BIRD SPECIES DIVERSITY AND GUILD STRUCTURE OF A TROPICAL FALLOW RICEFIELD *

DAVID R OSBORNE**, STEVEN R. BEISSINGER***
and GODFREY R. BOURNE***

ABSTRACT: Because avian community organization of tropical wetland habitats in Amazonia is not well known, we conducted a preliminary study on a two-year old fallow ricefield in coastal Guyana. Census of the field during July and August, 1974 found 31 diurnal species, a bird species diversity (H') of 3.22 and evenness (J') of 0.94. These values are probably the highest recorded. for a tropical nonforested area.

Community foraging utilization was diverse. Insectivores and omnivores dominated the primary food habit types but carnivorous, granivorous and nectivorous species were also represented. The bird community was dominated by species utilizing ground and water substrates for foraging and foliage gleaning was the dominant form of 8 types of foraging behavior recorded. Eighteen foraging guilds were found. Nine (50 %) were represented by only 1 species.

Factors accounting for high bird species diversity and guild richness are discussed. We propose high diversity in bird species and foraging utilization are the consequence of a highly productive system and the unstability of adjacent habitats.

Because we know little about bird community organization in Amazonian wetlands, we conducted preliminary studies on avian community structure in a coastal Guyana rice-culture habitat. Habitat structure has been shown to be a major determinant of avian community organization in that bird species diversity increased with habitat complexity through successional stages (Karr and Roth 1971; Willson 1974). Here we report an exception to this pattern.

METHODS

Field work was conducted at Burma at MARDS, Guyana (6° 28' N, 57° 45' W) in 1974. This flat alluvial coastal region, about 1.4 m (4.5 ft.) below sea level, and formerly wet savanna (Giglioli 1959), has been converted to rice farming and produces 2-3 crops annually. Ricefields at Burma increased in total area from 1619 ha(4.000 acres) in 1945 (Giglioli 1959) to 6721 ha (16.000 acres) in 1976 (Bourne 1976). General descriptions of the flora and fauna at Burma have been previously reported (Osborne and Bourne 1977 Bourne and Osborne 1978).

A 1.3 ha (3.2 acre) two-year-old flooded fallow field, surrounded by active rice - fields, was selected for censusing. Water depths averaged 221 mm, plant heights averaged 520 mm, and the field was composed of two vegetative layers (Bourne and Osborne 1978) A direct count of all diurnal birds utilizing the field was taken between 0600 and 0800

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** Department of Zoology, Miami University, Oxford, Ohio 45056 USA

*** School of Natural Resources, University of Michigan, Ann Arbor, Michigan 48109 USA.

hours twice weekly during July and August.

Bird species diversity was calculated using the Shannon-Weiner function (Shannon and Weaver 1949):

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

where p_i is the proportion of individuals in species i for all species 1 to s. Evenness of the distribution of abundance was calculated from:

$$J' = H' / H_{max}$$

where $H_{max} = \ln S$ and S is the number of species (Pielou 1966).

Foraging guilds were constructed from field observations and each species assigned a three-digit number (ABC) after Willson (1974) but modified for tropical systems to designate:

A. Primary food habits: 1. Frugivore, 2. Granivore, 3. Insectivore, 4. Omnivore, 5. Nectivore, 6. Carnivore.

B. Foraging substrate: 1. Ground, 2. Low (0-1m), 3. Middle (1-6 m), 4. High (> 6 m), 5. Bark, 6. Flower, 7. Termitorium, 8. Water, 9. Air.

C. Foraging behavior: 1. Ground Peck. 2. Foliage Glean, 3. Flower Probe, 4. Mud Probe, 5. Bark Drill, 6. Dabble, 7. Sally, 8. Dive, 9. Strike.

RESULTS AND DISCUSSION

Bird species richness and diversity of the fallow ricefield yielded 31 diurnal species (Table I) and a H' of 3.22. Unfortunately, avian diversity values are not available for other wetland Amazonian systems. H' values average slightly higher than ours for some tropical forests: 3.93 in Belem, Brazil (Lovejoy 1974); 3.45 (Karr and Roth 1971), 3.65 and 3.73 for Panama (Karr 1971); and 3.64 for Nicaragua (Howell 1971).

However, the fallow ricefield contained a more diverse (H') bird community than Peruvian forests (2.85-3.06), coffee plantations(2.89-2.99), cacao plantations (2.88) or second growth (3.08) (Terbough and Weske 1969), and Nicaraguan pine savannahs (1.44-2.08; Howell 1971). H' values of the fallow ricefield greatly exceeded those reported for African grasslands (2.63; Karr 1976), temperate North American grasslands (1.51- 1.62; Wiens 1969), and 15 North American and South American grassland sites (0,65-1.34; Cody 1966).

Evenness (J'), a measure of the apportionment of species diversity, was 0.94 for the fallow ricefield. This was considerably higher than values for forests in Brazil (0.79-0.87), Peru (0.85) and Panama(0.83)(Karr 1971; Lovejoy 1974), and for temperate marshes (0.72) and grasslands (0.84) (Tramer 1969). However, our J'values were only slightly higher than values for birds in tropical second growth forests (0.90; Lovejoy 1974).

High H' and J' values for the fallow ricefield could be the result of high number of species, low number of dominant species or a large number of rare species. Relative abundance of the three most common species was low: 9 % for both Wattled Jacanas and Red-breasted Blackbirds and 7% for Smooth-billed Anis. Also, 15 of 31 species (48 %) representing 20 % of the individuals were rare (2 % or less of the total avifauna).

Census technique must be considered when making cross-study comparisons. Our census was conducted by a direct count of all birds utilizing the habitat. In open fields (e. g. fallow ricefields), visual detection is easy and relatively complete as compared to other

structurally complex habitats such as forests. We feel few species or individuals escaped detection in our counts. In other studies, many habitats were censused by netting (e.g. Lovejoy 1974; Terbough and Weske 1969) which underestimates net-shy and canopy species, or by counting only territorial males (e.g. Cody 1966).

Most of the birds were not breeding residents. Twenty seven species (87.1 %) utilized the fallow ricefield only for foraging, and 4 (12.9 %) for nesting and foraging (Table I). All species except the Fork-tailed Flycatcher breed in Guyana during this time period (Bourne, unpublished data).

Analysis of foraging guild types (Fig.1) shows great diversity of food resource utilization occurring in the fallow field. Insectivores and omnivores dominated the primary food habit types, but 6 carnivorous, 3 granivorous and 2 nectivorous species were also represented. The bird community was dominated by species utilizing either the ground or water substrates for foraging. Foliage gleaning was the dominant foraging behavior followed by ground pecking and striking. Five other foraging behaviors were present representing small populations comprising 28 % of the species.

Assignment of guild numbers to each species based on primary food habits, foraging substrate, and behavior (Table I) illustrates the rich guild structure of the avian com munity. Eighteen different foraging guilds were recorded for the 31 species. The guild most frequently represented (689) was composed of 5 species of herons which feed by striking at prey in the water. This was followed by guild 482 (gallinules and jacanas) which glean a variety of foods from low emergent aquatic vegetation. Nine of 18 guilds (50 %) were represented by only 1 species.

To our knowledge, diversity and evenness in the fallow ricefield is the highest recorded for a tropical non-forested area. Parameters of habitat structure such as foliage height diversity (MacArthur and MacArthur 1961), percent vegetative cover (Karr 1971) or habitat heterogenity (Roth 1976) have been used successfully for predictors of bird species diversity in some habitats, but cannot account for our values being of similar magnitude to those of tropical forests. We do know that the fallow ricefield is physiognomically more complex than adjacent rice-culture habitats (Bourne and Osborne 1978). However, other aspects of fallow ricefields may be more important causes of high bird species diversity and guild richness.

In the past 25 years, coastal Guyana has been intensely developed for human habitation and agriculture. Fresh water marshes or mangroves which once covered the region are practically non existent and are confined to river borders. In the Burma area alone, 4,049 ha were cultivated in 1974, and only few areas were left fallow (Kennard, pers. comm.).

Rice agriculture in coastal Guyana involves year-round changes in water depths and vegetative cover as well as continuous mechanized manipulations by man. Thus, in a sense, the fallow ricefields may act as temporary refugia: relatively stable island habitats, in comparison to the surrounding landscape, used for breeding by some species and foraging by others which nest either on the borders of adjacent ricefields, or colonially elsewhere.

The higher diversity relative to other cited studies could also be due to water as an enhancing factor as has been suggested for temporate systems (Karr 1968). Thus, the rich guild structure might be the reflection of the high productivity of the system which supports a rich and varied trophic structure and thus high diversity. In any case, further studies are needed to examine the role of water and productivity as causal factors of diversity in tropical wetlands.

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RESUMEN

Una investigación preliminar sobre estructura y organización de una comunidad de aves se llevó a cabo durante julio-agosto de 1974 en un barbecho de arrozal de 1,3 ha en la costa de Guyana.

Utilizando conteo directo observamos 31 especies de aves. Usando la función Shannon-Weiner obtuvimos un índice de diversidad H' de 3,22; el índice de uniformidad fue 0,94. Estos valores son comparativamente altos, reflejando la falta de preponderancia numérica de cualquiera de las especies observadas. De las 31 especies sólo 4 nidificaron en el sitio.

Analizando la comunidad desde el punto de vista trófico, dividimos las especies por dieta, donde predominaban omnívoros e insectívoros; por lugar de alimentación, siendo los más usados el suelo y la superficie del agua; y por técnica de alimentación, resultando ser la más frecuente la exploración o superficial (*gleaning* *) del follaje. Con esta tríada de datos dividimos las 31 especies en 18 gremios de alimentación.

El alto índice de diversidad y la rica estructura gremial de la comunidad pueden reflejar la alta productividad del ecosistema.

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* Del francés "glaner": espigar, en el sentido de sacar o recoger cosas de la superficie.

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TABLE I: Bird species and foraging guilds found in a two-year-old fallow field in coastal Guyana, July – August 1974.

	Species[a]		Foraging Guild Number[b]	Nº Observed.
	White-necked Heron	*Ardea cocoi*	689	1
	Striated Heron	*Butorides striatus*	689	6
	Great Egret	*Casmerodius albus*	689	4
	Stripe-backed Bittern	*Ixobrychus involucris*	689	9
	Pinnated Bittern	*Botaurus pinnatus*	689	4
*	Black-b. Whistling Duck	*Dendrocygna autumnalis*	286	4
	Masked Duck	*Oxyura dominica*	488	7
	Snail Kite	*Rostrhamus sociabilis*	688	2
	Yelow-breasted Crake	*Porzana flaviventer*	382	8
	Purple Gallinule	*Porphyrula martinica*	482	3
	Azure Gallinule	*P. flavirostris*	482	2
*	Wattled Jacana	*Jacana jacana*	482	17
	Common Stilt	*Himantopus himantopus*	384	3
	Smooth-billed Ani	*Crotophaga ani*	311	13
	Striped Cuckoo	*Tapera naevia*	322	1
	Black-throated Mango	*Anthracothorax nigricollis*	523	3
	White-tailed Goldenthroat	*Polytmus guainumbi*	523	4
	Pale-breasted Spinetail	*Synallaxis albescens*	322	6
	Yellow-throated Spinetail	*Certhiaxis cinnamomea*	312	10
	Pied Water-Tyrant	*Fluvicola pica*	322	6
	White-headed Marsh-Tyrant	*Arundinicola leucocephala*	312	4
**	Fork-tailed Flycatcher	*Muscivora tyrannus*	397	8
	Tropical Kingbird	*Tyrannus melancholicus*	397	5
	Great Kiskadee	*Pitangus sulphuratus*	432	4
	Rusty-margined Flycatcher	*Myiozetetes cayanensis*	322	3
	Yellow-bellied Elaenia	*Elaenia flavogaster*	337	2
	Carib Grackle	*Quiscalus lugubris*	411	8
	Yellow Oriole	*Icterus nigrogularis*	332	5
	Red-breasted Blackbird	*Leistes militaris*	411	18
*	Variable Seedeater	*Sporophila americana*	212	10
*	Ruddy-breasted Seedeater	*S. minuta*	212	12
	TOTAL	31	18	192

[a] English and scientific names taken from Meyer de Schauensee (1966). [b] See methods.

* Nesting (1 pr. of each species).

** Southern Migrant

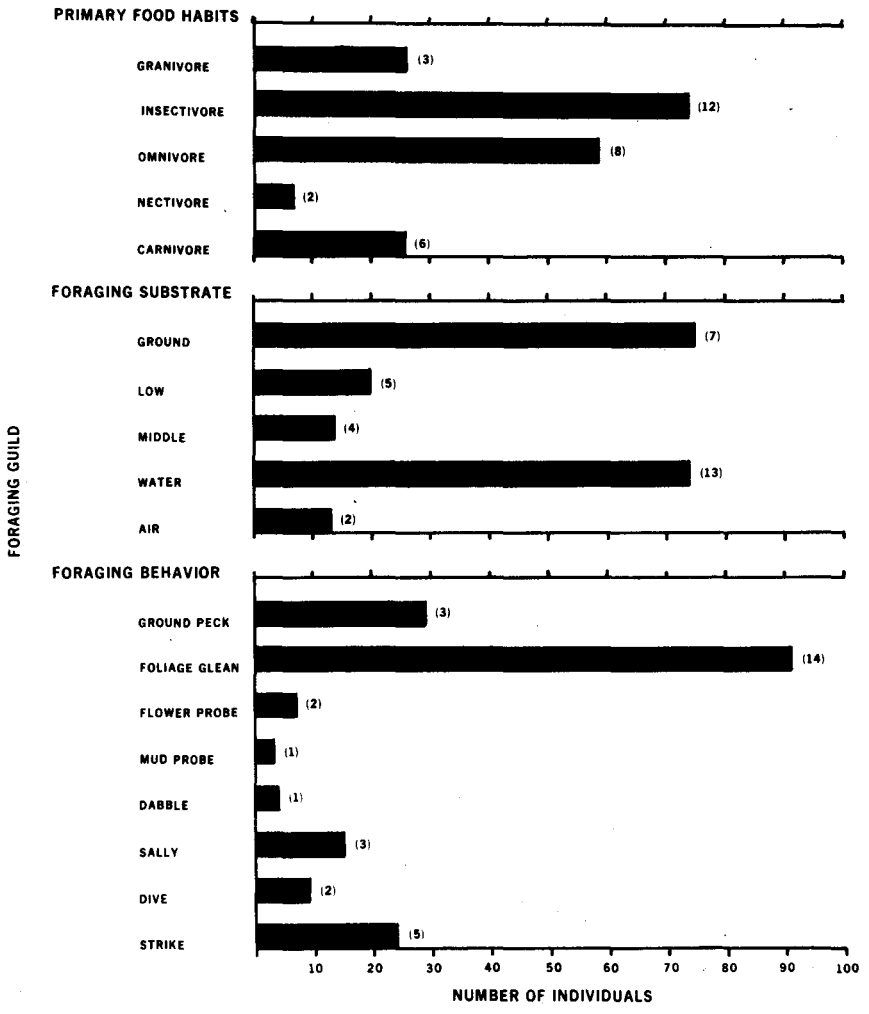

Fig. 1: Foraging bird guild types for a tropical fallow ricefield. Number of species appear in parentheses.