

Aquatic bird densities in two coastal lagoon systems in Chiapas State, Mexico, a preliminary assessment

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Key words: aquatic bird densities, coastal lagoons Mexico

Abstract

Six bodies of water in two coastal lagoon systems were investigated in Chiapas State, Mexico between July, 1990 and February, 1991. The size of water bodies ranged from 102.5 to 847.5 ha. Salinity varied seasonally being the lowest in July during the rainy season (1.0‰) and highest in February (35.8‰). The waters are hypertrophic with total phosphorus concentrations as high 900 mg m⁻³.

The number of bird species was the highest in February ($N = 9$ to 23) and the lowest in July ($N = 2$ to 15). The majority of birds present are resident species of Mexico but several species of northern birds were present in February (e.g. Lesser Scaup, Osprey, Peregrin Falcon).

The number of birds observed in the waterbodies varied during the study period being as high as 2800 Cormorants, 2300 White Pelicans and 681 Limpkins, at a particular time, or expressed in terms of units surface area of each lagoon 8.0, 2.7 and 1.9 individuals per hectare respectively. The daily food requirements of White Pelicans at such a high density is about 4.1 kg ha⁻¹ d⁻¹.

The hypertrophic state of Cerritos Lagoon allows a sufficient level of production to support such a high food requirement. Considering the limited survey time spent on the lagoons the bird population numbers are probably underestimated.

Introduction

There are more than 130 coastal lagoons in Mexico (Lankford, 1977) but the aquatic bird fauna of these lagoons is not well known (Lock, 1990 & Parkes, 1991). Beginning in the late 1970's teams from the Universidad Autónoma Metropolitana, Mexico D.F. conducted systematic baseline studies in 31 lagoons to document the hydrologic and biological conditions in these lagoons. (See Contreras & Kerekes, 1992). Some of these studies included surveys of aquatic birds. At about the same time, the Canadian Wildlife

Service conducted aerial surveys of the Pacific Coast of Mexico which enumerated aquatic birds observable from aircraft (Lock, 1990b). The purpose of this paper is to present some preliminary assessment of aquatic bird populations observed in four visits in relation to the trophic status in two lagoon systems in Chiapas State on the Pacific Coast of Mexico.

Study area and methods

The coast of Chiapas State runs along 260 km forming a coastal plain varying from 12 to 30 km

in width. There are 21 coastal lagoons on that plain covering an area of 76 238 ha. The largest systems from north to south include those of Mar Muerto; la Joya-Buenavista; La Carreta; Pereyra; Buenavista and Chantuto-Panzacola, and also the estuaries Cabeza de Toro and Pampa El Paredon.

Some systems extend up to 1000 ha or more, with depths averaging between one and three meters. Most of them have branching, elongated channels three to six meters deep with muddy-sand bottoms; the formation of islets and sandbars is the norm. Many of the state's rivers (20 permanent and 28 seasonal) drain into coastal lagoons.

The study was conducted in two lagoon systems each consisting of several distinct bodies of water connected by narrow channels. The two systems are: La Carreta-Pereyra (two bodies of water investigated) and Chantuto Panzacola (four bodies of water investigated) (Table 1). The two systems are fed by the rivers Coapa and Margaritas, and Cacaluta, Cintalapa, Camargo and Vado Ancho respectively. The lagoons and their connecting channels are surrounded by mangrove forest up to 30 m high, except on the side of the barrier beach which has openings to the sea. A large number of birds use the trees along the shores for preening, roosting and nesting.

The lagoon systems support a successful commercial shrimp fishery and a subsistence fishery

to satisfy the need of the local population numbering about 30 to 40 persons/km² living along the lagoons (Sepesca, 1990).

The average annual air temperature is 27 °C. The balance between precipitation (1300 to 5000 mm y⁻¹) and the evaporation (1800 to 2000 mm yr⁻¹) is basically the same through this stretch of coast (Sepesca, 1990).

The predominant human activity along the coast are shrimp fishing, agriculture and cattle ranching. The recent expansion of the former two pushed the cultivated fields and pastures to the edge of several lagoons.

The lagoons were visited four times; July, September, December 1990 and February 1991. Due to logistic problems some of the bodies of water were not visited at each occasion, (Table 4).

The surveys were conducted from a motor boat, run along the edge of the water bodies, driven by a local guide with three observers aboard using binoculars with 12 × 50 magnification. The bird survey began at 10:00 to 11:00 hrs and concluding at 16:00 to 17:00 hrs.

Methods used for measuring salinity, total phosphorus, inorganic nitrogen and chlorophyll are given by Contreras and Kerekes (1993).

Results and discussion

Six bodies of water in two coastal lagoon systems were surveyed to provide baseline data for aquatic

Table 1. The geographic location, surface area, salinity and total phosphorus (February, 1990) in two lagoon systems in Chiapas state Mexico.

System	Area Ha	Salinity ‰	Total phosphorus mg m ⁻³	Latitude	Longitude
Chantuto-Panzacola					
Panzacola*	102.5	1.05	234.2	15° 07'	92° 43'
Cerritos	415.0	17.9	240.0	15° 10'	92° 46'
Campon	357.5	24.6	905.6	15° 13'	92° 49'
Chantuto	320.0	11.3	112.0	15° 15'	92° 53'
Carreta-Pereyra					
Pereyra	482.5	35.8	129.0	15° 32'	93° 14'
Carreta	847.5	16.3	188.6	15° 29'	93° 08'

* The salinity and total phosphorus for Panzacola lagoon were taken from the July visit.

Table 2. List of aquatic birds species and their numbers observed in two coastal lagoon systems in Chiapas state, Mexico in February, 1991.

Species/lagoons	Cerritos	Campon	Chantuto	Pereyra	Carreta	Common name
<i>Pelecanus erythrorhynchos</i>	80	28	50		2300	White pelican
<i>Pelecanus occidentalis</i>				17	1	Brown pelican
<i>Phalacrocorax olivaceus</i>	111	2863	3	132	1090	Cormorant
<i>Anhinga anhinga</i>	2	1		2	3	Anhinga
<i>Fregata magnificens</i>	50		33		281	Magnificent frigate bird
<i>Tigrisoma mexicanum</i>	1				4	Tiger heron
<i>Ardea herodias</i>	9	1		1	6	Great blue heron
<i>Casmerodius albus</i>	18	147		38	62	Great egret
<i>Egretta thula</i>	6	3		14	2	Snowy egret
<i>Egretta caerulea</i>	8			2	6	Little blue heron
<i>Egretta tricolor</i>						Louisiana heron
<i>Egretta rufescens</i>		1				Reddish egret
<i>Bubulcus ibis</i>						Cattle egret
<i>Butorides striatus</i>	1				3	Green heron
<i>Nycticorax nycticorax</i>						Black crowned night heron
<i>Nycticorax violaceus</i>				1		Yellow crowned night heron
<i>Eudocimus albus</i>					3	White ibis
<i>Ajaia ajaja</i>						Roseate spoonbill
<i>Mycteria americana</i>	1				15	Wood stork
<i>Dendrocygna bicolor</i>	2					Fulvous whistling duck
<i>Dendrocygna autumnalis</i>						Black belied whistling duck
<i>Aythya affinis</i>					9	Lesser scaup
<i>Rostrhamus sociabilis</i>						Snail kite
<i>Pandion haliaetus</i>	10	11	1	8	6	Osprey
<i>Buteogallus anthracinus</i>	2	6		1		Common black hawk
<i>Falco peregrinus</i>				1		Peregrine falcon
<i>Porphyrius martinica</i>	1					Purple gallinule
<i>Aramides cajanea</i>						Gray necked wood rail
<i>Aramus guarana</i>		681				Limpkin
<i>Charadrius semipalmatus</i>						Semipalmated plover
<i>Hyphantopus mexicanus</i>		74				Black necked stilt
<i>Jacana spinosa</i>					3	Northern jacana
<i>Tringa solitaria</i>			9			Solitary sandpiper
<i>Cataporphus semipalmatus</i>	150	64		1		Willet
<i>Actitis macularia</i>						Spotted sandpiper
<i>Numenius phaeopus</i>	5		6			Whimbrel
<i>Limosa fedoa</i>			7			Marbled godwit
<i>Larus atricilla</i>	420	29	4		55	Laughing gull
<i>Sterna caspia</i>	63	2				Caspian tern
<i>Sterna maxima</i>			10	26		Royal tern
<i>Sterna elegans</i>		2				Elegant tern
<i>Sterna antillarum</i>						Least tern
<i>Rynchops niger</i>					1	Black skimmer
<i>Ceryle torquata</i>	8	1		2	4	Ringed king fisher
<i>Ceryle alcyon</i>						Belted kingfisher
<i>Chloroceryle amazona</i>	1					Amazon kingfisher
<i>Chloroceryle americana</i>	2				2	Green kingfisher
<i>Tachycineta albilinea</i>	60			2		Mangrove swallow
Total	1011	3914	123	248	3856	
Maximum	420	2863	50	132	2300	
Minimum	1	1	1	1	1	
Number of species	23	16	9	15	20	
Total species in Chantuto-Panzacola system	48					
Total species in Carreta-Pereyra system	35					

Table 3. The relative abundance (individuals/hectare) of aquatic birds observed in two coastal lagoon systems (five waterbodies) in Chiapas state, Mexico in February, 1991.

Species/lagoon	Cerritos	Campon	Chantuto	Pereyra	Carreta
* <i>Pelecanus erythrorhynchos</i>	0.193	0.078	0.156		2.714
* <i>Pelecanus occidentalis</i>				0.035	0.001
* <i>Phalacrocorax olivaceus</i>	0.267	8.008	0.009	0.274	1.286
* <i>Anhinga anhinga</i>	0.005	0.003		0.004	0.004
* <i>Fregata magnificens</i>	0.120		0.103		0.332
* <i>Tigrisoma mexicanum</i>	0.002				0.005
* <i>Ardea herodias</i>	0.022	0.003		0.002	0.007
* <i>Casmerodius albus</i>	0.043	0.411		0.079	0.073
* <i>Egretta thula</i>	0.014	0.008		0.029	0.002
* <i>Egretta caerulea</i>	0.019	0.000		0.004	0.007
* <i>Egretta tricolor</i>					
* <i>Egretta rufescens</i>		0.003			
+ <i>Bubulcus ibis</i>					
+ <i>Butorides striatus</i>	0.002				0.004
* <i>Nycticorax nycticorax</i>					
* <i>Nycticorax violaceus</i>				0.002	
* <i>Eudocimus albus</i>					0.004
* <i>Ajaja ajaja</i>					
* <i>Mycteria americana</i>	0.002				0.018
+ <i>Dendrocygna bicolor</i>	0.005				
+ <i>Aythya affinis</i>					0.011
+ <i>Rostrhamus sociabilis</i>					
* <i>Pandion haliaetus</i>	0.024	0.031	0.003	0.017	0.007
* <i>Buteogallus anthracinus</i>	0.005	0.017		0.002	
+ <i>Falco peregrinus</i>				0.002	
! <i>Porphyrio martinica</i>	0.002				
+ <i>Aramides cajanea</i>					
* <i>Aramus guarauna</i>		1.905			
! <i>Charadrius semipalmatus</i>					
+ <i>Hymantopus mexicanus</i>		0.207			
! <i>Jacana spinosa</i>					0.004
! <i>Tringa solitaria</i>			0.028		
+ <i>Catartophorus semipalmatus</i>	0.361	0.179		0.002	
! <i>Actitis macularia</i>					
+ <i>Numenius phaeopus</i>	0.012		0.019		
+ <i>Limosa fedoa</i>			0.022		
+ <i>Larus atricilla</i>	1.012	0.081	0.013		0.065
* <i>Sterna caspia</i>	0.152	0.006			
+ <i>Sterna maxima</i>			0.031	0.054	
+ <i>Sterna elegans</i>		0.006			
! <i>Sterna antillarum</i>					
+ <i>Rynchops niger</i>					0.001
+ <i>Ceryle torquata</i>	0.019	0.003		0.004	0.005
+ <i>Ceryle alcyon</i>					
! <i>Chloroceryle amazona</i>	0.002				
! <i>Chloroceryle americana</i>	0.005				0.002
! <i>Tachycineta albilinea</i>	0.145			0.004	
Total	2.436	10.948	0.384	0.514	4.550
* Large size birds	0.870	10.473	0.272	0.448	4.459
+ Medium size birds	1.412	0.476	0.084	0.062	0.085
! Small size birds	0.154	0.000	0.028	0.004	0.006

Note: The size grouping is based in the length of the species.

Large birds greater than 35.5 cm long, medium smaller than 30.5 cm long and small less than 24.5 cm.

bird populations in Chiapas State, Mexico making four visits between July 1990 and February 1991. Most of the reporting in this paper is based on the February visit which was the most comprehensive.

The size of the water bodies ranged from 102.5 to 847.5 ha. Salinity varied seasonally being the lowest in July (1.2 to 10.0‰) during the rainy season and the highest in February (11.3 to 35.8‰) during the drought. The waters are hypertrophic according to the OECD trophic classification system (Vollenweider & Kerekes, 1982) with total phosphorus ranging from 112 to 905 mg m⁻³. The hydrological and biological conditions including primary productivity of these waterbodies are described in some detail by Contreras & Gutierrez, 1989, Contreras & Castañeda, 1991, and the phosphorus-chlorophyll relationship is discussed by Contreras &

Kerekes, 1993. The basis for the very high productivity of these lagoons is the continuous high phosphorus supply from the drainage basin (e.g. agricultural runoff) and the evaporation of sea water. The alkaline conditions (e.g. pH 7.8 to 9.4) also stimulate the release of phosphorus from the sediments (internal loading) which in turn maintains high concentrations of phosphorus and productivity in the water column.

The list of aquatic birds species and their numbers observed in February is given in Table 2. In total 48 species of waterbirds were seen in the six waterbodies during the four visits ranging from 9 species in Chantuto to 23 species in Cerritos in February. The birds were not evenly distributed among the lagoons ranging from 123 individuals belonging to 9 species in Chantuto to 3914 individuals (16 species) in Campon where 2863 birds were Olivaceous Cormorants. The largest accumu-

Table 4. The relative abundance (individuals/hectare) of aquatic birds of four sampling dates between July 1990 and February 1991 in two coastal lagoon systems in Chiapas state, Mexico.

July 23 and 24 visits/lagoons	System 1			System 2		
	Panzacola	Cerritos	Campon	Chantuto	Pereyra	Carreta
Total	0.907	0.019	0.011	0.603	0.555	0.107
* Large size birds	0.887	0.019	0.011	0.587	0.520	0.103
+ Medium size birds	0.019			0.003	0.033	0.001
! Small size birds				0.012	0.002	0.004
September 20 and 21						
Total	11.785		1.034		0.390	0.109
* Large size birds	11.307		1.016		0.388	0.100
+ Medium size birds	0.137		0.009		0.002	0.006
! Small size birds	0.068		0.009			
December 1, 2 and 3						
Total	3.102		0.417		1.844	0.347
* Large size birds	2.761		0.202		1.788	0.340
+ Medium size birds	0.107		0.070		0.009	0.004
! Small size birds	0.244		0.145		0.028	0.004
February 3 and 4						
Total		2.436	10.948	0.384	0.514	4.550
* Large size birds		0.870	10.473	0.272	0.448	4.459
+ Medium size birds		1.412	0.476	0.084	0.062	0.085
! Small size birds		0.154		0.028	0.004	0.006

lation of birds in a single location both in terms of number and biomass were 2300 White Pelicans and 280 Magnificent Frigate Birds which were observed fishing in one area in the large Carreta Lagoon during the February visit.

The relative abundance of aquatic birds (No/ha) observed in the lagoons is given in Table 3. There was no attempt made to express the abundance of birds in the terms of biomass, but three size classes of birds (large = e.g. White Pelican; medium = e.g. Cormorant, Heron; small = e.g. Green Heron, Royal Tern) were recognized and indicated in Table 3. The densities ranged from 0.38 to 10.9 birds ha^{-1} in Cerritos and Chantuto respectively. The 2300 White Pelicans in Carreta represent 2.7 individuals ha^{-1} or in terms of body weight approximately 20.25 kg ha^{-1} . Assuming that pelicans consume fish at a rate of 10% of their body weight [7.5 kg, (Dunning, 1984)] per day, then the daily food requirement of White Pelicans at such high density is 4.1 kg fish $\text{ha}^{-1} \text{d}^{-1}$, which is about equal to the annual fish production per hectare in a northern oligotrophic lake (Kelso, 1988).

The densities of birds expressed as per unit surface area (e.g. No/ha) varied considerably among the lagoons and also varied seasonally (Table 4). The greatest densities were found in February when both resident and migratory birds were present.

The bird observations and numbers reported here should be viewed as preliminary. Due to the very limited survey time spent on the lagoons and the time of day which excluded the early morning and late afternoon when the birds are most active, the numbers given here must be considered minimum numbers and underestimates of the true situation. Also, the large numbers of birds observed in the connecting channels and in the mangrove forest along the edge of the lagoons are not included neither is there any information available on the movements of birds among bodies of water including the sea. Nevertheless, the numbers and biomass of birds reported here suggest that these waterbodies are extremely pro-

ductive both in terms of numbers and biomass. They are similar to that shown in this symposium by Hoyer & Canfield (1994) in two figures depicting total phosphorus versus bird number and bird biomass (unit surface area) relationships in hypertrophic lakes in Florida.

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