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SHORT COMMUNICATION

Estimating the relative abundance of small mammals when there is no record of catching effort

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ABSTRACT. Estimates of local population abundances, which require carefully designed sampling procedures, can provide valuable information on population size and density. Even though small mammals are one of the most widely studied vertebrate groups, many surveys have not recorded basic information to estimate local abundances, for instance catching effort. Here we suggest a simple comparative trapping frequency index that can be used as an alternative to the relative abundance index in data sets that only contain the number of species and individuals collected, thus lacking information on sampling effort. To compare trapping frequency and relative abundances we used capture records from more than four years, from seven species of rodents and two marsupial species collected by the Brazilian Plague Service. We calculated the trapping frequency index of each species as the proportion of trapped individuals per total of all individuals caught. We found that this trapping index was significantly correlated with a relative abundance index (number of captured individuals divided by number of trap nights). Our findings suggest that the proposed index may be useful for comparisons in situations where data on catching effort is lacking. The index may also provide a simple, though approximate quantification of relative local abundances, with possible applications in comparative studies (e.g. meta-analysis). We suggest that this index is used in studies that do not focus on obtaining accurate population parameter estimates, but which nonetheless contain data that can still offer a representative measure to compare local population abundances.

KEY WORDS. Mammal collections; population index; removal; trapping.

Even though small mammals are one of the most widely studied vertebrate groups, basic information such as catching effort is not available for many specimens in museum collections and surveys (historical and current). Without this information, the important issue of false absence is being ignored, given that the detection probability of a great majority of wild-living species is <100% (Mackenzie et al. 2002). Imperfect detection of species should be separated from imperfect detection of individuals. The former addresses the question of detecting or not a species in the study area. The latter pertains the issue of successfully detecting the presence of a species from the capture (or traces of) an unknown proportion of the local population. However, accounting for imperfect detection of individuals is only important when more sophisticated capture-mark-recapture (CMR) frameworks are used with the intent of obtaining accurate population estimates. Museum collections and any other type of collected data may lack sophisticated CMR frameworks, but despite this they contain large amounts of valuable data that can be used in ecological analyses.

Here we suggest a simple comparative index as an alternative to the complex indices of abundance. It can be applied to apparently deficient data sets that only contain information on the number of species and individuals collected. Such data sets generally result from removal methods or simple CMR studies, lacking information on catching effort. The proposed index overcomes such problems and the difficulties related to sophisticated CMR sampling designs.

When researchers annotate the number of traps set each night, a simple abundance index may be calculated from the number of individuals caught, divided by the number of trap-nights, which gives the frequency of captures per trap per night (Caughley 1977). This index is referred to as catch per-unit-effort (Richards & Schnute 1986) and is recommended when the population is being exploited, for instance in fisheries

(Caughley 1977). Some assumptions are required to use this index (Harley et al. 2001), but if it has a value below 0.2, the catch index regression on absolute density can be assumed to be linear. In other cases, the total number of trapped animals is recorded but the number of trap-nights is not. By dividing the number of individuals of a species by the total number of animals caught we may intuitively deduce an index, which is analogous to the catch-per-unit effort.

We gathered data from a continuous trapping by the Brazilian Plague Service of SUCAM, now known as National Health Foundation (Fundação Nacional da Saúde – FNS), over a five-year period (1985-1989). We used capture data from 52 months, during which the collectors recorded the catching effort. We used data from 14 localities (Appendix 1), all located in or near Serra de Baturité, a mountain range in the state of Ceará, northeastern Brazil.

We used data for seven species of rodents and two marsupial species (Appendix 2). We pooled the data from all localities and calculated the monthly frequency of captures for each species as: $FC_i = N_i$/Number of trap-nights, and the monthly frequency of trapped animals as: $FTA_i = N_i$/Total number of individuals caught each month, where N_i is the number of specimens of the i-th species. We then performed a Spearman rank correlation between FC_i and FTA_i, since both measures are ratios. Significant correlations ($p < 0.001$) were found in all comparisons, except for *Euryoryzomys* sp., which was collected only in six out of 52 months. Correlations were performed using Statistica software (StatSoft Corp. 2003).

Our results indicated that FC_i and FTA_i were highly correlated (Table 1). Therefore, dividing the number of individuals of a species by the total number of specimens collected may be informative. The correlations suggest that the FTA index can potentially substitute the population abundance index when the total number of captured specimens in a locality is known, but the capture effort is not. For example, the FTA index can be applied to museum collection data lacking capture effort. This could potentially provide valuable information on historic population abundances. Such analysis can be validated through comparison with present day surveys from the same location where the capture effort is reported from. Additionally, data from published studies or museum collections are often compiled to discuss variations in community composition across different environments, where any information on abundance is important. Therefore, another possible application of the proposed index is for mean or effect size comparisons in meta-analyses. The FTA index may remain only a gross approximation of reality; however, it potentially provides a valid proxy for comparison of local abundances. Further studies are required to evaluate the behavior or this index in different circumstances, such as when capture methods and community composition vary extensively.

There are various advanced methods for obtaining accurate and more realistic population parameter estimates. However, such advanced methods demand a complex CMR sampling design, which is not the case of museum collections. We suggest that this index is used to obtain estimates from studies which main focus was not to obtain accurate population parameter estimates, but which still offer a representative measure to compare local/historic population abundances.

Table 1. Correlation between the monthly frequencies of captures (FC_i) and the monthly frequency of trapped animals (FTA_i).

Species	N	Spearman ρ	t(N-2)	p-level
Rodents				
Euryoryzomys sp.	6	0.8857	3.816	0.019
Cerradomys langguthi (Weksler, Percequillo & Voss, 2006)	51	0.8219	10.102	<0.001
Holochilus sciureus (Thomas, 1929)	41	0.8776	11.430	<0.001
Necromys lasiurus (Lund, 1841)	52	0.9104	15.555	<0.001
Oligoryzomys gr. *eliurus*	37	0.9350	15.603	<0.001
Rattus rattus (Linnaeus, 1758)	52	0.5145	4.242	<0.001
Thrichomys laurentius (Thomas, 1904)	50	0.9214	16.425	<0.001
Marsupials				
Monodelphis domestica (Wagner, 1842)	30	0.8795	9.778	<0.001
Didelphis albiventris (Lund, 1841)	27	0.8388	7.704	<0.001

FC_i = Ni/Trap-nights; $FTA_i = N_i$/Total number of animals caught each month, N_i being the number of specimens of the i-th species.

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Appendix 1. Localities were the material was collected.

The data were collected at the following localities: Aracoiaba (4°22'S, 38°48'W), Aratuba (4°25'S, 39°02'W), Baturité (4°20'S, 38°53'W), Capistrano (4°28'S, 38°54'W), Canindé (4°21'S, 39°18'W), Guaiúba (4°02'S, 38°38'W), Guaramiranga (4°15'S, 38°55'W), Itapiúma (43°35'S, 38°55'W), Itatira (4°31'S, 39°37'W), Mulungu (4°18'S, 39°00'W), Pacoti (4°13'S, 38°56'W), Palmácia (4°09'S, 38°50'W), Pedra Branca (4°30'S, 38°47'W) and Redenção (04°13'S, 38°48'W). All are located in or near the Serra de Baturité, a mountain range in the north-eastern Brazilian state of Ceará.

Appendix 2. The rodent and marsupial species used. Identification of species followed PERCEQUILLO et al. (2008) and WEKSLER et al. (2006).

Species	Number of specimens caught	Specie's frequency
Rodents		
Euryoryzomys sp.	19	0.0011
Cerradomys langguthi	1680	0.0973
Holochilus sciureus	541	0.0313
Necromys lasiurus	8460	0.4901
Oligoryzomys gr. *eliurus*	225	0.0130
Rattus rattus	5580	0.3233
Thrichomys laurentius	613	0.0355
Marsupials		
Monodelphis domestica	92	0.0053
Didelphis albiventris	51	0.0030

* All these species had the individuals' frequency of capture lower than 0.2.

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