

# MANAGEMENT OF COLONIAL WATERBIRDS

SUMMARY PROCEEDINGS OF A WORKSHOP

17-19 MAY 1979

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SUMMARY PROCEEDINGS

of a planning workshop on

THE MANAGEMENT OF COLONIAL WATERBIRDS

17-19 May 1979

Wilmington, North Carolina

edited by

James F. Parnell and Robert F. Soots, Jr.

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The success of the workshop was due to the enthusiastic participation of the biologists and resources managers who attended the meeting and who actively participated in all aspects of the workshop.

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## INTRODUCTION

Colonial waterbird management began in the United States as early as 1900. The first of a network of lands managed for the benefit of wildlife under the National Wildlife Refuge System was Pelican Island in Florida. It was set aside in 1903 to protect a nesting colony of Brown Pelicans (Pelecanus occidentalis). The National Audubon Society provided wardens to protect the Pelicans, and thus began their sanctuary program. Soon thereafter, the migratory bird act was signed into law and many colonial waterbirds received protection. Thus, management by the protection of nesting sites and by laws giving species protection from "taking" are not then really new. What we think is new is the developing concept that regional populations of colonial waterbirds can receive additional protection and management by the informal combined efforts of private, state, and federal agencies, and those concerned biologists who are aware of the regional needs and problems of the birds. We think that such management can be low key, inexpensive, and implemented with little or no new legislation. It involves primarily a sense of concern and cooperation by agencies and biologists.

This workshop was designed to bring a group of colonial waterbird specialists together with representatives of agencies involved either directly or indirectly with the management of colonial waterbirds. A program was designed to provide the group with current summaries of recent colonial waterbird population studies and current management efforts at private, state, and federal levels. The group then discussed the problems faced by colonial waterbirds, as seen by researchers presently involved with these birds. Problems associated with present and future management efforts were discussed by representatives of agencies currently involved, either directly or indirectly, with the management of colonial waterbirds.

Following two days of intense discussions, a summary panel of those in attendance met to summarize the findings of the group. This panel generated a series of recommendations relative to future research and management involving colonial waterbirds.

Summaries of the four working sessions and the recommendations of the summary panel constitute the body of this report.

REVIEW OF THE CURRENT STATUS OF COLONIAL  
WATERBIRD POPULATIONS IN THE UNITED STATES

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INTRODUCTION

Colonial waterbirds occupy high-level trophic positions within coastal ecosystems. Hence, many species potentially have significant roles as interfaces for the exchange of energy and materials within and among terrestrial and aquatic components of coastal, estuarine and other wetland ecosystems. The hypothesis has often been advanced that some species of colonial waterbirds might be useful as biological indicators of environmental perturbations. Such a conceptual realization, augmented by the spectre of petrochemical and other energy-related development, has recently led to a number of survey efforts of colonial waterbird nesting sites on rather broad regional scales.

Interest in the size, distribution, and productivity of colonial waterbird nesting populations has not evolved just recently. Although of a necessarily smaller scale, in terms of species attended to and regions monitored, the most consistent and long-term efforts have come from the National Audubon Society. The Society has employed wardens, established protection schemes and sanctuaries and sought the passage of conservation legislation.

During the early 1900s federal legislation was enacted protecting migratory nongame birds, including colonially nesting species. However, until very recently, reports submitted by federal refuge managers and Audubon wardens constituted the best and relatively untapped available resource for studying trends of colonial waterbird populations.

For several recent years, interest in colonial waterbirds and funds available for their study have grown considerably. Since 1975, biologists associated with the National Park Service, the Office of Biological Services, the U. S. Fish and Wildlife Service, the Bureau of Land Management, the Corps of Engineers, various state-government agencies and private conservation organizations have collected great amounts of data on the size and distribution of sea and wading bird nesting colonies, primarily in certain coastal regions of the United States, but also in some interior areas. The Great Lakes, the Upper Mississippi River Basin, and the Atlantic and Gulf of Mexico coasts have received the greatest

attention. As a result, we have a reasonably clear idea of the breeding distribution of many species along much of their range and over a variety of habitats.

There have been methodological difficulties as well as partial failure in attempts at adequate standardization of data collection and reporting. Nonetheless, combining current with historical data permits a rare glimpse at some interesting dynamics of some waterbird populations. For example, for waders, the most significant event along the Atlantic coast since the 1930s has been a northward drift of the breeding ranges of several species. Concomitantly, colony diversity in terms of numbers of species and the equitability with which they are apportioned within colonies appears to have increased over time.

In the interior United States, particularly along the upper Mississippi River and in riparian woodlands in states such as Minnesota, Wisconsin, and Illinois, the contemporary evidence suggests that breeding populations of another wading bird species, the Great Blue Heron, may have begun to decline.

The papers in this section will address, in greater detail, the current status of many colonial waterbird populations in several regions of the United States: the Atlantic coast, the Gulf coast, the interior, and the Pacific coast. Each of the papers will be presented by a biologist intimately associated with the surveying and reporting of data from the particular area.

There are several significant issues that I see as critical to the success of future efforts to census colonies and then to merge the information collected with that assembled previously. These are: (1) verification of census methodologies, (2) centralization of data, (3) sustained commitment to population monitoring, and (4) a commitment to research, complementary to population assessment.

The methodological difficulty inherent in attempts to census colonial waterbirds is generally recognized, but too little attention has been paid in the past to the development, verification, and comparison of results among various census procedures. Population trend analyses based upon diverse censuses thus present difficulties of interpretation, particularly when data collected by different observers using various techniques must be combined for assessment of local, regional, or national populations. More attention should be paid to field testing and laboratory simulation of various census methods to determine usefulness and accuracy under different conditions and for different species.

Federal survey efforts have been reduced, and although some states and private conservation organizations continue limited local or regional monitoring, the base of data we have now for waterbird populations on a

large national scale rapidly will become dated. Long-term surveying efforts and a well-articulated commitment, vigorously pursued by various groups, to active cooperation and participation in survey efforts and information exchange can ease the financial burden and loss of vital supplementary data for all. As a corollary, recognition of an active cooperation and exchange of data with centralized data banks can assure the efficient dissemination of population statistics to those in need of them. Such data bases can ease the need for costly published reports and atlases of the distribution of nesting colonies of waterbirds, many of which are outdated by the time they are printed.

These steps, coupled with ongoing research into more fundamental parameters of the biology and life history of waterbird species will enable realistic attempts at the management of the species. If, as Mike Erwin (personal communication) has stated: "The ultimate purpose in conducting all of these investigations is to understand how populations of colonially nesting waterbirds respond to their environment, both in ecological and evolutionary time," then the best test of the hypotheses by which we frame our understanding is their successful implementation as bases for action in management strategies. The end result of management action is the protection and preservation of these birds and the complex but often fragile ecosystems in which they live.



## POPULATION STATUS OF COLONIAL WATERBIRDS ALONG THE ATLANTIC COAST

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### I. Seabirds

A. Gulls: In the 1930s and 1940s, Herring and Great Black-backed Gulls exploded along the coast of New England, doubling in population every 12-15 years (Kadlec & Drury 1968). Great Black-backed continue to increase at a moderate rate throughout the Northeast. Although they now appear to be stable, or even declining in parts of New England, Herring Gulls continue to increase from New Jersey south. Habitat shifts are also occurring, with Herring Gulls usurping Spartina marsh sites from Laughing Gulls in New Jersey (Burger 1977) and areas south (Erwin in press a). Generally, however, except in the few areas where Herring and Laughing Gulls overlap, the population of the latter species is very abundant and apparently stable throughout the Mid- and South Atlantic. It has recently been reported breeding in northeast Florida (Loftin and Sallas 1977).

B. Terns and Skimmers: Gull-billed Terns should receive closer investigation; they have apparently undergone marked declines in Maryland and Virginia, and populations are only marginal in South Carolina and Georgia. In recent years, there has been only one moderate-sized colony reported in northeast Florida.

Caspian Terns nest only in small numbers from Virginia south and there is no indication that there ever were large numbers along the Southern Atlantic coast. Except for North Carolina, Sandwich Terns also nest in very small numbers south of Maryland. They are always associated with Royal Terns. They are considered "of special concern" on two state lists, North Carolina and Florida.

Royal Tern numbers seem to have increased recently in one or two colonies in northwest Florida and perhaps in North Carolina. They seem to be fairly stable in Virginia and South Carolina. They are also "of special concern" in North Carolina and Florida.

Little is known of Forster's Terns because their predominantly marsh-nesting habits have precluded systematic censuses in the past. Recent surveys have shown them to be quite abundant in New Jersey, Virginia, and North Carolina. It is puzzling why no Georgia or Florida nesting has been reported.

The Common-Arctic-Roseate Tern group appears to be in jeopardy in most of New England (Nisbet 1973) and New York (P. Buckley, personal

communication). The rise in Herring Gull numbers apparently had a severe effect on terns (Nisbet 1973). From New Jersey south, however, Common Terns are abundant and probably increasing, at least in North Carolina. A major concern, however, is a habitat shift that has resulted in terns nesting on salt marsh windrow in disturbed coastal areas of Long Island and New Jersey (Erwin in press a). Dangers of flooding and Herring Gull invasions may lead to declines in some areas.

Despite the dire scenarios portrayed by Downing (1973) concerning Least Terns, this species is doing well in most of the North Atlantic, even though New Jersey lists it as "Endangered" (J. Galli, personal communication). In the Mid-Atlantic, it has recently disappeared along the coast of Maryland, but Chesapeake Bay numbers have increased. Numbers in North Carolina have declined and rooftops are now in frequent use for nesting in South Carolina and Florida (Fisk 1975). The species' tendency to nest in disturbed mainland areas makes it susceptible to frequent nest failure.

Black Skimmers seem to be abundant and stable from New York to South Carolina. New Jersey lists them as "Endangered" due to the small number of colony sites. In Georgia and northeast Florida, only a few colonies are found.

C. Other Seabirds: Brown Pelicans, of course, are on the Federal Endangered Species List; early declines were attributed to pesticide use. Small numbers nest in North and South Carolina, but these are peripheral populations. The only sizable eastern nesting populations are in south and west Florida.

Double-crested Cormorants are increasing in New England. Control measures have been attempted both in the past and in recent times due to fishery interest. In 1978, the species apparently extended in its breeding range, from eastern Long Island to Tidewater, Virginia, where it was found nesting along the James River (Scott 1978).

Black Guillemots, Common Puffins, and Razorbills have all shown recent increases in Maine. Reasons for these population increases are unknown.

## II. Wading Birds

A. Historical Trends: Historical records of wading birds are much less complete than for those of seabirds, primarily because of their former tendency to nest inland in remote, densely vegetated swamps and on inaccessible islands.

Except for Great and Snowy Egrets, most waders were not heavily hunted by millinery traders. Nonetheless, most wading birds did not breed in most Mid- and North Atlantic coastal areas until the 1950s and 1960s (Erwin in press b). The Black-crowned Night Heron was almost the sole breeding species in North Atlantic until the 1950s. Little Blues predominated in the South Atlantic.

A dramatic northward expansion of breeding herons, egrets, and ibises began in the 1930s (Ogden 1978). All three egrets as well as Glossy and White Ibises have shown the most dramatic increases. In the past two years, Louisiana and Little Blue Herons have colonized Maine, illustrating that expansions are still under way (Erwin in press b). Considering the higher occurrence of organochlorine residues in waterbird eggs from the Northeast, they may never achieve population densities as high as for the Southeast (Ohlendorf et al. 1979).

Today almost all wader species are either stable or increasing throughout the Atlantic coastal zone. Some notable exceptions are as follows: (1) Glossy Ibises are decreasing from Maryland to North Carolina. They are also quite rare south of North Carolina, in contrast to their abundance in New Jersey and northern areas. (2) Cattle Egrets expanded very rapidly throughout Florida and up the coast to New Jersey. From that point, however, a departure in the colonizing pattern occurred. Apparently, the majority of pioneers went up the Hudson River to establish a large colony at Lake Champlain, New York. Only a small number followed the New England coastline. (3) Great Blue Herons have declined along the coast, especially in the North and Mid-Atlantic. Only in Maine are many coastal colonies left. The Chesapeake Bay colonies account of the majority of the Atlantic coastal population. Maritime forest destruction accounts for much of the decline. The majority of Great Blues now nest inland in the Atlantic region.

Even though most waders appear to be doing very well along most of the Atlantic Coast, the "heartland" of wading birds, Florida, is experiencing drastic declines. Surveys in 1972 indicated a total population of only about 130,000 adults, a mere 10% of the 1935 figure (Robertson and Kushlan 1974). Wetland alteration in southern Florida especially has led to rapid declines of White Ibis, Snowy Egrets, and Wood Storks.

B. Patterns of Abundance: An interesting pattern of species abundance is seen when comparing the North and South Atlantic wader populations (Table 1).

The species that rank first, second, and third in the North Atlantic have only an average rank of fifth in the South Atlantic. Only the Snowy Egret ranks high in relative abundance along the Atlantic Coast. The Glossy Ibis and Cattle Egret account for a larger fraction of all wading birds in the North than the South. Of course, if one includes all of south and interior Florida, Cattle Egrets compose a larger fraction.

Some of the pattern difference is based on historical occurrence. Black-crowns, as mentioned earlier, were almost the only coastal wading bird in the North during the first half of the 20th century and still rank high (second). The White Ibis, dominant in the South, is only now reaching the North Atlantic region (Virginia). Over time, it may achieve the success that the Glossy Ibis has in the North.

The relative decline of the Little Blue Heron is puzzling. Perhaps competition with the aggressive Cattle Egret has attributed to its decline (Burger 1978).

Table 1. Species Composition (%) and Relative Abundance of Colonial Wading Birds Along the Atlantic Coast.

SPECIES	SOUTH ATLANTIC N.C. - NO. FLORIDA (1975 DATA) <sup>a</sup>		NORTH ATLANTIC VIRGINIA-SO. MAINE (1977 DATA) <sup>b</sup>	
	%	RANK	%	RANK
White Ibis	59	(1.0)	0	
Glossy Ibis	1	(7.5)	14	(4.0)
Great Blue Heron	<1	(9.0)	7	(5.0)
Great Egret	7	(4.0)	6	(6.0)
Snowy Egret	11	(2.5)	26	(1.0)
Louisiana Heron	11	(2.5)	3	(7.5)
Little Blue Heron	3	(6.0)	3	(7.5)
Cattle Egret	6	(7.5)	17	(3.0)
Black-crowned Heron	1	(7.5)	23	(2.0)
TOTAL ADULTS	165,079		77,866	

<sup>a</sup>From Custer and Osborn 1977

<sup>b</sup>From Erwin in press b

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STATUS OF COLONIAL WATERBIRD POPULATIONS OF THE LOUISIANA,  
MISSISSIPPI AND ALABAMA COASTS

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The coastal wetlands of Louisiana, Mississippi and Alabama include over 4 million acres of fresh, brackish and saline marsh, as well as 2 million acres of swampland, providing feeding area and nesting sites for approximately 850,000 waterbirds of 26 colonial species. Despite the obvious importance of such large populations, and such extensive feeding habitat to North American waterbirds as a whole, ecological research and population monitoring have been fragmentary.

Although National Audubon Society wardens and biologists, limited in both time and money, have historically surveyed selected colonies, the existence of but one coastwide inventory, in 1976 (Portnoy 1977) precludes discussion of population trends. I shall therefore simply outline breeding abundance and habitat use, basing my remarks on data collected during the 1976 U. S. Fish and Wildlife Service Inventory.

My discussion will be organized by geographical region, ecologically separable by vegetative communities and/or species composition of waterbird nesting aggregations.

Region 1 extends from Sabine Lake and the Sabine National Wildlife Refuge to Vermilion Bay, Louisiana, a fresh and brackish marsh habitat fronted by a narrow barrier beach. In 1976 there were 17 waterbird colonies, including about 97,000 adults, principally wading birds nesting in emergent buttonbush (Cephalanthus sp.). Protection and management is limited to control of human access at four colonies: 30,000-bird Sidney Island and 4,000-bird Deadman Island, both administered by National Audubon, a 2,000-bird colony at Grand Chenier, Louisiana, and a 12,000-bird colony at Lacassine National Wildlife Refuge.

Region 2 comprises the Atchafalaya Basin cypress (Taxodium) - tupelo (Nyssa) swamp as far north as U. S. Route 190. This area was surveyed very quickly (one day of fixed-wing flying time) in 1976; nevertheless, in that time we located 14 heronries containing an estimated 56,000 adults nesting in the swamp forest. Many other undiscovered colonies probably exist. Of the 14 colonies found, only Avery Island's 4,000-bird heronry enjoyed protection from human intrusion.

Region 3 includes Atchafalaya Bay and the Lower Atchafalaya River (Sweet Bay Lake). In 1976, 48,000 herons, egrets, ibises, Black Skimmers, and Least and Gull-billed Terns nested on 12 dredged material islands. The exclusive use of these spoil islands appears related to the scarcity of elevated nest sites for both waders and seabirds. Human access is not controlled, and there appears to be little coordination of local oil drilling activities with conservation of nearby wildlife resources. In 1976, part of an active White-faced Ibis colony was inadvertently buried by dredged material, dramatizing the need for annual colony surveys, mapping and publication.

Region 4 is the cypress-tupelo swamp forest surrounding Lakes Maurepas, des Allemands, and Salvador, including 79,000 breeding wading birds in 25 colonies. Nearly all colonies exist on privately owned land and there is no management for, or protection of, colonial waterbirds.

Region 5 includes Terrebonne, Timbalier, Caminada and Barataria Bay salt marshes, together with these estuaries' protecting barrier beaches. About 224,000 waterbirds occupy 40 discrete colonies (at least 1 km apart), principally Ciconiiformes in mangrove shrubs and Larids and Skimmers on open beaches. Colony sites are privately owned. There are no refuges, no posting, and no protection from human intrusion.

Region 6 comprises the Mississippi Delta, the vast brackish and saline marshes east of the Mississippi River (Saint Bernard Parish, Louisiana), the shell banks around Chandeleur and Breton Sounds, and the Chandeleur barrier island chain. Two hundred thousand waterbirds nest here in 42 colonies; mangrove heronries, saltmarsh Laughing Gull colonies, and barrier beach skimmer and tern colonies. Managers from Delta National Wildlife Refuge post colonies on the Breton-Chandeleur chain, but only if birds happen to nest on refuge-owned land, and only when refuge staff can find enough manpower and time to make the lengthy trip. (In 1976, nearly all seabirds, including a colony of 54,000 Sandwich and Royal Terns, unfortunately chose to nest on unprotected state-owned islands immediately adjacent to the federally protected sites!) Refuge staff members do effectively patrol the very large heronry east of their headquarters at the Mississippi Delta.

Region 7 is the Mississippi and Alabama mainland beaches and coastal and barrier islands. In 1976, there were 20,000 birds nesting in 18 colonies, principally mainland and barrier beach Least Tern and Black Skimmer colonies, plus one 4,000-bird heronry (Cat Island, Alabama). Protection is afforded the large Least Tern colonies of Gulfport and Biloxi, Mississippi, public beaches and the few, small seabird colonies occurring on Gulf Islands National Seashore.

In summary, from the 1976 surveys and censuses, 847,000 waterbirds of 26 colonial species breed in 168 colonies on the north Gulf Coast. Table 1 summarizes abundance by species and indicates nesting habitat. Table 2 outlines land ownership and management at Gulf-Coast colonies and illustrates

how most waterbirds rely on private or state-owned land for nest sites. Few colonies are protected, and it unfortunately does not currently appear that these lands will be managed to maintain or enhance colonial waterbird nesting success in the near future.

Table 1. Nesting abundance of some common colonial waterbirds of the Louisiana, Mississippi, and Alabama coast, 1976.

SPECIES	BREEDING BIRDS	HABITAT
Great Blue Heron	10,100	Swamp forest
Great Egret	76,900	Swamp, coastal marshes
Snowy Egret	116,500	Fresh and coastal marshes
Cattle Egret	91,400	Swamp, fresh marsh
Louisiana Heron	139,900	Salt marsh
Little Blue Heron	81,300	Swamp, fresh marsh
Black-crowned Night Heron	20,400	Salt marsh
White-faced Ibis	12,500	Coastal marshes
White Ibis	87,800	Swamp, coastal marshes
Roseate Spoonbill	2,600	Fresh and brackish marshes
Olivaceous Cormorant	7,700	Fresh marsh
Anhinga	2,600	Swamp
Laughing Gull	56,800	Salt marsh, beach
Forster's Tern	19,200	Coastal marshes
Least Tern	14,300	Beach
Sandwich Tern	55,700	Beach
Royal Tern	21,300	Beach
Black Skimmer	30,000	Beach and salt marsh

The importance of following population trends should have been made painfully obvious to resource managers with the apparently rapid and unstudied extirpation of Louisiana's breeding Brown Pelicans in the late 1950's and early 1960's. Still, a complete survey of the remaining colonial species was not initiated until 1976. An equally intensive follow-up to the 1976 work, necessary for meaningful population monitoring and management, presently has neither federal nor local support. The proximity of unmatched and sensitive breeding bird populations and extensive petrochemical development in the Gulf of Mexico area, should necessitate population studies to predict, or even recognize, and ameliorate damage to an irreplaceable natural resource.



Table 2. Land ownership and protection at north Gulf Coast waterbird colonies, 1976.

OWNERSHIP	COLONIES	NUMBER RESTRICTED	NUMBER POSTED	BREEDING BIRDS
Oil, logging, development	76	2	1	431,000
State	49	1	3	162,000
Private Individual	24	2	0	131,000
Federal	11	1	1	45,000
Town/County	5	0	0	38,000
National Audubon	3	2	2	40,000
TOTALS	168	8	7	847,000

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## CURRENT STATUS OF COLONIAL WATERBIRD POPULATIONS ON THE TEXAS COAST

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For well over a hundred years, the richness and diversity of the Texas coastal avifauna have served as a human magnet, drawing the nation's natural historians, museum collectors, plume hunters, artists, photographers, and biologists to the area. For the most part, the activities of these invaders had little impact on the bird populations along the Texas coast. Populations of several species declined briefly during the plume-trade era, but climbed steadily back as the "flappers" went into retirement (Allen 1952). The Texas coast remained a secluded and primitive area. Gulls, terns, and skimmers nested on the barrier islands along the coast and on the few natural islands in the shallow lagoons and bays. Herons, egrets and other wading birds nested in the densely vegetated, marshy areas at the mouths of rivers (Allen 1935).

In the 1940's, however, the situation began to change rapidly. A series of events occurred that had a direct bearing on the current status of the state's colonial waterbirds. The first event was the widespread use of DDT and other chlorinated hydrocarbons as agricultural development increased on the coastal plains. The effects of chlorinated hydrocarbons have been well documented elsewhere, and they are apparent upon realization that Brown Pelican populations dropped from 5,000 to 50 in the Corpus Christi Bay region between 1940 and 1970 (King et al. 1977).

As with most other areas of the United States, human post-war population in coastal Texas increased dramatically. People need houses. Where better to live than on the water where recreation and domesticity could be combined? Thousands of acres of wetlands were developed to provide a boat at the back door. The increase in population also meant increases in use of and access to beaches. By 1950, almost every barrier island on the Texas coast had roads, traffic, and people; birds were displaced.

Another event that influenced waterbird populations was the discovery of vast oil and gas reserves along the Texas coast. The effects of oil and gas production have been varied. As a result of the development of a refinery system along the coast, valuable wetlands, once very inexpensive, were filled to accommodate plants and storage facilities. Refinery effluents were allowed to drain into marshes, bays, and lagoons, resulting in lower productivity in those waters (Smith 1972).

Finally, refining and industrialization increased the need for interport barge traffic. By 1945, the Gulf Intracoastal Waterway was completed, linking Port Brownville to Port Arthur and the remainder of the

Gulf Coast. Perhaps the only benefit that wading birds received from the increase in human populations and industrialization was the creation of a chain of islands through every bay and lagoon along the Texas coast when the Intracoastal Waterway was dredged. The islands were slowly colonized by plants, and the plant communities became nesting sites for colonial birds. Today, approximately 90% of the colonial waterbirds on the Texas coast nest on dredged-materials islands or natural islands that have been modified by dredged material (Chaney, et al. 1978).

The Texas coastline stretches nearly 800 km from the Rio Grande to the Sabine River. The coast can be divided into four climatic regimes based roughly on rainfall. Although the transition between these climatic zones is gradual, the differences in rainfall/evaporation patterns along the coast directly influence the physical properties of each bay and lagoon system along the coast. In the southern portion of the coast, semi-arid conditions prevail. Evaporation exceeds rainfall. Annual rainfall increases to the north and an equilibrium between rainfall and evaporation is reached in the vicinity of Port Lavaca. East of Galveston, the climate is humid (Thorntwaite 1948).

In the southern extremes of Texas, the bay systems tend toward hypersalinity. The Laguna Madre is usually hypersaline, having salinities normally between 50 to 70 ppt and occasionally as high as 120 ppt (Hedgpeth 1977). There are no permanent freshwater streams flowing into the Laguna Madre. By way of contrast, Galveston Bay and Trinity Bay are frequently hyposaline, and salinities rarely exceed 32 ppt. These climatic differences on the Texas coast affect distribution and abundance of the colonial wading birds.

In 1968, Gene Blacklock and Henry Hildebrand began a yearly effort to count all of the state's colonial birds. Later in this symposium, Doug Slack will describe the Texas Colonial Waterbird Survey, but it is important to mention one aspect of it here. For censusing convenience, the Texas coast is divided into three regions: the lower coast, from the Rio Grande to Baffin Bay; the central coast, from Baffin Bay to Pass Cavallo; and the upper coast, from Pass Cavallo to the Sabine River (Slack 1978).

In 1978, a total of nearly 200,000 pairs of colonial waterbirds nested on the Texas Gulf Coast. Of these, approximately 51% nested in the upper coast, 43% on the central coast, and 6% on the lower coast. Colonial waterbirds avoid the drier portions of the coast. Data summaries for Texas coastal colonies are available in Blacklock et al. (1978a,b) and Chaney et al. (1978).

When the counts of all waders are lumped together for each year since 1973, the general impression is that of a healthy, increasing wader population (Fig. 1). However, the populations of most species of waders have been declining. Only the Cattle Egret has shown population increases. No cause-and-effect relationship is implied between Cattle Egrets and these declines; little competition occurs between Cattle Egrets and other wader species. Cattle Egrets in Texas generally begin nesting later than the

other waders and, except for a few isolated instances of individual Cattle Egrets robbing nest material from structures of other herons, there is little interaction. In addition, most waders feeds in marshes and estuaries, whereas most Cattle Egrets feed in cultivated fields or rangeland pastures.

The accentuated decline in wader populations in 1978 (Fig. 1) may be related to a drought that occurred from mid-1977 to mid-1978. Bay salinities increased during this period and may have had a negative effect on fish populations. A severe storm also struck the coast just prior to the annual wading-bird census and many colonies were abandoned or destroyed. Renesting did occur, but after the official count period.

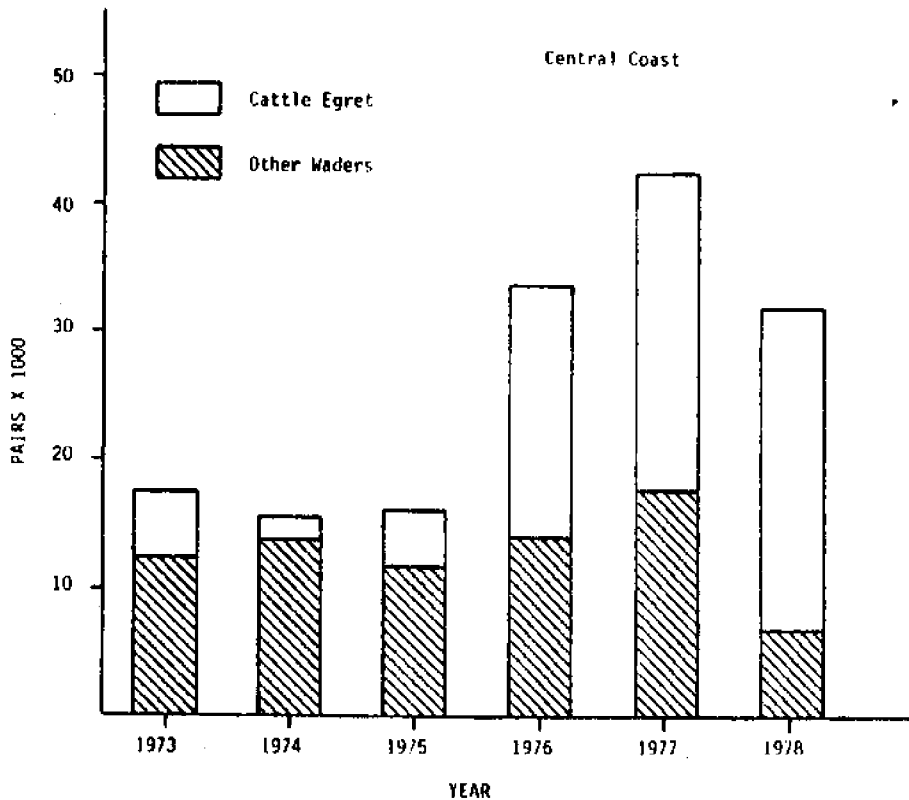


Figure 1. Comparisons of Cattle Egret populations with total populations of all other waders on the central coast region of Texas, 1973-1978.

Pelicaniform birds nest in specific areas of the coast and most seem to be doing well. Although 200 pairs of White Pelicans nested and laid eggs in 1978, only one young successfully fledged. Most nests were abandoned with near full-term embryos. Brown Pelicans have been increasing yearly. In 1978, 24 pairs nested and most fledged young. So far in 1979, over 30 nests have been counted.

Populations of gulls, terns, and skimmers have dropped slightly on the Texas coast since 1973. There has been a shift in the concentration of nests to the central coast region. This may relate to an increase in plant density on dredged islands in the northern areas; succession is much slower in the central coast of Texas (Chaney et al 1978). Terns and skimmers have increased in the central coast for two additional reasons. First, material dredged from the Intracoastal Waterway and other channels is still dumped on islands. Freshly exposed substrate is available. Second, the National Park Service has eliminated fishermen's cabins from a chain of approximately 30 islands within their jurisdiction. Birds have invaded many of these. On two of these islands, the National Park Service, with the help of biologists from Corpus Christi State University, have cleared 30m-diameter plots at the apex of the islands. Terns used these plots the first year and the density of terns in each plot has increased annually.

If, as Osborn and Custer (1978) suggest, colonial wading birds can be used as biological indicators, the Texas coast may be undergoing ecological trauma. Most of the colonial waterbirds that feed in Texas bays and wetlands are in a decline. Unfortunately, it is difficult to isolate a single factor, or even several important factors, responsible for these declines. Drops in waterbird populations may reflect decreases in water quality, but the factors influencing water quality are legion (Smith 1972). However, we should begin to look carefully at individual bay systems and their associated avian populations, as changes in population densities and distributions may well be closely correlated with ecosystem productivity.

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## STATUS OF GREAT LAKES POPULATIONS OF COLONIAL WATERBIRDS

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In 1976 and 1977, through funding provided by the U. S. Fish and Wildlife Service and Army Corps of Engineers (Scharf et al. 1978 and Scharf et al. 1979), Great Lakes colonial waterbird nesting was surveyed both from the air and, where possible, on the ground. Over half of 267 colonies recorded were visited by boat or by landing a floatplane at the colony site. Some of the general results of that study will be presented in this paper.

### 1. Herring Gulls

This species nests in a wide variety of habitats ranging from trees and high shrubs with tall herbs, such as thistles and nettles, to bare rock and cliff ledges. Great Lakes Herring Gulls in the early and mid-1960s were found to contain high pesticide levels (Ludwig and Tomoff 1966, Keith 1966). Concern about the stability of the Herring Gull population at that time was apparent. Our subsequent observations suggest a stabilization of Herring Gull populations at a lower level. This stability is now threatened by invasion of Ring-billed Gulls into mixed colony sites. However, many Herring Gull sites have not been invaded by Ring-billeds. Of the habitats described, only the heavy herbaceous type is suitable for the invasion of the Ring-billeds.

Certain isolated Herring Gull colonies such as Gull Island in northern Lake Michigan, have remained relatively stable for over a decade (Ludwig 1962, Scharf et al. 1978), whereas other colonies such as Bellows Island, Grand Traverse Bays, Lake Michigan and South Manitou Island, Lake Michigan have remained stable, but at much lower levels than the past. This is apparently due to human disturbance and changes in water level, affecting the surface area available for nesting (Scharf 1971, Scharf and Shugart 1975). Totals for each lake and for the species are given in Table 1.

### 2. Ring-billed Gulls

Ring-billed Gulls often nest in association with Herring Gulls or Common Terns. Where they do this, the Ring-billeds apparently invade and take over the nesting habitat of the other species. This observation correlates with those of Ludwig (1974) that this species is greatly expanding its populations in the U. S. Great Lakes.

Table 1. Numbers of Breeding Pairs of U. S. Great Lakes Colonial Nesting Birds by Species and Lake during 1977.

SPECIES	SUPERIOR	HURON <sup>1</sup>	MICHIGAN	ERIE <sup>2</sup>	ONTARIO <sup>3</sup>	TOTALS
Herring Gull	6,619	9,276	11,978	1,210	323	29,406
Ring-billed Gull	2,941	25,786	34,141	6,993	32,678	102,539
Common Tern	328	610	753	283	523	2,497
Caspian Tern	0	0	1,587	0	0	1,587
Great Blue Heron	254	286	138	2,586	0	3,264
Black-crowned Night Heron	0	166	558	3,000	130	3,854
Double-crested Cormorant	0	0	61	0	96	157
Great Egret	0	0	0	224	0	224
Snowy Egret	0	0	0	0	0	0
Cattle Egret	0	0	29	0	2	31
Little Gull	0	0	1	0	0	1
Forster's Tern	0	0	54	0	0	54
TOTALS	10,142	35,958	49,300	14,296	33,752	143,614

<sup>1</sup>Includes St. Mary's River area.

<sup>2</sup>Includes Lake St. Clair and Detroit River areas.

<sup>3</sup>Includes Niagara River area.

A few examples are instructive to show the Ring-billed Gull increase is at the expense of other species: Round Island and Gull Island in Lake Superior and Sulfur Island in Lake Huron have an expanding devegetated area caused by the Ring-billeds' feet and feces as they intrude on a Herring Gull colony. Intrusions into Common Tern colonies occurred at Port Authority in Lake Superior, Thunder Bay Island and Sebewaing Breakwater in Lake Huron, and at the Toledo Dike in Lake Erie.

Few exceptions to the increase in Ring-billed Gulls were seen. Decreases were noted at South Manitou Island, Lake Michigan. Human disturbance, foxes and vegetation changes have lowered the population. Certain Phragmites-covered dredged-material islands in the St. Mary's River suffered severe population declines from erosion and death of vegetation. Flooding of a large proportion of Little Galoo Island prevented nesting in those areas under water. Table 1 shows the populations of this species for each of the U. S. Great Lakes and for the region as a whole.



### 3. Common Tern

In addition to the invasions of Ring-billed Gulls into their colonies, Common Terns are threatened with habitat loss by plant succession on their preferred bare nesting areas, and by high water inundating nesting areas. Ludwig (1962) estimated 3,155 Common Terns in 16 colonies (average 197 terns per colony). Scharf et al. (1978) found 25 colonies in the same area with 1,521 terns (average 60 birds per colony). Thus, in the face of interspecific competition and habitat loss there are more, but smaller, colonies. Scharf and Shugart (in preparation) expect that the evidence will show this species has the most precarious status of all Great Lakes colonial nesters. Totals by lake and for this species are given in Table 1.

### 4. Caspian Terns

Despite the apparent historical fact that there were many more Caspian Tern colonies in the past (Barrows 1912, Jackson 1928), the species seems to have stabilized at four to seven sites in Lake Michigan. During the period from 1967 to 1978 there was a stable number of about 1,600 pairs of Caspian Terns, which reflected an 11% increase (Shugart et al. 1978) from 1967 (Ludwig 1968). Human disturbances and fluctuating water levels at low-lying colonies have taken their toll in recent low reproductive successes at High Island Shoals and Shoe Island. Due to the small numbers of this bird, continual monitoring is needed. Table 1 summarizes population numbers.

### 5. Double-crested Cormorants

Cormorant nesting sites in the U. S. Great Lakes are divided into two types: trees in the Cat Island Chain of Green Bay and Little Galloo Island in eastern Lake Ontario; and gravel and cobble material, where the birds nest on the ground, on Fish Island and Gravelly Island in Green Bay, Lake Michigan area.

The only previous assessment of the Great Lakes cormorant population is that done by Baillie (1947) in the pre-pesticide era. Sergej Postupalsky (personal communication, 1976) is presently summarizing recent information on Great Lakes cormorants. The species was once a very common nester in the Great Lakes. Cormorant populations are presumed to have been heavily depleted by pesticides and other toxic materials. Many records show that nesting cormorants have also been killed by fishermen. Possibly indicating a comeback, cormorants were seen loafing in the Apostle Islands, in Saginaw Bay, and at three places in Lake Ontario region between Rochester and Sacketts Harbor, New York. Postupalsky (unpublished notes) indicates that cormorants are still nesting on the Canadian side of Lake Erie; and with the recent discovery of new colonies in Green Bay, it appears that cormorant populations are going to increase in the Great Lakes, although their current low level demands constant monitoring. Table 1 summarizes population numbers.

## 6. Great Blue Herons and Great Egrets

The Great Lakes islands form a unique refuge for these two species, which have been found to be declining in numbers in other mainland parts of the Midwest (Thompson, 1978). Heron and egret nest sites are most frequently found in tall trees on islands adjacent to marshland feeding areas. However, in parts of the Apostle Islands, Lake Superior, the St. Mary's River and West Sister Island in Lake Erie; flights of 5-12 km to feeding areas are not uncommon.

The numbers and locations of colonies of these species remained stable for 1977 and 1978 (Table 1), although human intrusion was noted at a few sites.

## 7. Black-crowned Night Herons

Black-crowned Night Herons prefer brushy areas of willow, dogwood, or small trees near marshes (Hoffman and Prince 1975). Their populations are decreasing in the U. S. Great Lakes with three colonies experiencing reproductive failure from human intrusion in 1976-1977 (Scharf et al. 1978). The present numbers in colonies in Saginaw Bay area also reflect a historical decline when compared to Barrows (1912). There remain reservoirs of populations in the Mackinaw Straits area, Green Bay, Lake Michigan, Saginaw Bay, Lake Huron and the Monroe to Sandusky area of Lake Erie. Black-crowned Night Herons do not breed north of the Mackinaw Straits. Populations by lake and totals for the U. S. Great Lakes are given in Table 1.

## 8. Snowy Egret, Cattle Egret, Little Gull, Forster's Tern.

The status of these species' rather small populations is uncertain in the U. S. Great Lakes and numbers are summarized in Table 1.

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## POPULATION STATUS OF COLONIAL WATERBIRDS ON THE PACIFIC COAST

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My paper will cover the Pacific Coast. Inland colonies of Pacific coastal states will not be dealt with, although information has been collected and is available through several agencies, for example, the heron surveys of the California Department of Fish & Game. This summary will progress north from the Channel Islands of Southern California through Washington.

### 1. The Southern California Channel Islands

The Channel Islands of significance to breeding marine birds are Santa Barbara, Sutil, the Anacapas, Santa Cruz, Scorpion, Gull, Santa Rosa, San Miguel, Prince, and Castle (Table 1).

A. Santa Barbara Island: This island is part of the Channel Islands National Monument. The top of Santa Barbara Island is partially devegetated, through burning as well as the impact of rabbits. Recent attempts at control of the rabbit population apparently have been successful, as the vegetation is growing back.

At one time Santa Barbara Island held colonies of Brown Pelicans and Double-crested Cormorants, but these are gone now. Formerly a very large colony of Cassin's Auklets nested here. Only recently has the species returned to nest on the island. The single largest colony of Xantus' Murrelets in the United States is found on Santa Barbara Island.

B. Sutil Island: Historically, ten species nested here. Only the Brown Pelican has been eliminated. Sutil and Santa Barbara Islands are the only known nesting sites of the Black Storm-Petrel in the United States.

C. The Anacapa Islands: At least the eastern island is infested with rats, but it still has a large nesting colony of Western Gulls and apparently a few Xantus' Murrelets. West Anacapa Island is the location of the main southern California Brown Pelican colony. These islands are part of the Channel Islands National Monument.

D. Santa Cruise Island: This island is partially in private ownership; the Nature Conservancy has acquired a portion of the island.

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E. Prince Island: By far the most important colony in Southern California is Prince Island near San Miguel Island. The island holds nearly half of all the breeding birds in this region, including a colony of Cassin's Auklet numbering nearly 10,000 breeding pairs. This island is administered by the National Park Service.

Table 1. Summary of Breeding Birds of Southern California<sup>1</sup>

SPECIES	INDIVIDUALS	NUMBER OF COLONIES	TREND
Leach's Storm-Petrel	4+	2	?
Black Storm-Petrel	160	2	+?
Ashy Storm-Petrel	1,140	5	?
Brown Pelican	640	2	-
Brandt's Cormorant	6,000	12	-
Double-crested Cormorant	360	4	-
Pelagic Cormorant	460	9	?
Cattle Egret	<20	1	+
Black Oystercatcher	50		
Western Gull	9,600	11	+
Least Tern	1,360	19	-
Forster's Tern	800	1	
Caspian Tern	400	1	
Elegant Tern	200	1	+
Common Murre	0		-
Pigeon Guillemot	1,680	9	
Tufted Puffin	0		-
Cassin's Auklet	22,000	7	-(+)
Xantus' Murrelet	3,400	7	
Black Skimmer	20	1	+
Total (approximate)	48,000		

<sup>1</sup> Adapted from Hunt, G. L., Jr., R. L. Pitman, H. L. Jones, unpublished manuscript. Distribution and abundance of seabirds breeding in the California Channel Islands.

## 2. Central California

This region includes the coastline from Point Conception to San Francisco. Brandt's Cormorant is the most abundant breeding species.

Table 2. Summary of Breeding Birds of Central California<sup>1</sup>

SPECIES	INDIVIDUALS
Brandt's Cormorant	14,500
Pelagic Cormorant	1,800
Black Oystercatcher	160
Western Gull	2,200
Least Tern <sup>2</sup>	106
Forster's Tern <sup>2</sup>	2,200
Caspian Tern <sup>2</sup>	1,670
Common Murre	5,600
Pigeon Guillemot	5,600
Tufted Puffin	2
Total (approximate)	34,000

<sup>1</sup>Sowls, A., T. DeGange, J. Nelson, B. Rodstrom, and G. Lester. In prep.

<sup>2</sup>Varoujean, D. H. In Press. Seabird colony catalog: Washington, Oregon, and California. U. S. Fish and Wildlife Service.

## 3. The Farallon Islands

These islands lie approximately 30 miles west of San Francisco at the eastern edge of the Pacific Ocean. They have had an extensive history of disturbance, including Russian sealers, early whaling, commercial harvesting of murre eggs for human consumption, commercial lighthouse companies, and military operations of various sorts. Despite these disruptive intrusions, these islands remain the single most important seabird colony in the contiguous United States. The Farallon Islands are administered by the U. S. Fish & Wildlife Service (Farallon Island National Wildlife Refuge) and the U. S. Coast Guard. The Point Reyes Bird Observatory maintains a permanent research station on the island (Table 3).

## 4. Northern California

This shoreline region extends from Point Reyes in the south to the California/Oregon border in the north. Colonies are located primarily on numerous sea-stacks, small islands and inaccessible sea-facing mainland sites. By far the most numerous species is the Common Murre (275,000 individuals) (Table 4).

Table 3. Summary of Breeding Birds of the Farallon Islands<sup>1</sup>

SPECIES	INDIVIDUALS
Leach's Storm-Petrel	1,400
Ashy Storm-Petrel	4,000
Brandt's Cormorant	32,000
Double-crested Cormorant	180
Pelagic Cormorant	2,000
Black Oystercatcher	40
Western Gull	28,000
Common Murre	60,000
Pigeon Guillemot	3,000
Cassin's Auklet	103,500
Rhinoceros Auklet	100
Tufted Puffin	100
Total (approximate)	234,000

<sup>1</sup>Ainley, D. A., pers. comm., fide A. Sowls.

Table 4. Summary of Breeding Birds of Northern California<sup>1</sup>

SPECIES	INDIVIDUALS
Fork-tailed Storm-Petrel	350
Ashy Storm-Petrel	14
Leach's Storm-Petrel	15,760
Brandt's Cormorant	22,000
Double-crested Cormorant	720
Pelagic Cormorant	9,200
Black Oystercatcher	150
Western Gull	4,200
Pigeon Guillemot	3,400
Common Murre	275,000
Tufted Puffin	160
Cassin's Auklet	3,650
Rhinoceros Auklet	206
Total (approximate)	335,000

<sup>1</sup>Sowls, A., T. DeGange, J. Nelson, B. Rodstrom and G. Lester. In prep.



## 5. Oregon

The coastline of Oregon contains more breeding seabirds than any other region. Just as in Northern California, colonies are located on numerous sea-stacks, small islands and mainland sites. Similarly, the Common Murre (210,000 birds) is the most abundant species, followed by Leach's Storm-Petrel (150,000 individuals). The rugged shoreline habitat of the Pacific Northwest provides numerous nesting sites for a variety of seabirds (Table 5).

Table 5. Summary of Breeding Birds of Oregon<sup>1</sup>

SPECIES	INDIVIDUALS	NUMBER OF COLONIES
Fork-tailed Storm-Petrel	<1,000	3
Leach's Storm-Petrel	150,000	12
Brandt's Cormorant	13,600	45
Double-crested Cormorant	1,160	11
Pelagic Cormorant	6,700	137
Black Oystercatcher	240+	
Western Gull	9,200	146
Common Murre	210,000	47
Pigeon Guillemot	1,800	130
Tufted Puffin	6,400	33
Rhinoceros Auklet	<200	2
Cassin's Auklet	<1,000	6
Marbled Murrelet	≤2,000	
Total (approximate)	400,000	

<sup>1</sup>Adapted from Varoujean, D. H. and R. L. Pitman, unpublished manuscript. Oregon Seabird Colony Survey.

## 6. Washington, Outer Coast

The coastline of Washington is composed of numerous sea-stacks and several small islands. All but two islands are included in the Washington Islands National Wildlife Refuge, and they are administered by the U. S. Coast Guard. Cassin's Auklet is the most numerous breeding species (70,000 birds) (Table 6).

Table 6. Summary of Breeding Birds of the Outer Coast of Washington<sup>1</sup>

SPECIES	INDIVIDUALS	NUMBER OF COLONIES	TREND
Fork-tailed Storm-Petrel	10,000 <sup>+</sup>	6	?
Leach's Storm-Petrel	30,000 <sup>+</sup>	9	?
Brandt's Cormorant	180 <sup>-</sup>	3	-
Double-crested Cormorant	1,240	12	-
Pelagic Cormorant	3,000	45	?
Black Oystercatcher	160	42	
Glaucous-winged Gull	9,400	53	+
Ring-billed Gull	80	2	+
Caspian Tern	3,800	2	
Common Murre	22,000	17	-
Pigeon Guillemot	380	32	
Tufted Puffin	25,000	21	
Rhinoceros Auklet	22,200	4	+
Cassin's Auklet	70,000	4	+
Marbled Murrelet	<1,000		
Ancient Murrelet	40?		
Total (approximate)	200,000		

<sup>1</sup>Preliminary numbers from S.M. Speich, R. L. Pitman, U. Wilson and P. Gunther. In prep. Wildlife Surveys of the Washington Islands Wilderness: 1978 and 1979.

#### 7. Washington, Inland Marine Waters

Except for the Glaucous-winged Gull, breeding species in these waters are restricted to a few sites. One island, Protection Island, contains 70% of all the breeding birds in the region. Unlike the outer coast colonies, all these colonies are easily landed upon and entered. Apparently disturbance has particularly affected the numbers of cormorants and Tufted Puffins (Table 7). Except for Protection Island, nearly all colonies are located on national wildlife refuge lands. Protection Island is partially owned by the Washington Department of Game, but the remainder of the island is scheduled for development.

Table 7. Summary of Breeding Birds of the Inland Marine Waters of Washington<sup>1</sup>

SPECIES	INDIVIDUALS	NUMBER OF COLONIES	TREND
Double-crested Cormorant	420	6	-?
Pelagic Cormorant	1,850	12	-
Black Oystercatcher	80+		?
Glaucous-winged Gull	22,000	30	+
Arctic Tern	10	1	+
Pigeon Guillemot	3,600		?
Tufted Puffin	270	3	-
Rhinoceros Auklet	35,800	2	+
Marbled Murrelet	2,000		?
Total (approximate)	66,000		

<sup>1</sup>Adapted from Speich, S. M., D. A. Manuwal, T. Wahl and R. L. Pitman. Unpublished manuscript. Breeding Birds of the Inland Marine Waters of Washington.

## 7. Summary

It is clear that the largest numbers of nesting seabirds are found on the coast of Northern California and Oregon. The Farallon Islands provide the most important colony sites. Both Southern California and the inland marine waters of Washington colonies have been subjected to considerable disturbance. Despite these disturbances, the Farallon Islands birds still persist, as they do on Santa Barbara Island.

There are almost 1,300,000 individual breeding seabirds in California, Oregon, and Washington. The Common Murre (572,000 birds) makes up 40% of the total population, Cassin's auklet (200,000 birds) about 15%, and Leach's Storm-Petrel (180,000 birds) approximately 14%. Thirty-one percent of the total breeding population is found in Oregon, 26% in California, and 18% on the Farallon Islands.

Nearly all colony sites are in public ownership, and the resources they contain are known. During the past four years, all the shoreline of the Pacific Coast has been surveyed, and reports are now in preparation. Continued and increased protection of nesting sites should allow for increased numbers of some species. Attention must be paid to fishing stock levels and their possible effect upon nesting seabirds.

# CURRENT MANAGEMENT OF COLONIAL WATERBIRDS IN THE UNITED STATES

## A Panel Discussion

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### Summary

During the early decades of this century, and earlier, the major threat to colonial waterbirds was direct and premeditated human disturbance such as shooting and egg collecting. The kind of management required to correct these problems was relatively simple, in most cases consisting of restrictions to human activities at nesting sites. Beginning in different regions at different times, but recognized as early as the 1930s in Florida, habitat destruction or alteration, including land management for purposes other than wildlife protection, increasingly became a serious stress or limiting factor on colonial waterbirds. Habitat losses in combination with growing rates of other forms of indirect human disturbances (pollution, recreational activities, etc.) are now the principal factors responsible for colonial waterbird declines. Thus, the kinds of management required to maintain viable colonies or populations have changed during this century, becoming more complex and more costly.

The wide range of management activities required, both historically and within the broad framework of present needs, required a broad definition of "management" as it relates to colonial waterbirds. A suggested definition is as follows: any purposeful action designed to influence the

dynamics of colonial waterbirds. This definition includes such diverse activities as predator control, island building, planting vegetation, creating impoundments, and putting up fences.

Following are the major kinds of colonial waterbird management reported by representatives of one private conservation organization, three federal agencies and one state agency, all with long experience in the land and wildlife management business.

#### 1. National Audubon Society

The National Audubon Society owns or leases 64 sanctuaries throughout the United States, with about 15 managed wholly or in part as colonial waterbird breeding areas. The Society chooses not to formulate a strong central philosophy for sanctuary management; rather it encourages independent initiative on the part of sanctuary managers in developing plans based on needs for each site and on local expertise available to the manager. As a result, management of colonial waterbird colonies ranges from relatively simple efforts designed to reduce human intrusion into colonies to elaborate programs of habitat or species manipulation. Monitoring of colonial waterbird populations on sanctuaries is jointly conducted by sanctuary and research staff, while long-term studies for the purpose of gaining information needed to solve biological problems or to understand the dynamics of colonies is wholly handled by the Research Department.

The considerable diversity of management practices on National Audubon sanctuaries is revealed by the programs at four sites reviewed for this conference. At Cruickshank Sanctuary in Maine, the Society, in cooperation with the Canadian Wildlife Service and Massachusetts Audubon Society, has undertaken a program to establish a breeding colony of Common Puffins at a site where this species nested historically but was eliminated during the 15th Century due to excessive hunting. Nestling puffins have been acquired from a Canadian colony annually since 1973 and fledged from nest cavities in the Cruickshank Sanctuary. Subadult puffins have returned to the sanctuary in 1977 and 1978 and, if successful, adult puffins should return in 1980.

At Rainey Sanctuary in coastal Louisiana and Alafia in Tampa Bay, Florida, habitat has been manipulated to provide nesting sites for terns. At Rainey, a 200 by 500 foot sand island was created in 1966 by depositing dredged material adjacent to an extensive marsh in a region where tern nesting habitat was extremely limited. At Alafia, in cooperation with the Corps of Engineers, maintenance dredged material was deposited at one end of the existing island to create badly needed tern and gull nesting habitat. The remainder of the Alafia island is heavily vegetated and is an important nesting site for herons and ibises. The management plan for the dredged material is to keep the higher portions clear of vegetation where terns are likely to nest, while Spartina is being planted in the intertidal zone in an effort to reduce erosion and stabilize the entire feature.

At Corkscrew Sanctuary, in southern Florida, the Society has experimented with artificial feeding for nesting Wood Storks. At Corkscrew

nesting habitat is in good shape; nevertheless the colony often fails because of food shortage in adjacent wetlands. The Society experimented with raising fish in artificial ponds and making these fish available to nesting storks when natural supplies of food were low. The work at Corkscrew demonstrated that artificial feeding of storks is feasible, but expensive.

## 2. U.S. Fish and Wildlife Service

The major thrust of wildlife and habitat management by the Fish and Wildlife Service, historically, has been directed towards game species. This resulted, in large part, from strong and influential lobbying by sportsmen for legislation and funding of waterfowl management and related activities. Waterfowl management programs have indirectly benefited colonial waterbirds, primarily through acquisition and development of the network of National Wildlife Refuges. In fact, the 398 refuges include vast areas of wetland habitats that may be as important to many colonial waterbirds as to ducks. Although most wetland refuges have been established and managed primarily for ducks and geese, a few were specifically established to protect nongame waterbirds (for example, the Pelican Island and Great White Heron Refuges in Florida).

Presently, the main ways that the Service manages colonial waterbirds are through direct protection of the birds and their habitats on refuges, and through law enforcement outside, as well as within, the refuges. To a limited extent, the Service has conducted animal control projects; both to control predators of colonial birds and to attempt reduction of number or colony relocation for certain species. The Service is tightening its procedures for issuing Scientific Collecting Permits, Banding Permits, and Special Use Permits.

The Service protects colonial waterbirds, either directly or indirectly, through its administration and enforcement of various acts and treaties and their amendments. These include the Migratory Bird Treaty Act, the Migratory Bird Conservation Act, the Federal Aid in Wildlife Restoration (Pittman-Robinson) Act, and the Endangered Species Act. Federal Aid and Endangered Species Programs provide assistance to states for acquisition of wetland habitats and cooperative management of threatened or endangered species. Some of the Service's Regional Offices place high priority on acquisition of colonial waterbird nesting sites under the unique wildlife ecosystems program of the Land and Water Conservation Fund Act. Wetland habitats are protected through the Fish and Wildlife Coordination Act, by which the Service reviews Federal water development projects.

The Service is also involved with colonial waterbirds through migratory bird assessment studies. Through its Biological Services Program it has recently sponsored surveys of nesting colonies of seabirds and wading birds in Alaska, the U.S. Great Lakes and on the Atlantic and Gulf coasts and will start comparable studies on the Pacific coast. Number and distribution of birds revealed by the inventories will become the baseline data for establishing much needed regional and national management plans. Ideally, these plans should include management goals derived from an assessment of the status of each species within a region or ecosystem.

### 3. State of Florida

The Florida Game and Freshwater Fish Commission conducts surveys to determine distribution, numbers and nesting sites for species of colonial waterbirds of special interest, primarily the species included on the state's list of endangered or rare vertebrates. Presently, the Commission is surveying Brown Pelican nesting sites on the coasts, and in a cooperative program with National Audubon Society and Florida Audubon Society, is surveying colonial wading-bird colonies throughout the Florida peninsula. Special attention is directed to the Wood Stork, a species rated as endangered on the Florida list. Future plans for the cooperative wading bird survey include production of a state atlas of wading-bird colonies and an attempt to assess nesting success related to colony types and locations. An important part of the future program will be to measure human influence on nesting colonial wading birds, including levels of nesting success at artificial colony sites such as water impoundments.

The Commission has recently initiated a program to provide increased protection to colonial waterbird colonies on private islands where the state will post a colony as closed to human visitation if both the land owner and a state biologist concur that the colony is important and should be offered special protection. Posted colonies are subject to patrol by state game agents, and unauthorized entry is classified as a misdemeanor offense.

The Florida Game and Freshwater Fish Commission has conducted pesticide and food habit studies of Brown Pelicans, and in a cooperative program with the Louisiana Wildlife Commission, has transported nestling Brown Pelicans from Florida colonies for release in Louisiana in an effort to re-establish nesting Brown Pelicans in Louisiana. The program apparently is successful, as transported birds have bred in Louisiana—some as early as three years of age when still in the all-brown plumage.

### 4. U.S. Army Corps of Engineers

The Corps of Engineers has constructed over 2,000 dredged-material islands during the past 100 years. Although not constructed for use by colonial waterbirds, these man-made islands are of considerable importance as nesting and roosting habitat for this group of birds and have caused the Corps to become increasingly concerned with colonial waterbird management. The Corps is limited in the action it can take for colonial waterbirds for three reasons. First, the Corps has congressional authority for operation and maintenance of navigation channels and other works involving wetlands, but does not have authority to manage colonial waterbirds or their habitats. The Corps has only a limited number of staff biologists who can give attention to colonial waterbirds. And funds for dredging are earmarked for maintenance and operation, not for biological research or management. In spite of these limitations, the Corps can manage colonial waterbird habitats in the following two ways.

When channel maintenance is called for, the Corps has some flexibility

in deposition of dredged material. Working in cooperation with governmental agencies or private conservation organizations, the Corps can use new dredged material to alter vegetation on a dredged-material island. Decisions about how dredged material is deposited are made in District Planning Offices, which are responsive to requests by outside agencies or organizations.

Other considerations related to the effects of dredging activity on colonial waterbirds are timing of the operations and the kind of diking utilized at dredge sites. The Corps seeks information on waterbird use of dredged-material islands, both by in-house efforts by their own biologists and by getting up-to-date information from experienced local ornithologists for consideration in timing of dredging operations and selecting the type of diking used.

The Corps can aid in the protection of colonial waterbird nesting colonies on dredged material islands. The Corps is willing to work in cooperation with other agencies or organizations to post dredged-material islands, but has no authority to position wardens at such colonies. A legal problem is that the Corps does not own the dredged-material islands it builds.

#### 5. National Park Service

Approximately 230 areas are managed by the National Park Service. The large natural areas, including most national parks and many seashores and national monuments, place particular emphasis on protection of wild-life populations. About 25 of these National Park Service areas contain important breeding populations of colonial waterbirds. The overriding philosophy in National Park Service management of natural areas is preservation of ecosystems rather than management for individual species. However, none of the 25 National Park Service units with major waterbird colonies encompasses the full habitats or ecosystems required to sustain regional waterbird populations independent of outside influences.

The National Park Service fosters protection of colonial waterbirds through programs of inventory, monitoring, research, and management. Regional inventories conducted by National Park Service personnel have accelerated during the 1970s, in part stimulated by recent collaborative surveys and the publication of Paul and Francine Buckley's in-house guide for colonial waterbird management. The National Park Service is beginning to organize long-term monitoring programs for colonies in National Park Service units in the North Atlantic and South Florida, as well as in individual parks. Successful monitoring programs require long-term commitment, consistent methods and commitment of funds and personnel. Research and Resource Management personnel now assigned to parks and regional offices provide the professional cadre necessary to carry out such programs.

Research is considered an essential prerequisite to all phases of any active National Park Service management programs.



Whenever possible, such research is undertaken with an ecosystem perspective. Everglades National Park is now involved in a program of ecosystem-level research in the southern Everglades in an effort to produce management programs that will restore ecosystem processes and thereby stabilize the decline in the colonial wading-bird populations that traditionally nested in that region.

A standard National Park Service management procedure for colonial waterbird nesting sites is closure to the public and protection from other forms of unnatural disturbance. Closure of sand-nesting colonies is often difficult because of the need to allow visitor access to the beaches. This is an example of the conflict that may come from the dual National Park Service responsibility to protect natural processes while allowing public use. In general, National Park Service management readily supports such colony closures. It is most likely that management would oppose construction of new dredged-material islands in natural areas because of the unnatural character of such sites. Management of existing dredged-material islands for wading birds may be encouraged, especially in recreation areas. Predator control programs, where native species are involved, are usually in conflict with the National Park Service philosophy of allowing natural processes to occur. Control of natural predators occurring at natural densities would likely be opposed in most natural areas. In all such management, it is necessary to consider total regional populations of the affected species not just populations within a park.

The National Park Service ecosystem-oriented role in waterbird protection and management requires a regional perspective since few parks hold more than a fraction of the total regional population of a species. A regional perspective is the realization that the entire remaining natural area is critical to colonial waterbirds. Management policies by all agencies and organizations holding land within a region, as well as conditions in unmanaged areas, together define the fate of regional colonial waterbirds. Unified regional policies can best be accomplished through management plans that have been written and approved by representatives of agencies responsible for regional populations. Regional monitoring programs should be carried out through the combined efforts of the responsible agencies.

## Synthesis

Characteristics of current management programs by the above agencies and organizations can be summarized as follows:

1. Although most agencies and organizations have conducted active management programs for colonial waterbirds only relatively recently, interest in the topic and new inventory-management programs are rapidly emerging.
2. Individual agencies and organizations are often limited at present in what they can do for colonial waterbirds due to authorization, funding, and personnel constraints.
3. Colonial waterbird management thus far has been uncoordinated between agencies and has lacked the regional perspective required for management and protection of highly mobile waterbirds.
4. Although much has been learned about management techniques for some habitats or kinds of colonies, for example dredged-material islands, considerable additional research and testing of survey-management techniques remain to be done before most habitats and species can be properly managed.
5. Numerous examples exist where individual agencies or managed areas have successfully conducted innovative management programs in response to local problems or needs.

THE CURRENT NEEDS OF COLONIAL  
WATERBIRDS IN THE UNITED STATES

A Panel Discussion

Moderator

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This panel discussion was designed to answer the question "Do we need to manage colonial waterbirds?" Are colonial waterbirds having problems or are populations in good condition? If there are problems, are they local, regional or national? Are there a few problems that can be tackled on a national basis, or do birds in each locality have their own problems that must be handled at local levels?

The panel found that colonial waterbirds do have problems in most regions of the country. The magnitude of the problems varied considerably from region to region, and the species obviously changed. In some regions most populations appear to be stable or are increasing, while in other areas populations of some species are known to be declining.

Several problems were found to exist throughout the country and were mentioned by most panelists. Loss of habitat was the primary concern. Several panelists noted that nesting habitat, especially beach habitat, is being rapidly lost to development or is being rendered

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unsuitable by vehicular traffic. This appears to be especially important on the Atlantic and Gulf coasts. Loss of freshwater nesting habitat, primarily to wetland drainage, is also of primary concern in Florida and in the Mississippi Valley.

There was also concern over the loss or degradation of feeding habitat. In Florida and the Mississippi Valley, wetland drainage is resulting in significant losses of feeding habitat. In Texas, there is concern over the reduction of estuarine fish stocks and the resulting loss of the ability of the wetlands to support populations of wading birds.

A special concern was the loss of long-used traditional nesting sites. In some regions certain colony sites have been in use for many years. Such sites often have produced proportionately more young than newer sites and may be of such value as to deserve special attention.

A second major concern was the disturbance of active nesting colonies. While this was mentioned as important by most panelists, there are obviously considerable differences from region to region. In most cases, the severity of the problem appears to relate proportionately to the numbers of people in the vicinity of colonies during the nesting season. In New Jersey, where the human population is very high along the coast in the summer, there are many conflicts. In North Carolina, where colonies are generally more isolated, conflicts appear to be of less critical concern. This disturbance at colony sites took many forms, but the most generally cited offenders were beach vehicles and boaters. There was also concern, however, over the effects of bird watchers, photographers, banders, and even researchers. On the Pacific Coast, the problem of close fly-bys by military aircraft was mentioned as an important factor in causing egg losses in cliff-dwelling seabirds on offshore islands.

Colony disturbance by dogs was also mentioned as being important in several regions. It is apparently common throughout the country to take family dogs along on boat rides and to let them run free on isolated islands while the owners picnic, fish or otherwise amuse themselves.

Predation by natural predators was not mentioned as being important in most regions. The rapidly growing nesting population of Herring Gulls is, however, of primary concern in New Jersey. This avian predator eats both the eggs and young of other species and also competes with other ground nesting species for nesting sites. Herring Gulls have recently extended nesting populations south to North Carolina and will likely be a major problem along the Atlantic coast during the next few years.

Another major problem that elicited comment from most of the panelists was habitat degradation. This takes many forms, but usually involves colony sites becoming unsuitable for continued use without actually being developed or otherwise physically destroyed. The situation most often mentioned involves changes in vegetation on colony sites that prevent the user species from being able to continue to use the site. Most often these changes are the result of natural successional processes, although the ditching of marshes, over-fertilization by nesting colonial birds themselves, the diking of dredged-material islands and other human activities also appear to be important.

Site degradation becomes more acute as alternate sites with appropriate nesting habitats become fewer and fewer. It is much easier to prevent the development or destruction of an active colony site than it is to save an apparently suitable site that has no birds. Yet, movement from sites that have become unsuitable, either due to successional changes, to damage of vegetation by the birds themselves, to inundation of colony sites by high water conditions, or by man's activities is a normal factor in the lives of many species of colonial waterbirds. It was felt that in some regions alternate sites were becoming critically scarce. Further in some areas, particularly New Jersey, the availability of many small colonies assures that some young are produced most years. The presence of a large segment of the nesting population of any species in one or two colonies increases the vulnerability of that species.

Several panelists reported that colonial waterbirds in their regions have retreated from the traditional beach nesting sites to marsh sites or to man-made islands in the estuaries. These alternate sites appear to be the last refuge for many species, and there was considerable concern that, should these sites be lost or rendered unfit for nesting, populations will likely be much reduced. In North Carolina and Texas there is much concern that changes in dredging policy may result in reduction of the re-deposition of dredged material on coastal islands. At present this re-deposition is the primary factor maintaining the bare or nearly bare sites utilized by such species as Royal Terns.

Panelists also noted that, while there appears to be some recovery from the ravages of DDT and other pesticides, there is still much concern over pesticides and other pollutants in the environment. The threat of oil spills is a growing spectre to be faced by coastal and Great Lakes populations of colonial waterbirds.

Most panelists felt that habitat loss, habitat degradation, and colony disturbances are the primary problems faced by the birds. They also indicated that colonial waterbirds generally are facing problems of sufficient magnitude in all regions to require assistance in the form of management.

There were two problems identified by the panel that often render management difficult or impossible. First, it appears that in many parts of the country the ownership of colony sites is very difficult to determine. A case in point involves the ownership of the many dredged-material islands along the Atlantic and Gulf coasts. Long-range management becomes difficult or impossible without knowledge of ownership. A second problem identified is the lack of adequate inventories for many regions. While there has been considerable effort toward this end in recent years, many regions still lack the necessary information to determine population trends and to measure the effect of any management that may be attempted.

Most panelists agreed that the most needed management strategies involved the protection of colony sites, the management of people, and the manipulation of or maintenance of vegetation in colony sites. There was also general concern that management efforts be on a regional basis. It was strongly felt that there should be a coordinated effort to do more than to manage individual sites. Regional planning was perceived as a mechanism by which a concentrated effort could be mounted to assure adequate nesting sites for all species within natural, ecologically similar regions.

In summary, the panel, in its discussion, and the audience, through its participation, indicated strongly that in many cases management was needed to assure that colonial waterbirds will continue to be able to maintain viable populations throughout the United States.

PROBLEMS ASSOCIATED WITH THE MANAGEMENT OF COLONIAL WATERBIRDS  
AS SEEN BY MANAGING AGENCIES - A PANEL DISCUSSION

Moderator

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Summary

Traditionally, wildlife management focused almost exclusively on those animal species that were exploited for sport or commercial purposes (i.e. "game species"). Nongame species received little direct attention from wildlife managers, although many species derived indirect benefits from certain management practices such as wetland enhancement (waterfowl impoundments).

We have emerged from an era of benign neglect of nongame wildlife. Researchers, managers, and administrators alike are embracing the systems approach. Emphasis is placed upon conserving or enhancing entire communities or ecosystems, not just on important target species.

One such community that has been identified as being an important part of most wetland systems is the colonial waterbird group. Fortunately, we have fairly good information on the population status and many life history aspects of most East Coast species. However, many unknowns remain, especially concerning the vast seabird resources of Alaska and the waterbirds in many parts of the interior of the country.

Formulating wise management policies for a resource about which we know only parts of the puzzle is beset with problems. We are asked to make decisions based upon very little information. Further, any set of recommendations that biologists make inevitably must be modified vis-à-vis political, economic, and social interests. The final resource management strategy is, at best, a compromise among many conflicting interests.

In the following pages, I outline the major problems mentioned by spokesmen from eight managing organizations. A synthesis and summary of these problems follow:

#### 1. U.S. Fish & Wildlife Service

A necessary first step in the management process is to assess the resource, i.e., conduct inventories. Such inventories have been supported in the past four years by the Office of Biological Services, but these efforts are very costly. There is an urgent need to determine how often an intensive follow-up monitoring is needed. This objective must be coordinated with state, federal, and private agencies.

Habitat acquisition is a powerful means of protecting resources. However, problems of assigning priorities to acquisition of waterbird nesting and feeding habitat vs. endangered species habitat, for example, are unresolved. Further, there are limits to how much management can be done even on Federally owned lands. Predator and animal damage control is closely scrutinized. "Wilderness" classification precludes most active habitat management practices.

The permit review and law enforcement capabilities of the Service offer two additional means of conserving and protecting waterbirds and their habitats.

If and when a management plan is devised, it is essential that the plan be integrated with those of other managing agencies at the local, regional, and federal level. Inevitably, interagency agreements and cooperative state-federal plans become mired in debates of statutory authority and arguments over how spheres of influence are drawn. Often, goals may be in direct conflict, e.g., military range use and nesting habitat preservation.

#### 2. U.S. Army Corps of Engineers

Due to a lack of Congressional mandate, the Corps has no authority to manage biological populations. Nonetheless, proper planning of such operations as intracoastal waterway



dredging can have a beneficial effect on nesting waterbirds. The precise timing and placement of dredged material can often be manipulated in a manner that enhances nesting habitat quality.

However, a dredged material disposal technique that is attractive to waterbirds may be deleterious to other organisms. Containing deposition within dikes appears to be less harmful to benthos and fish, but diked dredge islands are not utilized extensively by waterbird species.

Obviously, many considerations must be integrated before any major environmental alteration is permitted. Here again, close communication is required among officials from the Corps, U.S. Fish and Wildlife Service, EPA, National Marine Fisheries, local watermen, and other agencies and individuals.

Another problem is education within the agency. Engineers may often be somewhat insensitive to environmental and ecological principles. This underscores the need for better information exchange among scientists, engineers, and the public.

### 3. National Audubon Society

Private conservation organizations like the National Audubon Society have assumed an important role as protectors of large parcels of habitat. With further land acquisition comes more responsibility and commitment of manpower (wardens) and funds. This requires an evaluation of priorities in acquisition.

Even if waterbird habitat is rated high, the choice of which areas to acquire and protect is difficult. We know very little about what determines colony site choice and site fidelity. Inland colony dynamics are much less understood than are those in coastal areas. More basic research into these fields is needed before sound management can be applied.

### 4. National Marine Fisheries Service

NMFS is involved only tangentially with colonial waterbird management. The most active interaction involves dredge deposition projects. As a rule, NMFS opposes creation of new dredge-material islands that may smother fish spawning and/or nursery areas. It was suggested that a blanket policy opposing island creation be modified to consider each proposal on a site-specific basis.

Ideally, there should be no conflict between waterbird and

fisheries interests, After all, waterbird biomass is largely dependent on fish biomass.

5. North Carolina Wildlife Resources Commission

The major problem faced by this state in addressing colonial waterbird problems is lack of money and manpower. Two pending pieces of legislation -- the State license fee increase and the Congressional Nongame Bill -- may provide the necessary revenue to begin active nongame work.

Already, some colonial waterbird work is under way through The Brown Pelican/Endangered Species Program. Further, waterbird biologists can help their cause by participating in the review of Environmental Impact Statements and in permit review.

Opportunities for logistical support of surveys is good in the State.

6. Texas Colonial Waterbird Survey

The State of Texas has demonstrated the effectiveness of a large volunteer network of field workers in waterbird monitoring. Nonetheless, current cooperator numbers have declined.

Although there has been excellent cooperation among state, federal, and private organizations, there remains a need for a lead agency to take the role of coordinating (and funding, if possible) a long-term monitoring effort.

In addition, because of competition for limited funds in the Texas parks and wildlife agency, waterbird biologists must address the question of the relative worth of waterbirds. How are administrators to be convinced that waterbirds demand funding at the expense of game species? Should all species be studied or only those declining in numbers?

7. Brown Pelican Recovery Team

The recovery team approach, as a planning process, has been valuable in segregating the few "knowns" from the many "unknowns." Here again, the major problems were felt to be a lack of understanding of the biological processes at work. Also, the designation of critical habitats requires knowledge that is, as yet, unknown.

Another problem has been the time required to develop a plan. Most Recovery Team members are heavily taxed with other professional commitments.

Because the recovery team is relatively new and acts in an advisory capacity only, its effectiveness has not yet been fully tested. Problems are certain to surface when team recommendations are compromised because of other interests. Nonetheless, several projects have been stopped through the actions of Recovery Teams.

8. Cape Lookout National Seashore, National Park Service

The major problems in the Seashore involve controlling human recreational pressures in critical areas. Waterbird colonies along beaches near inlets are especially susceptible to off-road vehicle disturbance and pressures from fishermen. A permit system for ORVs is one partial solution to the traffic pressure problem.

Synthesis

Problems of managing waterbirds can be generalized into three major categories:

(1) Lack of sufficient biological knowledge.

Both National Audubon Society and the Brown Pelican program underscored the need to learn more about habitat use and selection. We need to learn where the "bottlenecks" in survival and reproduction occur. Is it food during the nesting season or winter starvation in remote Caribbean areas? During the nesting season, we need long-term studies of populations and colony site occupation.

(2) Conflicts with humans.

In the past, waterbirds have been sacrificed for the interests of recreation (ORV effects on beach-nesters), industry (millinery trade), fisheries (cormorants), disease control (gulls), etc. The importance of waterbirds is gradually appreciating, but we need to justify their case more strongly before impartial judges.

(3) Policy (decision-making problems).

Priorities for managing waterbirds vis-à-vis all other nongame wildlife need to be addressed. Should we attempt to protect or manage all waterbird species or only those that appear to be declining? These are problems that both researchers and managers must confront.

A recurrent topic was the problem of limited coordination among state, federal, and private agencies and organizations. With the shortage of funds and manpower, each agency must work to achieve maximum effectiveness per dollar invested.

The concept of time-sharing (and cost-sharing) should be applied to cooperative survey/censuses on a regional level.

## RECOMMENDATIONS OF THE SUMMARY PANEL

### Moderator

James F. Parnell, University of North Carolina at Wilmington

### Panelists

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Participants in this conference attempted to assess and summarize the current knowledge and management strategies of colonial waterbird populations in the United States. The objective of our deliberations was the delineation of the most crucial problems facing the birds themselves as well as operational difficulties currently encountered by the agencies involved in management decisions.

A summary panel representing individuals and agencies involved in a variety of ways with colonial waterbirds met at the conclusion of the formal session to evaluate the program and to summarize the workshop. The panel arrived at the list of recommendations, set forth below, after considerable discussion and evaluation of the two days of formal sessions. We present these recommendations as a strong statement of interest and concern and in the hope that they will guide individual researchers as well as private and public agencies and organizations toward a greater degree of cooperation in the gathering of scientific data on colonial waterbirds and the knowledgeable management of these species. It is only through coordinated efforts of scientists and resources managers that the maintenance of viable North American populations of colonial waterbirds can be assured.

Clearly management is already needed to maintain certain regional populations of some colonial waterbird species; and in future years management

efforts will likely be needed for other species. Of fundamental importance is the realization that these birds breed in relatively few heavily-populated nesting sites. Some species show considerable adaptability, but most are quite vulnerable to catastrophic destruction--either from natural events or from man's activities. Mainland, and some of the larger more accessible coastal sites, are being severely impacted by development, off-road-vehicles, and simply by the large numbers of people visiting these areas. Even small island sites are being more and more heavily disturbed as the recreational use of both coastal and inland waters continues to increase. Island sites, only recently considered inaccessible, are now visited regularly by boaters during the warmer portions of the year. Such heavy visitation generally coincides with the reproductive efforts of the birds, thus interfering with nesting and causing either complete or partial losses of nests or young.

Colonial waterbirds are in special need of study and assistance in the form of carefully considered management plans. While they are very vulnerable to disturbance, some have also shown considerable adaptability, which suggests that constructive management may be especially productive. Biologists, resource managers, and all who are interested in the well-being of this important and spectacular part of the North American avifauna should be observant of local and regional population trends. Resource management agencies should be especially concerned about the effects of their actions on these birds. Steps to avoid or mitigate impacts on colonial waterbirds should be included in resource management planning by these agencies.

The following specific recommendations will help to insure the acquisition of fundamental information necessary for the formulation of appropriate regional and species-by-species management plans. If suitably implemented, these suggestions can do much to pave the way for well-coordinated interagency efforts to manage and protect colonial waterbird populations and the complex but often fragile ecosystems in which they breed.

The summary panel recommends:

1. That viable populations of all indigenous colonial waterbirds be maintained throughout their historic ranges in this country and that appropriate management be employed when necessary on a species specific basis. Management on the basis of recognizable ecological regions is encouraged (e.g. major bay, gulf, lake system, etc.).
2. That there should be the further development and evaluation of management techniques applicable to colonial waterbirds. It is generally felt that many species are amenable to management and that management may in fact be necessary in many instances. Active management practices (such as habitat manipulation) are conceptually realistic but, as yet, have not been widely used for colonial waterbirds.
3. That population inventories be continued on a regional basis to provide the necessary data base for evaluations of population trends and the possible need for management. Special efforts are needed in those regions

in which there have been no recent inventories. Systematic long-term monitoring of regional populations should follow initial inventories.

4. That strong efforts be made to develop and evaluate standardized methods to be used in population inventory and monitoring; and that, when developed, such standardized methods be used whenever possible and applicable.
5. That there be an increased use of existing data banks and the development of additional facilities as needed.
6. That further study of all aspects of the biology of colonial waterbirds at all seasons and throughout the ranges of all species be encouraged. Many species travel great, often interhemispheric, distances during the year. They further may show great regional variation in habitat selection. Study of the dynamics of as many of these discrete populations as possible should be accomplished.
7. That special efforts be made to study food availability as a limiting factor in population regulation.
8. That there be a special effort to determine the status and level of concern for populations of colonial waterbirds on a regional basis. The development of standardized criteria describing the status and level of jeopardy of waterbird populations would be especially helpful (e.g. Endangered, Threatened, etc.).
9. That there should be an increased level of coordination and cooperation among all agencies, organizations, and individuals involved in the study and management of colonial waterbirds. This should include international cooperation, as many species extend across national boundaries.
10. That consideration be given to establishing regional coordinating teams representing those agencies, organizations, and biologists with responsibilities and expertise relative to regional colonial waterbird populations. Such teams could evaluate regional population trends and attempt to identify regional problems. They could provide information and perhaps act as informal coordinating groups for all interested resources management agencies. Such groups could also actively review EISs and permit applications for managing agencies relative to projects that may affect colonial waterbird populations. Such groups should help to assure increased regional interagency coordination.
11. That the U.S. Fish and Wildlife Service take a stronger role as the lead agency for the management of colonial waterbirds.
12. That groups such as the Pacific Seabird Group and the Colonial Waterbird Group maintain the national perspective on colonial waterbird issues and facilitate information exchange on research and conservation topics.

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