuna, flour, and oil and were set under cover of shrubs or dense herbs to conceal them and to provide some thermal insulation. Small mammals caught were identified to species, marked by toe-clipping, and released at the point of capture (Gurnell and Flowerdew 1990). We used number of individuals trapped within the 3 days as an index of abundance of small mammal species in each study plot (Slade and Blair 2000). As a measure of richness, we used number of species in each sample, the simplest measure of biological diversity (Hellmann and Fowler 1999). We considered a sample to be each of the 11 trapping sessions conducted during 3 nights in each plot.

For barn owl pellets, we used information published for the area (Torre et al. 1996). To these published data were added 2 new sampling places for a total of 27 localities (different roosts) scattered across a gradient of 119–1,140 m elevation (elevation 392 ± 50 m; $\bar{X}$ ± *SE*). Barn owls are generalist and opportunist predators of crepuscular and nocturnal activity (Bunn et al. 1982), with a foraging range from 2–5 km^2 (Bunn et al. 1982). The small mammal remains in pellets were identified following an identification key for small mammals of the study area (Gosàlbez 1987) and also were compared to a reference collection at the Museu de Granollers. It is generally accepted that pellet analysis provides a true picture of proportions of vertebrates prey owls consume (Taylor 1994). Furthermore, changes in diet as seen in pellets reflect real changes in availability of small mammal species (Clark and Bunck 1991). In spite of some limitations (Clark and Bunck 1991; Saint-Girons and Spitz 1966), this method has been successfully used to study patterns of small mammal distribution at a geographical scale through gradients of elevation or latitude (Alegre et al. 1989; Clark and Bunck 1991; Moreno and Barbosa 1992; Torre 2001; Torre et al. 1996), and at the landscape or land-use scales (Cooke et al. 1996; Torre et al. 1997).

For genet scats, we used information published on the area (Arrizabalaga et al. 2002; Flaquer et al. 2001), adding 11 new sampling places, for a total of 42 latrines scattered along a gradient of 130–1,000 m elevation (elevation 489 ± 27 m). Analysis of scats followed a conventional procedure (Reynolds and Aebischer 1991), and skeletal remains (teeth, fragments of skull, bones, and so on) were used to identify and quantify the minimum number of individuals of every species present in a sample (Rosalino and Santos-Reis 2002). These remains were compared to an identification key (Gosàlbez 1987) and also to a reference collection at the Museu de Granollers. As latrines are used by 1–6 individuals (Torre et al. 2003), they provide more homogeneous samples of the diet than do scats from a single genet. Genets are exclusively nocturnal (Palomares and Delibes 1994), with a maximum foraging range of 7.8 km^2 (Palomares and Delibes 1994) and show a diet based on small mammals in the study area (>90% of prey—Torre et al. 2003). As a result of the generalist and opportunistic feeding habits of genets, which prey on small mammals according to their availability (Rosalino and Santos-Reis 2002; Virgós et al. 1999), their diet should reflect abundance of small mammals and composition of communities. In these studies, we recorded species richness (number of small mammal species detected in each sample), sample size (number of individual small mammals in a sample), and their relative abundance (number of individuals of a species in each sample).

Data analysis.—The simplest measure of species richness is the number of species present in a sample (Hellmann and Fowler 1999). However, estimates of species richness are influenced by patterns of

species abundance and by size of samples (Gotelli and Colwell 2001; Ludwig and Reynolds 1988). Richness and sample size generally fit curvilinear models for small mammal communities (Clark and Bunck 1991; Torre 2001). These curves rise rapidly at first and then more slowly as increasingly rare species are added. After that point, an asymptote will eventually be reached, and no further species will be added (Gotelli and Colwell 2001).

We used 3 statistical approaches to identify and quantify possible sampling biases between methods along the gradient of elevation. First, we used log-likelihood ratio tests (Zar 1996) to search for differences in species composition and abundance of small mammal communities revealed by the 3 sampling methods. Second, we used analysis of variance (ANOVA) to compare species richness and size of samples between methods and analysis of covariance (ANCOVA) to analyze patterns of species richness by statistically removing the effects of elevation and sample size (Rahbek 1997). Since ANCOVA assumes linear relationships between dependent variables and covariates (Stevens 1986), we transformed richness (square root) and sample size (logarithmic) to achieve linearity and also to reach homoscedasticity and normality (Zar 1996). The level of significance to reject the null hypothesis was set at $P = 0.05$ in all tests. Finally, we used rarefaction to provide a meaningful interpretation of species richness and species evenness between the 3 sampling methods, which differed in total number of individuals collected. Rarefaction takes account of species richness and species abundance and allows comparisons between assemblages of equivalent number of individuals. We used Ecosim 7.0 software (N. J. Gotelli and G. L. Entsminger, Ecosim: Null Models Software for Ecology, http://homepages.together.net/~gentsmin/ecosim.htm) to generate individual-based rarefaction curves of species richness and associated variance for the 3 sampling methods. The computer-sampling algorithm of the program randomly draws a sample of specified size from the total sample and computes a mean and a variance of species richness after 1,000 iterations. The individual-based data sets were obtained after pooling replicated samples in single ones for each sampling method (Gotelli and Colwell 2001).

Results

All together, the 3 sampling methods revealed 19 small mammal species in the study area. Qualitative and quantitative differences in small mammal communities between methods were evident, as revealed by the log-likelihood ratio test (interaction of species × method: $G = 5{,}339$; $d.f. = 30$; $P < 0.0001$). Barn owl pellets included 17 small mammal species represented by 17,232 individuals. Genet scats included 14 small mammal species in 2,145 individuals identified, and livetrapping sampled only 9 species from 1,488 individuals trapped (Table 1). Five species were found only in barn owl pellets (Cabrera water shrew, *Neomys anomalus*; common rat, *Rattus norvegicus*; house mouse, *Mus musculus*; Mediterranean pine vole, *Microtus duodecimcostatus*; and water vole, *Arvicola sapidus*). Two species were found only in genet scats (Eurasian red tree squirrel, *Sciurus vulgaris*, and edible or fat dormouse, *Myoxus glis*). Livetrapping did not uncover any unique species (except for the weasel, *Mustela nivalis*, which was not considered for this analysis).

Sampling bias between methods was also observed when prey species were assembled into 4 guilds according to their ecological requirements: insectivores, arboreal rodents, ground-dwelling woodland rodents, and grassland rodents (interaction of guild × method: $G = 4{,}473$, $d.f. = 6$, $P < 0.0001$). Standardized residuals of the log-likelihood ratio test showed that barn owl pellets contained a higher proportion of insectivores (shrews) and grassland rodents (field vole, *Microtus agrestis* and *M. duodecimcostatus*; Algerian mouse, *Mus spretus* and *M. musculus*), whereas these groups were underrepresented by genet scats and livetrapping (Fig. 1). By contrast, barn owl pellets contained few individual woodland ground-dwelling rodents (wood mouse, *Apodemus sylvaticus*; yellow-necked mouse, *A. flavicollis*; and bank vole, *Clethrionomys glareolus*), whereas genet scats and livetrapping had many. Genet scats contained more arboreal rodents (*S. vulgaris*; garden dormouse, *Eliomys quercinus*; and *M. glis*), whereas both livetrapping and pellets undersampled their abundance. Semiaquatic small mammal species were found only in owl pellets (*N. anomalus* and *A. sapidus*). Frequency of occurrence differed ($P < 0.0001$) for all 4 guilds of small mammals from sampling by genet scats and owl pellets (insectivores, $G = 874$; arboreal rodents, $G = 176$; woodland rodents, $G = 1{,}290$; and grassland rodents, $G = 930$; $d.f. = 1$ for all comparisons). Frequencies also differed significantly from sampling by barn owl pellets and livetrapping in 3 guilds (for insectivores, $G = 420$; woodland rodents, $G = 904$; and grassland rodents, $G = 701$). However, for arboreal rodents, frequency was not different ($P > 0.05$) when sampled by pellets or trapping ($G = 1.1$). Frequency also differed when assessed by genet scats and by livetrapping for 2 guilds (insectivores, $G = 24$, and arboreal rodents, $G = 43$), but there was no difference in frequencies determined for woodland rodents ($G = 0.4$) or grassland rodents ($G = 0.8$).

Barn owl pellets had a significantly higher proportion of insectivores relative to rodents than livetrapping, and this ratio was higher with livetrapping than in genet scats (31.05%

Table 1.—Species detected by the three sampling methods for studying richness and composition of small mammal communities in northeastern Spain. Asterisk indicates species present.

Species	Barn owl pellets	Genet scats	Live trapping
Talpa europaea	*	*	
Sorex minutus	*	*	*
Sorex araneus	*	*	*
Neomys anomalus	*		
Suncus etruscus	*	*	
Crocidura russula	*	*	*
Sciurus vulgaris		*	
Eliomys quercinus	*	*	*
Myoxus glis		*	
Apodemus sylvaticus	*	*	*
Apodemus flavicollis	*	*	*
Rattus rattus	*	*	
R. norvegicus	*		
Mus musculus	*		
Mus spretus	*	*	*
Clethrionomys glareolus	*	*	*
Microtus agrestis	*	*	*
Microtus duodecimcostatus	*		
Arvicola sapidus	*		

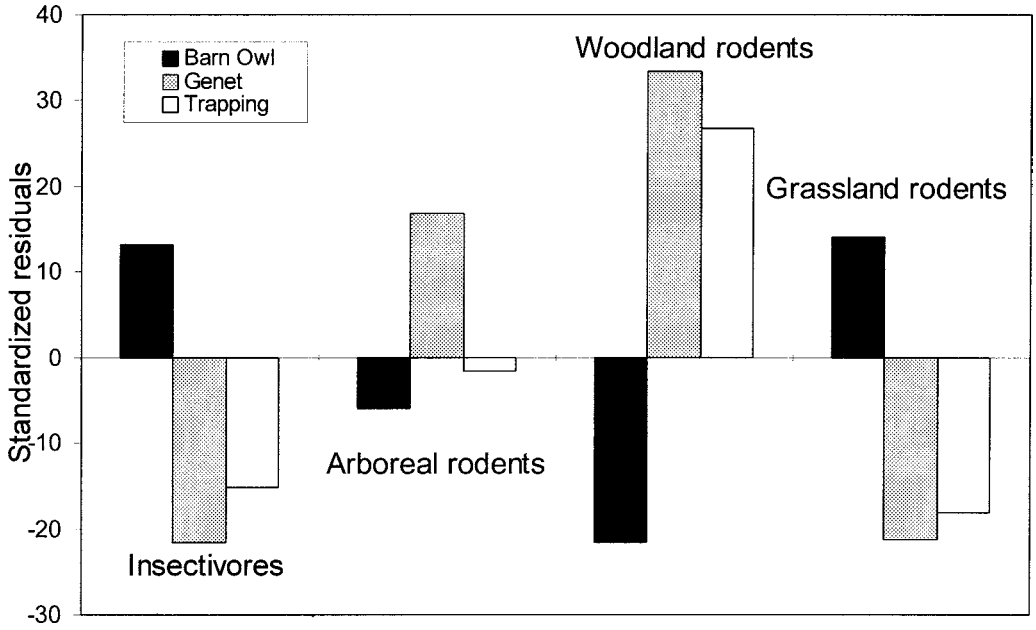

FIG. 1.—Differences in small mammal species composition and abundance as shown by 3 sampling methods (given as standardized residuals after a log-likelihood ratio test; $G = 4{,}473$; $d.f. = 6$; $P < 0.0001$). Negative residuals show the method undersamples abundance of each group of species; positive residuals show that it oversamples.

compared to 9.40% and 4.94%, respectively: $G = 1{,}140$, $d.f. = 2$, $P < 0.0001$). The proportion of grassland to woodland rodents was higher in barn owl pellets (49.7% compared to 1.98% and 1.63%, respectively: $G = 3{,}142$, $d.f. = 2$, $P < 0.0001$) but not significantly different in genet scats and livetrapping ($G = 0.5$, $d.f. = 1$, $P = 0.47$).

ANOVA of richness of small mammal species showed highly significant differences between the 3 sampling methods ($F = 50.73$, $d.f. = 2, 141$, $P < 0.0001$). Barn owl pellets detected greater species richness (8.00 ± 0.36 species/sample, coefficient of variation [CV] = 23 %) than genet scats (4.76 ± 0.41 species/sample, $CV = 56\%$) or livetrapping (3.30 ± 0.12 species/sample, $CV = 32\%$; Fig. 2), with significant differences between the 3 pairwise comparisons (Tukey post hoc tests). Sample sizes were significantly larger for barn owl pellets (638.70 ± 98.37 individuals/sample, $CV = 80\%$) than for livetrapping (one-sixth the size of the former, 101.12 ± 8.30 individuals/sample, $CV = 64\%$) or for genet scats (one-tenth the size of the former, 61.85 ± 10.32 individuals/sample, $CV = 108\%$; $F = 56.69$, $d.f. = 2, 141$, $P < 0.0001$; Fig. 2). Samples of genets scats were more heterogeneous both in species richness and sample size than barn owl and livetrapping samples, as shown by the coefficient of variation. ANCOVA showed no differences in species richness between barn owl and genet scats after sampling size biases were factored out, with a significant difference between both these methods and livetrapping ($F = 35.21$, $d.f. = 2, 139$, $P < 0.0001$; Fig. 3). Sample size accounted for a high amount of variance in species richness ($R^2 = 0.60$, $t = 14.58$, $d.f. = 139$, $P < 0.0001$), and there was a nonsignificant effect of elevation on species richness ($R^2 = 0.01$, $t = -0.95$, $d.f. = 139$, $P = 0.34$). A significant interaction was detected between species richness and sample size among the 3 sampling methods ($F = 3.80$, $d.f. = 4, 135$, $P = 0.005$), with a steeper regression slope for genets scats and shallower and similar slopes for barn owl pellets and livetrapping. That is, species richness estimated by the 3 methods changed with different values of the covariates. Three individual-based rarefaction curves of species richness and its variance were obtained for the 3 methods, allowing a direct comparison of species richness for the same number of individuals collected (Fig. 4). This figure showed that barn owl pellets oversampled species richness in small samples (<50 individuals) and that genet scats oversampled it in large samples (>100 individuals). Furthermore, both methods contained higher species richness than livetrapping regardless of sample size.

DISCUSSION

The combination of sampling methods for this study of small mammal communities detected 19 small mammal species in the study area. These represent the total community of small mammals (Insectivora and Rodentia, excluding bats and hedgehogs) known to be present in the area (Arrizabalaga et al. 2002; Torre et al. 1996). Overall, 89.5% of the species were detected in barn owl pellets analysis, 73.7% in genet scats, and only 47.3% by livetrapping. Owl pellets showed the highest species richness per sample. Pellets are easily found and analyzed (Bunn et al. 1982; Taylor 1994), which may explain why this is one of the most widely used methods to study richness and composition of small mammal communities across ecological gradients (Alegre et al. 1989; Clark and Bunck 1991; Moreno and Barbosa 1992; Torre 2001; Torre et al. 1996). The mean size of pellet samples, 638 individuals, was large enough to detect the maximum species richness of

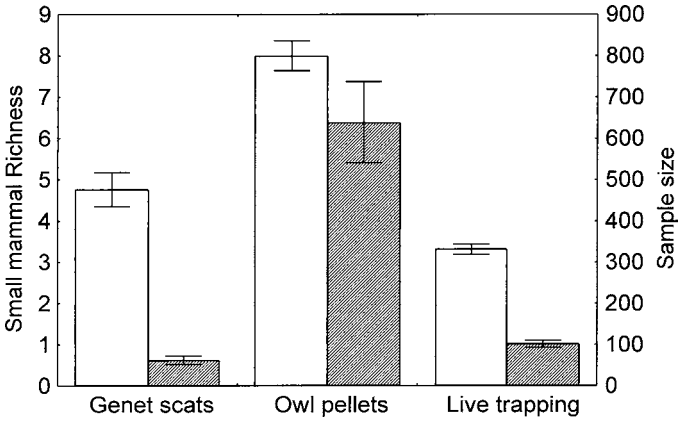

FIG. 2.—Small mammal richness (white bars) and number of individuals sampled (shaded bars) for 3 sampling methods (genet scats, barn owl pellets, and livetrapping). Values shown as mean ± *SE*.

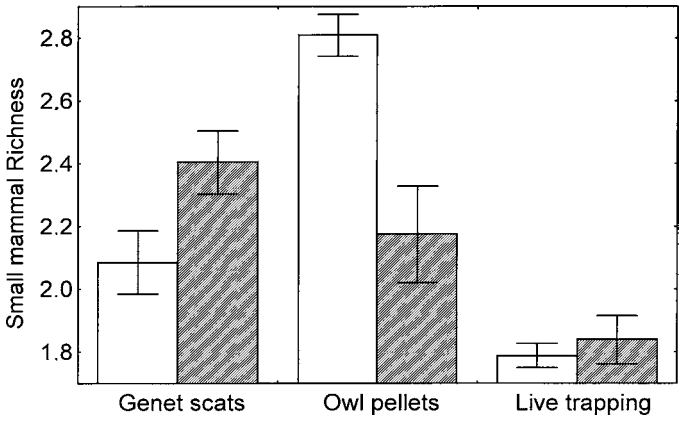

FIG. 3.—Small mammal richness determined by 3 sampling methods after controlling for differences in sample size and elevation; shown as observed (white bars) and expected (shaded bars; means adjusted after one-way ANCOVA). Values given as mean ± *SE* of the square-root-transformed data.

small mammal communities in the study area (Torre 2001) when compared with samples obtained from genet scats or livetrapping. Estimates of species richness are related to sample size (Gotelli and Colwell 2001; Ludwig and Reynolds 1988), with 60% of the variance in species richness in this study accounted for by sample size itself. Comparing values of absolute species richness obtained by the 3 methods would entail a significant bias since not controlling for sampling effort is one of the largest biasing factors in studies of patterns of species richness (Gotelli and Colwell 2001; Rahbek 1995). After controlling for sample size and elevation by means of ANCOVA, samples of genet scats and owl pellets gave similar estimates of small mammal species richness, and both showed higher values than livetrapping. Other factors not controlled, such as area sampled by each method, would account for these differences. Livetrapping plots covered an approximate area of 1 ha, whereas genets and barn owls sampled larger areas (Bunn et al. 1982; Palomares and Delibes 1994). Rarefaction curves show that genet scats estimate less species richness than barn owl pellets when small samples were analyzed, whereas genets scats provided higher estimates of species richness than barn owl pellets in large samples. Although it is more difficult to analyze remains in genet scats (as remains in scats are always crushed and are difficult to identify), even relatively small samples of genet scats (>100 small mammals) can provide more information on species richness than an equivalent sample of pellets. Samples of 300–500 small mammals identified in barn owl pellets are necessary to attain stabilization of the curve for species richness sample size (Spain—Torre 2001). Otherwise, both indirect methods detected a different picture of richness and composition of small mammal communities in the same area. Furthermore, the 2 methods were complementary, representing the small mammal fauna of open landscapes (grasslands and cultives) and riverbeds and of wooded landscapes, respectively. These differences are readily interpreted according to habitat requirements and the feeding strategies of the 2 predators. Barn owls inhabit open landscapes and are opportunistic and generalist predators feeding mainly on small mammals as a function of their availability (Díaz et al. 1996). Small-spotted genets are forest generalists and opportunistic predators (Rosalino and Santos-Reis 2002; Ruiz-Olmo and López-Martín 2001; Virgós et al. 1999), feeding mainly on small mammals in the north of their distribution area (Rosalino and Santos-Reis 2002; Torre et al. 2003; Virgós et al. 1999). Our results confirmed the generalist pattern since genets selected woodland rodents according to their availability, as suggested by their abundances in livetrapping in woodland habitats. However, genets significantly avoided insectivores (Rosalino and Santos-Reis 2002), doubtless owing to the presence of chemical repellents for carnivores in some insectivore species (Erlinge 1975). Our results confirmed that Sherman livetrapping provided a biased picture of species richness (at least in forest habitats, where arboreal or smaller species such as the white-toothed pygmy shrew, *Suncus etruscus*, were not captured), confirming that they are of low efficiency (O'Farrell et al. 1994; Patterson et al. 1989). Nonetheless, livetrapping and genet scats revealed a similar picture of small mammal communities, with the same proportion of grassland to woodland rodents, contrasting with results provided by barn owl pellets.

The 3 methods as a whole failed to detect patterns of richness in relation to elevation. These patterns can be attributed to differences in average elevation sampled with each method since livetrapping covered 4 stations above 1,000 m elevation (540–1,450 m), and barn owl roosts and genet latrines were located at similar lower elevations (119–1,140 m for owl roosts, 130–1,000 m for genet latrines). To conduct more appropriate comparative analysis of species richness across elevation, sampling stations and sampling effort should be equally distributed along gradients between the methods compared (Lomolino 2001; Rahbek 1995). Unfortunately, it is not possible when using owl pellets and genet scats, as ranges of both barn owls and small-spotted genets are significantly limited by elevation (Alegre et al. 1989; Virgós et al. 2001), and we had fewer samples from high elevations.

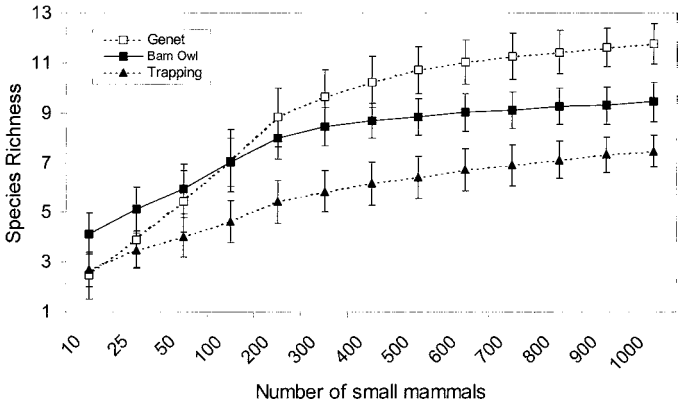

FIG. 4.—Individual-based rarefaction curves of species richness for the 3 methods used to study small mammal communities. Points represented were used to draw the curves. Values given as mean ± *SD*.

In conclusion, using a combination of 2 indirect methods, barn owl pellets and genet scats, to study small mammal communities provides more complete information on species of nonvolant small mammals present in the study area. Furthermore, owing to the generalist and opportunistic feeding behavior of barn owls and genets, composition of small mammal assemblages can be easily inferred from remains identified and quantified in their diet. Genets are the most common carnivores in these woodlands (Torre et al. 2003), and latrines are easy to find (Virgós et al. 2001), but their scats are difficult to analyze. Still, they offer a useful method for studying small mammal assemblages in wooded areas where barn owls are lacking. Finally, livetrapping in forest habitats provided a similar picture of small mammal composition and abundance as genet scats but underestimated richness.

RESUMEN

El análisis de egagrópilas de *Tyto alba* y excrementos de *Genetta genetta*, y el trampeo en vivo (Sherman), fueron comparados para evaluar la riqueza y composición de las comunidades de micromamíferos en una zona Mediterránea (NE España). Las egagrópilas proporcionaron 17 especies de micromamíferos (17,232 individuos), los excrementos 14 especies (2,145 individuos), y el trampeo 9 especies (1,488 individuos). Las egagrópilas sobreestimaron a los insectívoros y los roedores de herbazales y cultivos, e infravaloraron a los roedores arborícolas y forestales. Los excrementos y el trampeo sobreestimaron a los roedores forestales, e infravaloraron a los insectívoros y los roedores de herbazales y cultivos. Después de controlar el sesgo del tamaño de muestra y de la altitud mediante el ANCOVA y la rarefacción, las egagrópilas contuvieron más especies para muestras pequeñas (<50 individuos), mientras que los excrementos contuvieron más especies en muestras grandes (>100 individuos), pero ambos detectaron más riqueza que el trampeo independientemente del tamaño de la muestra analizada. Se concluye que los dos métodos indirectos son complementarios, permitiendo la detección de las 19 especies de micromamíferos presentes en el área de estudio.

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