Feeding ecology of the Grayish Saltator *Saltator coerulescens* (AVES: EMBERIZIDAE) in the Parana river floodplain (Argentina)

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Abstract

We investigate the feeding ecology of the Grayish Saltator *Saltator c. coerulescens,* species whose diet is poorly known, increasing its knowledge by quantifying its trophic spectrum, niche breadth and habitat selection throughout the four seasons (spring, summer, autumn and winter). The obtained information is relevant and useful to solve practice problems in wildlife management. Seventy-three stomachs were studied, identifying and quantifying the organisms into different taxonomic levels. Results show an omnivore diet, *Solanum amigdalifolium* (Seeds) and *Acromirmex* sp. (Insects) being the prevailing organisms out of 20 taxonomic entities. The following values were obtained for the trophic niche breadth: 1.75 in spring, 2.38 in summer, 2.17 in autumn and 5.0 in winter. The habitat selection index showed the highest values in forest (0.43) and in gallery forest (0.46), revealing a marked preference for these environmental units, matching previous information for the area. The obtained results constitutes new information on the knowledge of the feeding biology of the Grayish Saltator, mainly those concerning the interactions between populations and the environment.

Key Words: Birds, niche, feeding ecology, Paraná River, Argentina.

Resumen. *Biología Alimentaria del Pepitero Gris* Saltator coerulescens *(AVES: EMBERIZIDAE) en el valle de inundación del Río Paraná (Argentina)*

Este estudio fue encarado a fin de investigar la ecología alimentaria del Pepitero Gris *Saltator c. coerulescens*, especie de la que existe un solo antecedente, ampliándose la información previa mediante la cuantificación del espectro trófico, amplitud del nicho y

selección de hábitat durante las cuatro estaciones (primavera, verano, otoño, invierno). La información obtenida en el presente manuscrito presenta información relevante y útil para solucionar problemas prácticos en el manejo de vida silvestre.

Setenta y tres estómagos fueron estudiados, identificando y cuantificando los organismos en diferentes niveles taxonómicos.

Los resultados muestran una dieta omnívora, siendo *Solanum amigdalifolium* y *Acromirmex* sp. los items más importantes de las veinte entidades taxonómicas encontradas. Los siguientes valores fueron obtenidos para la amplitud trófica del nicho: 1.75 en primavera, 2.38 en verano, 2.17 en otoño y 5.0 en invierno. En lo que refiere al índice de preferencia de hábitat se obtuvieron valores elevados pertenecientes al monte (0.43) y al bosque en galería (0.46), revelando una marcada preferencia por estas unidades de ambiente. Lo previamente mencionado es coincidente con los antecedentes para la especie en el área de estudio. Los resultados obtenidos permiten ampliar el conocimiento de la biología alimentaria del Pepitero Gris, aspectos importantes que hacen al manejo de cualquier especie con el objeto de establecer las interacciones que se establecen entre las poblaciones y su medio.

Palabras clave: Aves, Emberizidae, ecología alimentaria, río Paraná, Argentina.

Introduction

Studies related to the feeding ecology and behavior of birds, have acquired a great importance to solve practice problems in wildlife management. This contribution is part of an integral project devotes to study for the first time this type of studies at Mid-Paraná river floodplain.

The Grayish Saltator (*Saltator c. coerulescens* Vieillot, 1817) is a species that resides at the alluvial valley of the Paraná river. This specie, if abundant (it is not an endangered species) at the study area, have been poorly studied and no detailed information on its diet requirements is known. A first contribution to the Grayish Saltator feeding biology was made with stomachs from exploratories samples (Beltzer, 1988), which allowed to determine its trophic range, fidelity degree (association intensity between the birds and the environmental units) and trophic participations (amount of food obtained at each environmental unit) compared to its cogeneric species (*Saltator a. aurantiirostris* Vieillot,1817). The present study improves the previous information by offering more detailed information on its trophic spectrum (quantitative minimum sample determination) and habitat selection.

Reports of previous works on the area show some aspects of its biology, geographical distribution and nesting. (Conras, 1980; De La Peña, 1977, 1979, 1981; Olrog, 1959, 1979). The objective of this contribution is to show quantified information of the Grayish Saltator trophic spectrum, niche breadth and habitat selection.

Area of Study

The captures were done at Carabajal Island (Santa Fe, 31 39’ S , 60 42’ W); belonging to the geomorphological unit called bank plain (Iriondo and Drago, 1972). The island includes approximately 4000 hectares with a lot of lentic

water bodies, some of which are very extensive (La Cuarentena pond, 250 ha., La Cacerola, 80 ha. and La Vuelta de Irigoyen, 70 ha). The environmental units that the species frecuents are the forest and the gallery forest.

Material and Methods

Seventy three stomachs of specimens captured between 08:00 and 17:00 from 1991 to 1993 (22 specimens in spring, 15 in summer, 20 in autumn, and 16 in winter) were used to determine the trophic spectrum

Birds were hunted with fire guns, sexed and stored at INALI´s collection. Due to the samples availability we decided to study its diet, despite of capture techniques.

Captures were conducted with scientific aims and authorized by the Department of Ecology and Wildlife protection of Santa Fe State (Argentina).

The advantage of using stomachs analyses is that the full content can be extracted. It is known that the stomach-flushing technique is a good option, but the obtained contents are not always complete and the technique have to be conducted two or three times on the same bird, thus increasing death rates (Montalti & Coria, 1993).

Food items were preserved into a 5% formol solution and analyzed under stereoscopic magnifier.

Hurtubia criteria (1973) was followed to determine the trophic diversity of each specimen, which consists of calculating the trophic diversity (H) for each individual, using the Brillouin (1965) formula:

$$H = (1/N) (\log 2\ N! - \Sigma \log 2\ Ni!)$$

where: N is the total number of taxonomic entities found in the stomach of each individual and ¨Ni¨ is the total number of preys of the i species in each stomach.

Stomachs were studied individually and items identified to the lowest taxon possible (Burgoni & Vooren, 2004) The structures with identifying taxonomic characteristics (heads, jaws, etc) were considered to identify the organisms with an advanced digestion condition.

In order to know the contribution of each food category to species´ diet a relative importance index (IRI) (Pinkas et al., 1971), was applied:

$$IRI = FO (N + V)$$

where FO is the frequency of occurrence in per cent, N the numerical percentage and V the volumetric percentage. These parameters were determined for each food´s category. To calculate this index, the stomach contents of all the birds studied were treated like a single sample. This index was determined by water´s column displacements in a pipet.

The trophic niche spectrum (that reflects the spectra variation through seasons) per season was calculated using the Levins index (1968):

$$NB = (p_{ij}^2)^{-1}$$

where pij is the item i probability in the sample j.

An one way ANOVA was run to detect significant differences between seasons.

In order to compare this index to future studies of other sympatric Emberizidae species, the samples were standarized following Colwell and Futuyma (1971):

$$\text{Niche B´size: (Bobs – Bmin) (Bmax – Bmin)}$$

where: Bobs = NB, Bmax is the maximum number of items consumed and Bmin: 1.

In order to know the habitat selection, the habitat preference index (PI) was applied after Duncan criterion (1983):

$$Pi = \log [Vi/Ai] + 1$$

where Vi is the percentage of registered individuals per environmental units and Ai is the percentage covered by each unit. Based on previous information for the species and personal observations, was concluded that the bird was present at forest and gallery forest, reason why we sampled at the previously mentioned environmental units all year long between 1991 and 1993.

Thus the values higher than 0.3 show a high preference for a determined environmental unit whereas the lower ones show less selectivity (Bignal et al, 1988).

Results

All the analyzed stomachs contained food. Trophic diversity values varied from 0 to 2.58, being those between 2 and 2.5 the most frequents. Average diversity was 0.321 and accumulated trophic diversity (Hk) 2.37. When considering the 73 samples, the curve tends towards stability, which shows that the tests were run qualitatively and quantitatively with the adequate minimum sample (Fig. 1).

In the stomachs contents 2 724 items were found and identified into 20 taxonomic entities (food types), of which 11 were seeds and 9 were insects (Table 1).

The contribution of every food category to the Grayish Saltator`*s* diet was obtained by using the relative importance index (IRI), that showed the following values (Fig. 2): *Solanum amigdalifolium* = 2021; *Urera aurantiaca* = 1624; Seeds sp. E = 912; *Muelenbechia sagitifolia* = 640 and *Acromirmex* sp. = 440. The remaining items were not listed because the obtained values were too low. No diet variations were found among different sexes.

The trophic niche breath showed the next results: Spring = 1.75, Summer = 2.38, Autumn = 2.17 and Winter = 5. The former values were standardized being: Spring = 0.075, Summer = 0.19, Autumn = 0.09 and Winter = 0.36. No significant differences between seasons were found ($F = 1.36$; $P = 0.34$).

The Grayish Saltator shows a high fidelity for the forest and gallery forest. This is demonstrated by the high values obtained by the habitat preference index

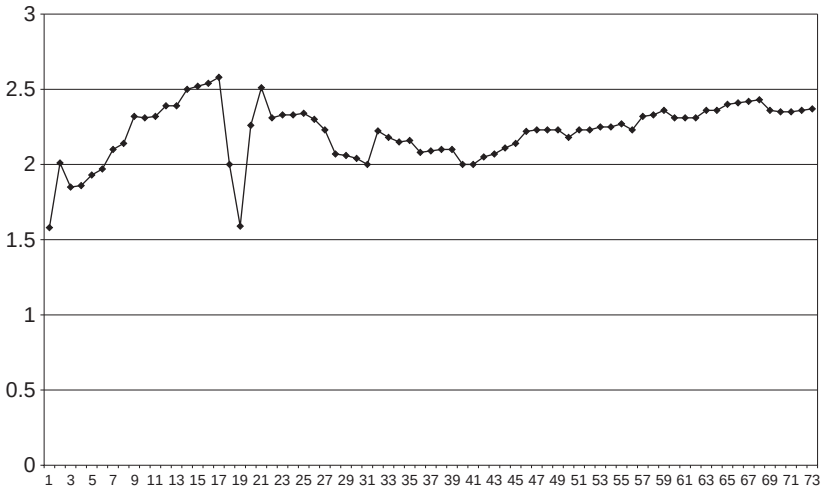

Figure 1. Acumulated trophic diversity curve based on the stomachs numbers (Hk).

application in the above mentioned environmental units: Forest = 0.43 and Gallery Forest = 0.46 (Fig. 3).

Discussion

Previous reports on the Grayish Saltator´s diet are based on occasional observations, with a poor food's taxonomic resolution and many related to other geographical areas (Conras, 1980; De La Peña, 1977, 1979, 1981; Olrog, 1959, 1979). Qualitative information was offered by Dinelli (1924) who pointed out that the Grayish Saltator is a frugivorous species with the same habits of the Golden Billed Saltator (*Saltator aurantiirostris)*, while Marone (1992) classifies it as herbivorous, accidental in Mendoza Province.

From the exposed antecedents and our own data, we may conclude that it is an omnivorous emberizidae (depredator of seeds). *Solanum amigdalifolium* and *Urera aurantiaca* constitutes its main food, followed by seeds of an unknown species and *Muehlenbechia sagitifolia*, all of them within the vegetal fraction. *Acromirmex* sp. constitutes the main component of the animal fraction. The ingested foods show their availability at the environment and they would be suggest that the Grayish Saltator has an opportunist behavior.

Some author suggested that intraspecific diet variations may occur among sexes or developmental stages (Bolnick et al. 2003), but we did not find significant differences on ingested items between sexes. Differences between developmental stages were not studied in the present manuscript.

From season comparison of diet measured by niche breadth, it is observed that it there is no significant difference thought-out the four seasons. In spite of this

Table 1. Trophic spectrum of Saltator c. coerulescens. N = numbers of organisms, F = frequency of capture.

	SPRING		SUMMER		AUTUMN		WINTER	
	N	F	N	F	N	F	N	F
SEEDS								
U. aurantiaca	2	1	-	-	849	15	6	2
S. amigdalifolium	584	10	238	3	208	8	57	6
Polygonum sp.	14	3	1	1	-	-	-	–
M.sagittifolia	70	9	30	1	78	4	76	5
C.martiana	–	-	2	2	1	1	-	–
S. arvensis	–	-	-	-	28	1	-	–
Unidentified seed sp.A	–	-	5	1	5	1	25	1
Unidentified seed sp.B	–	-	-	-	9	1	-	–
Unidentified seed sp.E	–	-	47	12	12	5	38	13
Passiflora sp.	101	8	-	-	-	-	-	–
Seeds of unidentified composta	–	-	62	2	53	3	-	–
INSECTS								
Unidentified Coleoptera	3	3	2	2	7	6	3	3
Coleoptera	3	3	-	-	-	-	1	1
Formicidae Unidentified	5	2	8	6	42	15	4	4
Solenopsis	–	–	-	-	1	1	-	–
Acromyrmex sp.	–	-	2	1	-	-	25	5
Belostoma	–	-	-	-	-	-	1	1
Unidentified Insects	4	4	-	-	4	4	3	2
Molusca	3	1	-	-	1	1	1	1
Zigoptera	1	1	-	-	-	-	-	–

similarity, niche breath values keep stable in spring, summer and autumn, while in winter the maximum value was reached. Similar obtained values (spring, summer and autumn), are caused by the presence of majority items like seeds (*Solanum amygdalifolium*, *Muehlenbechia sagittifolia* and *Urera aurantiaca*), and *Acromyrmex* (except in spring where Coleoptera is the main item). The maximum value (winter) responds to a more homogeneous sample. This values also supports the opportunist behavior pattern of the studied species, being the seasonal food abundance strongly represented on its diet.

The 20 taxonomic entities that compose the trophic spectrum of the bird, offer a good measure of the trophic niche breadth for the studied environment (Bmax), which could be considered the closest one to the fundamental niche of the Grayish Saltator. This value of Bmax does not occur at any of the seasons of the year

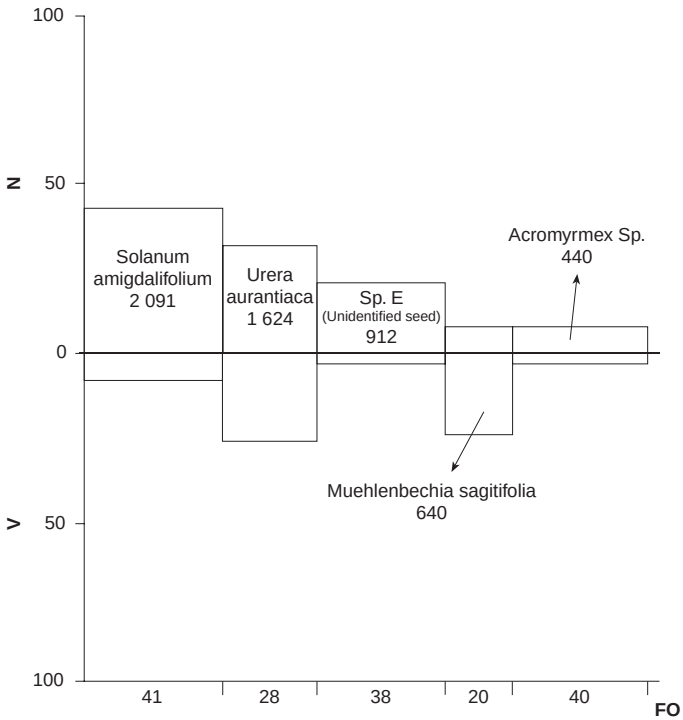

Figure 2. Relative Importance Index (IRI). N: numeric percentage, V: volume percentage, FO: frequence of occurrency percentage.

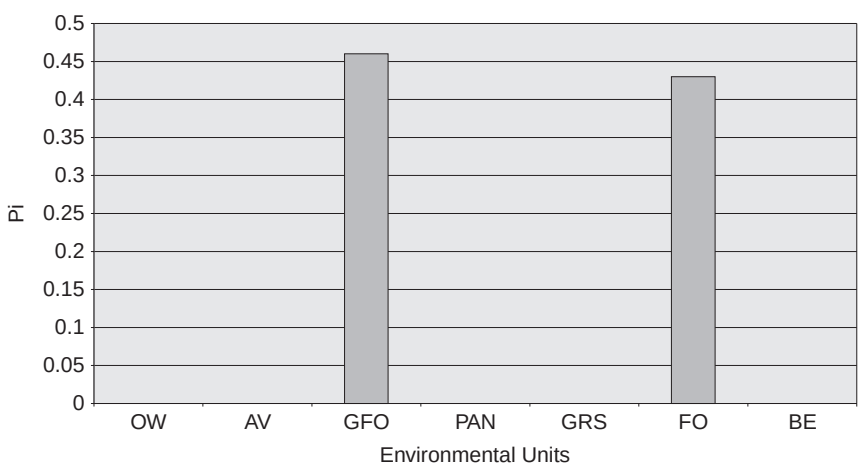

Figure 3. Habitat Preference Index (Pi). OW: Open Waters, AV: Aquatic Vegetation, GFO: Gallery Forest, PAN: Grassland of Panicum, GRS: grassland, FO: Forest and BE: Beach.

and so the values get closer to Bmin. Therefore it could be expressed that the effective trophic niche is manifested seasonally.

Values for habitat preference index describe the Grayish Saltator as an arboricole bird at the Paraná river floodplain. Our results constitute new information on the knowledge of the Grayish Saltator feeding biology (trophic niche breadth and habitat selection).

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