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BREEDING PASSERINES COMMUNITIES IN THE VALDES PENINSULA (PATAGONIA, ARGENTINA)

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Resumen. – Comunidad de paseriformes nidificantes de la Península Valdés (Patagonia, Argentina). – La Península de Valdes es un area de gran riqueza natural, localizada en la costa Este de la Patagonia Argentina. El propósito de este trabajo fue analizar la comunidad de aves Passeriformes de las areas internas de la región, con el proposito de identificar las especies que caracterizan cada comunidad, determinando las principales tipologias ambientales frecuentadas, para poder estudiar las relaciones entre la riqueza y abundancia de aves y la estructura del ambiente. Se realizaron 107 puntos de conteo durante la temporada reproductiva de 2011, en donde se detectaron 869 aves pertenecientes a 23 especies de Passeriformes. Para los análisis se usó el método de agrupamiento por el método del *Indicator Value*. Los resultados evidencian la existencia de dos diferentes comunidades: una asociada exclusivamente a la estepa herbácea y caracterizada por las especies Cachirla uña corta (*Anthus furcatus*) y Minero común (*Geositta cunicularia*); mientras que la otra, asociada a la estepa arbustiva, es caracterizada por diferentes especies típicas, como el Chingolo (*Zonotrichia capensis*), que es la especie de mayor distribución. Estos resultados constituyen una actualización al conocimiento de la fauna de la Península de Valdés, los cuales pueden ser útiles para el manejo y conservación de la avifauna de la región.

Abstract. – The Valdes Peninsula is a high-natural value area, located on the east coast of Argentine Patagonia. The aim of the reported research was to analyze the community of breeding passerine birds of the inland areas, with the purpose to identify the species that characterize each community, determining the main environmental typologies frequented, in order to study the relationships between bird richness and abundance, and environmental structure. During the breeding season 2011, 107 point counts were performed. 869 birds belonging to 23 passerine species were contacted and analyzed through a cluster analysis using the Indicator Value method. Results revealed the existence of two different communities: one that essentially refers to the grassy steppe where the characteristic species are Short-billed Pipit (*Anthus furcatus*) and Common Miner (*Geositta cunicularia*), and the other one, which occupies the shrub-steppe consisting of more characteristic species, starting from the Rufous-collared Sparrow (*Zonotrichia capensis*), the most widespread species. These results update previous results on the community of passerines living in the study area and provide some useful insights for management purposes. *Accepted 28 April 2014.*

Key words: Argentina, breeding birds, characteristic species, Indicator Value, passerine communities, steppe environment, Valdes Peninsula.

INTRODUCTION

Although there is an important number of scientific papers on non-passerine avian communities in the Valdes Peninsula (Bertelotti *et al.* 1995, D'Amico *et al.* 2004, Guy Morrison *et al.* 2004, Hernández *et al.* 2004, Hernández & Bala 2007, Cooke & Mills 2008), few information refers to on passerine species. Yet, passerine birds are often used in ecology as indicators of environmental quality because they are good "ecological indicators" of the degree of complexity and degradation of terrestrial ecosystems (Gregory 2003). In fact, the prerogative of a good ecological indicator is to be widespread in the environment as the birds are, because they live on the ground, in the vegetation and up to the lower layers of the atmosphere, occupying different habitat types. They also play a fundamental role in the trophic network, since they are organisms that can occupy different roles in the food chain. Another feature of the bird community that allows to use it as an environmental indicator is its strict correlation with the structure of the vegetation, which is, in turn, influenced by the type of management environmental in place; in fact the number and diversity of birds in an area reflect the availability of critical resources, such as vegetation volume (Mills *et al.* 1991).

Therefore, an analysis aimed at the study of passerines can provide useful information on both the species and their aggregations, which depend on the occupied areas, and on the state of the health of the ecosystem which they are a part of; this analysis can provide useful information, considering that vegetation of Peninsula Valdes has been profoundly influenced by over-grazing of sheep. In fact, starting from the last century, to the large herds of wild herbivores, the grazing of domestic livestock (mainly sheep) introduced by pioneers was added. This system of land use could not succeed given the region's ecology, because stocking rates were above the carrying capacity of the pasture (Rostagno & Del Valle 1988): long-term effects of over-grazing include decrease of the dimension of shrub patches, reduction of species richness, reduction of cover of palatable plants, and increase of unpalatable woody plants (e.g., Milchunas & Lauenroth 1993, Bisigato & Bertiller 1997, Perelman *et al.* 1997).

For all these reasons, the aim of this paper is to analyze the species of passerines in the Valdes Peninsula during the breeding season, by studying the distribution of species in relation to vegetation structures, in order to define the communities and to draw some useful indications for conservation purposes.

This contribution is the first revision of the occurrences of each breeding species of passerines in the Valdes Peninsula.

STUDY AREA

The study was conducted in 2011 in the Valdes Peninsula (Fig. 1), a peninsula situated in the Atlantic coast, in the north-east area of the Chubut Province, Argentina. It is about 3600 km^2 and it is an important nature reserve which was inscribed in 1999 on the list of World Heritage Sites by UNESCO (World Heritage Committee 1999) and an important bird area (IBA AR237) for bird conservation (Yorio *et al.* 2005, Coconier & Di Giacomo 2009). The landscape is composed of vast expanses of arid flat land and of some salt lakes. The largest ones are called Salina Grande and Salina Chica, the latter being 40 m b.s.l., the lowest point in South America.

The climate of the Valdes Peninsula is semi-arid, with an average annual rainfall of about 240 mm, mainly occurring in autumn and winter. The monthly average relative humidity is between 65% in winter and 50% in summer. The average monthly temperature is 18 ºC in summer and 8 ºC in winter, with a wide range of daily temperatures, due to the considerable influence of the Atlantic Ocean (Rivero 1983). According to Rivas-Martínez (2010), the study area is considered as a part of the Mediterranean macrobioclimatic region, with a xeric oceanic bioclimate, upper mesomediterranean thermotype, and semiarid ombrotype.

As for the floristic aspect, the Valdes Peninsula occupies the Neotropical Region, the Andean-Patagonian District, the Patagonian Province, the Central District (Cabrera 1976), and the Soriano District (Soriano 1956). This last district has been further subdivided, thus giving birth to the Subdistrict Chubutense. Among the four types of vegetation described by Codesido *et al.* (2005), one can identify two main types of environmental units, that can be distinguished on the basis of differences in the flora: shrub steppe and herbaceous steppe. In general terms, the shrub steppe is composed of low shrub. The most spread plants are *Chuquiraga avellanedae*, *Lycium chilense*, *Schinus johnstonii*, *Acantholippia seriphioides* and *Prosopis denudans*. Higher shrubs mainly grow together with mounds of the soil, because plant roots contribute to hold the soil where the plant can grow up (Rostagno & Del Valle 1988). These species often have shallow-root systems which allow them to profusely grow in sandy soils. On the contrary, the herbaceous steppe is dominated by *Stipa tenuis* and *Piptochaetium napostaense*, a community characterized by low vegetation, with some isolated spots of *Acantholippia seriphioides*. The dynamics of these ecosystems is often associated with the movement of dunes.

METHODS

Bird data. The survey on birds was conducted from 4–28 November 2011, early in the morning during clear days with little wind. 107 point counts (Bibby *et al.* 1992) were uniformly located in the Valdes Peninsula, a minimum of 1 km apart, and evenly distributed, depending on the vegetation types (proportionally stratified sampling, in order to perform a greater number of point counts in the most widespread vegetation types) (Fig. 1). Two main vegetation types were distinguished:

H, herbaceous steppe, 24 point counts; and

S, shrub steppe, 83 point counts, further subdivided into:

2.1 SL shrubs (shrubs < 1 m), 41 point counts;

2.2 SH high shrubs (shrubs > 1.5 m), 20 point counts;

2.3 SM low shrubs with some high shrubs, 22 point counts.

Each single point counts were simultaneously monitored by three observers for 10 minutes. All birds belonging to a passerine species were visually or acoustically detected within a radius of 100 m from the observer and consequently recorded. Only breeding birds in the peninsula are considered in this paper, according to the criteria of the European Bird Census Council (Hagemeijer & Blair 1997). In every point, also coordinates and altitude were recorded.

Analysis. Bird data were processed through cluster analysis carried on the basis of presence/absence of bird species in every point count. In clustering the number of groups is defined by the user prior to the analysis. Then, an objective criterion is required to evaluate the appropriate number of clusters (Milligan & Cooper 1985). In order to objectively assess whether adding one more cluster improves the classification of point counts on the basis

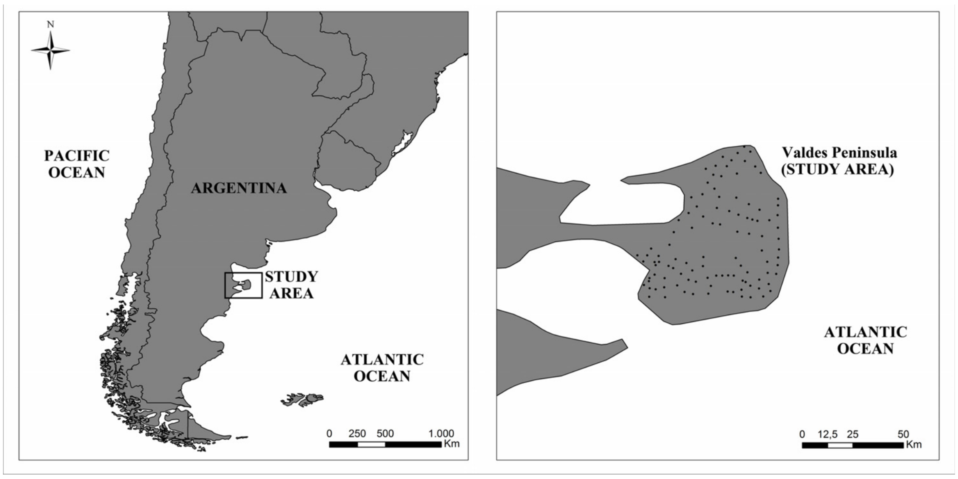

FIG. 1. Study area corresponding to Valdes Peninsula, Argentina, and the location of the 107 point counts.

of the avian composition, the Indicator Value (IV) was used. It is a method proposed by Dufrêne & Legendre (1997), by which an indicator for each species in every cluster is calculated. This indicator considers both fidelity and specificity. Fidelity of species to a given group indicates that that species is widespread in that group. It is measured in terms of relative frequency within the group, that is the ratio between the number of units - in this case point counts -, in which the species is present and the total number of units composing the group. Specificity indicates how a species exclusively belongs to a group. It is measured through the ratio between the number of units in which the species is present within the group and the total number of units in which the species considering all clusters. The product between specificity and fidelity multiplied by 100 produces the IV, which is a measure of the effectiveness of a species as an indicator of a group. The values may vary between 0 and 100.

The Indicator Value for each species is calculated as follows:

$IV_{zx} = S_{zx} \times F_{zx} \times 100$,

$S_{zx} = P_{zx} / P_z$,

$F_{zx} = P_{zx} / P_x$,

where P_{zx} is the number of point counts in x cluster with z species present; P_z is the total number of point counts occupied by z species in all clusters; P_x is the total number of point counts x in cluster; and IV_{zx} is the Indicator Value of z species in x cluster.

Therefore, the sums of Indicator Values of all species were calculated for each cluster solution, ranging from no-splitting solution to 10-cluster solution. The difference between cluster solution x and x-*1* for all species is also calculated (Pasinelli *et al.* 2001). If the Indicator Value of a species abruptly increases between subsequent cluster steps, the new subdivision better corresponds to the species distribution. Conversely, an important decline indicates a poorer representation of the species distribution by the new subdivision. That is why, the cluster analysis solution with the highest IV value and with the largest difference between the solutions of subsequent cluster steps was selected. Each identified cluster was analyzed in order to study the composition of species, which characterizes and defines the bird community. According to Dufrêne & Legendre (1997), characteristic species for each cluster were also determined, by considering species with an

IV > 25% for a specific cluster and the higher value of specificity and fidelity in the same cluster.

The mean bird richness and the mean number of individuals per point count in each cluster were also calculated. The same clusters were finally characterized on the basis of vegetation, by calculating the percentage of point counts for each vegetation type in each cluster, in order to obtain a description of the habitat occupied by every bird communities.

RESULTS

869 recorded birds were classified into 20 species. Figure 2 shows the results of the IV computation for the different solutions, ranging from two to ten subdivisions and used to determine the number of clusters.

According to the results, the four-cluster solution is the best one because it is characterized by high sums and by the largest difference between the solutions of subsequent cluster steps, indicating that by increasing the number of clusters considerably improves the model. The number of point counts belonging to each cluster and the IV of every species in the four clusters are showed in Table 1.

The number of characteristic species of cluster 4 is markedly the higher of all clusters (six species), while in the first two clusters the number of characteristic species is 2 and in the third cluster it is 3. The total amount of the IV values identifying the species of each cluster (indicated in Table 1 as "TOT") increases accordingly. The results of the calculation of the average number of individuals and species in the point counts of each cluster results are reported in Table 2. The same table also shows the percentages related to the different types of vegetation present in each cluster.

The mean number of individuals and the mean richness progressively increase from cluster 1 to cluster 4. As for vegetation, in cluster 1 only herbaceous steppe is present, which progressively decreases in the other clusters. In cluster 4, high shrub steppe is prevalent.

DISCUSSION

The values of the IV clearly suggest that the solution of cluster 4 is preferable. The two characteristic species of the first cluster (Short-billed Pipit *Anthus furcatus* and Common Miner *Geositta cunicularia*) are minimally present or even absent (IV close or equal to 0) in the other clusters, while the characteristic species of cluster 2 change their IV though remaining present in the other clusters and one of the two (Rufous-collared Sparrow *Zonotrichia capensis*) is characteristic species also in clusters 3 and 4. In these last two clusters, and especially in the last one, there are more characteristic species with a higher IV than those of the other clusters. Another interesting feature is that from the first to the fourth cluster the average values of species richness and the average number of individuals increase, as well as vegetation which also increases in terms of height, in effect, the percentage of the shrubs higher progressively increase from the first to the fourth cluster (cf. Table 2). This suggests that in the study area there are two different communities of passerines: one that exclusively refers to cluster 1, characterized by a herbaceous steppe environment, where each point counts has a mean only 1.2 individuals belonging to the two abovementioned characteristic species; another one, which is described by clusters 2, 3, and 4, substantially characterized by shrub steppe which progressively grows in height from cluster 2 to cluster 4. As well as the species present (although not characteristics) in the cluster 2, become more numerous in clusters 3 and 4, i.e., less common species progressively join the most common one, the

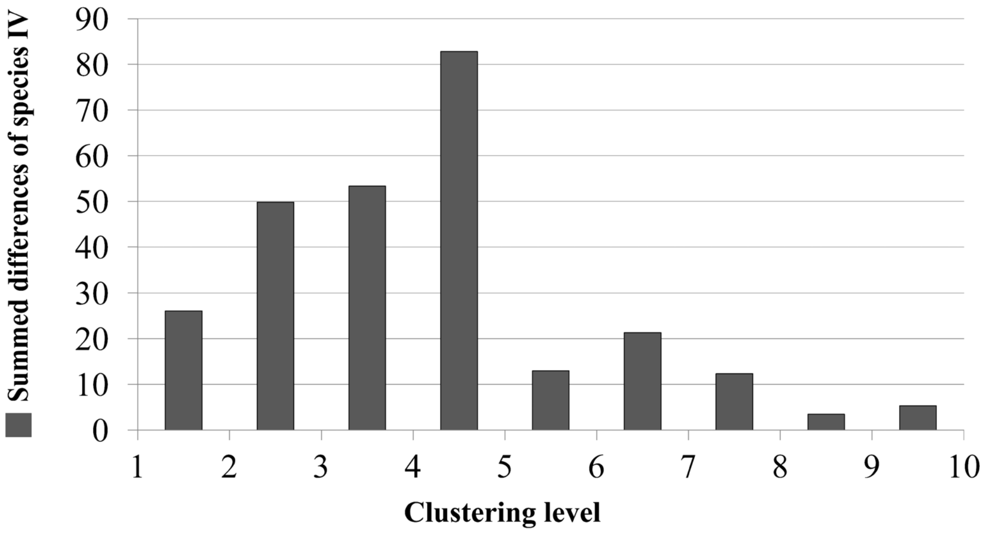

FIG. 2. Sums of the differences of the species Indicator Values for two to ten clustering levels. Bars represent differences between cluster levels *x* and *x-1*.

Rufous-collared Sparrow which has the higher IV summing the IV of all clusters. Instead the species of cluster 1 are almost absent in clusters 2, 3, 4. By doing so, the average number of species and of individuals increases from cluster 2 to cluster 4. This confirms the relation between bird species richness and structure of vegetation, already supported by MacArthur (1960), and the positive correlation among breeding bird density and vegetation volume (Mills *et al.* 1991).

Even if many other studies have confirmed that for terrestrial communities the number of bird species as well as their diversity are strongly positively correlated with aspects of the structural complexity of vegetation (e.g., MacArthur 1964, Recher 1969, Karr & Roth 1971, Pearson & Ralph 1978), the results of this study appear to be at odds with what has been indicated by Vuilleumier (1972) about the northern Patagonian forest bird communities. His data indicated that more species of birds inhabited the structurally simpler habitats than the more complex. This can be explained by considering that the study of Vuilleumier (1972) was focused on a forest environment, different from steppe of Peninsula Valdes, and certainly it has been less affected by human alteration (overgrazing by sheep). Ralph (1985) confirmed Vuilleumier's results (1972), i.e., birds were more diverse and abundant in the lower stature shrub than in complex forests, but only by excluding low vegetation in his analysis. This may confirm that the shrubby steppe of the peninsula, characterized by low vegetation, has a different dynamics concerning bird richness than those observed for areas with greater vegetation.

With regard to the species that make up the herbaceous steppe community, the only two are the Short-billed Pipit and the Common Miner. This data are in agreement with Vuilleumier (1993), according to which both species prefer open areas with few shrubby vegetation, especially in the south-eastern part of the peninsula.

In the nearest IBA of Patagonian steppe, Meseta de Somuncurá (RN06), located about 250 km west of Peninsula Valdes, the Com-

TABLE 1. Indicator Value of bird species in the 4 clusters; * indicates characteristic species (IV > 25).

CLUSTER 1		CLUSTER 2		CLUSTER 3		CLUSTER 4	
N° of point counts	19	N° of point counts	36	N° of point counts	26	N° of point counts	26
Species	IV	Species	IV	Species	IV	Species	IV
Anthus furcatus *	37.6	*Zonotrichia capensis* *	35.6	*Diuca diuca* *	42.2	*Leptasthenura aegithaloides* *	52.2
Geositta cunicularia *	28.8	*Agriornis murinus* *	33.4	*Zonotrichia capensis* *	30.6	*Mimus patagonicus* *	37.8
Agriornis micropterus	0	*Mimus patagonicus*	11.9	*Mimus patagonicus* *	25.1	*Diuca diuca* *	35.7
Agriornis murinus	0	*Asthenes pyrrholeuca*	6.3	*Phrygilus fruticeti*	11.7	*Asthenes pyrrholeuca**	30.9
Anairetes parulus	0	*Xolmis rubetra*	5.6	*Asthenes pyrrholeuca*	10.7	*Zonotrichia capensis* *	30.6
Asthenes pyrrholeuca	0	*Leptasthenura aegithaloides*	4.6	*Agriornis micropterus*	5.1	*Phrygilus fruticeti* *	26.4
Diuca diuca	0	*Sturnella loyca*	4.2	*Xolmis rubetra*	4.3	*Phrygilus carbonarius*	17.3
Furnarius rufus	0	*Diuca diuca*	2.9	*Sicalis lebruni*	3.8	*Anairetes parulus*	12.3
Leptasthenura aegithaloides	0	*Furnarius rufus*	2.8	*Anthus furcatus*	2.5	*Agriornis murinus*	8.2
Mimus patagonicus	0	*Pygochelidon cyanoleuca*	2.8	*Mimus triurus*	1.9	*Sturnella loyca*	5.8
Mimus triurus	0	*Upucerthia dumetaria*	2.8	*Agriornis murinus*	1.2	*Pseudoseisura gutturalis*	3.8
Pygochelidon cyanoleuca	0	*Agriornis micropterus*	0.9	*Upucerthia dumetaria*	1	*Mimus triurus*	1.9
Xolmis rubetra	0	*Anthus furcatus*	0.2	*Anairetes parulus*	0.8	*Upucerthia dumetaria*	1
Phrygilus carbonarius	0	*Anairetes parulus*	0	*Geositta cunicularia*	0.3	*Xolmis rubetra*	0.5
Phrygilus fruticeti	0	*Geositta cunicularia*	0	*Furnarius rufus*	0	*Geositta cunicularia*	0.3
Pseudoseisura gutturalis	0	*Mimus triurus*	0	*Leptasthenura aegithaloides*	0	*Anthus furcatus*	0
Sicalis lebruni	0	*Phrygilus carbonarius*	0	*Pygochelidon cyanoleuca*	0	*Agriornis micropterus*	0
Sturnella loyca	0	*Phrygilus fruticeti*	0	*Phrygilus carbonarius*	0	*Furnarius rufus*	0
Upucerthia dumetaria	0	*Pseudoseisura gutturalis*	0	*Pseudoseisura gutturalis*	0	*Pygochelidon cyanoleuca*	0
Zonotrichia capensis	0	*Sicalis lebruni*	0	*Sturnella loyca*	0	*Sicalis lebruni*	0
TOT	66.4	TOT	113.8	TOT	141.1	TOT	264.7

TABLE 2. Number of point counts, mean number of individuals per point counts, mean bird richness per point counts, and percentage of vegetation type of the four clusters. H - herbaceous steppe; SL - shrubs < 1 m; SM:- low shrubs with some high shrubs; SH - shrubs > 1.5 m.

Cluster	N° of point counts	Bird data		% of vegetation type			
		Mean N° of individuals	Mean Richness	H	SL	SM	SH
1	19	1.7	1.2	100	0	0	0
2	36	6.8	2.9	13.9	63.9	13.9	8.3
3	26	8.6	3.7	0	53.8	30.8	15.4
4	26	14.2	5.7	0	15.4	34.6	50.0

mon Miner is reported as breeding while the Hellmayr's Pipit (*Anthus hellmayri*) is reported but not the Short-billed Pipit (Llanos *et al.* 2011).

Llanos *et al.* (2011) confirm that the species surveyed in this study in the shrub steppe prefer bushy environment also in the Meseta de Somuncurá, where, however, Patagonian Yellow Finch (*Sicalis lebruni*), Grey-bellied Shrike-Tyrant (*Agriornis micropterus*), and Lesser Shrike-Tyrant (*Agriornis murinus*) were not reported. The reporting of the Lesser Shrike-Tyrant as breeding bird in Valdes Peninsula is of particular interest considering that it is regarded a rare species in Argentina (Lopez-Lanús *et al.* 2008).

Conclusions. The study here reported is the most recent contribution to the knowledge of the avifauna in Valdes Peninsula, so far being under-investigated, in particular as far as steppe passerines are concerned. The sampling method was simultaneously performed by three samplers, under conditions of good visibility, which is typical of the steppe open environment. Moreover, the species under study are relatively few in number and little wary. This makes data on the species, and especially on their abundance, particularly reliable, much more than in other cases such as those related to the point counts in wooded areas (Bibby *et al.* 1992).

Concerning results, it was observed that the unproductive environment of the Patagonian steppe determines a relatively low number of individuals and of species in each point counts of study area (on average 8.1 and 3.5, respectively) (Vuilleumier 1993, 1995). The analysis shows that the steppe can be basically divided into two major types: shrub steppe and herbaceous steppe. These two types of steppe are characterized by different types of vegetation and different species of passerines. In particular, in the shrub steppe it was observed that the number of species and of individuals increases proportionally with the increase of the heights of the shrubs.

The Valdes Peninsula has been historically subject to great pressures by grazing of sheep which has severely restricted growth and evolution of vegetation thus decreasing the complexity of the steppe environment. This is compounded by the grazing operated by guanacos which are sharply increasing, especially in the Valdes Peninsula (Nabte 2010). These effects are evident in numerous areas of the peninsula where the shrub steppe has been drastically reduced by the action of pasture, which has prevented shrubs from completing their ecological succession (Catorci *et al.* 2012).

This can cause serious consequences, especially considering that some of the breeding species in the peninsula are endemic in

Argentina (Rusty-backed Monjita *Xolmis rubetra*, Carbonated Sierra Finch *Phrygilus carbonarius*, White-throated Cacholote *Pseudoseisura gutturalis*) and two of them, i.e. the Rusty-backed Monjita and the White-throated Cacholote, are considered in the conservation status "vulnerable" (Lopez-Lanús *et al.* 2008). In order to protect the community of passerine birds in steppe environments, it is necessary to preserve their habitat and to allow shrubs to grow to maturity so to accommodate passerine species that would likely be otherwise absent. Therefore it's need for attentively define the perimeters of grazing areas, e.g. to restrict the number of sheep to a certain extent: this would be essential to maintaining the natural dynamics of the steppe vegetation and its positive effects on the associated bird communities.

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