BIRDS OF THE GULF OF MEXICO AND THE PRIORITY AREAS FOR THEIR CONSERVATION

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INTRODUCTION

Information regarding marine birds of the Gulf of Mexico is surprisingly scarce, particularly when compared with existing data for other insular and marine regions of the country (Anderson 1983; Cody and Velarde 2002; Velarde *et al*. 2004). In the case of terrestrial and aquatic birds there is more information. The raptor migration through central Veracruz is particularly well known because systematic censuses in the corridor have taken place for more than ten years (Ruelas *et al*. 2000). This region is considered the most important migratory pathway in the world for this group of birds (Ruelas *et al*. 2000; Zalles and Bildstein 2000), with more than 4 million birds of prey counted every fall. Since the 1930's, the waterfowl in Mexico has been systematically censused by the U.S. Fish and Wildlife Service (DUMAC 1999a). Eighty-three percent of migratory waterfowl in Mexico are concentrated in 28 areas, seven of which are found in coastal areas of the Gulf of Mexico (DUMAC 1999b).

With the exception of the instances cited above, the only data existing for the Gulf of Mexico region is a species list. Thus, changes in historical or recent distribution of species or in their absolute or relative abundance are unknown. It is important to have basic data and time series to be able to make comparisons and useful predictions in the planning of management strategies.

GEOGRAPHICAL SETTING

The Gulf of Mexico is a basin approximately 1,400 km in diameter. The northern limit is the southern coast of the United States, on the west and south is the eastern coast of México and to the east the peninsula of Florida, the island of Cuba and the waters of the Atlantic Ocean. It is a subtropical and tropical marine zone with great diversity in climatic and environmental conditions. In addition, this diversity of conditions is coupled with varying hydrology and bathymetry, generating complex biotical associations within the basin. In the terrestrial region, topographic and climatic conditions favor vegetation associations from thorny thickets to tropical rainforest (*sensu* Rzedowski 1983). The flora and the fauna of this area display diverse and complex ecological interactions.

Environmental conditions create a mosaic of habitats in the coastal zones as well as on the continental platform and pelagic regions, allowing the presence of a great diversity of migratory and resident bird species. Approximately 60% of Mexico's watersheds drain into the coastal waters of the Gulf of Mexico. In these areas, wetlands and lagoons containing habitats that are vital to numerous species exist from the Laguna Madre in Tamaulipas to Rio Largartos in the Yucatan Peninsula. For example, 15% of all migratory aquatic birds in México are concentrated within the limits of the Laguna Madre (DUMAC 1999b).

The broad continental platform of the Gulf of México, especially off the coasts of Campeche and Yúcatan, contains wide range of reefs and associated "keys" or islands, which are suitable for nesting by marine birds. For some species, these are the only areas where they breed within the limits of the Gulf of México. Among the species that use these islands are the red-footed booby (*Sula sula*) and the least tern (*Sterna antillarum*), which are both included in the endangered species list of the Norma Oficial Mexicana (Official Mexican Regulations, NOM-059-ECOL-2000). These islands and reefs are also resting places for many migratory species that cross the Gulf of México.

SPECIES DISTRIBUTION

Since most species of marine birds feed on marine organisms, the regional processes that influence primary productivity and species composition of prey communities also shape bird community structure. On a smaller scale, distribution and abundance of marine bird species is also determined by local oceanographic conditions. Although these conditions can change within a few hours they are also influenced by seasonal oceanic characteristics. Over longer periods of time, periodic variations like the El Niño Southern Oscillation (ENSO) can also affect distribution and abundance of marine birds and may even cause changes in their feeding strategies and reproductive habits (Anderson 1983; Velarde *et al*. 2004, 2005).

The diversity of birds from various origins and influences is a result of the geographical location of the Gulf of Mexico. We can identify three relatively well-defined regions in the Gulf of Mexico (Fig. 9.1). Zone I, where resident and wintering species with Nearctic affinities are found, is located between Laguna Madre and Laguna Tamiahua. Eighty-two percent of the birds present in Laguna Madre originate in the Nearctic. This zone represents the southern limit in the winter distribution for several species, such as of the bald eagle (*Haliaeetus leucocephalus*) (Buehler 2000). Zone II runs from north of Barra de Tuxpan (south of Tamiahua) to the south of Campeche. This zone is mainly characterized by aquatic species with Neotropical affinities. Its northern extent represents the northern limit for some species, like the pinnated bittern (*Botaurus pinnatus*) (Howell and Webb 1995) and the snail kite (*Rostrhamus sociabilis*), which are found through Central and South America. Zone III runs from the central and north of Campeche to the northern border of Quintana Roo. This area is characterized by Neotropical aquatic species but with Caribbean influence. These species feed or nest on the coasts and/or islands of the zone.

DIVERSITY OF SPECIES

COMMUNITY DESCRIPTION

In the Gulf of Mexico there are 231 species of birds representing 17 orders and 46 families (Table 9.1); 44% are aquatic, 29% terrestrial and 27% marine (Fig. 9.2). The orders best represented in terms of number of species are: Charadriiformes (plovers and related marine birds) with 60 (27.7%), Passeriformes (sparrows and related) with 44 (19.6%), Anseriformes (ducks and related) with 31 (13.8%), Ciconiformes (herons and related) with 21 (9.4%), Gruiformes (cranes and related) with 15 (6.7%), Pelecaniformes (pelicans and related) with 13 (5.8%), and Procellariiformes (albatrosses and related) with 11 species (4.9%) (Lowery and Dalquest 1951; Contreras-Balderas 1993; Montejo-Diaz, J.E. 1994; Ortiz-Pulido *et al*. 1995; Cruz 1999; Gallardo 2003; Gallardo *et al.* 2000; Valenzuela and Vargas-Hernandez 2000; Valenzuela 2001). The best represented families are: Procellaridae (fulmars, petrels and shearwaters), Anatidae (ducks, swans and geese), Rallidae (rails, gallinules and coots), Charadriidae (plovers), Scolopacidae (sandpipers), Laridae (seagulls and terns), Tyrannidae (tyrant flycatchers) and Parulidae (wood warblers); these families represent 59% total species richness (Fig. 9.3) (Lowery and Dalquest 1951; Contreras-Balderas 1993; Montejo-Diaz 1994; Ortiz-Pulido *et al*. 1995; Gallardo 2003; Gallardo *et al*.2000; Valenzuela and Vargas-Hernandez 2000; Valenzuela 2001).

The birds species know to occur in the Gulf of Mexico represent approximately 22% of the 1,060 birds species recognized in Mexico (Navarro and Benitez 1993). This diversity can be explained by the biogeographical and ecological characteristics of the regions bordering the Gulf. Some species with very different biogeographical affinities may be

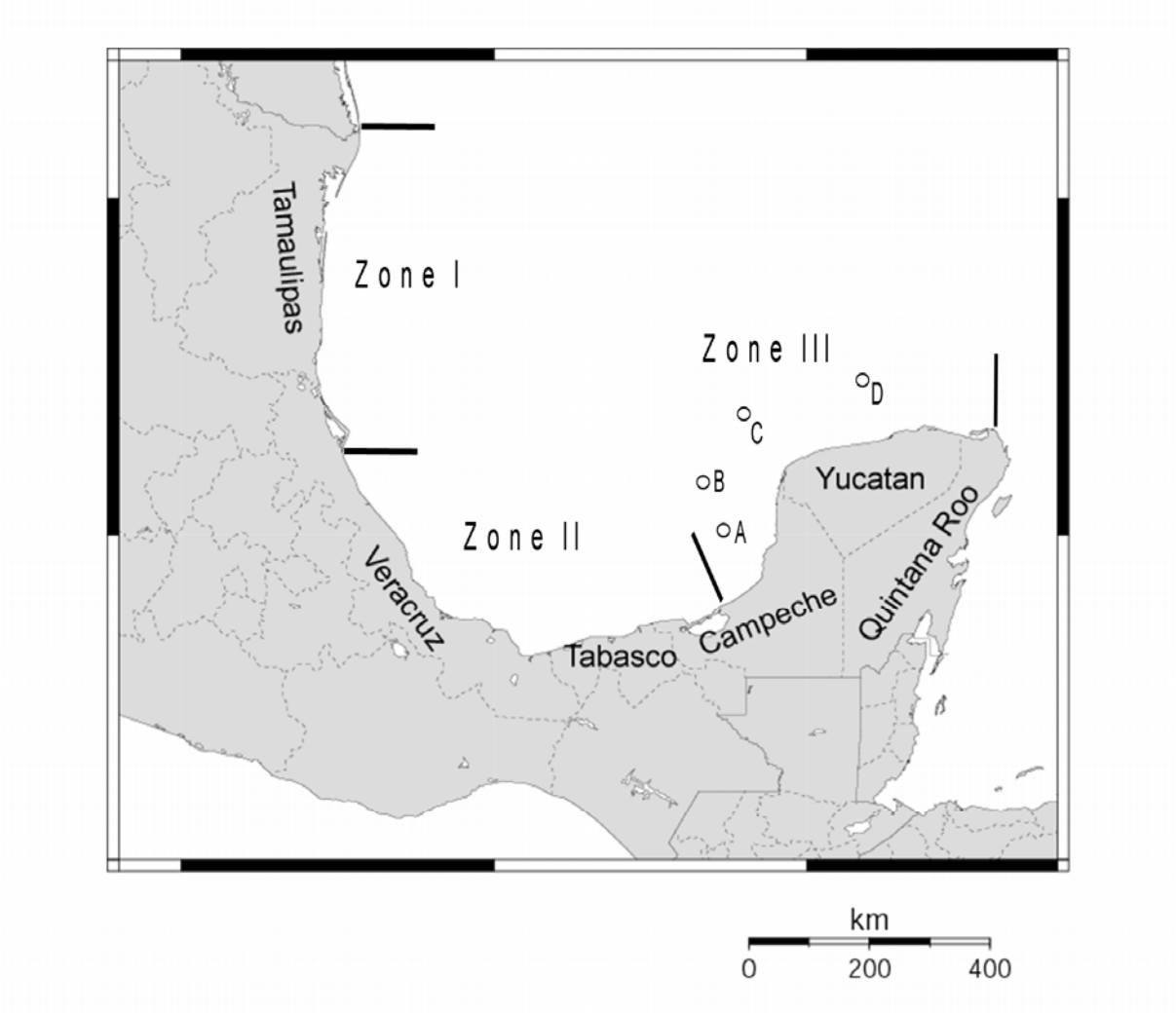

Figure 9.1. Proposed regions of the Gulf of Mexico by the affinities and biogeography of the avifauna. A = Cayo Arcas; B = Triángulos Reef; C = Cayo Arenas; D = Alacrán Reef.

irregular or nomadic in the region. For example, in the northern part of Tamaulipas, mainly in winter, species from temperate areas can be found, like the oldsquaw (*Clangula hyemalis*), as can species that regularly occur in the Caribbean like the Audubon's shearwater (*Puffinus lherminieri*) (Howell and Webb 1995).

SEASONALITY

Species composition of the Gulf of Mexico bird community shows strong seasonality (Fig. 9.4). About 65% of all Gulf of Mexico species depend on suitable places to spend winter, or to feed and rest during their migratory journey. Wintering species, like the common snipe (*Gallinago gallinago*) represent the majority. Transitory species like the American golden plover (*Pluvialis dominica*), spend only a short time in the Gulf of Mexico on their way to wintering areas in more southern latitudes. Accidental or nomadic species like the purple sandpiper (*Calidris maritima*), have been documented only rarely or sporadically in the Gulf of Mexico.

Only about one-third of species are breeding residents, with no apparent population movements. An example is the collared plover (*Charadrius collaris*), also a species under

Table 9.1. Listing of families of birds found in the Gulf of Mexico with the number of species in each and percentage of total species richness.

FAMILY	SPECIES	%
Anatidae	31	13.5
Scolopacidae	29	12.6
Laridae	26	11.3
Ardeidae	15	6.5
Parulidae	14	6.1
Rallidae	11	4.8
Tyrannidae	11	4.8
Charadridae	8	3.5
Procellariidae	7	3.0
Columbidae	6	2.6
Sulidae	5	2.2
Accipitridae	5	2.2
Emberizidae	5	2.2
Threskeornithidae	4	1.7
Alcedinidae	4	1.7
Podicipedidae	3	1.3
Hydrobatidae	3	1.3
Icteridae	3	1.3
Phaetontidae	2	0.9
Pelicanidae	2	0.9
Phalacrocoracidae	2	0.9
Ciconidae	2	0.9
Gruidae	2	0.9
Recurvirostridae	2	0.9
Cuculidae	2	0.9
Trochillidae	2	0.9
Vireonidae	2	0.9
Hirundinidae	2	0.9
Troglodytidae	2	0.9
Cardinalidae	2	0.9
Gaviidae	1	0.4
Diomedeidae	1	0.4
Anhingidae	1	0.4
Fregatidae	1	0.4
Phoenicopteridae	1	0.4
Falconidae	1	0.4
Heliornithidae	1	0.4
Aramidae	1	0.4
Hematopodidae	1	0.4
Jacanidae	1	0.4
Capromulgidae	1	0.4
Picidae	1	0.4
Sylvidae	1	0.4
Turdidae	1	0.4
Mimidae	1	0.4
Thraupidae	1	0.4

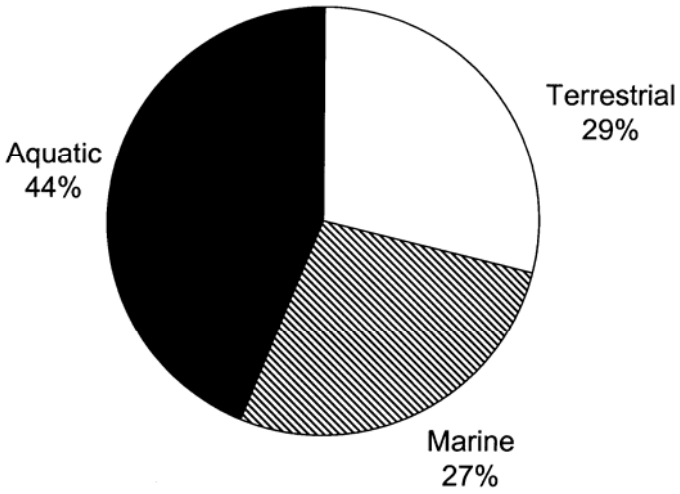

Figure 9.2. Percentage of bird species in the Gulf of Mexico by general habitat type.

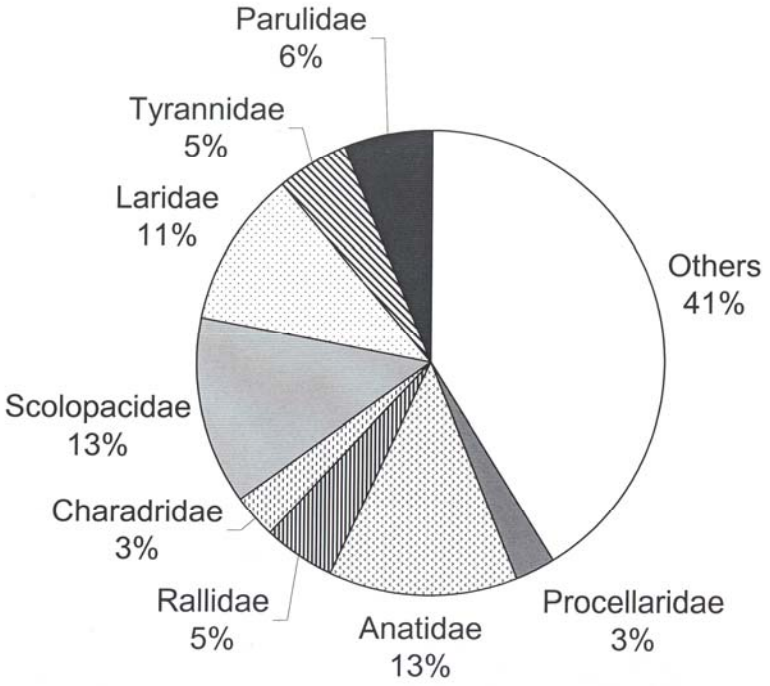

Figure 9.3. Percentage of bird species in the Gulf of Mexico by family.

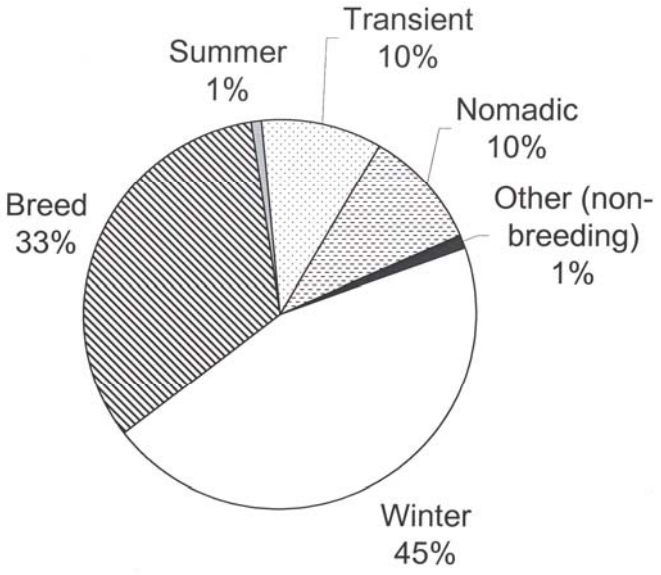

Figure 9.4. Percentage of bird species in the Gulf of Mexico by seasonality.

special protection. The non- reproductive species can be found at any time of the year in the Gulf of Mexico, but they reproduce in other areas. Examples of these include the pomarine and parasitic jaegers (*Stercorarius pomarinus* and *S. parasiticus*) and the common tern (*Sterna hirundo*). Summer residents are those that breed in the Gulf but return south at the end of the season. It is important to point out that the high percentage of non-resident species is due to the fact that the Gulf of Mexico is situated in the convergence of the four bird migratory routes in North America, forming one of the most important paths for migratory birds worldwide (Zalles and Bildstein 2000).

FEEDING GUILDS

Most species in the Gulf of Mexico feed on vertebrates and invertebrates (Fig. 9.5), with the majority of this group preying on terrestrial and aquatic invertebrates. These top predators are more sensitive to pollutants and represent 82% of the species present in the Gulf of Mexico. These species may serve as indicators of environmental conditions.

The seven families with the greatest species richness feed partially or totally on invertebrates. For example, the tyrant flycatchers, feed on flying insects although they also add some fruits to their diet, and the sandpipers feed on crustaceans and small mollusks in the rivers, estuaries and beaches. Predators specializing in invertebrates are also found, like the snail kite that lives in swamps, mangroves and lagoons. The gulls and terns are the majority of the to species that feed on vertebrates. Fish are the primary food source for them as well as herons and egrets (Ardeidae), the red-breasted merganser (*Mergus serrator*) and the osprey (*Pandion haliaetus*).

The remaining birds are distributed among several smaller feeding guilds that are mostly made up of terrestrial birds. The seed-eating guild consists mainly of ducks like the mallard (*Anas platyrhynochos*) and the cinammon teal (*Anas cyanoptera*). Terrestrial species such as the chalk-browned mockingbird (*Mimus saturninus*) and blackbirds (*Icterus spp*.) as well as some aquatic species like the whooping and sandhill cranes (*Grus americana* and *G. canadensis*) eat fruits. Hummingbirds (Trochilidae) feed on nectar and sap. Ducks and geese (Anatidae) and grebes (Podicipedidae) are the main species consuming aquatic vegetation.

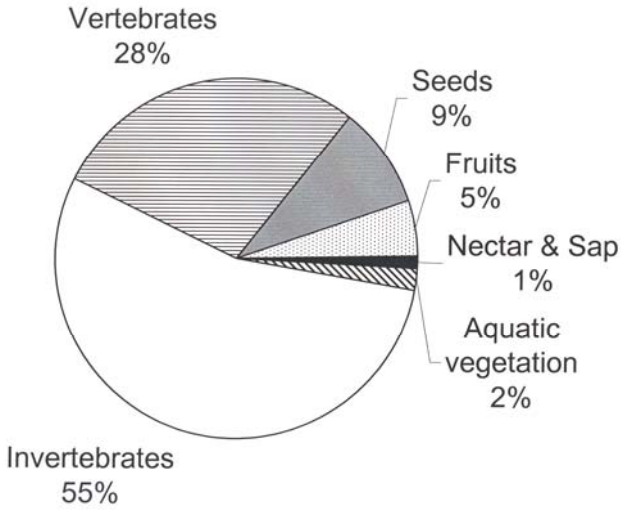

Figure 9.5. Percentage of birds in the Gulf of Mexico by feeding guild.

MIGRATION AND HABITAT

The four bird migratory routes (flyways) of North America join in the Gulf of Mexico. The most important routes are the Central, the Mississippi and the Atlantic. The conditions that favor the concentration of the four migratory routes correspond to the funnel created by the mountain range that extends from the south of Canada to Mexico, emphasized by the intersection of the Transversal Neovolcanic axis with the Sierra Madre Oriental in the center of Veracruz. Here the climatic effects produced by the currents generated by movement of air masses between high and low pressure areas during fall, cause the greatest concentration of migratory birds of prey in the world (Ruelas *et al.* 2000; Zalles and Bildstein 2000). Likewise, a great number of individuals of other species migrate through the Gulf, mainly through the center of Veracruz. The coastal lagoons found along the Gulf of Mexico are especially important to migratory aquatic birds, such as ducks, teals and geese and some scolopacids (DUMAC 1999b). Some species, mainly from the Mississippi and the Atlantic flyways, migrate across the Gulf waters, as do some warblers (Curson *et al.* 1994).

Estuary and lagoon systems and their associated wetlands represent 30% of the Mexican Gulf coastline. These habitats are of vital importance to 44% of the resident and migratory bird species in the Gulf of Mexico. The importance of the wetlands in the Gulf of Mexico is underscored by the fact that Laguna Madre in Tamaulipas alone hosts 15% of all aquatic migratory birds in Mexico and 80% of the geese, ducks and swans. The lagoon system of Alvarado, Veracruz, is the third most extensive wetland in Mexico. Cruz (1999) reports 273 bird species (aquatic, terrestrial and marine) from this region, representing 25.6% of the bird species present in Mexico. These habitats are without doubt very important to resident threatened species, like the limpkin (*Aramus guarauna*), as well as migratory species. The coastal habitats and lake systems are especially important to the visiting winter birds and both fresh and saltwater habitats are used by a large number of neotropical migrants (Rappole 1995).

The majority of the islands in the Gulf of Mexico are found on the vast continental platform. They are important breeding areas for beach birds and colonial nesting marine birds, because predation is low or lacking, they are isolated from human disturbance and they are close to feeding areas. Recently, few marine birds have been found nesting on the islands

in the Gulf of Mexico (e.g., Arrecife Alacrán, Triángulos, Cayo Arcas and Cayo Arenas in Campeche), but more marine birds possibly used them in the past. These islands are also important to many terrestrial bird species migrating to the Yucatan Peninsula or the Antilles, which use them for resting and feeding as they cross the Gulf of Mexico.

RISKS AND THREATS

ENDANGERED SPECIES

There are 36 species receiving some degree of protection under Mexican law or which are in international risk categories. Of these 36 species, 33 are listed within Mexican law (SEMARNAP 2000) and four are also listed as endangered by IUCN. Of the species receiving some kind of protection under Mexican law, we can highlight certain ducks and teals (*Anas acuta, A. americana, A. discors* and *A. fulvigula*), which are valued game species with regard to both sports and subsistence. Mexican and international law considers the whooping crane (*Grus americana*) in serious danger of extinction due to ongoing threats to growth by its population. In all, 16 resident reproductive species, 13 wintering species, two nomadic species, and five resident and wintering species have been accorded some category of protection. In addition, 25 of the 36 species of aquatic birds are at some degree of risk, as well as five terrestrial and three marine species. All this reflects the importance, on a national and international scale, of the conservation of bird fauna resources in the Gulf of Mexico.

PESTICIDES AND AGRICULTURAL ACTIVITY

Agricultural activities have affected the bird population, its resources and their habitats in three different ways: a) through direct poisoning due to the application of large quantities of pesticides (the most common, but least researched); b) by the accumulation of pesticides such as organochlorines, which have negatively affected the reproductive success of some species like the great blue heron (*Ardea herodias*), which is under special protection, and in whose case there is a correlation between DDT and eggshell thinning (Butler 1992); and, c) due to the acidification of waters, which is a less eminent threat. Some aquatic birds, such as the least bittern (*Ixobrychus exilis*) have been affected by pH changes in the water where they feed (Gibbs *et al.* 1992). This is the result of erosion in cultivated land, which causes various agrochemicals in the sediments to enter the water bodies.

HUMAN SETTLEMENTS AND POLLUTION

Human settlements increase the demand for services and resources, endangering the ecosystems' capacity to recover and regenerate. In many cases, anthropogenic disturbance has had the most direct and visible effect on bird populations. For example, during the reproductive period of the white-faced ibis (*Plegadis chihi*), partial or total abandonment of their nesting places has been observed (Ryder and Manry 1994). There is little information on the direct and indirect effects of human activities on bird populations along the Gulf of Mexico, which prevents us from making comparisons over time and establishing its consequences for the bird population.

Tourist development in some of the parts of the Gulf of Mexico may be affecting endangered species due to the increase of human presence in previously isolated places as well as the increase in the tourist developments. An example of a species that may be affected is the least tern (*Sterna antillarum*). Despite the fact that Thompson *et al.* (1992) consider this species to be absent from most of the Gulf, in the years 2000 and 2001, nesting colonies

were found on beaches in the Gulf with a high degree of industrial and tourist development in the center and north of Veracruz (Straub and Gallardo, pers. obs.). This leads to the possible conclusion that the species could have been more widely distributed in the past.

PETROCHEMICAL ACTIVITY

Petróleos Mexicanos (PEMEX), the Mexican oil company, through PEMEX Exploracion y Producción (PEP) has been operating in the Campeche Bay since 1978, extracting heavy and light crude petroleum, as well as natural gas, from the oilfields of Cantarell, Ixtoc, Balam, Nohoch and others located in the area. In the Cantrell oilfield there are only 65 platforms and three production complexes. The crude petroleum extracted at the platforms is transported through a network of oil pipelines to the complexes where it is stabilized. Usually light crude is separated from heavy crude in the Cantarell facilities and is sent to the petrochemical complex of Ciudad Pemex, in Tabasco, and to storage tanks in Dos Bocas. The gas produced there is sent inland, via gas ducts, to the station in Atasta, Campeche.

Up to 200 different companies can operate as contractors for PEP in the area of Cantarell, where the production complexes of Akal-C, Akal-J and Akal-N are located, approximately 75 km out to sea, northeast of Ciudad del Carmen in Campeche. The production complexes are being modernized by the “Project for the rehabilitation, modernization and optimization of the infrastructure of Camp Cantrell” under the direction of PEP.

Petrochemical activities in the Gulf of Mexico are being monitored, to a certain extent, by government agencies such as SEMARNAT and PROFEPA. However the potential risk of hydrocarbon leaks or the emission of pollutants into the atmosphere always exists despite the environmental policies and technological measures that have been gradually implemented by PEP (PEMEX 2001).

At least 18 species of migratory and local birds have been noted using the process complex as a resting place. (R. Arreola, pers. obs.). These are species that reside only temporarily in the complexes. However, they can be seen feeding in places as varied as the complex dumps or the lodging platforms, or preying on the schools of fish that gather around the support structures of the complexes, drawn by the organic waste from the dining rooms on the lodging platforms. Some exhausted birds have also been observed resting on the platform deck. Birds like the magnificent frigatebird (*Fregata magnificens*) glide on rising warm air currents generated by the gas burners (R. Arreola, pers. obs.). The interaction of birds with industrial marine activity is complex and some effects can be interpreted as negative both to the environment and to the fauna.

IMPORTANT AREAS FOR BIRD CONSERVATION

PROTECTED AREAS

The main protected natural areas in the region of the Gulf of Mexico are classified as one of the following: biosphere reserve, national park, protected area for flora and fauna, sanctuary and protected area for natural resources. The biosphere reserves in the Gulf zone are Los Tuxtlas in Veracruz, the Centla swamps of Tabasco, Los Petenes in Campeche, Río Celestun in Campeche, and Río Lagartos in Yucatan. The national parks in the region are the Veracruz Reef System and the Alacrán Reef on the Campeche Bank. In the last three categories are the beach at Rancho Nuevo in Tamaulipas, Laguna La Mancha in Veracruz and the Laguna de Términos in Campeche. These protected natural areas are not nearly

representative of the existing habitats of the region nor large enough to cover the habitat needs of the resident and migratory birds in the area due, among other things, to the fact that many of them have not been declared specifically for protection of birds, but have been justified by some other taxonomic group. Therefore we see that the most important populations of many of the key bird species of the different ecosystems are not included in these protected areas. As a result, many regions with essential habitats for these species are being disturbed, severely altered or even totally destroyed. A clear example of this is the Altamira yellowthroat (*Geotlypis flavovelata*), a species that depends on northern Mexican wetlands and is not represented in any natural protected area. This is just one example of many.

IMPORTANT BIRD AREAS (IBAs)

In response to this severe problem, a great number of ornithologists in Mexico, with the support of several academic entities (UNAM, UBIPRO Iztacala) government agencies (SEMARNAP, CONABIO) as well as private organizations (CIPAMEX, FMCN) and various international organisms (Commission for Environmental Cooperation, National Fish and Wildlife Foundation, BirdLife International, American Bird Conservancy, National Audubon Society) have joined forces in their attempt to identify the Important Bird Areas (IBAs) in Mexico (Arizmendi and Márquez Valdelamar 2000). Twenty IBAs have been proposed in the Gulf of Mexico region, emphasizing the importance of the coastal systems, lakes and islands. Through these areas the, Gulf of Mexico can be appreciated as a great system divided into regions, each with its own characteristics but interacting the others through ecological phenomena such as migration and productive processes in the marine and aquatic regions.

FINAL CONSIDERATIONS

In terms of information relating to marine birds in the Mexican portion of the Gulf of Mexico, the importance of their distribution and abundance should be emphasized because they reflect oceanic conditions and, therefore, the nourishing resources available during different seasons of the year or during years with different oceanic conditions (Anderson 1983, Velarde *et al.*2004, 2005). For this reason, marine birds may be excellent indicators of the condition of their prey populations (Anderson et. al. 1980; Anderson and Gress 1984; Furness 1984; MacCall 1984; Berruti and Colclough 1987; Furness and Nettleship 1991; Hamer et al. 1991; Velarde *et al.* 1994; Crawford and Dyer 1995; Montevecchi and Myers 1995; Crawford 1998; Furness and Tasker 1999; Lewis et al. 2001). The value of marine birds as a tool for monitoring and, more importantly, for obtaining time series for predicting fishing captures, is of vital importance in fishing management, particularly nowadays when the most of the important fisheries on the planet have reached their exploitable limits or are being overexploited (MacCall 1979; Radovich 1982; World Resources Institute 1994; Cisneros-Mata et al. 1995; Botsfored et al 1997). To be able to use the information that marine birds give us in reference to the fisheries it is necessary to have basic information and time series that allow comparisons under different circumstances.

In reference to the petrochemical industry and its effects, we can say that under present conditions it is hard to acquire an overall vision of the effect this activity is having on the environment. Research and monitoring of the refineries and production platforms by specialized personnel is required; something which, until now, has never been done in an appropriate way. Despite the existence of prevention policy and the response of government agencies to environmental contingencies, such as hydrocarbon leaks (Lopez 2002; Guerrero 2003), it is obvious that a greater effort is required in order to gain complete control over

pollutants being generated there. Hence, we believe it is important for these places to be monitored in a direct way by the government agencies responsible for environmental care, in order to have a better understanding of the bird species in the Gulf of Mexico that are affected by these pollutants, and be able to establish strategies for their administration and protection.

Concerning the natural protected areas it is important to say that, despite the great efforts that recent administrations have made to formulate appropriate management programs and obtain the financing for their implementation, not all protected areas have budgets large enough to meet their conservation objectives. The outlook becomes bleaker when the complex socioeconomic problems that, in turn, affect the conservation problem around the country are considered. It is not enough to declare an area "protected" if the needs of human populations living around or in them are not considered or met. Conservation of natural resources in these areas will only be possible or, at least, will be made easier, if the local population becomes committed to the planning and implementation of the programs.

Many specialists have asserted that the natural wealth of out planet is our heritage and source of survival, and that without it the human species is destined to destruction or, at least, to ubiquitous poverty, something that is hard to imagine at the moment. We have also heard and read that Mexico is one of the five richest countries on Earth, at least in terms of plant species, reptiles, birds and mammals. This also applies to the cultural sphere of our country, since it is located in the Mesoamerican region, cradle of some of the most highly developed cultures on the planet, as well as the most complex and efficient agricultural systems. Although this information has begun to circulate among the general population, awareness needs to be increased, particularly among those sectors outside of the traditional, rural workforce, including those that make decisions at all levels of government, as well as in the private sector.

Experience has shown that the best results are obtained when traditional knowledge and social participation are mixed with scientific and technical knowledge, with the purpose of obtaining a rational and sustainable use of resources. The greatest challenge faced by our society is the sustainable use of our natural resources. This means that current generations must use these resources in such a way that will make them available to future generations. At the same time we must maintain existing species, elements and the ecological processes in the natural ecosystems.

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