USE OF VOCALIZATIONS TO ESTIMATE POPULATION SIZE OF ROE DEER

DAVID REBY,[1] Institut de Recherche sur les Grands Mammifères, Institut National de la Recherche Agronomique, BP 27, Castanet-Tolosan Cedex, F31326, France

A. J. MARK HEWISON, Institut de Recherche sur les Grands Mammifères, Institut National de la Recherche Agronomique, BP 27, Castanet-Tolosan Cedex, F31326, France

BRUNO CARGNELUTTI, Institut de Recherche sur les Grands Mammifères, Institut National de la Recherche Agronomique, BP 27, Castanet-Tolosan Cedex, F31326, France

JEAN-MARC ANGIBAULT, Institut de Recherche sur les Grands Mammifères, Institut National de la Recherche Agronomique, BP 27, Castanet-Tolosan Cedex, F31326, France

JEAN-PAUL VINCENT, Institut de Recherche sur les Grands Mammifères, Institut National de la Recherche Agronomique, BP 27, Castanet-Tolosan Cedex, F31326, France

Abstract: Estimating population abundance of large mammals generally requires substantial time and effort, and low-investment alternatives are needed. We present a novel application of a capture–mark–recapture (CMR) method, using vocalization frequency to estimate the size of roe deer (*Capreolus capreolus*) populations. The technique involves walking along fixed transects to disturb all animals present on a study plot, potentially provoking a vocal response. Those animals heard to vocalize (whether observed or not) are then considered the total number of "marked" individuals in the population. The proportion of "marked" individuals in the population is estimated from the proportion of animals that vocalize in the subsample of individuals observed (the vocalization frequency). Population size is estimated by dividing the number of marked individuals by the vocalization frequency, correcting for bias, which is directly analogous to the Lincoln-Petersen (L-P) estimate for CMR. We used this method to estimate population size for roe deer inhabiting a 150-ha forest plot for 8 separate surveys, and we used the L-P estimator to compare our estimates to mark–resight estimates. We estimated deer density as 23.45 ± 7.80 deer/100 ha by CMR and 19.87 ± 7.92 deer/100 ha by the vocalization frequency (VF) method ($\bar{x} \pm$ SE). If the assumptions are met, this method provides estimates of absolute population size at low cost and with little material investment, because physical capture and marking of animals is not necessary. Further research is required to validate the assumption that visually observed animals have the same probability of vocalizing as those disturbed but not seen.

Key words: barking frequency, *Capreolus capreolus*, capture–mark–recapture, density estimators, population estimation, radiotracking, vocalizations.

A recurrent problem in population biology is estimation of animal abundance to obtain population size or density for research or management purposes (Seber 1986). Among the most reliable methods to estimate population size of free-ranging animals are CMR techniques (Pollock et al. 1990). However, CMR requires considerable investment of time, personnel, and resources to mark and recapture a sufficiently large proportion of the population, especially for large study areas. Because the financial and logistical resources available to managers often are limited, management programs often rely on indices of abundance (Caughley 1977, Seber 1982). Indices may be extremely valuable tools for monitoring long-term trends of populations; however, they do not provide an estimate of the absolute number of animals.

Indices of species' presence or abundance based on auditory cues such as vocal calls are widely used for birds (Frelin 1982, Lauga and Joachim 1987) and bats (Chiroptera; Ahlen 1990, Kapteyn 1993), but less so for terrestrial mammals (e.g., gray wolf [*Canis lupus*]; Harrington and Mech 1982, Fuller and Sampson 1988). To our knowledge, vocalization surveys have not been used to provide estimates of population size (Fuller and Sampson 1988). In this paper, we present results of a study that used vocalizations to evaluate a population estimator for roe deer.

When disturbed, adult roe deer of both sexes emit loud, conspicuous barks that are easily identified (D. Reby and B. Cargnelutti, unpublished data). A roe deer, when disturbed, typically will seek dense cover, bounding and emitting "staccato barks." The deer will then bark loudly and repeatedly at regular intervals (mean