ORNITOLOGIA NEOTROPICAL 20: 35–46, 2008

PRIORITIES FOR THE CONSERVATION OF AN ENDANGERED GRASSLAND BIRD: CLUES FROM ITS NESTING BIOLOGY

Sergio M. Zalba, Rocío Sánchez, & Natalia C. Cozzani

GEKKO Grupo de Estudios en Conservación y Manejo, Departamento de Biología, Bioquímica y Farmacia, Universidad Nacional del Sur, San Juan 670, (8000) Bahía Blanca, Argentina. *E-mail:* szalba@criba.du.ar

Resumen. – Prioridades para la conservación de un ave de pastizal amenazada: claves que aporta su biología reproductiva. – La Loica pampeana (*Sturnella defilippii*) es una especie considerada vulnerable según la UICN (Unión Internacional para la Conservación de la Naturaleza) debido a que sufrió una gran retracción y disminución de su abundancia en los últimos 100 años y también a que habita uno de los ecosistemas mas modificados de la Argentina. La información sobre sus requerimientos de cría, fidelidad de sitio y tolerancia a las actuales prácticas productivas sería crucial para seleccionar una estrategia apropiada para su conservación. El estudio se realizó sobre un grupo hallado en un campo con ganado vacuno en el sudoeste de la provincia de Buenos Aires. Se estimó en dos escalas la composición y cobertura de la vegetación en diferentes estratos de altura para identificar posibles parámetros asociados con la selección de sitios para nidificar. Mediante análisis discriminantes se compararon las características del entorno de los nidos con las de puntos al azar. El éxito total de los nidos fue de 0,29. Por lo tanto, parece elegir sitios de matas densas cercanas al nido, pero con suelo desnudo a una escala mayor. A la menor escala considerada los nidos se asocian con mayores valores de cobertura de *Stipa tenuis*. En cuanto a la parcela mayor, las variables de cobertura de *S. tenuis*, *Aristida* sp. y el porcentaje de suelo desnudo se asocian de forma positiva con los nidos. Los nidos exitosos aparecen asociados a menores porcentajes de suelo desnudo en las parcelas menores respecto de los depredados. La Loica pampeana requiere matas altas de pasto en sitios relativamente abiertos cercanos al nido. Niveles intermedios de pastoreo podrían ser apropiados para la nidificación de esta especie.

Abstract. – The Pampas Meadowlark (*Sturnella defilippii*) is considered a vulnerable species by the IUCN (World Conservation Union) due its great range retraction and decrease in abundance over the last 100 years and also because it inhabits one of the most modified ecosystems in Argentina. Information about its nesting requirements, site fidelity and tolerance to current productive practices can be crucial for selecting an appropriate strategy for its conservation. This study was carried out on a breeding group found on a beef cattle farm in the southwest of Buenos Aires province. Plant species composition and vegetation cover at different heights were estimated at two scales, to identify possible parameters associated with nest site selection. The characteristics of these plots were compared with others selected at random in the immediate surroundings by discriminant analysis. Overall nest success was 0.29. Nests are associated with greater cover by bunch grass *Stipa tenuis* at the smaller scale, whereas in the larger plots the nests are positively related to areas of greater cover of *S.tenuis*, *Aristida* sp. and also greater percentage of bare ground. Therefore the species appears to choose to nest next to thick grass clumps, but at the larger scale prefers fairly open ground. The successful nests appear to be associated with lower percentages of bare ground in the smaller plots when compared to the predated nests. The Pampas Meadowlark requires tall clumps of grass in relatively open ground to nest. Intermediate levels of grazing might result in appropriate conditions for this species to nest. *Accepted 11 September 2008*.

Key words: Conservation, Pampas grasslands, *Sturnella defilippii*, nest success, biodiversity.

INTRODUCTION

Wild birds, like other organisms, show a tendency for selecting habitats of defined characteristics for feeding and reproduction (Cody 1985, Chase 2002, Davis 2005). These preferences are usually related to factors such as season, vegetation structure and resources availability and abundance (Steele 1993), as well as presence of competitors (Sherry & Holmes 1988) and risk of predation (Kelly 1993, Chase 2002). Nest predation is generally recognized as the main cause of mortality in a wide variety of birds (Ricklefs 1969). In grassland habitats the rates of predation of eggs and immature birds are often particularly high and so habitat selection may be affected by the availability of protected sites for nesting (Martin & Roper 1988, Rotenberry & Wiens 1989, Warren & Anderson 2005, Aguilar *et al.* 2008). In these habitats choosing an appropriate nesting site is particularly significant in terms of reproductive success and this situation is reflected, among other factors, in differences in structural characteristics of the vegetation surrounding successful and predated nests.

Grassland habitats are among the most modified habitats at a global level due to their suitability for cropping and cattle husbandry. These changes in grassland ecosystems, among other things, mean that birds cannot find favorable sites for feeding, nesting and rearing their young, therefore modifying key parameters of their population dynamics, such as reproductive success (Bucher & Nores 1988, Fraga 1998, Murphy 2003, Fondell & Ball 2004).

Habitat transformation is especially important in the case of species defined as "obligate grassland specialists" by Vickery *et al.* (1999), i.e., birds that depend entirely on grassland, with little or no use of other habitats. This is the case of the Pampas Meadowlark (*Sturnella defilippii*), considered one of the grassland birds that is most affected by modifications to the natural Pampas grassland habitats in Argentina (Fernández *et al.* 2003). The Pampas Meadowlark is currently included in the list of threatened species at international level, in the "vulnerable" category (BirdLife International 2000) due to notable retraction in its range of distribution and decrease in its abundance (Gabelli *et al.* 2004). The preference of reproductive groups of Pampas Meadowlark for natural grasslands (prairies dominated by native grasses like *Stipa* and *Piptochaetium*) over improved pastures and agricultural fields, have been highlighted in earlier studies (Tubaro & Gabelli 1999, Fernández *et al.* 2003). However, the presence of reproductive groups in cultivated land (Gochfeld 1979) or on cattle ranches (Tubaro & Gabelli 1999) is also cited. The species is very rare and there are almost no citations of the presence of breeding groups. Gochfeld (1976) compared the reproductive behavior of this species with others in the genus *Sturnella*, but the complete description of its nest was not published until 2004 (Cozzani *et al.* 2004). It has become necessary to analyze which are the key characteristics for nest site selection and in particular which habitat features are associated with successful nests, considering the tendencies of grassland habitat transformations described and the decline of the species in the last century.

Breeding biology can also give important clues for selecting among different management alternatives for the conservation of bird species (Keitt *et al.* 2003, Currie *et al.* 2004). This study presents a detailed analysis of environmental parameters associated with nest site selection by a reproductive group of the Pampas Meadowlark, analyzes the differences associated with successful and failed nests and discusses the appropriateness of different conservation approaches based on these results. Our specific goals are to assess

FIG. 1. Location of the study area.

habitat features associated to nesting site selection and, particularly, to successful breeding.

METHODS

This study was carried out on a 170 ha farm in the Southwestern Buenos Aires province, 30 km to the West of Bahía Blanca (Fig. 1). The climate of the region is temperate with an average annual temperature that oscillates between 14 and 20ºC with well marked seasons. The annual rainfall varies between 500 and 600 mm with a high level of monthly variability, being most abundant at the end of the spring and beginning of the summer (Campo de Ferreras *et al.* 2004).

The vegetation of the area is grass steppe with two periods of low growth, due to low temperatures in winter and drought and extremely high temperatures in summer (Bertonatti & Corcuera 2000). The study area was under a low intensity grazing regime (c. 10 cows) which was reflected by grass height in comparison with adjacent farms under heavier cattle density (Söderström *et al.* 2000). The dominant vegetation consists of grasses such as *Stipa tenuis*, *S. tenuisima*, *S. trichotoma* and *Piptochaetium* spp., forming fairly dense clumps, together with herbs such as *Margyricarpus pinnatus* and *Baccharis* spp as well as isolated bushes of *Discaria americana*.

The study started from the accidental observation of a breeding group in the site during spring 2003. We made intense surveys in that field and in others around that resulted in the finding of a unique group of 16 nests. Three nests were found during laying, six dur-

TABLE 1. Mean values and standard deviations of percentages of bare ground and vegetation cover in different height strata in plots of 0.5 and 16 m^2 centred on nests and random points. BG: bare ground, SD: standard deviation. N= 16 nests and 16 random points.

		Nests		Random points		t-test
		Mean	SD	Mean	SD	t (*P*)
0.5 m^2	BG	10.31	7.63	19.38	12.63	-2.20 (0.04)
Plot	0–15 cm	13.44	12.74	19.38	18.06	-0.93 (0.37)
	15–30 cm	56.88	16.42	42.50	19.92	2.60 (0.02)
	> 30 cm	19.69	14.55	19.06	14.17	0.17 (0.87)
16 m^2	BG	16.88	9.11	12.81	5.15	2.86 (0.01)
Plot	0–15 cm	16.88	9.64	17.81	9.83	-0.51 (0.62)
	15–30 cm	47.19	16.22	45.00	15.60	0.52 (0.61)
	> 30 cm	19.06	7.79	25.00	13.42	-1.50 (0.15)

TABLE 2. Composition of the vegetation associated with each nest and random point in plots of 0.5 and 16 m^2. Bac: *Baccharis* sp.; Stiten: *Stipa tenuis*; Stitss: *Stipa tenuissima*; Stitri: *Stipa trichotoma*; Pip sp.: *Piptochaetium* spp., Marpin: *Margyricarpus pinnatus*; SD: standard deviation. Only plants species found in more that 5% of the samples were included. N= 16 nests and 16 random points.

		Nests		Random points		t-test
		Mean	SD	Mean	SD	t (*P*)
0.5 m^2	Bac	7.63	11.61	10.25	18.57	-0.32 (0.75)
Plot	Stiten	42.81	13.41	20.38	17.39	5.13 (0.00)
	Stitss	3.44	5.98	14.13	8.96	-0.28 (0.78)
	Stitri	6.63	9.91	7.69	11.13	-0.11 (0.91)
	Pip sp.	16.94	12.41	17.56	20.36	0.02 (0.99)
	Marpin	5.13	12.47	1.38	4.98	1.12 (0.28)
16 m^2	Bac	10.19	12.09	9.44	15.72	0.62 (0.54)
Plot	Stiten	35.00	14.38	21.25	8.85	4.44 (0.00)
	Stitss	1.75	5.03	2.81	5.34	-1.23 (0.24)
	Stitri	3.69	5.24	7.56	11.74	-1.25 (0.23)
	Pip sp.	16.69	10.71	23.56	19.99	-0.88 (0.39)
	Marpin	2.31	3.38	1.94	3.17	0.10 (0.92)

ing incubation and the seven remaining at the nestling stage (Cozzani *et al.* 2004). No replications were analyzed as no other nests were found even though other farms with similar characteristics were surveyed in the study area. Finding the well-hidden nests of Pampas Meadowlark is labor-intensive. Nests were found by locating adults in construction activities or carrying food for their nestlings or flushing when an observer walked in the proximity of the nests. For each nest a random point 10 m away was taken as a reference, close enough to avoid the effect of any confounding factor related to variations in vegetation originated in soil or microtopography changes. Percentage cover of

TABLE 3. Mean values and standard deviations of percentages of bare ground and vegetation cover in different height strata in plots of 0.5 and 16 m^2 centred on successful and predated nests. BG: bare ground, SD: standard deviation, N = 7 successful and 7 predated nests.

		Successful nests		Predated nests		t-test
		Mean	SD	Mean	SD	t (*P*)
0.5 m^2	BG	5.71	5.35	13.57	8.52	-2.20 (0.04)
Plot	0–15 cm	12.14	10.35	16.43	16.51	-0.63 (0.54)
	15–30 cm	57.86	12.86	54.29	19.67	0.36 (0.72)
	> 30 cm	24.29	17.42	15.71	11.34	1.17 (0.26)
16 m^2	BG	17.14	9.06	17.14	10.75	-0.05 (0.96)
Plot	0–15 cm	19.29	12.39	15.71	7.87	0.54 (0.60)
	15–30 cm	43.57	19.52	49.29	15.12	-0.61 (0.55)
	> 30 cm	20.00	6.45	17.86	8.59	0.61 (0.55)

TABLE 4. Composition of the vegetation associated with each successful and predated nest in plots of 0.5 and 16 m^2. Bac: *Baccharis* sp.; Stiten: *Stipa tenuis*; Stitss: *Stipa tenuissima*; Stitri: *Stipa trichotoma*; Pip sp.: *Piptochaetium* spp., Marpin: *Margyricarpus pinnatus*; SD: standard deviation. Only plants species found in more that 5% of the samples were included. N= 7 successful and 7 predated nests.

		Successful nests		Predated nests		t-test
		Mean	SD	Mean	SD	t (*P*)
0.5 m^2	Bac	4.43	7.79	5.14	11.11	-0.02 (0.97)
Plot	Stiten	47.14	14.10	42.14	12.86	0.68 (0.51)
	Stitss	5.00	7.64	2.86	4.88	0.56 (0.58)
	Stitri	6.43	11.07	8.57	10.29	-0.68 (0.51)
	Pip sp.	18.57	11.07	20.00	12.58	0.09 (0.92)
	Marpin	1.57	3.74	6.57	16.95	-0.52 (0.61)
16 m^2	Bac	5.14	5.64	10.29	13.61	-0.54 (0.60)
Plot	Stiten	42.14	15.77	30.00	11.90	1.63 (0.13)
	Stitss	3.71	7.41	0.29	0.49	1.21 (0.24)
	Stitri	3.71	5.47	4.57	5.86	-0.34 (0.74)
	Pip sp.	16.43	5.56	21.43	12.15	-0.92 (0.37)
	Marpin	0.71	0.49	3.86	4.53	-1.47 (0.16)

each plant species that appeared in more than 5% of the samples and of bare ground were visually estimated using a modified canopy cover method (Daubenmire 1968) at all nest sites and reference points, as well as the percentage of vegetation cover in strata of 0 to 15 cm, 15 to 30 cm and more than 30 cm of height. This data was recorded at two scales: in quadrats of 0.5 m^2 (80 cm diameter) next to the nests and reference points, and at a larger one in 16 m^2 plots, the smaller included in the larger one. The smaller scale was selected to reflect characteristics of the nesting point itself that could be related with the detectability of the nests, while the larger samples were intended to render information about other

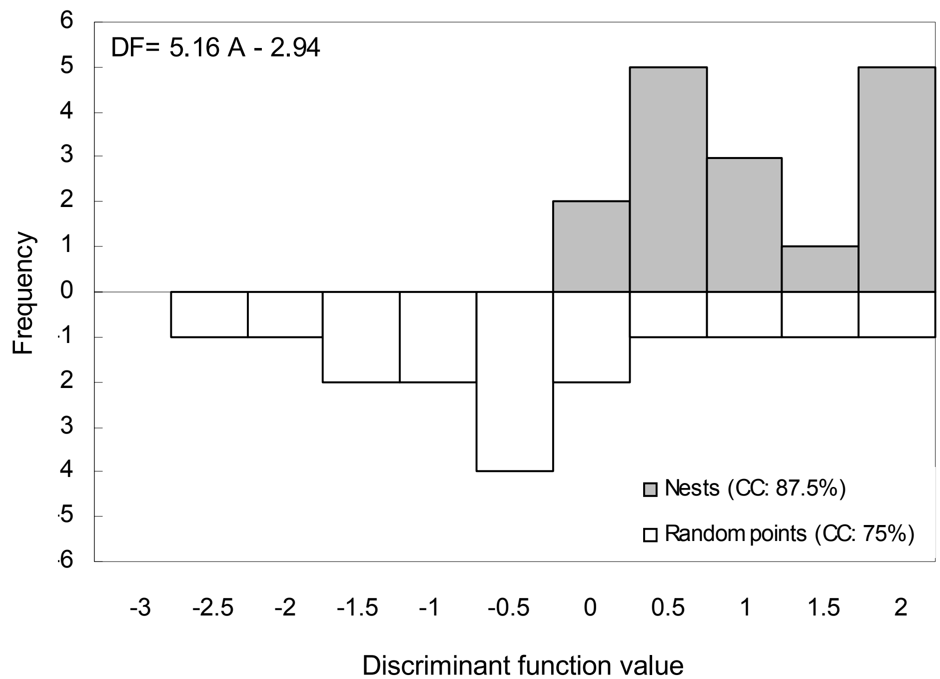

FIG. 2. Histogram of frequencies of discriminant analysis for nests and random points in the plots of 0.5 m^2. DF: discriminant function, A: cover of S*tipa tenuis*, CC: correctly classified.

habitat requirements, like food availability in the vincinity.

Vegetation data were recorded during December and January when the nests were abandoned by the birds, to avoid interfering with their behavior during incubation or rearing.

All nests were monitored daily until they were predated or abandoned by the young birds. A nest was classified as predated when it was found empty earlier than expected for nestling maturation and abandoned when no further parental activity (incubation or nestlings feeding) was observed, taking a 10 days rearing period into account (Cozzani *et al.* 2004). Daily survival rate was calculated following Mayfield survival rate estimation method (Mayfield 1975), modified by Bart & Robson (1982).

Characteristics of the 16 nests sites were compared with the random points by a discriminant analysis run for each scale of habitat assesment. The values of the habitat parameters estimated as percentages were transformed to the arc sine of the square root. Discriminant analysis was conducted using the SPSS version 6.1 statistical program, stepwise technique and Wilks' Lambda algorithm of selection of variables were used in all cases.

Environmental parameters of the nests and random points were also compared individually using paired samples t-tests, while successful and predated nests were compared by conventional t-tests, in all the cases for the two plot sizes.

Finally, distances from each nest to a main road and a farm track were measured graphically using points taken with a Garmin 12

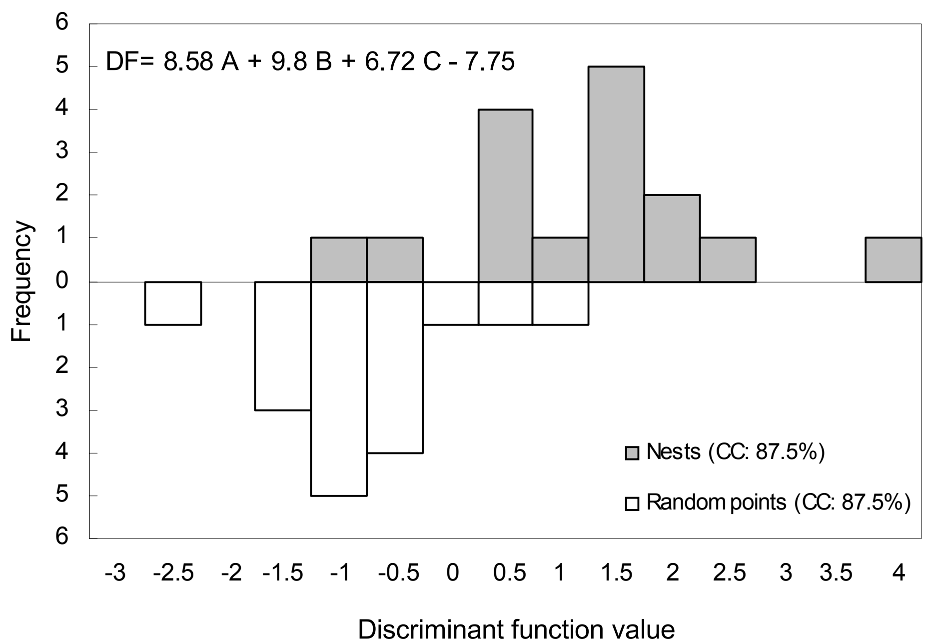

FIG. 3. Histogram of frequencies of discriminant analysis for nests and random points in plots of 16 m^2. DF: discriminant function, A: cover of *Stipa tenuis*, B: cover of *Aristida* sp., C: percentage of bare ground, CC: correctly classified.

GPS in the field, and t-tests were used to determine if there were differences in the average distances between successful and predated nests.

Visits to the same study site were repeated in the following two years in order to determine the presence of nesting pairs.

RESULTS

Seven of the sixteen nests studied were predated (11 nestlings and 10 eggs) and seven were successful (27 nestlings). Only one nest was abandoned, abandonment occurred during the laying phase, between the second and the third monitoring visit. Potential predators in the area include Chimango Caracaras (*Milvago chimango*), Burrowing Owls (*Athene cunnicularia*), Southern Lapwings (*Vanellus chilensis*), crossed pit viper (*Bothrops alternatus*), Geoffroy's cat (*Oncifelis geoffroyi*), pampas fox (*Lycalopex gymnocercus*), molina's hog-nosed skunk (*Conepatus chinga*), lesser grison (*Galictis cuja*), and large hairy armadillo (*Chaetophractus villosus*), but the cause of predation was not assessed for any nest. One nest was abandoned and the remaining one was already empty when found and the nestlings were in an intermediate state of maturation, so no conclusion could be drawn (Cozzani *et al.* 2004). Daily survival rate was 0.94 (n = 14, SD = 0.02). The overall nesting success for the population was 0.29, calculated as the survival rate raised to the power of the length of the nesting period (estimated in 20 days from our results).

Discriminant analysis showed that the nests had a greater cover of *Stipa tenuis* than the random points in the immediate surroundings (F = 17.14; df = 30; df = 1; P <

0.001) (Fig. 2) and higher percentages of cover of bare ground, *S. tenuis* and *Aristida* sp. in the larger plot (F = 9.92; df = 29; df = 2; P < 0.001; F = 10.95; df = 30; df = 1; P < 0.01 and F = 9.62; df = 28; df = 3; P < 0.001 respectively) (Fig. 3), even though the latter species showed very low percentage cover in both samples.

Nests were associated with tall vegetation (high percentage cover of the 15–30 cm height strata), and dominated by *Stipa tenuis* and *Piptochaetium* sp., in both the 0.5 m^2 and the 16 m^2 plots. The t-tests of paired samples showed that there were lower percentages of bare ground and greater cover in the 15 to 30 cm strata in the immediate surroundings of the nests. The paired t-tests also agreed with the results of the discriminant analysis in that they showed that the percentages of bare ground in the 16 m^2 plots were greater at the nest sites than at the random points (Tables 1 and 2).

Significant differences between successful and predated nests were found only for the percentage of bare ground in the 0.5 m^2 plots, that was greater for the predated ones (t = 2.20, P = 0.04; Tables 3 and 4).

Successful and predated nests were located at a mean distance of 20.9 m (SD = 14.71) and 20.5 m (SD = 8.20), from the main road, and at 59.1 (SD = 30.10) and 39.2 (SD = 37.95) from the farm track, respectively. These differences were not statistically significant (P > 0.94 and P > 0.30, respectively).

Adults showing breeding behavior were detected in the same area in the following two years, but no nests were detected, despite intensive nest search.

DISCUSSION

The results obtained confirm the existence of patterns of nest site selection by the Pampas Meadowlark at the two scales studied, and that they are associated with differences in vegetation composition and cover. In the study area, at a scale of a few metres diameter, the birds selected the more open sites to nest, but preferred the more closed microhabitats as specific nest sites. We are aware about the limitations related to the small sample size (only 16 nests) and to the fact that they were all concentrated to a unique location and at a single year, at the light of these considerations, the results obtained should be taken mostly as hypothesis about the nesting requirements of this extremely rare species. According to our results the Pampas Meadowlark chooses points with a predominant vegetation of 15 to 30 cm height strata, and in particular clumps of *Stipa tenuis*, which together with *Piptochaetium* sp. are the species used for nest construction. The lack of evidences of nest abandonment or nestlings mortality due to starvation or severe climate episodes (no nestlings were found dead in the nests and only one abanndoned nest was recorded), indicate that predation seems to be the main cause of breeding failure. The selection of sites with greater vegetation cover in the immediate surroundings of the nests might be related to low risk of detection by the predators. Several studies on ground nesting birds show that risk of predation is greater in areas of short grass where nests are much more visible (Sutter 1997, Willson *et al.* 2001, Chase 2002, Fondell & Ball 2004). In our work, nests built in more open grass tussocks (greater cover of bare ground in the 0.5 m^2) were predated more frequently that nests with more vegetation cover, supporting this selection tendency. This was the only habitat parameter for nest site selection with a noticeable effect on successful reproduction, which might at first seem to be a contradiction to the hypothesis that states that preferences in selected sites strongly develop in response to predation. Chase (2002) explains this apparent contradiction by considering that high levels of predation caused by a diverse community of predators diminish the selection of appropriate nesting sites, because a certain group of selected characters probably does not offer protection for multiple types of predators. Dion *et al.* (2000) also observed that different predators prefer sites with different vegetation cover. Therefore, a diverse group of predators might dilute the advantages associated with the selection of a particular type of habitat, except, precisely, in the case of the degree to which the nests are hidden.

At a larger spatial scale the preference found for nest establishment in relatively open areas (in our case nests surrounded by areas with a relatively high percentage of bare ground) might be related to greater liberty for movement on the ground and greater facility for obtaining food. These observations appear to be in agreement with data reported by Söderström *et al.* (2000) who studied semi-natural pastures in the centre south of Sweden, and argued that species weighing more than 30 g, classified as large insectivorous species (the group to which the Pampas Meadowlark belongs), feed on large prey that have maximum richness and abundance at intermediate grazing levels. Capture of large prey might provide these birds with significant energy with a smaller investment of time in comparison to birds that prefer small prey (Britschgi *et al.* 2006).

Other studies postulate that the Pampas Meadowlark is sensitive to changes in the vegetation structure and is not adapted to modified areas. They suggest that the main cause for the decline of the species is the destruction of the habitat (Tubaro & Gabelli 1999, Gabelli *et al.* 2004). Nevertheless, Fernández *et al.* (2003) show that a high percentage of natural grassland, apparently very suitable for reproduction, were not occupied or re-used for nesting.

Our study seems to indicate that the species prefers relatively open sites and that a complete absence of grazing might be associated with a decrease in the quality of breeding habitat. We could not find any nests of this species in the same field the following year when higher rainfall had resulted in a notably greater vegetation density, probably reducing its suitability for the species, in agreement with this presumption. The idea that intermediate levels of grazing are associated with high quality habitat for grassland birds has often been cited in the literature. Herkert (1998) emphasises that the absence of regular disturbances in natural areas lead to an increase in the density and height of the vegetation, resulting in a negative impact on species that prefer grassland areas with low grass. Zalba & Cozzani (2004) recommend that the maintenance of moderate grazing regimes should be considered as a strategy for maintaining bird diversity and specifically for favoring grassland bird species in natural grassland areas in Argentina. The Pampas ecosystem evolved in the presence of native herbivores, such as deer and guanacos (Chebez 1994), and it is therefore possible that the typical birds of this ecosystem prefer habitats with moderate levels of grazing. However these considerations are based on only one study area and one nesting season, so it is important to repeat this analysis to reinforce the conclusions.

Finally, our study also reports a lack of correlation between the distance to a main road and a farm track and the breeding success of the Pampas Meadowlark, although it is likely that the scale used for the study was too small to detect an effect of this nature. Stephens *et al.* (2003) suggested that the presence and impact of predators is sensitive to fragmentation at landscape scales, and consequently variations in birds breeding success might be better explained if the landscape conditions are considered on a large scale. Despite the fact of our study site being a small grassland patch of 170 ha, calculated daily predation rates are lower than those obtained for grassland birds breeding in small (< 100 ha) prairie patches in midcontinental USA, and also smaller than most of those obtained for medium size (100–1000 ha) patches in the same work (Herkert *et al.* 2003). More work is necessary to attribute the studied effects to fragmentation or to other phenomenon associated with habitat alteration rather than to stochastic variations of the environment.

CONSERVATION STRATEGIES

A set of considerations can be postulated from our results in order to suggest conservation strategies for the species. All these points must be taken as preliminary deserving further confirmation, considering that they were elaborated from a small number of nests in a unique breeding area. Nevertheless, considering the rarity of the species, they could be taken as hypothesis for proposing an adaptive conservation approach: (1) The species' reproductive activity seems to be compatible with moderate levels of grazing, even in the vicinity of disturbed areas such as roads; (2) The species selects certain fields for nesting leaving others with apparently similar characteristics; and (3) The use of a given field for nesting, even if reproduction is successful there, does not predict its use the next season.

From these observations it seems appropriate to propose the adoption of versatile conservation measures, directed to the promotion of appropriate management decisions in productive areas, specially in beef ranches, that are compatible with the presence of the species. The option of establishing protected areas, that exclude livestock, alone, does not seem the most appropriate considering the extension and intensity of land transformation in the region, land costs, and the difficulty of predicting the use of a given area for breeding. We recommend, instead, to deepen the knowledge about the effects of different productive practices on the populations of this species, in order to promote its conservation in fields destined to agriculture and in cattle ranches. Accordingly, it is crucial to implement an educational policy to highlight the importance of range management as a tool to protect biodiversity and to preserve the processes and resources constituting the productive basis in the whole region.

ACKNOWLEDGMENTS

We would like to thank all the help and friendship received from Manuel Ignacio Remondegui during our field work. Cristóbal Doiny Cabré kindly provided written information about the species and also data from his own experience as bird-watcher. Guillermo and Jose Barrenechea, Jose Luis Vidal, Francisco Kuhar and Martín Sotelo assited us in the field. We also want to thank Dr. M. Gochfeld and two anonymous reviewers that provided valuable suggestions on the manuscript. This work received financial supprot from CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas).

REFERENCES

Aguilar T. M., R. I. Dias, A. C. Oliveira, & R. H. Macedo. 2008. Nest-site selection by Blue-black Grassquits in a Neotropical savanna: do choices influence nest success? J. Field Ornithol. 79: 24–31.

Bart J., & D. S. Robson. 1982. Estimating survivorship when the subjects are visited periodically. Ecology 63: 1078–1090.

Bertonatti, C., & J. Corcuera. 2000. Diagnóstico ambiental de la República Argentina. Fundación Vida Silvestre Argentina, Buenos Aires, Argentina.

BirdLife International 2000. Threatened birds of the world. Birdlife International, Cambridge, UK.

Bucher, E. H., & M. Nores. 1988. Present status of birds in steppes and savannas on northern and central Argentina. Pp. 71–79 *in* Goriup, P. D.

(ed.). Ecology and conservation of grassland birds. ICBP Technical Publication nº 7, International Council for Bird Preservation, Cambridge, UK.

Britschgi, A., R. Spaar, & R. Arlettaz. 2006. Impact of grassland farming intensification on the breeding ecology of an indicator insectivorous passerine, the Whinchat *Saxicola rubetra*: Lessons for overall Alpine meadowland management. Biol. Conserv. 130: 193–205.

Campo de Ferreras, A. M., A. M. Capelli de Steffens, & P. G. Diez. 2004. El clima del suroeste bonaerense. Departamento de Geografía y Turismo, Univ. Nacional del Sur, Bahía Blanca, Argentina.

Chase, M. K. 2002. Nest site selection and nest success in a Song Sparrow population: the significance of spatial variation. Condor 104: 103–116.

Chebez, J. C. 1994. Los que se van. Especies argentinas en peligro. Ed. Albatros, Buenos Aires, Argentina.

Cody, M. L. 1985. Habitat selection in grassland and open-country birds. Pp 191–226 *in* Cody M.L. (ed.). Habitat selection in birds. Academic Press, San Diego, California.

Cozzani, N., R. Sánchez, & S. M. Zalba. 2004. Nidificación de la Loica pampeana (*Sturnella defilippii*) en la provincia de Buenos Aires. Hornero 19: 47–52.

Currie, D., R. Fanchette, J. Millett, C. Hoareau, & N. J. Shah. 2004. The breeding biology of the critically endangered Seychelles Scops-owl *Otus insularis*: consequences for conservation and management. Bird Conserv. Int. 14: 123–137

Daubenmire, R. F. 1968. Plant communities: A Textbook of plant synecology. Harper & Row, New York., New York.

Davis, S. K. 2005. Nest-site selection patterns and the influence of vegetation on nest survival of mixed-grass prairie passerines. Condor 107: 605–616.

Dion, N., K. A. Hobson, & S. Larivière. 2000. Interactive effects of vegetation and predators on the success of natural and simulated nests of grassland songbirds. Condor 102: 629–634.

Fernández, G. J., G. Posse, V. Ferretti, & F. M. Gabelli. 2003. Bird-habitat relationship for the declining Pampas Meadowlark populations in the southern pampas grasslands. Biol. Conserv. 115: 139–148.

Fondell, T. F., & I. J. Ball. 2004. Density and success of bird nests relative to grazing on western Montana grasslands. Biol. Conserv. 117: 203–213.

Fraga, R. 1998. Comprendiendo a un ave amenazada: Tordo Amarillo. Nat. Conserv. 2(3): 12–15.

Gabelli, F. M., G. J. Fernández, V. Ferretti, G. Posse, E. Coconier, H. J. Gavieiro, P. E. Llambías, P. I. Peláez, M. L. Vallés, & P. L.Tubaro. 2004. Range contration in the Pampas Meadowlark *Sturnella defilippii* in the southern pampas grasslands of Argentina. Oryx 38: 164–170.

Gochfeld, M. 1976. Comparative ecology and behavior of Red-breasted Meadowlarks (Aves, Icteridae) and their interactions in sympatry. Ph. D. diss., City Univ. of New York, New York, New York.

Gochfeld, M. 1979. Brood parasite and host coevolution: interactions between Shiny Cowbirds and two species of meadowlarks. Am. Nat. 113: 855–870.

Herkert, J. R. 1998. The influence of the CRP on Grasshopper Sparrow population trends in the mid-continental United States. Wildl. Soc. Bull. 26: 227-231.

Herkert, J. R., D. L. Reinking, D. A. Wiedenfeld, M. Winter, J. L. Zimmerman, W. E. Jensen, E. J. Finck, R. R. Koford, D. H. Wolfe, S. K. Sherrod, M. A. Jenkins, J. Faaborg, & S. K. Robinson. 2003. Effects of prairie fragmentation on the nest success of breeding birds in the mid-continental United States. Conserv. Biol. 17: 587–594.

Keitt, B. S., B. R. Tershy, & D. A. Croll. 2003. Breeding biology and conservation of the Black-vented Shearwater *Puffinus opisthomelas*. Ibis, 145: 673–680.

Kelly, J. P. 1993. The effect of nest predation on habitat selection by Dusky Flycatchers in limber pine-juniper woodland. Condor 92: 83–93.

Martin, T. E., & J. J. Roper. 1988. Nest predation and nest-site selection of a western population of the Hermit Thrush. Condor 90: 51–57.

Mayfield, H. F. 1975. Suggestions for calculating nest success. Wilson Bull. 87: 456–466.

Murphy, M. T. 2003. Avian population trends within the evolving agricultural landscape of eastern and central United States. Auk 120: 20–34.

Rotenberry, J. T., & J. A. Wiens. 1989. Reproductive biology of shrubsteppe passerine birds: geographical and temporal variation in clutch size, brood size, and fledging success. Condor 9: 1–14.

Söderström, B., T. Pärt, & E. Linnarsson. 2000. Grazing effects on between-year variation of farmland bird communities. Ecol. Appl. 11: 1141–1150.

Steele, B. B. 1993. Selection of foraging and nesting sites by Black-throated Blue Warblers: their relative influence on habitat choice. Condor 95: 568–579.

Stephens, S. E., D. N. Koons, J. J. Rotella, & D. W. Willey. 2003. Effects of habitat fragmentation on avian nesting success: a review of the evidence at multiple spatial scales. Biol. Conserv. 115: 101–110.

Sutter, G. C. 1997. Nest-site selection and nest-entrance orientation in Sprague's Pipit. Wilson Bull. 109: 462–469.

Tubaro, P. L., & F. M. Gabelli. 1999. The decline of the Pampas Meadowlark: difficulties of applying the IUCN criteria to Neotropical grassland birds. Stud. Avian Biol. 19: 250–257.

Vickery, P. D., P. L. Tubaro, J. M. C. Da Silva, B. G. Peterjohn, J. R. Herkert, & R. B. Cavalcanti. 1999. Conservation of grassland birds in the Western Hemisphere. Stud. Avian Biol. 19: 2–26.

Warren K. A., & J. T. Anderson. 2005. Grassland songbird nest-site selection and response to mowing in West Virginia. Wildl. Soc. Bull. 33: 285–292.

Willson, M., J. L. Morrison, K. Sieving, E. T. L. De Santo, L. Santisteban, & I. Diaz. 2001. Patterns of predation risk and survival of birds nests in a chilean agricultural landscape. Conserv. Biol. 15: 447–456.

Zalba, S. M., & N. C. Cozzani. 2004. The impact of feral horses on grassland bird communities. Anim. Conserv. 7: 35–44.