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Effect of observer experience on the monitoring of a mouflon population

Mathieu GAREL, Jean-Marc CUGNASSE, Jean-Michel GAILLARD, Anne LOISON, Yanto SANTOSA and Marie-Line MAUBLANC

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Analysis of changes in population size can be severely biased when factors related to the acquisition of data, such as differences between observer experience and changes through time in the ability of individual observers to detect animals, are not controlled for. We analysed the effect of observer qualification on the number of groups and individuals observed during two census days of a mouflon *Ovis gmelini musimon* × *Ovis* sp. population. The difference between professional wildlife biologists and volunteers was strong during the census day one (87 groups and 410 mouflons vs 55 and 249 by experienced observers and volunteers, respectively) but decreased significantly on the second day for the number of animals detected (390 vs 292 mouflons by experienced observers and volunteers, respectively). Our result indicates that additional training will enhance reliability of data obtained from volunteers. Given the effect of observer qualification on performance during the census, we recommend to use observers of similar and adequate qualification in population counts.

Unité Mixte de Recherche n°5558 "Biométrie et Biologie Evolutive", Bâtiment Gregor Mendel, Université Claude Bernard Lyon 1, 43 Boulevard du 11 novembre 1918, 69622 Villeurbanne Cedex, France, e-mail: mgarel@biomserv.univ-lyon1.fr (MG, JMG, AL); Office National de la Chasse et de la Faune Sauvage, Centre National d'Etude et de Recherche Appliquée Faune de Montagne, BP 74267, 34098 Montpellier Cedex 5, France (MG, JMC); Faculty of Forestry, Bogor Agricultural Institut, PO Box 169 Bogor, Indonesia (YS); Institut de Recherche sur les Grands Mammifères, BP 27, 31326 Castanet-Tolosan (MLM)

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Introduction

Monitoring change in population size is essential for studying population dynamics and effective wildlife management (Lancia *et al.* 1994, Buckland *et al.* 2000, Williams *et al.* 2002). However, population census still remains a difficult task for wildlife biologists and managers (Wilson *et al.* 1996, Schwarz and Seber 1999, Pollock *et al.* 2002), despite a long history of refinements in the design and development of census methods (see Buckland *et al.* 2000, Pollock *et al.* 2002 for reviews). As alternatives to census approaches, indices of abundance such as standardized counts have been developed (Eberhardt and Simmons 1987, Link and Sauer 1997, Williams *et al.* 2002).

Ideally population indices need to track variation in population size and remain proportional to it (Lancia *et al.* 1994, Pollock *et al.* 2002, Williams *et al.* 2002). Analysis of trend counts can be severely biased if data contain sources of variation other than changes in the size of the population. Potential sources of variation include weather, habitat, time of day, or differences between observers in their ability to detect animals. These effects are seldom taken into account (Bourlière 1969, Fafarman and White 1979, Santosa *et al.* 1990, James *et al.* 1996, Freilich and LaRue 1998). For example, differences between observers in their ability to detect animals are generally overlooked although several studies have shown that experience and motivation may affect census results (eg Caughley 1974, LeResche and Rausch 1974, Delorme 1989, Rubin *et al.* 1998).

Changes in abundance of the wild population of mouflon *Ovis gmelini musimon* × *Ovis* sp. (Cougnasse 1994) of the Caroux-Espinouse (South of France) were monitored since 1989 using an index of abundance based on animal counts. We compared the effect of observer experience on the number of groups and individuals observed. We tested the ability of volunteers to detect mouflon during two consecutive census days and their performance to that of a group of professional wildlife biologists with prior experience observing mouflons.

Study area

Our study site is situated on the south-western border of the Massif Central, in southern France. The population of mouflons inhabits the Caroux-Espinouse massif (43°40'N, 3°0'E) covering 17 000 ha. Elevation ranges from 300 to 1124 meters. Climatic conditions are variable, consisting of a mixture of oceanic, mediterranean and mountain influences, with generally hot dry summers (Garel *et al.* 2004), wet autumns and fairly cold winters (Thiebaut 1971). Vegetation cover occurs in a mosaic pattern, with open habitats (heather and broom-land) and woods (*Pinus* sp., *Picea* sp., *Fagus sylvatica*, *Castanea sativa*, *Quercus ilex*) in a N/S irregular gradient.

The population was monitored by the Office National de la Chasse et de la Faune Sauvage since 1974. Except in two protected areas (1821 ha) located in the central part of the massif, hunting (by stalking and beating) occurred from September to February. Further information about the study area was given by Auvray (1983) and Baudière (1970).

Material and methods

Observer categories

We recognized 2 observer categories, according to their experience with mouflon census: volunteers (group A) and professional wildlife biologists (group B). The first category consisted of students interested in wildlife management but without any experience of counting mouflons. The second category was composed of individuals very experienced in mouflon counts, and was considered the control category. We assumed that the level of motivation among participants was similar.

Data collection

On May 23 and 24 1989, 6 observers belonging to group A and 6 to group B were assigned to the following sampling design. Twelve transects were chosen across the entire massif in open habitat, and

were surveyed each day during the period of maximal activity of mouflon (Santosa 1990, Bon *et al.* 1991): 6 were surveyed within 2 hours after sunrise, while the other 6 were surveyed during the 2 hours before sunset. Between 3 and 4 observation points were distributed along each transect. Each transect were surveved by 2 observers (one of each group). From the 40 observation points (sampling units)observers simultaneously surveyed the panorama for 15–30 minutes with binoculars (10 × 42 mm) and noted the number of groups and the number of mouflons observed. Any visual and oral communication was prohibited. Failure to this requirement led to discard the transect sampled from the analysis. Observers of different experience were paired randomly for each survey. In addition, the following rules contributed to insure the independence between observers: (1) observers only faced the area to scan, (2) the observation time was short compared to the potential number of observations to perform so that no time was left for any exchange between observers, (3) observers did not know the results before the end of two day-sampling. We are thus confident that volunteers were not influenced by the behaviour of experienced observers.

Data analysis

The experimental sampling generated a non-independent sample set and count variables are usually distributed either as a Poisson or negative binomial distribution (Ramakrishnan and Meeter 1993, White and Bennetts 1996). So, we used non-parametric Wilcoxon paired-tests to analyze absolute differences between observer categories on the 40 sampling points (Hollander and Wolfe 1973). Further, we used Wilcoxon signed-rank paired tests to test the possibility of learning by group A between the first day and the second day. Using the Wilcoxon signed-rank paired test procedure, we tested the null hypothesis that the distribution of $|X - Y|$ is symmetric around zero. X corresponds to the absolute differences recorded on sampling points between A and B on the first day and Y the absolute differences recorded on the second day. The alternative hypothesis is that the difference $|X - Y|$ is greater than 0 (one-tailed test), ie there is a learning process of group A between the 2 days of observations. To summarize the distributions of X and Y, we computed their median (ME) and median absolute deviation (MAD). MAD corresponds to the median ($|Yi - \tilde{Y}|$) where $\tilde{Y}$ is the median of the data and $|Yi|$ is the absolute value of Y (Venables and Ripley 2002). All analyses were performed on both the number of groups and the number of individuals recorded using software R 1.8.0 (Ihaka and Gentleman 1996).

Results

We found a significant difference between observer categories on the first day for individuals observed (410 vs 249 mouflons observed by experienced observers and volunteers, respectivley, Wilcoxon paired test: $Z = -3.54$, $p < 0.001$) as well as for groups observed (87 vs 55 groups, $Z = -3.61$, $p < 0.001$). The differences were less marked on the second day but still occurred (390 vs 292 for individuals, $Z = -2.84$, $p = 0.005$; 80 vs 59 for groups, $Z = -2.63$, $p = 0.009$). In most cases group B recorded more animals or groups than group A (Fig. 1).

The range of the differences between observer categories in the number of individuals recorded (Fig. 1) was greater on the first day (ME = 2.00, MAD = 3.71) than on the second day of observations (ME = 0, MAD = 1.48). The differences between the 2 days of observations were less marked for the number of groups observed (ME = 0.50, MAD = 0.74 for the first day and ME = 0, MAD = 0.74 for the second day, Fig. 1). Thus, differences between the 2 days (learning process) were statistically significant only for the number of individuals (Wilcoxon signed-rank paired test: $Z = -1.66$, $p = 0.05$ for individuals; $Z = -1.06$, $p = 0.15$ for groups).

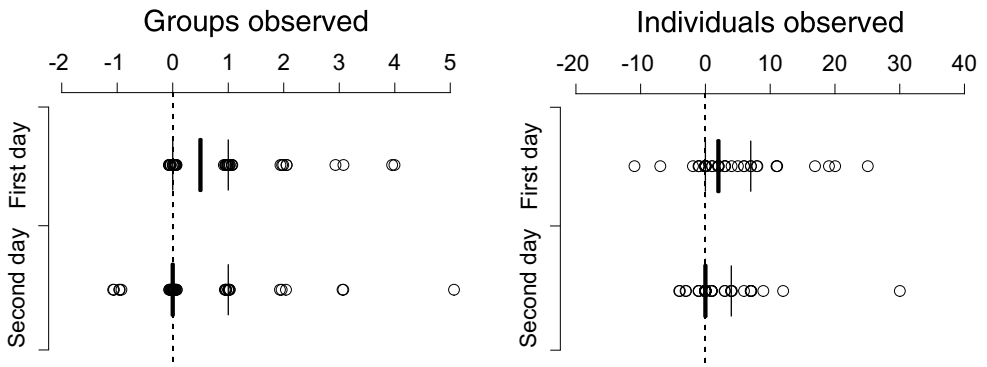

Fig. 1. Comparisons of the range of differences in counts (number of groups and number of mouflons, respectively) between volunteers (group A) and professional wildlife biologists (group B). The vectors of differences were computed each day as the counts of group B recorded on 40 sampling points minus counts of group A. The lines corresponds to – from left – 1st quartile, median (bold line), 3rd quartile; circles correspond to data. The second day, both for groups and individual data, median value is equal to 1st quartile, ie 0.

Discussion

As expected, the experienced observers were more proficient than inexperienced observers regardless of variables or day of observation. These results indicated that observer experience is an important component of variation in detection of ungulates, as previously reported in roe deer *Capreolus capreolus* (Delorme 1989) and moose *Alces alces* (LeResche and Rausch 1974). We believe that groups with few animals were more difficult to detect for inexperienced observers than for experienced ones. This may explain why the increase of performance of group A was greater for the number of animals observed than for groups and suggests that census should take place in spring after the birth period when large groups occur in open areas (Auvray 1983, Bon *et al.* 1990, Dubois *et al.* 1992). The ability of volunteers to improve their observation skill was illustrated by the lessened differences between groups A and B on the second day. Observers in group A had never seen mouflons before and were not used to look for this species within a broad and rugged panorama, yet they were able to increase their number of observations markedly with only a single day of experience.

Our work highlights problems associated with using inexperienced people to collect data and demonstrates the effect of observer qualification on performance during the census of a mouflon population. In analyses of population trends, incorporating additive observer effects may decrease precision (James *et al.* 1996). So, we recommend the use of observers of similar and adequate qualification in population counts.

The practice of wildlife management depends upon long-term databases, but collecting such data can be difficult, expensive and labour intensive (Bildstein 1998, Williams *et al.* 2002). For example, census methods often require to employ numerous observers (Schwarz and Seber 1999). Therefore, many monitoring

programs are undertaken with the assistance of volunteers interested in wildlife studies (Bildstein 1998, Bleich 1998, Freilich and LaRue 1998, Rubin *et al*. 1998, Whitaker 2003). Our results indicated that training can be valuable for in-experienced observers and thus enhance reliability of data recorded. With current declines in budgets allocated to wildlife programs, the involvement of volunteers in data collection is often required and likely to increase in the future (Bleich 1998, Whitaker 2003). Managers could take advantage of this apparent "willingness and ability to learn" when providing orientations for volunteers, but need to evaluate the abilities of volunteers before assuming data are accurate. Indeed, while the volunteers did get better on day 2, they were still poorer observers than the experienced ones. Thus, when training volunteers, >1 training sessions is likely needed to be confident of their data. More generally, prior to conducting surveys managers should always ensure that participants not familiar with the population being studied have received adequate training to detect the study species in representative habitats.

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