A COMPARISON OF TWO METHODS FOR ACQUIRING ECOLOGICAL DATA ON ARMADILLOS FROM ARGENTINEAN PAMPAS: FIELD WORK *vs* INTERVIEWS

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SUMMARY

*The objective of this work is to compare information collected on the ecology of three species of Pampean armadillos (*Chaetophractus villosus*,* C. vellerosus *and* Dasypus hybridus*), obtained through interviews with the information obtained previously in a typical ecological field study. The study area encompasses ~1000km^2 of the northeastern part of the Pampas grasslands of Argentina. Thirty four farms evenly distributed throughout the study area were randomly selected and either the farmer or an employee was interviewed on the presence of armadillos. Traditional ecological data were collected in two ways: searching for indirect signs of armadillos and capturing and marking live individuals. The majority of the results were coincident between both methods. It is concluded that interviews can contribute to ecological research in the Pampas grassland by helping to design field surveys in the initial phase of a study. Interviews can be an important tool in decision making regarding land use and management, because they are a low cost method in terms of time and budget, and do provide reliable results.*

COMPARACIÓN DE DOS MÉTODOS PARA LA ADQUISICIÓN DE DATOS ECOLÓGICOS SOBRE ARMADILLOS EN LAS PAMPAS ARGENTINAS: TRABAJO DE CAMPO vs ENTREVISTAS

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RESUMEN

*El propósito de este trabajo es comparar la información acerca de la ecología de tres especies de armadillos de las Pampas (*Chaetophractus villosus*,* C. vellerosus *y* Dasypus hybridus*) recogida a través de entrevistas con aquella información previamente obtenida en un estudio ecológico de campo típico. El área de estudio abarca ~1000km^2 del noreste de las Pampas argentinas. Fueron seleccionadas al azar 34 estancias homogéneamente distribuidas en el área de estudio y se entrevistó a los hacendados o a empleados. Los datos ecológicos tradicionales fueron obtenidos a través de dos maneras: buscando signos indirectos de la presencia de armadillos, y por la captura y marcaje de individuos vivos. La mayoría de los resultados fueron coincidentes en los dos métodos. Se concluye que las entrevistas pueden contribuir a la investigación ecológica en las llanuras pampeanas al ayudar en las fases iniciales de un estudio al diseño de levantamientos en campo. Las entrevistas pueden constituir una herramienta importante en la toma de decisiones acerca del uso y manejo de la tierra, dado que representan un método de bajo costo en términos de tiempo y dinero, a la par de aportar resultados confiables.*

Introduction

In the past two decades, many researchers have used interviews to study different topics linked to Neotropical mammalian wildlife, including population trends (Giroux, 1987); the relation between hunting, conservation and sustainable use (Robinson and Redford, 1991; Quintana *et al*., 1992; Robinson and Bennett, 2000; Zapata Ríos, 2001; Barbarán, 2003; Noss *et al*., 2004); distribution (Dietrich, 1995); fauna inventories (Sayre *et al*., 2000; Ochoa *et al*., 2005; Gil and Heinonen Fortabat, 2003; Sánchez *et al*., 2004); and natural history (Fleck *et al*., 1999). Controversy still exists, however, on the validity and quality of information gathered through interviews in wildlife biology (Gros *et al*., 1996; Huntington, 1998; López *et al*., 2003; Yamada *et al*., 2003; Msoffe *et al*., 2007).

In this work, the validity of interviews that are commonly used in field studies is assessed by comparing two data sets. The objective of the study was to compare the information collected during interviews on the ecology of three species of Pampean armadillos (*Chaetophractus villosus*, *C. vellerosus* and *Dasypus hybridus*), with the information obtained previously in a typical ecological

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COMPARAÇÃO DE DOIS MÉTODOS PARA A AQUISIÇÃO DE DADOS ECOLÓGICOS SOBRE TATUS NOS PAMPAS ARGENTINOS: TRABALHO DE CAMPO vs ENTREVISTAS

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RESUMO

*O propósito deste trabalho é comparar a informação sobre a ecologia de três espécies de tatu campestre (*Chaetophractus villosus*,* C. vellerosus *e* Dasypus hybridus*) recolhida através de entrevistas com uma outra informação préviamente obtida em um estudo ecológico típico de campo. A área de estudo abrange ~1000km² do nordeste dos Pampas argentinos. Foram seleccionadas de forma aleatória 34 estâncias homogeneamente distribuídas na área de estudo e foram entrevistados fazendeiros ou empregados. Os dados ecológicos tradicionais foram obtidos através de duas maneiras: mediante a procura de sinais indiretos da presença de tatus, e pela captura e marcação de indivíduos vivos. A maioria dos resultados foram coincidentes nos dois métodos. Conclui-se que as entrevistas podem contribuir com a investigação ecológica nas planícies pampeanas ao ajudar nas fases iniciais de um estudo para o desenho de levantamentos em campo. As entrevistas podem constituir uma ferramenta importante na tomada de decisões sobre o uso e manipulação da terra, devido a que representam um método de baixo custo em termos de tempo e dinheiro, e também por aportar resultados confiáveis.*

field study (Abba *et al*., 2007; Abba and Cassini, 2008).

Study area

The study area encompasses ~1000km² of the northeastern part of the Pampas grasslands of Argentina between 34°58.410´ and 35°30.604´S, and between - 57°47.389´ and 57°12.920´W. The climate is moderately warm and humid with mean temperature of 16.2°C and 1,035mm of annual precipitation. Most of this region is devoted to cattle grazing on natural or semi-natural grasslands, and less than 10% of the area is used for agriculture (INDEC, 2002). Farm sizes vary between 0.7 and 18km². Rural population density is very low, and it is normally limited to the owners of farms and a few employees. Density varies from 11.26 ind./km² in the northern part of the area, to 3.5 ind./km² in the southern part (INDEC, 2001). Pampas' inhabitants have a higher income than those of other rural areas of Argentina, and their level of education is high or intermediate (INDEC, 2001).

Xenarthra is one of the most characteristic groups of mammals in the Neotropics. Like many mammalian groups, conservation is becoming an increasing concern within this group. Thirty eight percent of the extant species (21 armadillos, 6 sloths and 4 anteaters) are threatened with extinction (Aguiar and Fonseca, 2008). Armadillos possess distinctive features. They are characterized by bony plates covered by a horny epidermis on the dorsal and lateral surfaces of the thorax and abdomen. Most prey are obtained by digging in the soil, and in general their diet consists of soil invertebrates, although they can also feed on some plant material and are occasionally observed preying on small vertebrates (McDonough and Loughry, 2008). Many species excavate burrows that are used as refuges, resting places, and nest sites for rearing the young. As a consequence, armadillos have strong fore and hind limbs ending in large, sharp claws that facilitate digging (McDonough and Loughry, 2008).

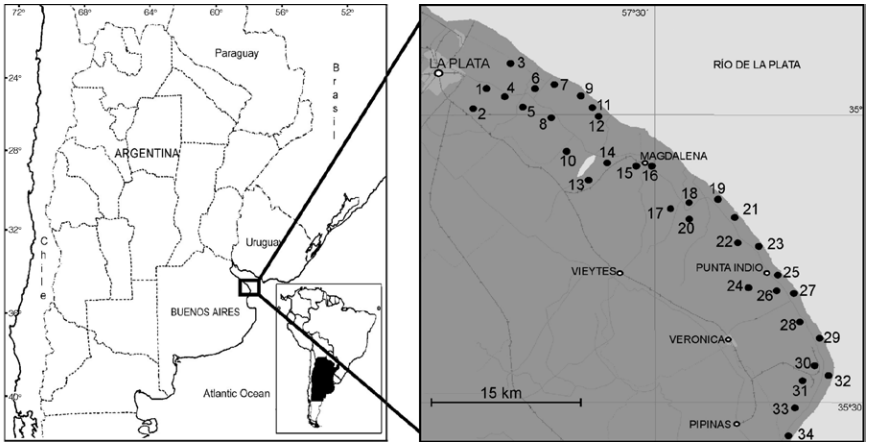

Figure 1. Geographic location of the study area in eastern Buenos Aires Province, Argentina, including the 34 surveyed localities.

In this study, we focused on three species of armadillos with different conservation status. *Chaetophractus villosus* (hairy armadillo) is widespread and abundant, and is frequently eradicated as a pest; it is the largest *Chaetophractus* species (~3500g), has carnivore-omnivore food habits, and is well known for eating carrion. It occupies a wide variety of environments. In Argentina it prefers grasslands and can tolerate highly modified habitats (Abba and Cassini, 2008). *C. vellerosus* (little hairy or screaming armadillo) is the smallest *Chaetophractus*, with an average body mass of 1000g. This species has been also described as carnivore-omnivore and mainly occupies arid and semi-arid environments where the soil is not hard (Redford and Eisenberg, 1992). It is a species with few conservation concerns. However, *Dasypus hybridus* (southern long-nosed armadillo) is considered as near threatened, both globally (Aguiar and Fonseca, 2008) and locally (Díaz and Ojeda, 2000). This species is of intermediate size (~2000g), with an average falling between the two *Chaetophractus* species living in the same area. It is a generalist insectivore that consumes a high proportion of ants, and is mostly found in open areas covered by natural grasslands; however, in recent times its presence has also been recorded in agro-ecosystems (Abba and Cassini, 2008).

Materials and Methods

Thirty four farms evenly distributed throughout the study area (Figure 1) were randomly selected. At these farms, qualified informants were interviewed. Interviewees were classified as qualified informants if they had

lived in the area for at least five years and drove, rode or walked around the farmland every day. Most of them were either the owner or an employee in charge of the farm. Data obtained through interviews were finally expressed as numbers of farms with positive responses (absolute frequencies) per question.

Semi-structured interviews were performed, because they are more flexible than standardized methods such as structured interviews or surveys. The advantage of this method is that it combines elements of a structured interview (questions are asked in a similar order and format, limited set of questions, etc.) with the possibility of exploring emergent themes and ideas, rather than relying only on concepts and questions defined in advance of the interview (Taylor and Bogdan, 1998).

The interview questionnaire consisted of three parts. The first part addressed the general characteristics and intensity of land use of the farms, the second asked questions specifically about armadillos, and the third part concerned interactions between people and armadillos. In Abba *et al.* (2007) the first and third parts were used. For this paper, in order to compare the answers with field data results, the seven following questions about armadillos were selected:

1) Which armadillo species exist on your farm?

2) What is the observed frequency of armadillos? In this question the answer was divided into two categories: a) high observation frequency, when the interviewee reportedly observed one or more armadillos per week, and b) low observation frequency, when the interviewee reported armadillos twice a month.

3) Which armadillo species is most commonly observed?

4) Did you see the armadillos in groups or alone? This question was separated by species.

5) Where is it common to find armadillos? This question was separated by species and by two major habitats: grasslands and woodlands.

6) At what time of day do you usually observe armadillos?

7) In which season (spring, summer, autumn, and winter) do you observe more armadillos?

Traditional ecological data were collected with two methods: searching for indirect signs, and mark-recapture. For the former, 70ha of each of the 34 farms were surveyed for signs of armadillos from Dec 2003 to Oct 2004. Two observers walked in a straight line, 20m apart, and located burrows within a distance of 10m to both sides. Observers walked for 5h at a speed of 3.5km/h, controlled with a global positioning system. Two types of burrows were identified for the three armadillo species: complex structures or home burrows, and simple structures or foraging holes. The features that allowed discrimination of burrows between species were the width and shape of the entrance, as well as the direct observation of digging individuals (Abba *et al.*, 2007).

Captures were conducted in sampling areas of 100ha, located in four fields that had been selected, based on abundant evidence of the presence of armadillos during the previous indirect sign survey. Capturing and marking techniques of similar armadillo species were developed by McDonough and Loughry (McDonough and Loughry, 1997; Loughry and McDonough, 1998). From Feb 2006 to Feb 2007, seasonal diurnal samplings were conducted from 08:00-09:00 to 19:00-20:00 during four days each. Two field workers walked 30m-wide sections or transects until covering the whole sampling area. The resulting sampling effort was of 60h per field and season, for a total of ~1000h. During the survey, all animals were captured and processed, and all burrows were checked for presence of armadillos. Animals were captured by hand or using a net, and burrows were checked by hand or sometimes opening them with a shovel. Animals were marked in the ears with an ear notcher (National Band and Tag Co. Nº 1559), and small skin samples were collected for future genetic studies. In addition, numbered metal ear tags (National Band & Tag Co. Nº 1005-1) were applied, and a sticker of different shapes and color was glued to the carapace. The latter were used as temporary marks to follow the animals after their release and to avoid recapturing them the same day.

Ecological data were expressed as numbers of farms with signs, quantity of signs by species, quantity of animals, and frequency of captures (Table I).

Answers to questions 1, 2, 3 and 5 were compared with signs survey, and those to questions 4, 6 and 7 with were compared with captures (see above). All comparisons between absolute frequencies obtained with both methods were conducted with contingency analyses (Statview v.5.0.1). For questions 1, 4, 5, 6 and 7 a probability of $p<0.05$

TABLE 1
FREQUENCIES USED TO CALCULATE THE χ^2 VALUES (SEE TABLE II)*

Question	Type				
1	Total abundance			Source	
				Interviews	Signs
				34 - 31 -5	29 - 15 - 7
2	Frequency of observation			Interviews *vs* signs	
	Agreements in high frequency			8	
	Agreements in low frequency			17	
	Disagreements			9	
3	Most common species	Agreements between interviews and signs			
		No	*C. villosus*	*D. hybridus*	*C. vellerosus*
	C. villosus	4	18	2	2
	D. hybridus	0	3	3	1
	C. vellerosus	0	0	0	1
4	Grouping *vs* alone			Interviews	Captures
		Grouping		13 - 9 - 3	3 - 28 - 0
		Alone		28 - 5 - 0	12 - 39 - 226
5	Grassland *vs* woodland			Interviews	Signs
		Grassland		22 - 29 - 1	204 - 60 - 14
		Woodland		12 - 4 - 2	75 -12 -13
6	Time			Interviews	Captures
		Morning		13 - 18 - 3	3 - 13 - 35
		Afternoon		10 - 16 - 3	10 - 36 - 93
		Night		23 - 0 - 0	5 - 0 - 9
7	Four seasons			Interviews	Captures
		Spring		23 - 24 - 4	2 - 26 - 21
		Summer		23 - 23 - 4	7 - 5 - 21
		Autumn		15 - 15 - 3	4 - 5 - 29
		Winter		19 - 17 - 3	2 - 3 - 41

* When the analysis is by species the values are in the order: *C. villosus* - *D. hybridus* - *C. vellerosus*.

implied that answers to interviews differed significantly from the data collected with signs or captures.The analyses of the questions 2 and 3 were conducted with frequencies of agreements and disagreements between both methods; therefore, $p<0.05$ implies that there were a significant number of agreements.

Results

Data collected through interviews and that obtained with sign surveys and captures of armadillos agreed for most variables: population abundance, frequency of observation, commonness, social behavior, seasonality, and habitat selection. Disagreement was found particularly in relation to daily rhythms. An analysis of each question follows.

Question 1: Which armadillo species exist in your farm? In all farms (34), informants reported the presence of *C. villosus*, most (31) reported *D. hybridus*, and only 5 farms reported *C. vellerosus*. In the sign survey, evidence of the presence of *C. villosus* was obtained in 29 farms, of *D. hybridus* in 15, and of *C. vellerosus* in 7 farms (Table I). No difference, or total coincidence, was found in the statistical comparison of the two methods (Table II).

Question 2: What is the observed frequency of armadillos? The same categories were used for the interview data and the signs in order to compare the data obtained at each of the 34 farms: i. High observation frequency, when >60 signs were found at the site, and ii. Low observation frequency, <60 signs were found (Table I). The number of 60 signs was chosen as the limit because this is the average of signs found per farm. No difference was found in the statistical comparison of the two methods (Table II).

Question 3: Which armadillo species is most commonly observed? For the signs data, the species of which more signs were registered at a farm was considered to be the more commonly observed. This information was compared to the interviewee's answer (Table I). No difference was found in the statistical comparison of the two methods (Table II).

Question 4: Did you see armadillos in groups or alone? This question was separated by species, and the results were compared with the frequency of captures (Table I). No differences were found for *C. villosus* and *D. hybridus* (Table II). For *C. vellerosus*, however, the interviewees reported that it is common to see this species in groups but our captures showed the opposite (Table II).

Question 5: Where is it common to find armadillos? The comparison was made with the frequency of signs found in each habitat (Table I) and did not show statistical differences in the three species (Table I).

Question 6: At what time do you usually observe armadillos? The categories of this question were (Table I) morning (08:00-12:00), afternoon (12:01-17:00) and night (17:01-20:00). Differences were found between interviews and the frequency of captures in *D. hybridus* and *C. villosus* (Table II). Comparison with *C. vellerosus* was not made because of the low quantity of interview data.

Question 7: In which season do you observe more armadillos? This comparison was carried out with frequency of captures for each season (Table I). No significant differences were found for *C. villosus* and *C. vellerosus*, but for *D. hybridus* there was partial coincidence (Table II).

In summary, 71% (10/14) of the results were coincident between both methods. All comparisons between signs and interviews agreed, but the captures gave different results for the social behavior of *C. vellerosus*, the diurnal activity pattern of *C. villosus* and *D. hybridus*, and for the seasonal activity pattern of *D. hybridus*.

TABLE II
COMPARISON BETWEEN DATA OBTAINED WITH INTERVIEWS AND TRADITIONAL ECOLOGICAL DATA (SIGNS AND CAPTURES)*

N°	Type	χ^2	p	Interviews vs. traditional
1	Total abundance	3.40	0.18	~
2	Frequency of observation	10.46	0.01	~
3	Most common species	14.30	0.03	~
4	Grouping *vs* alone			
	C. villosus	0.74	0.39	~
	D. hybridus	2.36	0.12	~
	C. vellerosus	98.12	0.0001	≠
5	Grassland *vs* woodland			
	C. villosus	0.36	0.55	~
	D. hybridus	0.30	0.30	~
	C. vellerosus	0.37	0.54	~
6	Time			
	C. villosus	6.89	0.03	±
	D. hybridus	5.98	0.01	±
	C. vellerosus	Not enough data		
7	Four seasons			
	C. villosus	3.44	0.33	~
	D. hybridus	14.56	0.002	±
	C. vellerosus	2.12	0.55	~

* $P>0.05$ implies coincidences between methods, with the exception of questions 2 and 3. In the latter case, analyses were conducted with frequencies of agreements and disagreements, and $p<0.05$ implies that there were a significant number of agreements (see Materials and Methods). +: total coincidence, ≠: misperceptions of respondents, ±: partial coincidence.

Discussion

Overall, there was agreement between fieldwork and interview results for the three armadillos species. *Post-hoc* explanations of the four observed discrepancies follow.

Although interviewees reported that *C. vellerosus* form groups, fieldwork suggested the opposite. The observations indicate that, in areas with high densities of this species, distances between individuals can be relatively short, but no less than 5m. Locals may infer that animals form groups because they observed them simultaneously foraging in the same area. The discrepancy in the data on daily activity for *C. villosus* can be explained by a deficiency of the field study; no surveys were carried out at nighttime, but 50% of the interviewees reported that *C. villosus* has nocturnal habits. Interviewees reported that *D. hybridus* is active both during the morning and afternoon hours, but the field data suggest that daily activity is concentrated in the afternoon. Although a slight difference between field data and interviews was found, both information sources agreed that the southern long-nosed armadillo is diurnal (there were no reports of this species being observed at night for both types of methods, but the χ^2 test dord not accept null values). Interviewees reported that *D. hybridus* is active all year long, but more animals were captured in spring; this difference seems to be caused by the high number of juveniles captured (14), which are very difficult to observe, in that season.

The semi-structured interview is a powerful method for documenting traditional ecological knowledge (Huntington, 1998). It allows the interviewer to collect a wide range of information by directing discussions to the ex-

tent necessary to cover specific topics more thoroughly. It also allows the participants in the interview to discuss and describe their understanding of the topics, and to establish connections based on that understanding rather than on the questions drawn up in advance by the interviewer (Huntington, 1998).

The broad concurrence among the result of the field work and the interviews is similar to that observed for carnivore densities in Africa (Gros, 1998) and belugas in Alaska (Huntington, 1998). A study on large migratory species in East Africa (Msoffe *et al*., 2007), comparing data from interviews and field work concluded, however, that field work information can not be replaced by secondary data such as interviews. Nevertheless, Msoffe *et al*. (2007) point out the importance of interviews in determining the general distribution of species and in guiding managers in the development of monitoring plans. These authors mention that direct census methods are often inadequate for shy and/or small-sized species, whose distribution is more reliably covered using different types of secondary data. This observation may be appropriate for the species of armadillos studied.

The interviews performed in wildlife studies provide overall descriptions of abundance, presence/absence, migratory patterns, local movements, feeding behavior, prey patterns, predator avoidance, ecological interactions, human influences, and other information. Broadly, the descriptions are in accordance with current scientific understanding, although the overlap is not complete. The main limitations of this kind of survey is that respondents can affect the results due to problems originating from poor memory and incorrect determination of number, sex, age of fauna at the time of observation (Gros, 1998). To minimize some of these problems and to confirm the collected information, it is necessary to generate as large a data set as possible for each surveyed area.

It is concluded that interviews can contribute to ecological research in the Pampas' grassland by helping to design field surveys in the initial phase of a study. Interviews can be an important tool in decision making in land use and management, because they are a low cost method in terms of time and budget and provide suitable results.

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