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ALIMENTARY BIOLOGY OF THE GOLDEN BILLED SALTATOR *Saltator aurantiirostris* (AVES: EMBERIZIDAE) IN THE PARANA RIVER FLOODPLAIN (ARGENTINA)

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RESUMEN:

Biología alimentaria del pepitero de collar *Saltator aurantiirostris* (aves: emberizidae) en el valle de inundación del Río Paraná (Argentina).

El objetivo de este trabajo ha sido investigar la ecología alimentaria de *Saltator aurantiirostris* a través de mediciones estacionales (primavera, verano, otoño e invierno), cuantificando el espectro trófico, amplitud del nicho, ritmo circadiano de actividad alimentaria y selección del hábitat. Se estudiaron 23 estómagos identificandose y cuantificandose los organismos a distintos niveles taxonómicos. Los resultados revelan una dieta omnivora, siendo *Solanum amigdalifolium* y *Acromirmex* sp. los organismos más importantes sobre un total de 23 entidades taxonómicas. La amplitud trófica del nicho varió estacionalmente entre los siguientes valores 1,26 en primavera, 2,64 en verano, 3,17 en otoño y 2,07 en invierno. En lo referente al ritmo diario de actividad alimentaria se apreció un patrón en campana en tanto que el índice de preferencia de hábitat mayores a 0,48 para el monte y 0,42 para selva en galería que revelan una marcada preferencia por éstas unidades ambientes. Los resultados obtenidos permiten ampliar el conocimiento de la biología alimentaria de *saltator aurantiirostris,* aspectos importantes que hacen al manejo de cualquier especie con el objeto de establecer las interacciones que se establecen entre sus poblaciones y el medio.

Palabras clave: Aves, nicho, ecología alimentaria, Río Paraná, Argentina,

SUMMARY

This study was undertaken to investigate the alimentary ecology of *Saltator a. aurantiirostris* by quantifyng the trophic spectrum, niche breadth, circadian alimentary activity rythm and habitat selection throughout the four seasons (spring, summer, autumn and winter). Twenty three stomachs were studied, identifying and quantifying the organisms into different taxonomic levels. Results show an omnivore diet, *Solanum amigdalifolium* and *Acromirmex* sp. being the prevailing organisms out of 23 taxonomic entities. The following

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values were obtained for the trophic niche breadth: 1.26 in spring, 2.64 in summer, 3.17 in autumn and 2.07 in winter. A bell standard was observed as regards the daily alimentary activity rythm, whereas the habitat preference index gave values higher than 0.48 for the forest and 0.42 gallery forest, revealing a marked preference for these environmental units. The obtained results show important advances in the knowledge of the alimentary biology of *Saltator a. aurantiirostris,* mainly those concerning the interactions between populations and the environment.

Key words: Aves, niche, feeding ecology, Paraná River, Argentina.

INTRODUCTION

The Golden Billed Saltator (Saltator a. aurantiirostris Vieillot, 1917) is a species that resides at the alluvial valley of the Paraná river. Reports of previous works on the area show some aspects of its biology, geographical distribution and nesting. (OLROG, 1959; JENKINS, 1969; DE LA PEÑA, 1977, 1979; OLROG, 1979; CONTRERAS, 1980; DE LA PEÑA, 1981, 1993). A first contribution to Saltator a. aurantiirostris alimentary biology was made with 14 stomachs from the studied samples (BELTZER, 1988), which allowed us to determine its trophic range, fidelity degree and trophic participations compared to its congeneric species (Saltator c. coerulescens). The objective of this contribution is to present quantified information on Saltator a. aurantiirostris alimentary spectrum, trophic niche breadth, daily rhythm of alimentary behavior 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 & DRAGO, 1972). The island includes approximately 4000 hectares with a lot of lentic water bodies, some of which are very extensive (La Cuarentena lagoon, 250 hectares, La Cacerola, 80 and La Vuelta de Irigoyen, 70). The environmental units that the species frequents are the forest and the gallery forest (Fig 1 and 2).

MATERIAL AND METHODS

Twenty three stomachs of specimens captured between 08:00 am and 5:00 pm during 1991 (10 specimens in spring, 6 in summer, 3 in autumn, and 4 in winter) were used to determine the trophic spectrum. Despite the results were based in a low number of individulas which, seasonaly distributed becomes the samples pooerer, the objetive was to use the individuals available at INALI's collection, in order to avoid new hunting.

The criterion of HURTUBIA (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) fórmula:

$$H = (1/N) (\log_2 N! - \Sigma \log_2 Ni!)$$

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.

The stomachs were studied individually and the organisms were identified and qualified according to different taxonomic levels. The structures with identifying taxonomic characteristics (heads, mandibles, etc) were considered to identify the organisms in an advanced digestion condition.

The values of a relative importance index (IRI) (PINKAS *et al*., 1971) were compared and applied to each feeding group in the studied species.

Figura 1. Monte. Forest

Figura 2. Selva en galería. Gallery forest

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

Where FO is the frequency of occurrence in per cent, N is the numerical percentage of one category of food and V is the volumetric percentage. 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 per season was calculated using the LEVINS index (1968):

$$NB = (pij^2)^{-1}$$

where píj is the probability of item i in the sample j.

In order to compare this index to future studies of other sympatric Emberizidae species, the samples were standardized following COLWELL & FUTUYMA (1971):

Niche B' size: (Bobs - Bmin) (Bmax - Bmin)

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

To study the circadian alimentary activity rythm, the average index of satiety was calculated (index of fullness: IF), measured as stomach content volume (ml) divided by the body weight (gr) per each capture time (MAULE & HORTON, 1984).

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 unit and Ai is the percentage covered by each unit. The individuals were identified from 08.00 am to 05.00 pm by a monthly expedition composed by three observations each (9:00; 12:00 and 17:00 hours). Thus the values which are 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 23 stomachs analyzed were found to contain food. The trophic diversity values varied from 0 to 1.32, those included in the low diversity intervals being the most frequent. The average diversity was 0.33 and the accumulated trophic diversity (Hk) was 1.53. When considering the 23 samples, the curve tends towards stability, which shows that the tests were run qualitatively and quantitatively with the adequate minimum sample (Fig. 3).

The trophic spectrum based on the identification of 2,685 organisms was integrated by 26 taxonomic entities, 12 of them corresponding to the vegetal fraction and 14 to the animal fraction. (Table 1)

The contribution of each food category to the diet of *Saltator a. aurantiirostris* obtained by the application of the IRI, shows the following results:

Solanum amygdalifolium = 10,396
Acromyrmex sp. and other insecta = 1,540
Unindentified seed sp. A = 720
Urera aurantiaca = 570
Other seeds = 450
Polygonum sp. = 140 (Fig. 4).

The remaining items were not listed because the obtained values were too low.

The breath of the trophic niche showed the following results: Spring= 1.26, Summer= 2.64, Autumn= 3.17 and winter= 2.07. With the standardization, the following results were obtained: Spring= 0.02, Summer= 0.12, Autumn= 1 and Winter= 0.11.

Regarding the daily alimentary activity rythm evaluated by the average satiety index, a bell standard between 08:00 am and 5:00 pm

TABLE 1. TROPHIC SPECTRUM OF SALTATOR A. AURANTIIROSIS. N=numbers of organism. F=frequency of capture

	SPRING		SUMMER		AUTUMN		WINTER	
n		10		6		3		4
	N	F	N	F	N	F	N	F
SEDDS								
Urera aurantiaca	19	1	78	2	0	0	0	0
Solanum amygdalifolium	1806	7	296	4	48	2	80	3
Poligonum sp.	46	5	3	2	40	3	2	2
Muelhenbechia sagitifolia	21	3	0	0	0	0	0	0
Gramíneas sp	0	0	17	1	0	0	0	0
Cyperus sp	0	0	2	1	0	0	0	0
Cayaponia martiana	0	0	0	0	0	0	1	1
Spergula arvensis	0	0	0	0	0	0	1	1
n.i. sp. A	33	4	14	3	30	2	44	3
n.i. sp. B	1	1	0	0	0	0	0	0
n.i. sp. C	1	1	0	0	0	0	42	1
n.i. sp. D	0	0	8	1	0	0	0	0
INSECTS								
Carabidae	0	0	5	3	0	0	0	0
Dytiscidae	0	0	0	0	0	0	1	1
Curculionidae	1	1	0	0	0	0	0	0
Hydrophilidae	0	0	0	0	0	0	1	1
Coleoptera n.i.	5	4	0	0	0	0	0	0
Acromyrmex sp.	12	7	4	3	6	3	8	3
Orthoptera n.i.	0	0	1	1	0	0	0	0
Hemiptera n.i.	2	2	0	0	0	0	0	0
Anysoptera n.i.	0	0	1	1	0	0	0	0
Diptera n.i.	2	1	0	0	0	0	0	0
Insecta n.i.	3	2	1	1	0	0	0	0

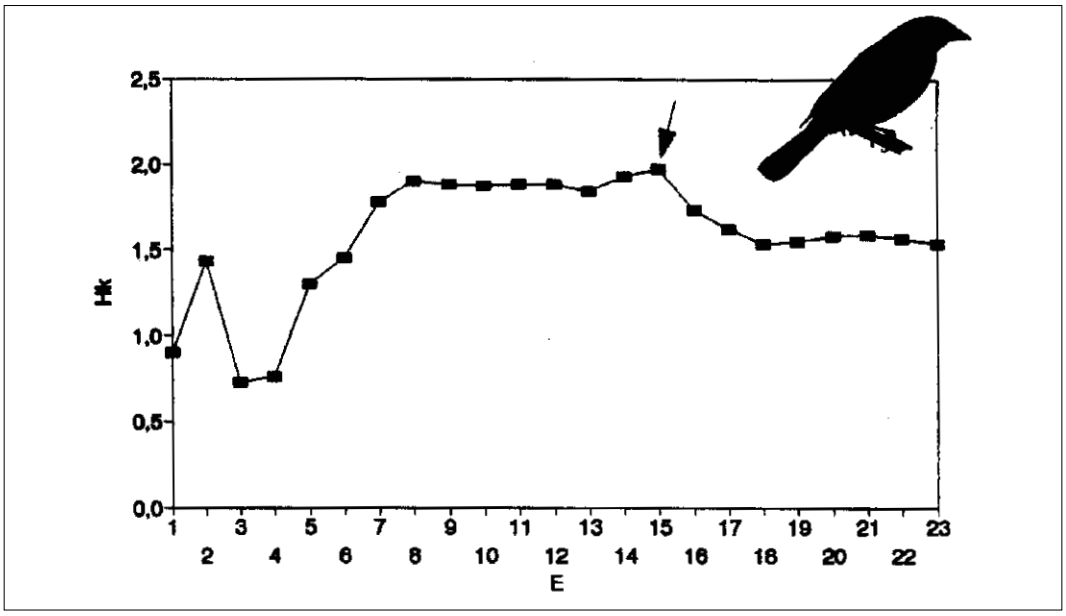

Figura 3. Diversidad trófica acumulada. Curva basada en el n˙mero de estómagos.
Acumulated trophic diversity curve based on the stomachs numbres.

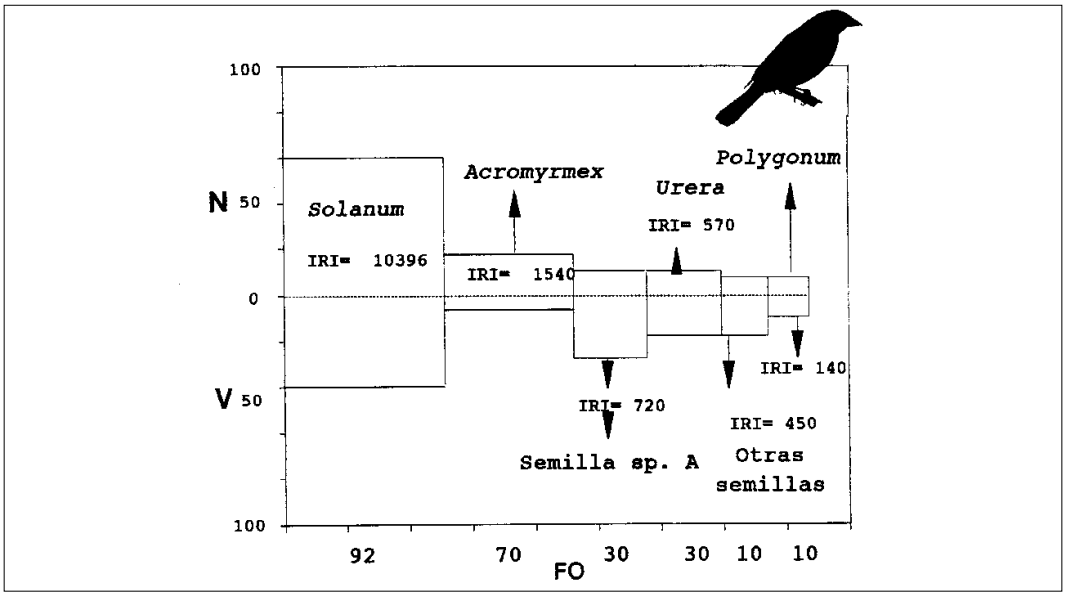

Figura 4. Indice de importancia relativa (IRI). N: porcentaje numérico, V: porcentaje volumétrico, FO: porcentaje de frecuencia de ocurrencia.

Relative Importance Index (IRI). N: numeric percentage, V: volume percentage; FO: frequence of ocurrency percentage.

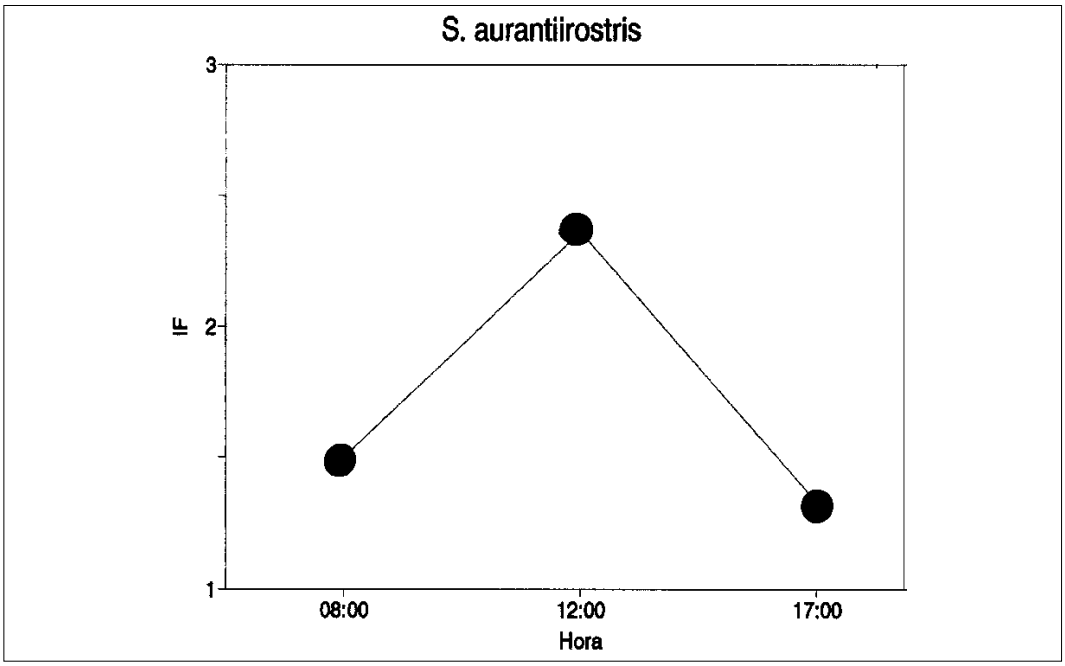

Figura 5. Indice de saciado.
Index of Fullness.

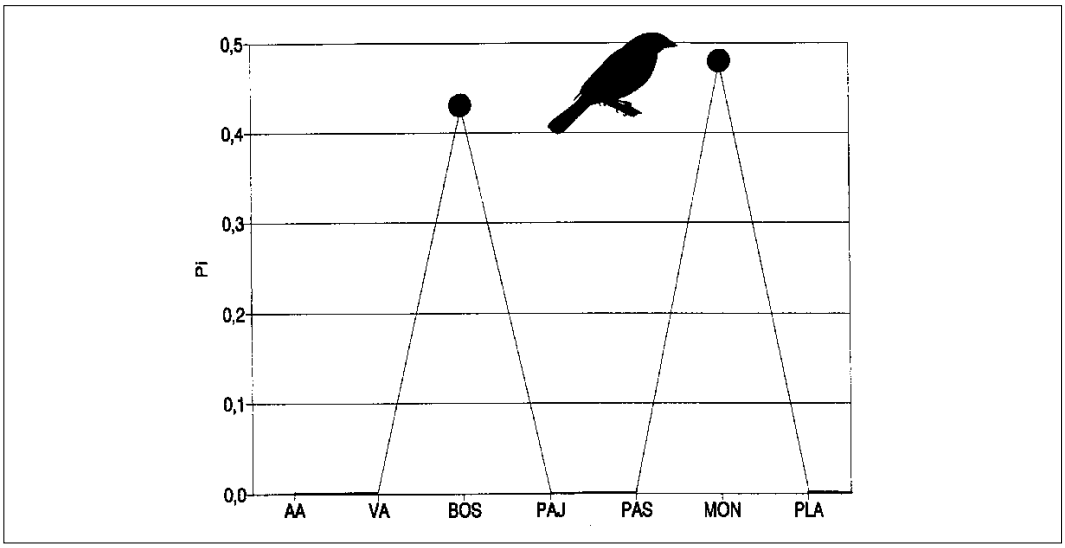

Figura 6. Indice de preferencia de hábitat (Pi). AA: aguas abiertas; VA: vegetación acuática; BOS: bosque en galería; PAJ: pajonal; PAS: pastizal; MON: monte; PLA: playa.

Habitat Preference Index (Pi). AA: open waters; VA: aquatic vegetation; BOS:gallery forest; PAJ: grassland of Panicum ; PAS: grassland; MON: forest; PLA: beach.

with a maximum activity at midday was observed. (Fig. 5).

With the habitat preference index application it was observed that the species fidelity between the units of environment was given by forest and gallery forest. This is demonstrated by the high values obtained in the above mentioned environmental units, 0.48 for the first and 0.42 for the latter. (Fig. 6).

DISCUSSION and CONCLUSIONS

Previous reports on the *Saltator a. aurantiirostris* diet are not satisfactory, because they are based on occasional and anecdotic observations, with a low level of precision in relation to the taxonomic identification of food items and many such observations were related to other geographical areas. The qualitative information was offered by DINELLI (1924) who points out that *Saltator a. aurantiirostris* is a frugivorous species sometimes causing damage by eating pulses when they begin to bud. MARELLI (1919) reports coleopterans and seeds to be the diet of the species under study. MARONE (1992) classifies the *Saltator a. aurantiirostris* as herbivorous, arboricolous and summer resident in Mendoza. In San Luis, OCHOA DE MASRAMÓN (1979) states that in winter the diet is based on seeds. De la Peña defines the *Saltator a. aurantiirostris* as exclusively granivorous-frugivorous mentioning that it consumes seeds, fruits and grains. From both the analysis of the area antecedents and what it has been exposed, we may conclude that the same taxonomic entity has been found, it being an Emberizidae, omnivorous in which *Solanum amigdalifolium* constitutes its main food at the vegetal fraction (MARTA, 1977; BAYO, LALLANA, LORANZATTI Y MARTA, 1981; SABATTINI, 1983, 1985) and *Acromyrmex* sp. at the animal fraction. The resources abundance and easy availability make this food item the main energetic contribution, representing its best forage in which the searching spending is almost null. The ingerited foods show their availability at the environment and they would suggest that *Saltator a. aurantiirostris* has an opportunist behaviour.

In relation to the seasonal comparison of diet measured by the niche breadth, it is observed that it is low in spring (1.21), increases in summer (2.64), reaches the maximum value in autumn (3.17) and decreases in winter (2.07). This shows seasonal variations in the composition of the diet manifested by the main item (*Solanum amigdalifolium* seeds). On the other hand, the similarity of summer and winter values shows a disminished numerical presence, making the samples of both periods more homogeneous. This situation is more clearly expressed in autumn where the values per alimentary item are similars.

The abundance of ingested seeds is related to a bigger development of the proventricle (CHIKILÁN et al., 1993) which allows a better utilization of the food with low protein contents as is the case of other birds (ZISWILER & FARNER, 1972; SING, 1973), while the muscular stomach presents an important covering of gastric cuticle with a lot of folds and friction films that make the mechanical digestion more effective.

The 23 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 Saltator aurantiirostris. This value of Bmax does not occur at any of the seasons of the year and so the values get closer to Bmin. Therefore it could be expressed that the effective trophic niche is manifested seasonally. The results of the compared test between *S. aurantiirostris y S. coerulescens* (BELTZER, 1988) allow us to point out the first one as efficient in food obtainment.

The values of the habitat preference index describes *Saltator a. aurantiirostris* as a species associated to arboricolous formations in the

Parana river floodplain.

The obtained results show important advances in the knowledge of *S. aurantiirostris* alimentary biology (trophic niche breadth, circadian rhythm of alimentary activity and habitat selection), mainly those concerning the interactions between populations and the environment.

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