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WINTER BIRDS OF BAHIA KINO, CENTRAL GULF OF CALIFORNIA COAST, SONORA, MEXICO

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Bahia Kino is a small fishing village in a biologically rich coastal region that demarcates the upper Gulf of California from the lower two-thirds of the l000-km-long Gulf. The rich biodiversity of this region is attributed to an intermingling of tropical and temperate biotas in the Gulf (Brusca, 1980), and locally to the juxtaposition of several distinct ecosystems: marine, intertidal, estuarine, and desert. The intertidal areas are further distinguished by both rocky and sandy shores, and the coastal desert exhibits altitudinal and topographic variations. Moreover, several oceanic islands lie offshore. This variety of habitats provides for a great diversity of breeding, migrant, and wintering bird species.

Although the ornithological literature includes avian distributional studies for greater Sonora (van Rossem, 1945; Phillips and Amadon, 1952; Russell and Lamm, 1978; Gallucci, 1981), seleced Gulf islands (van Rossem, 1932; Vaurie, 1953; Boswall and Barrett, 1978), and biogeographical studies of the entire Gulf (Anderson, 1983; Cody, 1983), few published data exist on the avifauna of Bahia Kino (Alden, 1969: 23-26). Furthermore, except for a recent work on the far northern Gulf (Mellink and Palacios, 1993) published studies are lacking for any site along the Sonoran coast.

Seabirds in the Gulf of California have long been recognized as an important, threatened biological resource of international value (pacific Seabird Group, 1974; Anderson *et al.,* 1976; GIIGC, 1990), but threats -in the form of oil tanker traffic, sport and commercial fisheries, shoreline development, and swelling numbers of tourists- continue to increase. The wildlife and natural diversity of Bahia Kino thus need to be documented so that proper protection and management can be provided. This paper presents distributional accounts of the area's avifauna as initial documentation for future studies, as well as for management considerations.

The study area was centered at Bahia Kino, Sonora (28^0 50' N, 111^0 55" W), a small fishing village on the east coast of the central Gulf of California. In recent years the settled area has doubled in size as vacation homes, condominiums, and tourist facilities ("Kino Nuevo") have been established adjacent to the original townsite.

Vegetation of the surrounding desert is typical of the Torchwood-Cardon Series of the Central Gulf Coast Subdivision of Sonoran Desertscrub (Turner and Brown, 1982). This desert is characterized by abundant columnar cacti (Cardon *[Pachycereus pringlei],* Senita *[Lophocereus schottii],* Organpipe *[Stenocereus Thurberi],* and Saguaro *[Carnegia gigantea]),* as well as numerous shrubs and small trees, including Torchwood *(Bursera microphylla),* Ocotillo (Fouquiera splendens), Limberbush *(Jatropha cuneata),* Creosotebush *(Larrea divaricata),* and Palo Verde *(Cercidium microphyllum).* True riparian vegetation is absent from the study area, although xeroriparian habitats, with more abundant leguminous trees, are present along intermittent desert washes. Estero Santa Cruz, a 40 km^2 estuary, supports Littoral Scrub vegetation (Felger and Lowe, 1976), including Black Mangrove *(Avicennia germinans),* small patches of Red Mangrove *(Rhizophora mangle),* as well as extensive mudflats and alkaline flats of halophytic scrub, including *Allenrolfea occidentalis, Suaeda esteroa,* and *Salicornia bigelovii.* This is one of the northernmost mangrove-dominated estuaries in the world.

Bahia Kino lies along the eastern shore of the Midriff Islands section of the Gulf of California. This narrowest section (approximately 140 km wide) of the Gulf contains the majority of its islands. In addition, this portion of the Gulf is oceanographically unique, with strong tidal currents, high current velocities, substantial upwelling, and consequent high biological productivity (Maluf, 1983). Within Bahia Kino itself is Isla Alcatraz (=Pelicano), a 0.5 km^2 seabird island, which lies 1.4 km offshore. Farther offshore (26-35 km) lie Isla Tiburon, the largest island in the Gulf (1208 sq km), Isla Datil (= Turner's; 1.5 sq km), and Isla Cholludo (=Roca Foca; 0.1 sq km).

The study area was bounded on the south by the south edge of Estero Santa Cruz and Punta Hueso de Ballena, on the east by an approximate line 6 km inland from the shoreline, on the north by Cerro Eucla (=Kino), and on the west by Isla Datil, the farthest offshore island that could be reached within one hour by boat (Figure 1). The study area comprised approximately 600 km^2.

We distinguished five categories of bird habitat:
Offshore (more than 0.5 km from the mainland coast, including open water and islands), Nearshore (rocky and sandy intertidal, and coastal waters up to 0.5 km from shore), Mangrove Estuary, Sonoran Desertscrub, and Human Habitation (in immediate vicinity of human dwellings and structures). Four categories of relative bird abundance were established:
Abundant (almost always encountered, often in large numbers), Common (usually encountered, but in smaller numbers), Uncommon (infrequently encountered, always in small numbers), and Rare (encountered only a few times, always as

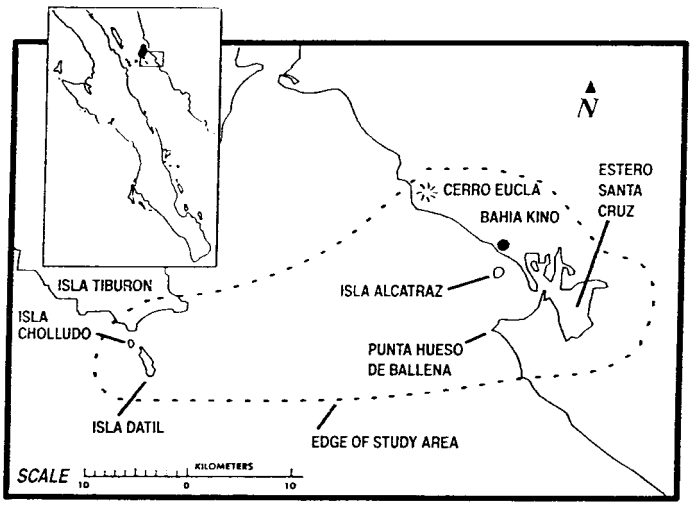

Figure 1.- Bahia Kino and adjacent study area along the Central Gulf of California Coast, Sonora, Mexico.

individuals or pairs).

Observations were made during two-week periods in five consecutive Januarys (15-30 January 1989, 15-29 January 1990, 9-23 January 1991, 12-27 January 1992, and 10-25 January 1993). The Mangrove Estuary, Nearshore, Sonoran Desert, and Human Habitation habitats were observed daily. The Offshore habitat was surveyed less frequently; while Isla Alcatraz was surveyed several times each field season, the waters and islands farther offshore (Datil, Cholludo, and the southern tip of Tiburon) were surveyed only five times in five years. Observations were made from land and boat. All terrestrial sites surveyed were below 1000 m in elevation.

Relative abundance and habitat usage by winter birds are summarized in the Appendix. One hundred and eight (108) species, representing sixteen orders and thirty-seven families, were observed.

The coincidence of mangrove estuary, seabird islands, and desert is typical of several sites along the Sonoran coast in the Midriff Islands section of the Gulf of California. The habitat diversity of Bahia Kino contributes to its avian diversity, and is representative of this region of the Sonoran coast. Furthermore, Bahia Kino is near the northern distributional limit for many southern species, such as Black Vulture *(Coragyps atratus),* Blue-footed Booby *(Sula nebouxii),* Brown Booby *(S. leucogaster),* and Magnificent Frigatebird *(Fregata magnificens),* while still being rich in northern avifauna, including many migrants (especially shorebirds), which breed in the far north. High diversity is particularly evident within certain taxonomic groups, such as wading birds (75% of North American ardeids occur in Estero Santa Cruz) and shorebirds (39% of North American Charadrii were observed).

The habitat type with the greatest avian diversity was the Mangrove Estuary, which was used by 58% of the species. By far, the habitat with lowest diversity was Human Habitation, which was used by 19% of the species.

The Bahia Kino area provides habitat for the endangered Peregrine Falcon *(Falco peregrinus);* we observed feeding and probable nesting within the study area.

Due to the scant information on birds of this area, comparisons with the past are difficult to make. The emphasis of Russell and Lamb's (1978) work in Sonora was on terrestrial habitats, and thus lacked data on coastal and marine species. Alden (1969) provided the only previous information specific to Bahia Kino, but his list did not distinguish among the markedly different seasonal bird populations found here. During a brief survey of Isla Tiburon sixty years ago, van Rossem (1932: 134) noted that the California Gull *(Larus californianus)* was "perhaps the most common non-resident gull to be found in the Gulf area during the winter months." During the five field seasons of our research, this species was absent from the study area.

Bahia Kino and the entire central Sonoran coast is a biological treasure, but this good fortune hangs by a tenuous thread. Threats to the biological integrity grow steadily, and time is not on the side of biodiversity preservation unless steps are taken soon to increase protection of the area's biota. Even during the course of this study, considerable denaturation (which is, as Soule [1990] aptly pointed out, a more accurate term than "development") occurred. A new road was built around the perimeter of Estero Santa Cruz.

New beachfront condominium and subdivision plans abound, threatening to convert more of the Mangrove Estuary and Nearshore habitat types into the less diverse Human Habitation type. Alarmed by a recent decrease in commercial fishing success, local fishermen recognize detrimental overharvesting of fishes and benthic shellfish.

The value of Estero Santa Cruz as avian habitat follows from the overall biological richness of Sonoran esturaries. Brusca (1980: 15) pointed out the extremely high biological productivity and diversity of estuaries along the Sonoran coast, and their vulnerability to human impact. Threats to Estero Santa Cruz exist in the form of proposed resort development (with attendant dredging), as well as decreased freshwater input from the harnessed Rio Sonora. These threats may impact sensitive avian inhabitants such as ospreys *(Pandion haliaetus),* which, according to Henny and Anderson (1979: 105), "require some protection if they are to be maintained as a part of the fauna" of the Gulf of California.

Well over a decade ago Anderson *et al., (1976)* described the need for a seabird sanctuary system in the Gulf of California. They considered Isla Alcatraz as a top priority for

sanctuary status, due to its high vulnerability and importance as a seabird breeding site, including the largest Double-crested Cormorant *(Phalacrocorax auritus)* colony in the entire Gulf. Although they mentioned this "immediate need" in 1976, little has been done since.

While the islands in the Gulf are protected by Mexican law, other critical habitats, such as Estero Santa Cruz, should also receive protection. A number of Mexican institutions and agencies (e.g., SEDESOL) are collaborating to develop a comprehensive management strategy for the northern Gulf. In addition, internationally supported protected status for this area of high biological diversity seems warranted. The area may qualify as a Biosphere Reserve under the UNESCO Man and the Biosphere Program (Dyer and Holland, 1988), particularly because of the coincidence of rich biological and cultural heritages: both Mexican and intact Seri Indian cultures coexist with the rich biodiversity described in this paper. In addition, the high diversity of wintering shorebirds qualifies this region as a potential candidate for inclusion in the Western Hemisphere Shorebird Reserve Network (Myers *et al., 1987).*

Economic strategies are also available. Natural history-based "ecotourism" has potential to contribute to preservation of the area's biodiversity by providing a positive economic incentive to local peoples (Boo, 1990; Whelan, 1991). Such an approach must be taken cautiously, however, to avoid counterproductively encouraging a large tourism industry. Seabird colonies, for example, could easily be disturbed by excessive numbers of tour boats. Local cultures could be distorted by attempting to conform to standards of the travel industry. Nevertheless, this approach has much to offer.

Undoubtedly, some combination of political and economic strategies will be necessary to preserve this center of avian diversity.

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APPENDIX.- Relative abundance and habitat use of bird species observed during the winters of 1989-1993 in the vicinity of Bahia Kino, Sonora. (See text for explanation of habitat types and relative abundance categories. OS =Offshore, NS=Nearshore, ME=Mangrove Estuary, SD=Sonoran Desertscrub, HH=Human Habitation; R=Rare, U=Uncommon, C=Common, A=Abundant).

Habitat Types	OS	NS	ME	SD	HH
ORDER GAVIIFORMES					
Family Gaviidae					
Pacific Loon *(Gavia pacifica)*	R	-	-	-	-
Common Loon *(G. immer)*	C	C	C	-	-
ORDER PODICIPEDIFORMES					
Family Podicipedidae					
Horned Grebe *(Podiceps auritus)*	R	-	-	-	-
Eared Grebe *(P. nigricollis)*	U	C	U	-	-
Western Grebe *(Aechmophorus occidentaIis)*	U	U	U	-	-
ORDER PROCELLARIIFORMES					
Family Procellariidae					
Black-vented Shearwater *(Puffinus opisthomelas)*	U	-	-	-	-
ORDER PELECANIFORMES					
Family Sulidae					
Blue-footed Booby *(Sula nebouxii)*	C	C	-	-	-
Brown Booby (*S. leucogaster)*	U	U	-	-	-
Family Pelecanidae					
American White Pelican *(Pelecanus erythrorhynchos)*	-	-	U	-	-
Brown Pelican *(P. occidentaIis)*	A	A	A	-	-
Family Phalacrocoracidae					
Double-Crested Cormorant *(Phalacrocorax auritus)*	A	A	A	-	-
Brandt's Cormorant *(P. penicillatus)*	R	R	-	-	-
Family Fregatidae					
Magnificent Frigatebird *(Fregata magnificens)*	U	U	-	-	-
ORDER CICONIIFORMES					
Family Ardeidae					
Great Blue Heron *(Ardea herodias)*	C	C	C	-	-
Great Egret *(Casmerodias aIbus)*	-	-	U	-	-
Snowy Egret *(Egretta thula)*	U	U	C	-	-
Little Blue Heron *(E. caerulea)*	-	-	R	-	-
Tricolored Heron *(E. tricolor)*	-	-	U	-	-

Reddish Egret *(E. rufescens)*	U	U	C	-	-
Cattle Egret *(Bubulcus ibis)*	-	-	-	-	R
Green-backed Heron *(Butorides striatus)*	-	-	U	-	-
Black-crowned Night-Heron *(Nycticorax nycticorax)*	-	-	C	-	-
Yellow-crowned Night-Heron *(N. violaceus)*	-	-	C	-	-
Family Threskiornithidae					
White Ibis *(Eudocimus albus)*	-	-	U	-	-
ORDER ANSERIFORMES					
Family Anatidae					
Brant *(Branta bernicla)*	-	U	C	-	-
Green-winged Teal *(Anas crecca)*	-	-	U	-	-
Cinnamon Teal *(A. cyanoptera)*	-	-	R	-	-
Redhead *(Aythya americana)*	-	R	-	-	-
Lesser Scaup *(A. affinis)*	-	C	C	-	-
Bufflehead *(Bucephala albeola)*	-	U	U	-	-
Red-breasted Nerganser *(Magus serrator)*	U	U	C	-	-
Ruddy Duck *(Oxyura jamaicensis)*	-	R	-	-	-
ORDER FALCONIFORMES					
Family Cathartidae					
Black Vulture *(Coragyps atratus)*	-	U	-	U	-
Turkey Vulture *(Cathartes aura)*	C	U	C	C	C
Family Accipitridae					
Osprey (Pandion haliaetus)	C	C	C	-	U
Northern Harrier *(Circus cyaneus)*	R	R	U	-	-
Cooper's Hawk *(Accipiter cooperii)*	-	-	R	R	-
Red-tailed Hawk *(Buteo jamaicensis)*	-	U	R	C	-
Family Falconidae					
American Kestrel *(Falco sparverius)*	U	U	R	U	U
Peregrine Falcon *(F. peregrinus)*	U	U	R	-	-
Prairie Falcon *(F. mexicanus)*	-	R	-	-	-
ORDER GALLIFORMES					
Family Phasianidae					
Gambel's Quail *(Callipepla gambelii)*	-	-	-	U	-
ORDER GRUIFORMES					
Family Rallidae					
Clapper Rail *(Rallus longirostris)*	-	-	R	-	-
ORDER CHARADRIIFORMES					
Family Charadriidae					
Black-bellied Plover *(Pluvialis squatarola)*	U	U	C	-	-
Snowy Plover *(Charadrius alexandrinus)*	-	-	U	-	-
Wilson's Plover *(C. wilsonia)*	-	-	U	-	-
Semipalmated Plover *(C. semipalmatus)*	-	-	U	-	-
Family Haematopodidae					
American Oystercatcher *(Haematopus palliatus)*	U	U	U	-	-
Family Recurvirostridae					
Black-necked Stilt *(Himantopus mexicanus)*	-	-	U	-	-
American Avocet *(Recurvirostra americana)*	-	-	U	-	-
Family Scolopacidae					
Greater Yellow legs *(Tringa melanoleuca)*	-	-	C	-	-
Lesser Yellowlegs *(T. flavipes)*	-	-	C	-	-
Willet *(Catoptrophorus semipalmatus)*	-	C	C	-	-
Spotted Sandpiper *(Actitis macularia)*	U	U	U	-	-
Whimbrel *(Numenius phaeopus)*	U	U	C	-	-
Long-billed Curlew *(N. americanus)*		-	C	-	-
Marbled Godwit *(Limosa fedoa)*	-	-	C	-	-
Ruddy Turnstone *(Arenaria interpres)*	-	-	U	-	-
Sanderling *(Calidris alba)*	-	U	-	-	-
Western Sandpiper *(C. mauri)*	-	-	A	-	-
Dunlin *(C. alpina)*		-	U	-	-
Short-billed Dowitcher *(Limnodromus griseus)*	-	-	U	-	-
Family Laridae					
Bonaparte's Gull *(Larus philadelphia)*	U	U	U	-	-
Heermann's Gull *(L. heermanni)*	A	A	A	-	-
Ring-billed Gull *(L. delawarensis)*	C	A	A	-	A
Herring Gull *(L. argentatus)*	U	U	U	-	-
Yellow-footed Gull *(L. livens)*	A	A	A	-	C

Caspian Tern *(Sterna caspia)*	U	U	U	-	-
Royal Tern *(S. maxima)*	R	-	-	-	-
Forster's Tern *(S. forsteri)*	C	C	C	-	-
Black Skimmer *(Rynchops niger)*	-	-	U	-	-
ORDER COLUMBIFORMES					
Family Columbidae					
Rock Dove *(Columba Livia)*	-	-	-	-	U
Inca Dove *(C. inca)*	-	-	-	-	C
White-winged Dove *(Zenaida asiatica)*	-	-	R	C	U
ORDER CUCULIFORMES					
Family Cuculidae					
Greater Roadrunner *(Geococcyx californianus)*	-	-	-	R	-
ORDER APODIFORMES					
Family Trochilidae					
Costa's Hummingbird *(Calypte costae)*	-	-	-	C	-
ORDER CARACIIFORMES					
Family Alcedinidae					
Belted Kingfisher *(Ceryle alcyon)*	R	R	U	-	-
ORDER PICIFORMES					
Family Picidae					
Gila Woodpecker *(Melanerpes uropygialis)*	-	R	-	C	U
ORDER PASSERIFORMES					
Family Tyrannidae					
Flycatcher sp. *(Empidonax sp.)*	-	-	-	R	-
Say's Phoebe *(Sayornis saya)*	-	-	-	U	U
Ash-throated Flycatcher *(Myiarchus cinerascens)*	-	-	-	C	-
Family Hirundinidae					
Violet-green Swallow *(Tachycineta thalassina)*	-	-	R	U	-
Family Corvidae					
Common Raven *(Corvus corax)*	U	C	U	C	U
Family Remizidae					
Verdin *(Auriparus flaviceps)*	U	-	-	C	U
Family Troglodytidae					
Cactus Wren *(Campylorhynchus brunneicapillus)*	-	-	-	C	-
Rock Wren *(Salpinctes obsoletus)*	R	U	-	C	-
Canyon Wren *(Catherpes mexicanus)*	U	-	-	U	-
Family Muscicapidae					
Blue-gray Gnatcatcher *(Polioptila caerulea)*	-	-	-	U	-
Family Mimidae					
Northern Mockingbird *(Mimus polyglottos)*	U	-	-	C	U
Curve-billed Thrasher *(Toxostoma curvirostrey)*	U	U	-	U	-
Family Ptiolgonatidae					
Phainopepla *(Phainopepla nitens)*	-	-	-	U	-
Family Laniidae					
Loggerhead Shrike *(Lanius ludovicianus)*	-	-	-	U	U
Family Emberizidae					
Yellow Warbler *(Dendroica petechia)*	-	-	-	R	-
Mangrove Warbler *(D. erithachorides)*	-	-	U	-	-
Northern Cardinal *(Cardinalis cardinalis)*	-	-	-	R	-
Pyrrhuloxia *(C. sinuatus)*	-	-	-	U	-
Green-tailed Towhee *(Pipilo chlorurus)*	-	-	-	U	-
Lark Sparrow *(Chondestes grammacus)*	-	-	-	U	-
Black-throated Sparrow *(Amphispiza bilineata)*	-	-	-	C	-
Lark Bunting *(Calamospiza melanocorys)*	-	-	-	R	-
Song Sparrow *(Melospiza melodia)*	-	-	-	R	-
White-crowned Sparrow *(Zonotrichia leucophrys)*	-	U	U	C	-
Western Meadowlark *(Sturnella neglecta)*	-	-	R	-	-
Brewer's Blackbird *(Euphagus cyanocephalus)*	-	-	-	-	R
Great-tailed Grackle *(Quiscalus Mexicanus)*	-	-	-	U	C
Hooded Oriole *(Icterus cucullatus)*	-	-	-	-	R
Family Fringillidae					
House Finch *(Carpodacus mexicanus)*	C	-	-	C	C
Family Passeridae					
House Sparrow *(Passer domesticus)*	-	-	-	U	C
Number of species per habitat	42	45	63	36	20
Percentage of total species per habitat	39	42	58	33	19

(note: Some species occurred in more than one habitat)