CRUSH THOSE CATTAILS!
ASSOCIATIONS BETWEEN AVIAN FEEDING GUILDS AND HABITATS ON A COSTA RICAN MARSH

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Abstract: The marsh at Palo Verde National Park contains three main habitats: open water; low, floating plants (water hyacinth and water fern); and sedges with cattails. We tested whether marsh birds partition feeding territory based on their preferred diet and method of feeding, hypothesizing that bird species would be distributed across these habitats according to their feeding guilds. We found very strong support for a non-random distribution of bird species and feeding guilds across the three habitats. Diving carnivores were found in areas of open water and surface-foraging carnivores were found on floating plants. Our findings suggest that maintenance of varied habitats is essential for conservation of bird diversity on the Palo Verde marsh.

Keywords: habitat heterogeneity, marsh management, conservation, marsh birds, feeding guilds, Palo Verde

INTRODUCTION

The distribution of aquatic bird species across marsh habitats may reflect partitioning of resources among coexisting species. Aquatic birds use different methods to feed, e.g. skimming, filtering or visual hunting. Different habitats may provide opportunities for effective use of these feeding methods. Marsh management can be improved with better understanding of whether and how habitat heterogeneity promotes biodiversity (e.g. Therriault and Kolas 2000; Brauns *et al.* 2007).

The habitable area in the marsh at Palo Verde, Costa Rica, was drastically reduced with the establishment of the reserve in the 1970s. The cattail *Typha domingensis* became dominant, homogenizing the marshland. Active management maintains a few small open areas of the marsh. Cattle grazing and the use of tractors remove or crush marsh vegetation and prevent any species from dominating. This keeps the vegetation of the marsh in an early successional stage (Mitchell *et al.* 2006) and preserves heterogeneity. We focused on open water, low aquatic vegetation, and tall cattail habitats.

Since these three habitats vary considerably in physical structure, we hypothesized that each would sustain bird species with different feeding strategies. Based on known diet as described in Stiles and Skutch (1989), we also hypothesized that any given feeding guild would show a clear preference for a specific habitat and

that guilds would not share habitats. This leads to the prediction that the birds of any guild will be concentrated in one habitat type. Finally, we hypothesized that birds of the same guild should have the same distribution regardless of activity.

METHODS

We performed the study from the bird observation tower on the marsh, 0.5 km from the Palo Verde Biological Station in Guanacaste, Costa Rica. We worked in two teams, each studying two patches from each of three habitats: sedges and cattails ("cattails"), water hyacinth and water fern ("lilies"), and open water ("water"). Each team chose its six patches at random, then continued to observe the same six patches, in randomized order, over the course of the morning. Teams alternated time in the tower every hour from 0920 to 1120 on 13 Jan 2008, and 0720 to 1120 on 14 Jan, so that each patch was observed for one 5-minute period every 2 hours, totaling between 3 and 4 observation periods of each patch over 2 days. We recorded the species of every bird in the patch and noted its activity. Birds were identified using Garrigues and Dean (2007).

We divided bird species into three feeding guilds according to their diets (Stiles and Skutch 1989), and used Paszkowski and Tonn (2006) as a guide for the categories: diving carnivores; surface-foraging carnivores; and surface-foraging omnivores (Table 1). Since feeding guilds describe only the feeding behavior of birds, we excluded observations from all non-feeding birds in our guild data analysis. We compared feeding and non-feeding birds in a later analysis.

RESULTS

There was a significant association between habitat types and species (Likelihood ratio, $\chi^2 = 52.68$, df = 26, P = 0.0015), as well as feeding guilds (Likelihood ratio, $\chi^2 = 17.27$, df = 6, P = 0.0084).

Feeding guilds tended to occupy different habitats while feeding; eighty percent of the diving carnivores observed were in open water habitats while over 70% of surface-foraging carnivores observed were on lilies (Table 2).

We found that surface-foraging birds were differentially distributed across habitats depending on whether they were feeding or resting ($\chi 2 = 6.08$, df = 2, P = 0.0477 for carnivores, and $\chi 2 = 19.6$, df = 2, $P < 0.0001$ for omnivores). Both of these guilds showed a more even distribution across habitats when feeding, than when resting (both rested almost exclusively on lilies).

Table 1. Numbers of feeding birds observed in three habitat types on marsh near Palo Verde Biological Station, Costa Rica

			Habitat		
Feeding Guilds	Species	Lilies	Cattails	Water	Total
Diving carnivores	Anhinga	0	0	1	1
	Least Grebe	1	0	3	4
Surface-foraging carnivores	Little Blue Heron	1	0	0	1
	Cattle Egret	2	0	1	3
	Great Egret	7	0	1	8
	Green Heron	2	1	0	3
	Limpkin	2	0	2	4
	Snail Kite	0	0	1	1
	Snowy Egret	1	0	0	1
Surface-foraging omnivores	Common Moorhen	6	1	3	10
	Northern Jacana	15	6	10	31
	Purple Gallinule	5	14	1	20
	Total	43	22	23	88

Table 2. Number and percent of birds observed by habitat on Palo Verde marsh, Costa Rica

	Habitat							
	Lilies		Cattails		Water		Total	
Feeding Guild	Count	% of guild	Count	% of guild	Count	% of guild	Count	% of guild
Diving Carnivores	1	20.00	0	0.00	4	80.00	5	100.00
Surface-foraging Carnivores	15	71.43	1	4.76	5	23.81	21	100.00
Surface-foraging Omnivores	26	42.62	21	34.43	14	22.95	61	100.00

DISCUSSION

Feeding guild helped predict the distribution of diving carnivores and surface-foraging carnivores, but the more generalist feeders in the surface-foraging omnivore guild showed no clear habitat preference (e.g. the Northern Jacana was found mostly on lilies while the Purple Gallinule was mostly in cattails). This is probably because of their broad omnivorous diets. These associations suggest that feeding guilds alone cannot reliably predict distributions of birds among habitats.

The distributions of feeding and non-feeding birds were visibly different at the feeding guild level. Finer knowledge of such behavioral nuances could help guide habitat predictions.

Our results suggest that all three feeding guilds depend on the open water and low aquatic vegetation habitats created by current

management practices. Many aquatic bird communities worldwide have already suffered from the destruction of wetlands (Snell-Rood and Cristol 2003) and habitat fragmentation. The loss of such habitat from Palo Verde appears inevitable if human management were to cease. Maintaining vegetative heterogeneity through marsh management is essential to support the great diversity and richness of bird life in Palo Verde.

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