Supplemental Information for the Reddish Egret

Biological Status Review Report

The following pages contain peer reviews received from selected peer reviewers, comments received during the public comment period, and the draft report that was reviewed before the final report was completed

March 31, 2011

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Peer review #1 from Dr. Ann Hodgson

From: Ann Hodgson
To: Imperiled
Cc: Rodgers, James
Subject: Reddish Egret Final Draft BSR 11-15-10 Hodgson 12Jan2011
Date: Thursday, January 13, 2011 1:31:00 PM
Attachments: Reddish Egret Final Draft BSR 11-15-10 Hodgson 12Jan2011.docx

Attached is my review copy of the Reddish Egret Final Draft BSR. I generally concur with (1) the completeness and accuracy of the biological information and data analyses in the BSR, and the (2) reasonableness and justifiability of the assumptions, interpretations, and conclusions.

Specific comments:

- Add Green 2006 to the literature cited. His population estimate is more conservative – 250-300 pairs.
- Additional data would better support the assumptions re generation time – the leap from known longevity of 12 years to assumed longevity of 25 years could be examined further –increasing anthropogenically-generated hazards may affect longevity.
- It is likely that sea level rise (SLR) will affect both foraging and nesting habitat availability, since many coastlines are armored coastal habitats may not extend inland, and some nesting sites may submerge. At least a few American Oystercatcher territories have been lost to subsidence in the Tampa Bay area. A few areas with Reddish Egret territories are vulnerable potentially.
- Increasing mammalian predator populations, and the possibility that new predatory species may be introduced,

I concur with the recommendation to list Reddish Egret in Florida as a threatened species, primarily because of low population size, few, scattered large groups of nesting egrets compared to behavior that produced large aggregations historically, both known and potential foraging and nesting habitat loss, and nesting failure due to human disturbance and predation.

Thank you for the opportunity to participate in this review and please contact me with any questions.

Ann B. Hodgson, PhD
Professional Wetland Scientist #1109
Certified Wildlife Biologist®
Resource Designs, Inc.
Natural Resource Research & Planning

Biological Status Review
for the Reddish Egret
(*Egretta rufescens)*

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of September 1, 2010. Public information on the status of the reddish egret was sought from September 17, 2010 to November 1, 2010. A three member biological review group met on November 3-4, 2010. Group members were James A. Rodgers (FWC lead), Peter C. Frederick (University of Florida), Jerry Lorenz (National Audubon Society), Mark Cook (South Florida Water Management District), and John C. Ogden (Research Director at Audubon of Florida). In accordance with rule 68A-27.0012, F.A.C, the Reddish Egret Biological Review Group was charged with evaluating the biological status of the reddish egret using criteria included in definitions in 68A-27.001(3), F.A.C., and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels Version 3.0 (2003)* and *Guidelines for Using the IUCN Red List Categories and Criteria Version 8.1 (2010)*. Please visit http://myfwc.com/WILDLIFEHABITATS/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Biological Review Group concluded from the biological assessment that the reddish egret met the population size and trend and population very small or restricted criteria for listing. Based on the literature review, information received from the public, and the biological review findings, FWC staff recommends listing the reddish egret as state threatened.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

BIOLOGICAL INFORMATION

Taxonomic Classification – Reddish egrets (*Egretta rufescens*) are members of the Family Ardeidae, along with other egrets, herons and bitterns. The species has two distinct color morphs: white and dark. The more common dark morph and name sake is characterized by a reddish head and neck and a gray body, whereas the less common white morph has an entirely white plumage. Both forms have pink bills with black tips [horn-colored in non-breeding condition, brightening to pink in "high" breeding condition], and blue to grayish-black legs. Some authorities recognize two subspecies: the nominate *E. r. rufescens* on the east coast of North America and in the Caribbean, and *E. r. dickeyi* along the Pacific coast of the southern U.S. and Mexico (Lowther and Paul 2002). Previously, the species was placed in the monotypic genus *Dichromonassa*.

Geographic Range and Distribution – Reddish egrets occur along the coastlines of Florida, Alabama, Louisiana, Mississippi, and Texas (Rodgers et al. 1996, Lowther and Paul 2002, Green 2006, Hodgson and Paul in review 2010). They are found on the eastern coast of Mexico, and the Baja Peninsula on the Pacific coast. Their range extends through the Caribbean islands, Cuba, Belize, and the Bahamas, and south along Central America to northern Colombia

and Venezuela. The species is generally resident at breeding locations and not considered migratory as are other species of wading birds (Rodgers et al 1996, Mikuska et al. 1998).

Life History References – Rodgers et al. 1995, Toland 1999, Lowther and Paul 2002, Florida Fish and Wildlife Conservation Commission 2003, IUCN 2009.

BIOLOGICAL STATUS ASSESSMENT

Threats – Reddish egret populations suffered huge losses during the plume trade of the late 1800s and early 1900s and are still considered one of the rarest heron species (Kale et al. 1992, Rodgers et al. 1996, Lowther and Paul 2002). Current threats to reddish egrets are not well understood, but coastal development, recreational disturbance at foraging and breeding sites, environmental degradation, loss of genetic diversity and interchange, and increased pressure from predators are of primary concern (Powell et al. 1989, Lowther and Paul 2002, Hunter et al. 2006, Bates et al. 2009). The reddish egret was one of fourteen species identified as regional priority species in need of Critical Recovery or Immediate Management in the 2006 Southeast U.S. Waterbird Conservation Plan (Hunter et al. 2006). The species is listed as Near Threatened on the IUCN Red List of Threatened Species, and labeled as "red", or species of greatest conservation concern, on Audubon's Watchlist due to its moderately small population and suspected population declines (Butcher et al. 2007, IUCN 2009).

Statewide Population Assessment – Reddish egret populations gradually increased through the 20th century as a result of protection measures and hunting prohibitions. However, current population estimates are still estimated at only 10% of the pre-plume hunting population size (Lowther and Paul 2002). While the non-breeding range of the species extends along both the Atlantic and Gulf of Mexico coasts of the state, breeding sites are located along the southern half of the state into Florida Bay and the Lower Keys (Paul and Dunstan 1975, Paul et al. 1979, Rodgers and Schwikert 1986, Toland 1991, Toland 1999). The species initiated breeding in South Carolina in 2005 (Ferguson et al. 2005). Estimates for the Florida population of reddish egrets were 350-400 pairs in the early 1990s (Lowther and Paul 2002). Because ~~of its~~ most birds have dark plumage and white morph birds can be mistaken for white egrets (usually Great Egrets), and tendency to nest under the nesting canopy of trees, it is difficult to survey for reddish egrets during statewide aerial surveys (Rodgers et al. 2005, Conroy et al. 2008, Hodgson et al. 2008).

Status Review - In its review of the reddish egret's status, the Biological Review Group made the following assumptions and conclusions:

- Generation time: Most birds breed at 3-4 years of age. Maximum known age of a recovered banded bird was 12 years but maximum longevity probably is about 25 years. What data support this estimate? Calculation of generation time is based on the mid-point of onset of breeding to maximum age at death: (25-4)=21/2=11 years; thus generation time is 11+4=15 years of age. Therefore, the time period for evaluation of change/trend analysis is 3x15=45 years or beginning of the period at 1965.
- Extent of Occurrence (EOO): The species most frequently occurs along coastal areas from Titusville south to the Keys and north to the Tampa Bay region in Florida, an area of about 2,400 km^2 of mangrove/estuarine habitat. At most there is about double the

2,400 km^2 of shallow, open-water foraging habitat, which is the limiting factor for the distribution of the species. Thus, the EOO is a maximum of about 5,600 km^2.

- Area of Occupancy (AOO): This is less than EOO as the species is not evenly distributed along the coasts and in Florida Bay; thus, habitat actually available, used, or suitable (e.g., large areas of coastline are either developed or not available due to human recreation) for foraging, etc., is probably <2,000 km^2.

Biological Status Review for the reddish egret—The review group concluded the reddish egret met the population size and trend criteria C1, C2 and population very small or restricted criteria D1, D2. See Table 1 for details.

Regional Application—The review group concluded there was no change in the recommendation for the reddish egret. See Table 2 for details.

LISTING RECOMMENDATION

Staff recommends that the reddish egret be listed as a Threatened species because it met criteria for listing as described in 68A-27.001(3) F.A.C.

SUMMARY OF THE INDEPENDENT REVIEW

To be added later.

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Table 1. Biological status review information findings for the reddish egret in Florida.

Biological Status Review Information Findings				
	Species/taxon:	Reddish Egret		
	Date:	11/04/10		
	Assessors:	Rodgers, Ogden, Lorenz, Cook, Frederick		
	Generation length:	15 years		
Criterion/Listing Measure	**Data/Information**	**Data Type***	**Criterion Met?**	**References**
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	While the species experienced population decreases prior to 1965, there is no evidence of population decrease during the 1965-2010 period. Rather, the species exhibited a slow increase in numbers up to 2000s. Surveys indicate circa 300-400 pairs (600-800 individuals) in statewide population. Some indication of a relatively slow, steady decline in Keys and Florida Bay during the 2000s. Green concluded 250-300 pairs	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002, Green 2006.
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	See A1 above.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	No evidence species will decrease in the next 45 years unless major alteration in coastal/Florida habitat quality. It is possible that human disturbance will cause widespread nesting failure even if habitat quality remains consistent.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	Tampa Bay and Indian River Lagoon populations stable but Keys/Florida Bay populations are slowly decreasing due to unknown reasons. Sea level rise probably will not cause significant decrease of foraging habitat (=limiting factor for distribution of species since nesting habitat is not limited) and mangroves might increase in area by moving inland. Depending on assumptions, SLR may cause reductions in foraging habitat and nesting habitat where inland movement of coastal habitats is constrained by existing development. Some nesting sites will be lost to subsidence/ submergence.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				

(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	About 5,600 km^2.	O	Y	See EOO on notes tab.
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	Probably <2,000 km^2.	O	Y	See AOO on notes tab.
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Numerous individual colonies (circa 50+) with small number of nests (mostly <25 nests) at each colony but there only appears to be 5 natural clusters (=locations) of colonies: Tampa Bay, Indian River Lagoon, North Florida Bay, Lower Keys, and a continuous area along the SW coast.	O	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	No evidence of any of these variables.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No evidence.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Current population is circa 300-400 pairs (600-800 individuals). However, 2007-08 surveys in Florida Bay found only about 56 nests, a decrease from the 1990s. Which cit.? unpublished data?	O	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR	Florida Bay population has decreased from the 1990s because of unknown reasons and an amount ~~amount~~ during the last 45 years. Based on total population of 600-800 individuals, a 10% decrease in the future would only be about a decrease of 60-80 individuals. It is reasonably likely this percent decrease could be met in Florida Bay alone.	E/I	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	A decline has occurred in Florida Bay.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
a. Population structure in the form of EITHER	Total population is only about 600-800 individuals.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	East coast, west coast, and Florida Bay birds considered as one population.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
b. Extreme fluctuations in number of mature individuals	No evidence.		N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(D) Population Very Small or Restricted, EITHER				

(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	Total population is only about 600-800 individuals.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	See B2.a for identification of 5 clusters or locations.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	None completed to date.		N	

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meet at least one criteria	C1, C2, D1, D2
Is species/taxon endemic to Florida? (Y/N)	No
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meets at least one criteria above	C1, C2, D1, D2

Table 2. Biological status review information for the regional assessment of the reddish egret.

1	Biological Status Review Information Regional Assessment	Species/taxon: Reddish Egret
2		Date: 11/4/10
3		Assessors: Rodgers, Ogden, Lorenz, Cook, Frederick
4		
5		
6		
7		
8	Initial finding	Supporting Information
9		
10	2a. Is the species/taxon a non-breeding visitor? (Y/N/DK). If 2a is YES, go to line 18. If 2a is NO or DO NOT KNOW, go to line 11.	No, resident breeding species.
11	2b. Does the Florida population experience any significant immigration of propagules capable of reproducing in Florida? (Y/N/DK). If 2b is YES, go to line 12. If 2b is NO or DO NOT KNOW, go to line 17.	Do not know. It is not clear what would be significant movement by the species into Florida and what numbers were suspected/inferred to have moved into the state from Cuba/Bahamas in order to rescue the Florida population. At most, movement into Florida would be a slow process during the 3 generation time period and it may require >2055 to have an impact on Florida population. Movement from Texas is an unknown entity. In conclusion, it is uncertain if there would be enough immigrants within 45 years to prevent extirpation of the species in Florida.
12	2c. Is the immigration expected to decrease? (Y/N/DK). If 2c is YES or DO NOT KNOW, go to line 13. If 2c is NO go to line 16.	
13	2d. Is the Florida population a sink? (Y/N/DK). If 2d is YES, go to line 14. If 2d is NO or DO NOT KNOW, go to line 15.	
14	If 2d is YES - Upgrade from initial finding (more imperiled)	
15	If 2d is NO or DO NOT KNOW - No change from initial finding	
16	If 2c is NO or DO NOT KNOW- Downgrade from initial finding (less imperiled)	
17	If 2b is NO or DO NOT KNOW - No change from initial finding	No change in initial finding.
18	2e. Are the conditions outside Florida deteriorating? (Y/N/DK). If 2e is YES or DO NOT KNOW, go to line 24. If 2e is NO go to line 19.	
19	2f. Are the conditions within Florida deteriorating? (Y/N/DK). If 2f is YES or DO NOT KNOW, go to line 23. If 2f is NO, go to line 20.	
20	2g. Can the breeding population rescue the Florida population should it decline? (Y/N/DK). If 2g is YES, go to line 21. If 2g is NO or DO NOT KNOW, go to line 22.	
21	If 2g is YES - Downgrade from initial finding (less imperiled)	
22	If 2g is NO or DO NOT KNOW - No change from initial finding	
23	If 2f is YES or DO NOT KNOW - No change from initial finding	
24	If 2e is YES or DO NOT KNOW - No change from initial finding	
25		
26	Final finding	No change in initial finding.

APPENDIX 1. Biographies of the members of the Reddish Egret Biological Review Group.

Mark I. Cook has a M.S. in Ecology from the University of Durham, UK and Ph.D. in Ecology from Glasgow University, UK. He is a senior environmental scientist with the South Florida Water Management District. His expertise is in the behavioral ecology, conservation biology, habitat quality and reproductive success, and restoration ecology related to wading bird foraging and reproductive performance especially applied to hydrologic management and restoration issues in the Everglades. He has published numerous papers on the food ecology of wading birds.

Peter C. Frederick received a Ph.D. in Zoology from the University of North Carolina. He is Research Professor at the University of Florida. His expertise is in the areas of wetland ecology, ecotoxicology, and avian ecology of wading birds, especially with the wood stork, great egret, and white ibis and the Everglades. He has published numerous papers on waterbird ecology, pesticide contamination, population biology, and habitat requirements of wading birds in Florida.

Jerome J. Lorenz received a M.S. in Zoology from Miami University and a Ph.D. in Marine Biology and Fisheries from the University of Miami. Since 1989 Jerry has been a staff scientist for the Audubon Society and has been primary investigator of the National Audubon Society's Florida Bay Estuarine Research Project since 1992. This project focuses on the impact of water management in the southern Everglades on the coastal ecosystems of Florida Bay. In 2005, he became the state research director for Audubon of Florida. He serves as a member on numerous advisory committees and has published numerous papers.

John C. Ogden received a B.S. degree in Zoology from the University of Tennessee. He has held positions as research ecologist with the Everglades National Park and National Audubon Society, environmental scientist with the South Florida Water Management District working on the everglades restoration, and most recently as research director with Audubon of Florida. His expertise is in the ecology of wading birds, especially the wood stork, and has served on the USFWS recovery teams for the wood stork, California condor, and American crocodile. He serves on numerous advisory committees and has published over 100 technical papers.

James A. Rodgers received a M.S. from Louisiana State University and a Ph.D. from the University of South Florida. Since joining the FWC in 1980, he has worked on snail kites, double-crested cormorants, several species of wading birds including little blue herons and wood storks, development of buffer distances for waterbirds, pesticide contamination, and population genetics of birds. He was elected a Fellow of the American Ornithologist Union in 2009 and has published numerous papers on the breeding and nesting ecology of waterbirds.

APPENDIX 2. **Summary of letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010.**

Most information received by FWC staff was anecdotal and consisted of general observations of presence or absence. Information from Ann Hodgson (~~Tampa Bay~~ Florida Coastal Islands Sanctuaries, NAS) for the status of the species in the Tampa Bay region was used in the review of the species by the BSR panel on November 3-4, 2010.

APPENDIX 3. Information and Comments Received from Independent Reviewers.

To be completed later.

Green 2006

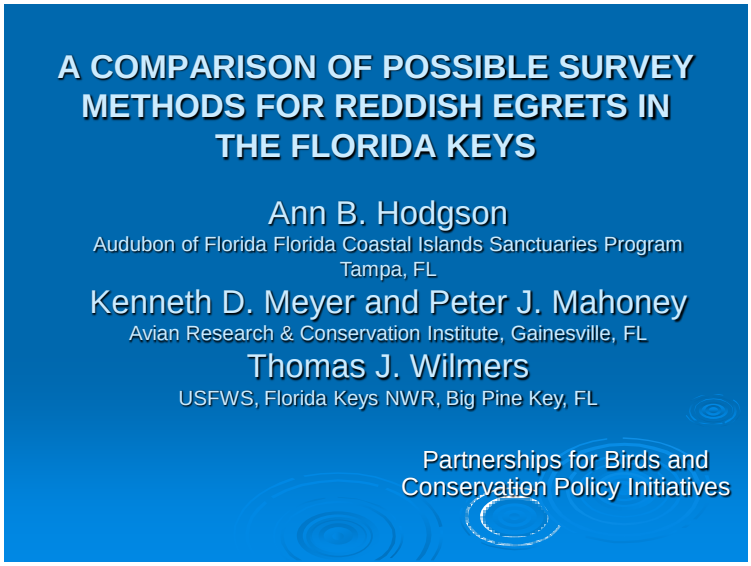
FLORIDA

Reddish Egrets were once common breeders in Florida, specifically Florida Bay, Tampa Bay, Charlotte Harbor and Clearwater Harbor (Paul 1991). The impact of plume hunting on Reddish Egrets was severe enough that this species was considered extirpated from Florida by the turn of the 20th century (Pearson 1918, Paul 1991). By 1938, Reddish Egrets were confirmed nesting in Florida again and their numbers have slowly

increased over the past 75 years. The current range of Reddish Egrets in Florida extends from Pinellas County and Tampa Bay on the Gulf Coast south to Florida Bay and the Florida Keys (Figure 1). On the Atlantic Coast, Reddish Egrets nest from Merritt Island National Wildlife Refuge south to the Keys.

Currently there is concern that while Reddish Egrets are "recolonizing" many regions of Florida, the overall number of breeding pairs may be declining (A. Paul, pers. comm.). In 1991, R. Paul estimated the Florida breeding population to be at 350-400 breeding pairs with the majority of nesting occurring in Florida Bay and other smaller nesting concentrations in Tampa Bay, Lower Florida Keys, and Merritt Island National Wildlife Refuge (MINWR). Nesting pairs along the west coast of Florida (A. Paul, unpubl. data) and MINWR (M. Epstein, pers. comm.) remain relatively stable at approximately 90-100 and 50-60 pairs, respectively. Colonies along the west coast of Florida have been regularly ground counted since the 1980s (R.T. Paul and A. Paul, unpubl. data). However, colonies in Florida Bay and the Lower Florida Keys have not been thoroughly ground surveyed since the 1977-1980 surveys (Powell et al. 1989). In 2002, islands within the Florida Keys National Wildlife Refuges were ground surveyed for Reddish Egrets. Nesting was confirmed on 11 islands for a total of 17 breeding pairs. This survey also included 7 islands that Rich Paul (unpubl. data) surveyed in 1980 and confirmed 35 breeding pairs. These same islands in 2002 yielded only 4 Reddish Egret nests. **The current estimate for the Florida population of Reddish Egrets is 250-300 breeding pairs.** This estimate is based on recent colony surveys of the Gulf Coast (90-110 breeding pairs, A. Paul unpubl. data; South Florida Wading Bird Report 1997-2003) and the Florida Keys NWR (17 breeding pairs, T. Wilmers, unpubl. data); all other areas were estimated based on most recent surveys and personal communications with area biologists, refuge managers, etc. This is a "best-guess" estimate however as data from current and complete surveys of Florida Bay and the Lower Florida Keys is lacking for more precise estimates.

Hodgson, AB, KD Meyer, PJ Mahoney, and TJ Wilmers. 2008. A comparison of possible survey methods for Reddish Egrets in the Florida Keys. Presentation - Annual Meeting of theWaterbird Society, Corpus Christi, TX. 8 November 2008.



Summary of Results

- 6 islands were searched by boat and ground survey
- The helicopter search did not know which target islands would be searched
- Individual Reddish Egret search:
  - helicopter – 1 in the search area vs. boat – 0
  - boat – 12 in the search area vs. helicopter - 0
- Nest Search
  - helicopter – 0 vs. 8 nests on 3 islands by ground

Peer review #2 from Clay Green

From: Green, M. Clay
To: Imperiled
Subject: RE: Reddish egret Draft BSR Report
Date: Tuesday, January 11, 2011 11:27:29 AM
Attachments: Independent review of Biological Status Review for the Reddish Egret_Green.doc

Caly
I have attached my review comments for the Reddish Egret Draft BSR report. Please let me know if you have any questions

Clay

M. Clay Green
Assistant Professor
Department of Biology
Texas State University
San Marcos, TX 78666

Independent review of Biological Status Review for the Reddish Egret
M. Clay Green, Department of Biology,
Texas State University-San Marcos, Texas 78666

BRG assumptions:

1) The BRG assumptions on generation time, extent of occurrence and area of occupancy seem well-founded based on current literature and available data.

Biological Status Review Findings

1) Population size reduction: Overall I concur with BRG on population size reduction findings based on observed and/or estimated data from Tampa Bay/Indian River Lagoon. However, based on the literature cited, there was not any data provided on 2009-2010 data from Tampa Bay but based on population decreases during 2004-2008, it is important to note if this downward trend continued in 2009-2010 in Tampa Bay area. Also, limited data from Florida Keys/Florida Bay indicates population declines in these areas which I think are of concern (down from 100-125 nesting pairs (Powell 1979) to 56 nesting pairs in 2007-2008), but difficult to project a >30% population size reduction over next 3 generations.

2) Geographic Range: I concur with BRG findings of limited extent of occurrence, area of occupancy, and severely fragmented populations.

3) Population Size and Trend: I concur with population size being less than 10,000 individuals AND an estimating continuing decline of >10% over 3 generations. As mentioned above, the FL Bay/Keys population has dropped considerably since 1979

(~50% decrease), this drop is significant regardless of the relatively stable populations in Tampa Bay and Indian River. Additionally, the population in Florida is small and limited banding studies suggest FL birds are all one subpopulation.

4) Population Very Small/Restricted: I concur with finds that population is very small (< 800 individuals) and population has restricted area of occupancy.

5) Overall, I concur with the findings that criteria C1, C2, D1, D2 are met for Reddish Egrets in Florida. Based on the met criteria, the FWC staff recommendation of Reddish Egret as "state threatened" is justified.

Peer review #3 from Elizabeth Bates

From: Elizabeth Bates
To: Imperiled
Subject: Reddish egret BSR review
Date: Monday, January 10, 2011 1:58:28 PM
Attachments: ReddishEgretFinalDraftBSR.docx
Review of REEG status review.docx

Dear Dr. Haubold,

Thank you for the opportunity to review the reddish egret BSR. I have attached my review in a word document. Also, I made a couple of edits using track changes (mostly just typos). Please let me know if you have any questions regarding the review or edits.

Sincerely,

Elizabeth Bates
Ph.D. Candidate
Graduate Research Assistant
Caesar Kleberg Wildlife Research Institute
Texas A&M University-Kingsville

As a peer reviewer for the biological status review of the reddish egret I was asked to comment on, (1) the completeness and accuracy of the biological information and data analysis, and (2) the reasonableness and justifiability of the assumptions, interpretations and conclusions made. After examining the literature used in this report, I conclude that the review committee has done a thorough job collecting the available literature on the biology of reddish egrets and has applied this information in a conservative manner when making inferences and assumptions. Unfortunately, very little information exists concerning this species and decisions have to be made even with a lack of information.

I agree with the assumptions and conclusions made by the committee. The method used to calculate generation time seems to be the best option available under section 4.4 of the *Guidelines of using IUCN Red List Categories and Criteria* given the lack of information on survival for this species. A maximum longevity of 25 years seems reasonable given the oldest banded recovered individuals of similar species (snowy egret and great egret) are between 22 and 23 years. The conclusion that the reddish egret met population size and trend criteria C1 and C2 and population very small and restricted criteria D1 and D2 is reasonable given the consistently low population size and the declines and the distribution of nesting colonies described in Hodgsons and Paul 2010. I agree with the conclusion that the reddish egret be listed as a Threatened species.

Biological Status Review
for the Reddish Egret
(*Egretta rufescens)*

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of September 1, 2010. Public information on the status of the reddish egret was sought from September 17, 2010 to November 1, 2010. A three member biological review group met on November 3-4, 2010. Group members were James A. Rodgers (FWC lead), Peter C. Frederick (University of Florida), Jerry Lorenz (National Audubon Society), Mark Cook (South Florida Water Management District), and John C. Ogden (Research Director at Audubon of Florida). In accordance with rule 68A-27.0012, F.A.C, the Reddish Egret Biological Review Group was charged with evaluating the biological status of the reddish egret using criteria included in definitions in 68A-27.001(3), F.A.C., and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels Version 3.0 (2003)* and *Guidelines for Using the IUCN Red List Categories and Criteria Version 8.1 (2010)*. Please visit http://myfwc.com/WILDLIFEHABITATS/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Biological Review Group concluded from the biological assessment that the reddish egret met the population size and trend and population very small or restricted criteria for listing. Based on the literature review, information received from the public, and the biological review findings, FWC staff recommends listing the reddish egret as state threatened.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

BIOLOGICAL INFORMATION

Taxonomic Classification – Reddish egrets (*Egretta rufescens*) are members of the Family Ardeidae, along with other egrets, herons and bitterns. The species has two distinct color morphs: white and dark. The more common dark morph and name sake is characterized by a reddish head and neck and a gray body, whereas the less common white morph has an entirely white plumage. Both forms have pink bills with black tips, and blue to grayish-black legs. Some authorities recognize two subspecies: the nominate *E. r. rufescens* on the east coast of North America and in the Caribbean, and *E. r. dickeyi* along the Pacific coast of the southern U.S. and Mexico (Lowther and Paul 2002). Previously, the species was placed in the monotypic genus *Dichromonassa*.

Geographic Range and Distribution – Reddish egrets occur along the coastlines of Florida, Alabama, Louisiana, Mississippi, and Texas (Rodgers et al. 1996, Lowther and Paul 2002). They are found on the eastern coast of Mexico, and the Baja Peninsula on the Pacific coast. Their range extends through the Caribbean islands, Cuba, Belize, and the Bahamas, and south along Central America to northern Colombia and Venezuela. The species is generally

resident at breeding locations and not considered migratory as are other species of wading birds (Rodgers et al 1996, Mikuska et al. 1998).

Life History References – Rodgers et al. 1995, Toland 1999, Lowther and Paul 2002, Florida Fish and Wildlife Conservation Commission 2003, IUCN 2009.

Comment [L1]: Not listed in Literature Cited. Maybe this is suppose to be 1996?

BIOLOGICAL STATUS ASSESSMENT

Threats – Reddish egret populations suffered huge losses during the plume trade of the late 1800s and early 1900s and are still considered one of the rarest heron species (Kale et al. 1992, Rodgers et al. 1996, Lowther and Paul 2002). Current threats to reddish egrets are not well understood, but coastal development, recreational disturbance at foraging and breeding sites, environmental degradation, loss of genetic diversity and interchange, and increased pressure from predators are of primary concern (Powell et al. 1989, Lowther and Paul 2002, Hunter et al. 2006, Bates et al. 2009). The reddish egret was one of fourteen species identified as regional priority species in need of Critical Recovery or Immediate Management in the 2006 Southeast U.S. Waterbird Conservation Plan (Hunter et al. 2006). The species is listed as Near Threatened on the IUCN Red List of Threatened Species, and labeled as "red", or species of greatest conservation concern, on Audubon's Watchlist due to its moderately small population and suspected population declines (Butcher et al. 2007, IUCN 2009).

Statewide Population Assessment – Reddish egret populations gradually increased through the 20th century as a result of protection measures and hunting prohibitions. However, current population estimates are still estimated at only 10% of the pre-plume hunting population size (Lowther and Paul 2002). While the non-breeding range of the species extends along both the Atlantic and Gulf of Mexico coasts of the state, breeding sites are located along the southern half of the state into Florida Bay and the Lower Keys (Paul and Dunstan 1975, Paul et al. 1979, Rodgers and Schwikert 1986, Toland 1991, Toland 1999). The species initiated breeding in South Carolina in 2005 (Ferguson et al. 2005). Estimates for the Florida population of reddish egrets were 350-400 pairs in the early 1990s (Lowther and Paul 2002). Because of its dark plumage and tendency to nest under the nesting canopy of trees, it is difficult to survey for reddish egrets during statewide aerial surveys (Rodgers et al. 2005, Conroy et al. 2008).

Comment [L2]: Should this be (Paul et al. 1975)? Three authors are listed in the Lit. Cited

Status Review - In its review of the reddish egret's status, the Biological Review Group made the following assumptions and conclusions:

- Generation time: Most birds breed at 3-4 years of age. Maximum known age of a recovered banded bird was 12 years but maximum longevity probably is about 25 years. Calculation of generation time is based on the mid-point of onset of breeding to maximum age at death: (25-4)=21/2=11 years; thus generation time is 11+4=15 years of age. Therefore, the time period for evaluation of change/trend analysis is 3x15=45 years or beginning of the period at 1965.
- Extent of Occurrence (EOO): The species most frequently occurs along coastal areas from Titusville south to the Keys and north to the Tampa Bay region in Florida, an area of about 2,400 km^2 of mangrove/estuarine habitat. At most there is about double the 2,400 km^2 of shallow, open-water foraging habitat, which is the limiting factor for the distribution of the species. Thus, the EOO is a maximum of about 5,600 km^2.

- Area of Occupancy (AOO): This is less than EOO as the species is not evenly distributed along the coasts and in Florida Bay; thus, habitat actually available, used, or suitable (e.g., large areas of coastline are either developed or not available due to human recreation) for foraging, etc., is probably <2,000 km^2.

Biological Status Review for the reddish egret—The review group concluded the reddish egret met the population size and trend criteria C1, C2 and population very small or restricted criteria D1, D2. See Table 1 for details.

Regional Application—The review group concluded there was no change in the recommendation for the reddish egret. See Table 2 for details.

LISTING RECOMMENDATION

Staff recommends that the reddish egret be listed as a Threatened species because it met criteria for listing as described in 68A-27.001(3) F.A.C.

SUMMARY OF THE INDEPENDENT REVIEW

To be added later.

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Bates, E. M., R. W. DeYoung, and B. M. Ballard. 2009. Genetic diversity and population structure of reddish egrets along the Texas coast. Waterbirds 32: 430- 436.

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Table 1. Biological status review information findings for the reddish egret in Florida.

Biological Status Review Information Findings	Species/taxon:	Reddish Egret		
	Date:	11/04/10		
	Assessors:	Rodgers, Ogden, Lorenz, Cook, Frederick		
	Generation length:	15 years		

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	While the species experienced population decreases prior to 1965, there is no evidence of population decrease during the 1965-2010 period. Rather, the species exhibited a slow increase in numbers up to 2000s. Surveys indicate circa 300-400 pairs (600-800 individuals) in statewide population. Some indication of a relatively slow, steady decline in Keys and Florida Bay during the 2000s.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	See A1 above.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	No evidence species will decrease in the next 45 years unless major alteration in coastal/Florida habitat quality.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	Tampa Bay and Indian River Lagoon populations stable but Keys/Florida Bay populations are slowly decreasing due to unknown reasons. Sea level rise probably will not cause significant decrease of foraging habitat (=limiting factor for distribution of species since nesting habitat is not limited) and mangroves might increase in area by moving inland.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	About 5,600 km^2.	O	Y	See EOO on notes tab.
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	Probably <2,000 km^2.	O	Y	See AOO on notes tab.

AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Numerous individual colonies (circa 50+) with small number of nests (mostly <25 nests) at each colony but there only appears to be 5 natural clusters (=locations) of colonies: Tampa Bay, Indian River Lagoon, North Florida Bay, Lower Keys, and a continuous area along the SW coast.	O	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	No evidence of any of these variables.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No evidence.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Current population is circa 300-400 pairs (600-800 individuals). However, 2007-08 surveys in Florida Bay found only about 56 nests, a decrease from the 1990s.	O	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR	Florida Bay population has decreased from the 1990s because of unknown reasons and an amount ~~amount~~ during the last 45 years. Based on total population of 600-800 individuals, a 10% decrease in the future would only be about a decrease of 60-80 individuals. It is reasonably likely this percent decrease could be met in Florida Bay alone.	E/I	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	A decline has occurred in Florida Bay.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
a. Population structure in the form of EITHER	Total population is only about 600-800 individuals.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	East coast, west coast, and Florida Bay birds considered as one population.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
b. Extreme fluctuations in number of mature individuals	No evidence.		N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	Total population is only about 600-800 individuals.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.

(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	See B2.a for identification of 5 clusters or locations.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	None completed to date.		N	

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meet at least one criteria	C1, C2, D1, D2
Is species/taxon endemic to Florida? (Y/N)	No
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meets at least one criteria above	C1, C2, D1, D2

Peer review #4 from William E. Davis

I found the methodology, data, analysis, and interpretation to be appropriate. The historical aspects were thoroughly researched and the literature cited extensive. I did find, however, a number of inconsistencies in the latter, with inconsistencies between the in-text citations and the literature cited, references in the literature cited that were not cited in the text, and one reference cited in the text but not in the literature cited section. I have noted these using Track Changes. I have also made several editorial suggestions in the text.

The biological information appears to be complete and when they lack information they say so. I found the data analysis and conclusions supporting listing the Reddish Egret in Florida under criteria of population size or trend (C1, C2), and population size (D1, D2), compelling.

William E. Davis, Jr 12/14/1010

Biological Status Review
for the Reddish Egret
(*Egretta rufescens)*

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of September 1, 2010. Public information on the status of the reddish egret was sought from September 17, 2010 to November 1, 2010. A three member biological review group met on November 3-4, 2010. Group members were James A. Rodgers (FWC lead), Peter C. Frederick (University of Florida), Jerry Lorenz (National Audubon Society), Mark Cook (South Florida Water Management District), and John C. Ogden (Research Director at Audubon of Florida). In accordance with rule 68A-27.0012, F.A.C, the Reddish Egret Biological Review Group was charged with evaluating the biological status of the reddish egret using criteria included in definitions in 68A-27.001(3), F.A.C., and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels Version 3.0 (2003)* and *Guidelines for Using the IUCN Red List Categories and Criteria Version 8.1 (2010)*. Please visit http://myfwc.com/WILDLIFEHABITATS/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Biological Review Group concluded from the biological assessment that the reddish egret met the population size and trend and population very small or restricted criteria for listing. Based on the literature review, information received from the public, and the biological review findings, FWC staff recommends listing the reddish egret as state threatened.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

BIOLOGICAL INFORMATION

Taxonomic Classification – Reddish Eegrets (*Egretta rufescens*) are members of the Family Ardeidae, along with other egrets, herons and bitterns. The species has two distinct color morphs: white and dark. The more common dark morph and name sake is characterized by a reddish head and neck and a gray body, whereas the less common white morph has an entirely white plumage. Both forms have pink bills with black tips, and blue to grayish-black legs. Some authorities recognize two subspecies: the nominate *E. r. rufescens* on the east coast of North America and in the Caribbean, and *E. r. dickeyi* along the Pacific coast of the southern U.S. and Mexico (Lowther and Paul 2002). Previously, the species was placed in the monotypic genus *Dichromonassa*.

Geographic Range and Distribution – Reddish Eegrets occur along the coastlines of Florida, Alabama, Louisiana, Mississippi, and Texas (Rodgers et al. 1996, Lowther and Paul 2002). They are found on the eastern coast of Mexico, and the Baja Peninsula on the Pacific coast. Their range extends through the Caribbean islands, Cuba, Belize, and the Bahamas, and south along Central America to northern Colombia and Venezuela. The species is generally resident at breeding locations and not considered migratory as are some other species of wading birds (Rodgers et al 1996, Mikuska et al. 1998).

Life History References – Rodgers et al. 1995, Toland 1999, Lowther and Paul 2002, Florida Fish and Wildlife Conservation Commission 2003, IUCN 2009.

Comment [WED4]: Is this the Rogers et al 1996 of the Literature Cited?

BIOLOGICAL STATUS ASSESSMENT

Threats – Reddish Eegret populations suffered huge losses during the plume trade of the late 1800s and early 1900s and are still considered one of the rarest heron species (Kale et al. 1992, Rodgers et al. 1996, Lowther and Paul 2002). Current threats to reddish egrets are not well understood, but coastal development, recreational disturbance at foraging and breeding sites, environmental degradation, loss of genetic diversity and interchange, and increased pressure from predators are of primary concern (Powell et al. 1989, Lowther and Paul 2002, Hunter et al. 2006, Bates et al. 2009). The Rreddish Eegret was one of fourteen species identified as regional priority species in need of Critical Recovery or Immediate Management in the 2006 Southeast U.S. Waterbird Conservation Plan (Hunter et al. 2006). The species is listed as Near Threatened on the IUCN Red List of Threatened Species, and labeled as "red", or species of greatest conservation concern, on Audubon's Watchlist due to its moderately small population and suspected population declines (Butcher et al. 2007, IUCN 2009).

Statewide Population Assessment – Reddish Eegret populations gradually increased through the 20th century as a result of protection measures and hunting prohibitions. However, current population estimates are still estimated at only 10% of the pre-plume hunting population size (Lowther and Paul 2002). While the non-breeding range of the species extends along both the Atlantic and Gulf of Mexico coasts of the state, breeding sites are located along the southern half of the state into Florida Bay and the Lower Keys (Paul and Dunstan 1975, Paul et al. 1979, Rodgers and Schwikert 1986, Toland 1991, Toland 1999). The species initiated breeding in South Carolina in 2005 (Ferguson et al. 2005). Estimates for the Florida population of reddish egrets were 350-400 pairs in the early 1990s (Lowther and Paul 2002). Because of its dark

Comment [WED5]: Shouldn't this be Paul et al? The Literature Cited reference listed is Paul, Meyerriecks, and Dunstan.

plumage and tendency to nest under the nesting canopy of trees, it is difficult to survey for reddish egrets during statewide aerial surveys (Rodgers et al. 2005, Conroy et al. 2008).

Status Review - In its review of the R~~r~~eddish ~~e~~Egret's status, the Biological Review Group made the following assumptions and conclusions:

- Generation time: Most birds breed at 3-4 years of age. Maximum known age of a recovered banded bird was 12 years but maximum longevity probably is about 25 years. Calculation of generation time is based on the mid-point of onset of breeding to maximum age at death: (25-4)=21/2=11 years; thus generation time is 11+4=15 years of age. Therefore, the time period for evaluation of change/trend analysis is 3x15=45 years or beginning of the period at 1965.
- Extent of Occurrence (EOO): The species most frequently occurs along coastal areas from Titusville south through~~to~~ the Keys and north to the Tampa Bay region ~~in Florida~~, an area of about 2,400 km^2 of mangrove/estuarine habitat. At most there is about double the 2,400 km^2 of shallow, open-waer foraging habitat, which is the limiting factor for the distribution of the species. Thus, the EOO is a maximum of about 5,600 km^2.
- Area of Occupancy (AOO): This is less than EOO as the species is not evenly distributed along the coasts and in Florida Bay; thus, habitat actually available, used, or suitable (e.g., large areas of coastline are either developed or not available due to human recreation) for foraging, etc., is probably <2,000 km^2.

Biological Status Review for the R~~r~~eddish e~~E~~gret—The review group concluded the R~~r~~eddish E~~e~~gret met the population size and trend criteria C1, C2 and population very small or restricted criteria D1, D2. See Table 1 for details.

Regional Application—The review group concluded there was no change in the recommendation for the reddish egret. See Table 2 for details.

LISTING RECOMMENDATION

Staff recommends that the R~~r~~eddish ~~e~~Egret be listed as a Threatened species because it met criteria for listing as described in 68A-27.001(3) F.A.C.

SUMMARY OF THE INDEPENDENT REVIEW

To be added later.

LITERATURE CITED

American Bird Conservancy. 2007. Top 20 Most Threatened Bird Habitats. ABC Special Report. Plains, Virginia. 48 pages.

Bates, E. M., R. W. DeYoung, and B. M. Ballard. 2009. Genetic diversity and population structure of reddish egrets along the Texas coast. Waterbirds 32: 430- 436.

Comment [WED6]: This reference apparently has no in text citation

Butcher, G. S., D. K. Niven, A. O. Panjabi, D. N. Pashley, and K. V. Rosenberg. 2007. Watchlist: the 2007 Watchlist for United States birds. Technical Report. American Birds 61: 18-25.

Conroy, M. J., J. T. Peterson, O. L. Bass, C. J. Fonnesbeck, J. E. Howell, C. T. Moore and J. P. Runge. 2008. Sources of variation in detection of wading birds from aerial surveys in the Florida Everglades. Auk 125: 731-743.

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Comment [WED7]: This references apparently has no in text citation

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Table 1. Biological status review information findings for the Rreddish eEgret in Florida.

Biological Status Review Information Findings				
	Species/taxon:	Reddish Egret		
	Date:	11/04/10		
	Assessors:	Rodgers, Ogden, Lorenz, Cook, Frederick		
	Generation length:	15 years		
Criterion/Listing Measure	**Data/Information**	**Data Type***	**Criterion Met?**	**References**
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	While the species experienced population decreases prior to 1965, there is no evidence of population decrease during the 1965-2010 period. Rather, the species exhibited a slow increase in numbers up to 2000s. Surveys indicate circa 300-400 pairs (600-800 individuals) in statewide population. Some indication of a relatively slow, steady decline in Keys and Florida Bay during the 2000s.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	See A1 above.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	No evidence species will decrease in the next 45 years unless major alteration in coastal/Florida habitat quality.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may	Tampa Bay and Indian River Lagoon populations stable but Keys/Florida Bay populations are slowly decreasing due to unknown reasons. Sea level rise probably will not cause significant decrease of foraging habitat (=limiting factor for distribution of species since nesting habitat is not limited) and mangroves might increase in area by moving inland.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.

Comment [WED8]: Paul 1991 is not in the Literature Cited

not be understood or may not be reversible.[1]				
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	About 5,600 km^2.	O	Y	See EOO on notes tab.
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	Probably <2,000 km^2.	O	Y	See AOO on notes tab.
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Numerous individual colonies (circa 50+) with small number of nests (mostly <25 nests) at each colony but there only appears to be 5 natural clusters (=locations) of colonies: Tampa Bay, Indian River Lagoon, North Florida Bay, Lower Keys, and a continuous area along the SW coast.	O	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	No evidence of any of these variables.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No evidence.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Current population is circa 300-400 pairs (600-800 individuals). However, 2007-08 surveys in Florida Bay found only about 56 nests, a decrease from the 1990s.	O	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.

(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR	Florida Bay population has decreased from the 1990s because of unknown reasons and an amount amount during the last 45 years. Based on total population of 600-800 individuals, a 10% decrease in the future would only be about a decrease of 60-80 individuals. It is reasonably likely this percent decrease could be met in Florida Bay alone.	E/I	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	A decline has occurred in Florida Bay.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
a. Population structure in the form of EITHER	Total population is only about 600-800 individuals.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	East coast, west coast, and Florida Bay birds considered as one population.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
b. Extreme fluctuations in number of mature individuals	No evidence.		N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	Total population is only about 600-800 individuals.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	See B2.a for identification of 5 clusters or locations.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	None completed to date.		N	

Comment [WED9]: what is amount amount? It is confusing.

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meet at least one criteria	C1, C2, D1, D2

Is species/taxon endemic to Florida? (Y/N)	No
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meets at least one criteria above	C1, C2, D1, D2

Letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010

Email from Neil Langenberg

Florida's Imperiled Species – Biological Status Review

Department of Environmental Protection
Coastal and Aquatic Managed Areas
Charlotte Harbor Aquatic Preserves
Punta Gorda, Florida 33955

October 14, 2010

Please find attached rookery monitoring data for the Biological Status Review regarding Florida's imperiled species requested by the Florida Fish and Wildlife Conservation Commission. Data was collected from rookery islands in 2008, 2009 and 2010 by staff from Charlotte Harbor Aquatic Preserves (CHAP) and J.N. "Ding" Darling National Wildlife Refuge (USFWS). The study area is located in southwest Florida, within Lee County, more specifically, the lower Charlotte Harbor area including Pine Island Sound Aquatic Preserve, Matlacha Pass Aquatic Preserve, and portions of J.N. Ding Darling NWR complex. Colonial bird nesting activities were documented by direct counts of active nests via boat during the breeding season. Counts reflect the maximum number or peak estimates of adults with nest by species. Data listed is only for the following imperiled species; Tricolored heron (TRHE), Little blue heron (LBHE), Snowy egret (SNEG), Reddish egret (REEG), White ibis (WHIB), and the Brown pelican (BRPE).

Neil Langenberg
Environmental Specialist
Florida Department of Environmental Protection
Charlotte Harbor Aquatic Preserves
12301 Burnt Store Rd
Punta Gorda, Fl 33955
941-575-5861x102

Table 1. Colonial nesting bird survey peak estimates for Pine Island Sound AP, Matlacha Pass AP and J.N "Ding" Darling NWR complex between February and August 2010.

COLONY (ISLAND)	Lat	Long	TRHE	LBHE	SNEG	REEG	WHIB	BRPE
Bodiford Key	26.4977	-82.1125	0	0	0	1	0	18
Broken Isl. N	26.6768	-82.1940	1	0	3	0	0	62
Fish Hut Island	26.5467	-82.1245	0	0	0	0	0	5
Givney Key	26.5144	-82.0552	2	0	1	0	14	1
Hemp Key	26.6004	-82.1525	8	1	2	1	0	72
Lower Bird Island	26.5125	-82.0330	0	0	2	0	0	37
N. of York Island	26.4945	-82.1043	2	0	2	0	0	8
N. E. of York Island	26.4939	-82.1021	2	0	0	0	0	0
NW of Mason Island	26.5545	-82.1252	0	0	0	0	0	2
N. W. of Pumpkin Key	26.5660	-82.1279	0	0	0	0	0	1
Skimmer Island	26.5101	-82.0250	7	0	33	2	0	72
SW of Mason Island	26.5534	-82.1249	0	0	0	0	0	1
S. W. of Pumpkin Key	26.5642	-82.1276	0	0	0	0	0	1
Tarpon Bay Keys	26.4573	-82.0745	5	0	9	0	0	34
Useppa Oyster Bar	26.6522	-82.2144	9	1	1	3	0	100
TOTAL			36	2	53	7	14	414

Table 2. Colonial nesting bird survey peak estimates for Pine Island Sound AP, Matlacha Pass AP and J.N "Ding" Darling NWR complex between March and July 2009.

COLONY (ISLAND)	Lat	Long	TRHE	LBHE	SNEG	REEG	WHIB	BRPE
Bodiford Key	26.4977	-82.1125	0	0	0	0	0	6
Broken Isl. E	26.6782	-82.1920	0	0	0	0	0	1
Broken Isl. N	26.6768	-82.1940	1	0	1	1	0	10
BrokenIsl. S	26.6741	-82.1944	2	0	1	0	0	60
Givney Key	26.5144	-82.0552	0	0	0	0	108	2
Hemp Key	26.6004	-82.1525	5	0	0	0	0	56
Lumpkin Island	26.6015	-82.0526	2	1	1	0	0	1
N. of York Island	26.4945	-82.1043	3	0	3	1	1	0
Skimmer Island	26.5101	-82.0250	0	1	0	1	0	44
Tarpon Bay Keys	26.4573	-82.0745	7	5	8	5	0	40
Useppa Oyster Bar	26.6522	-82.2144	1	0	0	0	0	0
TOTAL			21	7	14	8	109	220

Table 3. Colonial nesting bird survey peak estimates for Pine Island Sound AP, Matlacha Pass AP and J.N "Ding" Darling NWR complex between March and July 2008.

COLONY (ISLAND)	Lat	Long	TRHE	LBHE	SNEG	REEG	WHIB	BRPE
Broken Isl.E	26.6782	-82.192	0	0	0	1	0	30
Broken Isl. N	26.6768	-82.1940	1	1	2	0	4	16
Broken Isl. S	26.6741	-82.1944	0	2	1	2	0	92
Crescent Island	26.5978	-82.0637	0	0	0	0	0	7
Givney Key	26.5144	-82.0552	6	4	4	0	201	9
Hemp Key	26.6004	-82.1525	14	3	2	4	0	153
Lower Bird Island	26.5125	-82.0330	0	0	0	0	0	37
Lumpkin Island	26.6015	-82.0526	15	10	5	1	0	0
Skimmer Island	26.5101	-82.0250	2	1	2	0	0	35
Tarpon Bay Keys	26.4573	-82.0745	8	14	13	3	10	32
TOTAL			46	35	29	11	215	411

Email from Marilyn Knight

From: Marilyn_Knight@fws.gov
To: Imperiled; Rodgers, James
Cc: Dana_Hartley@fws.gov
Subject: Re_ Florida Threatened Species update -- conference call Nov. 2. FW: FWC News Release: FWC seeks
information on listed species
Date: Tuesday, November 02, 2010 3:39:34 PM
Attachments: Paul 1991 reddish egret status survey.pdf

As per the species request, I have been able to locate the following document that may be useful to your review for the reddish egret:

Marilyn L. Knight
Fish & Wildlife Biologist
Endangered Species Recovery
U.S. Fish & Wildlife Service
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960-3559

-ALL-

United States Department of the Interior
Fish and Wildlife Service
DIVISION OF ECOLOGICAL SERVICES
17629 EL CAMINO REAL, SUITE 211
HOUSTON, TEXAS 77058

NOV 1 1991

October 29, 1991

We are enclosing for your information and use a status survey on the reddish egret (Egretta rufescens) recently completed by Mr. Richard Paul of the National Audubon Society (Audubon) for the U.S. Fish and Wildlife Service (Service). We are very pleased with the thorough detail of the report, but would appreciate receiving any additional information you may have, or any comments you wish to provide on the status and management needs of the species. For additional copies of this report, please contact Kathy Nemec of my staff (713-750-1700 or FTS 526-6700) or Mr. Paul at Audubon (813-623-6826).

Paul's report identifies the need for data on the ecology and habitat requirements of the reddish egret. Through a cooperative agreement with the Service, Audubon will analyze present reddish egret populations on the central and upper Texas coast, determine reproductive success and post-fledging survival, and locate and map important foraging habitat areas. The study will be carried out during the next year, with plans for a final report out in March of 1993. Please let us know if you are interested in receiving the resulting information, or if you have any questions or recommendations regarding the focus and protocol of the study.

Mike Farmer of Audubon has recently completed a one-year study of the species' breeding and foraging habits in the Laguna Madre complex of Texas, an area which has long supported a large portion of the breeding reddish egret population of Texas. A report on the study, which was partially funded by the Service, is now being finalized. Contact the Lower Rio Grande National Wildlife Refuge (512-630-4636) if you wish to receive a copy.

Both Farmer's and Paul's reports identify the importance of large, barren, tidally-influenced sand and mud flats as foraging habitat for the reddish egret and certain other species. Yet these types of habitats have historically been considered to be of low quality and, therefore, expendable or available for conversion to some other use. We hope that information contained in these and in future reports will allow land managers and resource agencies to recognize their value and initiate measures that will support their future preservation and protection.

Sincerely,

Julie K. Massey
for David L. Hankla
Field Supervisor

Enclosure

STATUS REPORT

EGRETTA RUFESCENS (GMELIN)
Reddish Egret

Prepared for:

U. S. Fish & Wildlife Service Region II
Office of Fish and Wildlife Enhancement
Albuquerque, NM

and

U. S. Fish & Wildlife Service
Office of Ecological Services
17629 El Camino Real, Suite 211
Houston, TX 77058

Prepared by:

Richard T. Paul
Manager, Tampa Bay Sanctuaries
National Audubon Society
410 Ware Blvd., Suite 500
Tampa, FL 33619

OCTOBER 1991

This status survey of the Reddish Egret (Egretta rufescens) has been prepared by Mr. Richard T. Paul, Sanctuary Manager with the National Audubon Society, through contract with the U.S. Fish and Wildlife Service.

Literature Citations should read as follows:

Paul, R. T. 1991. Status report - Egretta rufescens (Gmelin) Reddish Egret. U.S. Fish and Wildlife Service, Houston, Texas. 73 pp.

Additional copies may be requested from:

Field Supervisor
Ecological Services
U.S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058

(713) 750-1700
FTS: 526-6700

STATUS REPORT
on the
REDDISH EGRET (Egretta rufescens)

INTRODUCTION

The Reddish Egret is a characteristic resident of the great coastal lagoon systems of North America, and similar areas in other parts of its range. One of just seven herons in the world exhibiting plumage dimorphism, it is also the most active forager of all 60+ heron species worldwide. Although now locally common, the Reddish Egret remains the rarest heron in North America, and may be the last of the "plume birds" to recover from the ravages of the plume trade a century ago. This egret's rarity, striking plumage, and remarkable feeding behavior make it one of the most unusual and sought-after species by North American birdwatchers, and its narrow habitat requirements and highly restricted distribution render it highly vulnerable to development of coastal systems within its range.

Despite considerable effort to survey and protect Reddish Egrets in the first half of the 1900's, little has been published about them. Allen (1954-55) and Palmer (1962) summarized much of the information then available. McMurry (1971) and Simersky (1971) investigated aspects of Reddish Egret breeding biology, including nesting success and diet.

From 1974 to 1980 R. T. Paul carried out studies on the population biology and general ecology of Reddish Egrets in Florida and Texas. Paul also performed an extensive literature search in order to summarize and update the known distribution of the species. Most of this work still awaits publication. In addition, Reddish Egret populations have been monitored annually along the entire coast of Texas by the Texas Colonial Waterbird Society. The present report is based largely on these studies.

In 1989 Mike Farmer, Manager of National Audubon's Green Island Sanctuary, initiated an effort to identify important foraging areas for Reddish Egrets in the lower Laguna Madre in south Texas. This effort has now been expanded throughout the state, to identify foraging areas used by adults from all colonies >50 pairs (R. Wahl, pers. comm.)

CLASSIFICATION AND NOMENCLATURE

A. Scientific Name: Egretta rufescens (Gmelin)

B. Common name: Reddish Egret

C. Family: Ardeidae

D. Order: Ciconiiformes

E. Original Description: Buffon (1783)

F. Type specimens:

E. r. rufescens - No type specimen. Type by description, Ardea rufa Boddaert = Ardea rufescens (Gmelin).

E. r. colorata - Collected at breeding colony on Culebra Key, Bahia de la Ascension, Quintana Roo, Mexico, January 23, 1926 by Ludlow Griscom (AMNH no. 254,564). (Griscom 1926)

E. r. dickeyi - "Breeding male, adult; no. 15,112, coll. Donald R. Dickey; San Luis Island, Gulf of California; April 13, 1925; collected by A. J. van Rosem [sic], no. 8229." (van Rossem 1926)

G. **Synonyms:** None in current use. Obsolete names include

Ardea rufa
Ardea pealii (pealei) - "Peale's Egret" (white morph)
Dichromanassa rufa
Dichromanassa rufescens

The most complete synonymy is found in Hellmayr and Conover (1948: 192-194). See also Taxon History, below.

H. **Taxon History:** The Reddish Egret was first described by Buffon (1783), apparently on the basis of a color plate executed by E. L. D'Aubenton about 1780 (D'Aubenton 1765-1780). Both D'Aubenton and Buffon used the name "L'Aigrette rousse" and noted that the species was from Louisiana. Boddaert (1783) was the first to assign the binomial name Ardea rufa. Unfortunately, the same name was used two years later to indicate the "Rufous Heron" of Austria (Latham 1785). [Hellmayr and Conover (1948) also noted the use of the name Ardea rufa by Scopoli (1769).] Perhaps to resolve this duplication, Gmelin (1789) applied the name A. rufescens to the present species, and the specific name still stands.

Baird placed the species within the genus Demiegretta (Baird, Cassin and Lawrence 1858), but the name failed to achieve wide use. Nor did the genus Herodias used by Gundlach (1856, 1862). Ridgway (1878) erected the monotypic genus Dichromanassa, the accepted classification until Bock (1956) proposed its submergence in Hydranassa. Payne and Risley (1976) and Payne (1979) proposed the further lumping of several North American herons in the genus Egretta, a decision since formalized by the American Ornithologists' Union (1983).

In 1824 C. L. Bonaparte sent the young artist-naturalist Titian R. Peale to Florida on a collecting expedition (Howell 1932). Among the birds obtained was a white egret described by Bonaparte as a new species, Ardea pealii (Bonaparte 1826). Audubon (1835) regarded "pealii" as the immature of rufescens, a conclusion rejected by Gambel (1848) who noted the existence of nuptial plumes on specimens of "pealii" and the absence of white young in breeding colonies in Charlotte Harbor, FL, where the only adults found were rufescens. Observation of mixed pairs and even mixed broods of "pealii" and rufescens in the 1870s and 1880s (Ridgway 1878; Sennett 1879; Cory 1880, Scott 1881, N. B. Moore *in* Baird, Brewer and Ridgway 1884) led to the submerging of "pealii" in rufescens (Ridgway 1878, Baird, Brewer and Ridgway 1884, A.O.U. 1886).

Two subspecies have been described. Citing minor differences in color and wing and tail length, A. J. van Rossem (1926) distinguished the form dickeyi from the Gulf of California, Mexico. In the same year Ludlow Griscom described colorata from the state of Quintana Roo, Mexico, on the basis of equally minor color and mensural differences (Griscom 1926). Dickeyi was claimed to be slightly darker than the nominate race, colorata slightly paler. Wing length of both was said to be slightly longer than rufescens.

The validity of both races has been questioned. (1) dickeyi: Griscom (1926) argued that a series of Lower California specimens he assembled were no darker, and were in addition smaller, than a series of Texas specimens (i.e., rufescens). Peters (1931) and subsequently the A. O. U. (1944) submerged dickeyi in rufescens. Following comparison to 12 Texas and Florida specimens of just two adults (from Sinaloa and Guatemala), Hellmayr and Conover (1948) resurrected the form and the A.O.U. (1955) followed suit. (2) colorata: Paynter (1955) found differences in plume and wing covert color, but not head and neck color, between "colorata" and "rufescens," in a small series of specimens. However, at the Cayo Culebra colony in 1949 - the type locality - he could not find an adult typical of colorata and speculated that the form was extinct, due perhaps to genetic swamping by immigrants of the nominate race. By contrast, several workers in the West Indies and northern South America have upheld the form (Bond 1956, Voous 1957, Phelps and Phelps 1958, Meyer de Schauensee and Phelps 1978, Buden 1987). Allen (1954-55), despite broad experience with the species, "disclaimed" any knowledge of the finer points of its taxonomy and cautioned that plumage color in this species was quite variable. Likewise, Blake (1977:179) warned that the races were "weakly differentiated" and that there was little agreement on their respective distributions. Perhaps the most authoritative recent opinion was that of Payne (1979), who upheld dickeyi but submerged colorata in the nominate form. Most recently, Binford (1989) referred Reddish Egrets breeding on the Pacific coast of Oaxaca and Chiapas to D. r. rufescens, suggesting contact between that population and birds of the Gulf Coast. Banding records confirm that some birds from Texas do cross to the Pacific coast, and strongly suggest that the crossover point is the Isthmus of Tehuantepec (R. T. Paul, unpublished data).

My field work has been limited to Texas and Florida, with occasional encounters of Reddish Egrets in the Bahamas and Mexico. This work was not intended to address taxonomic questions, but it did give me the opportunity to observe hundreds of individuals at all times of year in two populations. I have also examined over 200 museum specimens, including representatives of all three reputed subspecies. While a detailed comparison of specimens and field populations is not possible, I have some pertinent comments.

(1) The two surviving specimens of colorata (including the type) collected by Griscom are indeed paler than average, with the back and wings appearing almost "frosted." The shaggy plumes of the head and neck are pale cinnamon, almost golden, and the scapular plumes are long and unworn. I have seen the same frosted appearance in birds at Texas and Florida colonies, just at the time of courtship and pair formation. Despite some individual variation, I think these characteristics can be seen in all pairing adults. Griscom visited Cayo Culebra in January, early in the nesting cycle when the fresh alternate plumage would be expected (half the birds were building nests, while half were incubating eggs - Griscom 1926). Paynter (1955) found mostly large young during his April visit, by which time the plumage of adults should have been duller. Paynter, upon examination of Griscom's two adult specimens, attributed color differences on the head and neck to individual variation. He did acknowledge differences in the color of wings and wing coverts, those of "colorata" being more vinaceous, but argued that this was merely an accentuation of a widespread tendency. Paynter also suggested that "colorata" might have been described on the basis of a tiny isolated population, since swamped by immigration of "rufescens." I propose, rather, that "colorata" was described on the basis of plumage characteristics that indicate not a local form but the stage of the nesting cycle and the freshness of the feathers.

(2) I have not seen "dickeyi" in the field, but museum specimens from Baja California and the Sea of Cortez appear to be slightly darker than those from Texas and Florida. I therefore concur with Hellmayr and Conover (1948) and Payne (1979).

(3) I have measured 134 adult Reddish Egret specimens. Specimens from the West Indies do appear to be longer winged than those from other localities, but with small sample sizes the inherent variability of the data is high.

For now, the validity and distribution of the subspecies - particularly colorata - remain poorly understood. But I consider these questions secondary. The key issues include the status, size, isolation and vulnerability of local populations.

PRESENT LEGAL STATUS

A. International:		(Migratory Bird Treaties)
B. National:		
	USA	C2 (category 2 candidate species)
	Other	none known
C. States:		
	Florida	Species of Special Concern
	Louisiana	none known
	Texas	Threatened
	Other	none known

D. Other

Florida Committee on Rare and Endangered Plants and Animals: *rare* (Robertson 1978).

The Nature Conservancy: LA, FL: *S2, G4* (imperiled in state due to rarity or vulnerability; apparently secure globally, although may be rare in some parts of range)

Blue List (National Audubon Society): *Listed* 1972, in 1972, 1975-80; *Special Concern* 1981-82, 1986; "no longer of concern to respondents" but more information requested (Tate 1986).

[Also listed in USFWS report, "Nongame Migratory Bird Species with Unstable or Declining Population Trends in the United States." Reasons for listing: small population size, restricted habitat. Senner (1986)]

DESCRIPTION

A. Plumage and Morphology

Reddish Egrets are robust, medium-sized herons, standing about 30" (50 cm) tall with a wingspread exceeding 3.5 feet (1.2 m). As noted above they are also dimorphic.

(1) Adult, dark morph: Head and neck are chestnut (note: color names follow Palmer 1962), with shaggy lanceolate plumes on the crown, nape, neck and upper breast. On some individuals (especially early in the nesting season) the head plumes appear tawny or cinnamon, giving a "golden-maned" appearance. By the end of the breeding season the head and neck fade toward dark cinnamon. Following breeding, adults appear much less shaggy due to abrasion at the tips of the plumes. The body (back, wings, tail, abdomen) are dark neutral gray, with the abdomen slightly lighter. Lanceolate scapular plumes cover much of the back and are dark neutral gray with a blackish gray central stripe. Scapular plumes are dark neutral gray and extend well beyond the tail (up to 15 cm) when unworn; as the nesting season progresses these plumes abrade and therefore become shorter and paler, contrasting with the gray back. By the end of nesting, primaries, secondaries, and wing coverts may fade toward a flat brownish gray similar to the subadult. In some individuals, contour feathers or wing coverts may be edged in chestnut. The eye is straw yellow. During the nesting season the bill is sharply bicolor, with the basal 55% pink and the distal 45% black. Late in the cycle the pink fades, and the entire bill becomes quite dusky. This condition remains until the onset of the following nesting season. Lores are flesh color during breeding (turquoise blue during courtship and pair formation), but begin to darken before the young fledge. Adults have dusky or blackish lores when not breeding. The legs and feet are black, except during nesting when the sides and backs of the legs, and bottoms of the feet, are turquoise blue.

(2) Immature, dark morph: duller than adults. Medium gray or grayish brown, with feathers tipped with cinnamon. Recently fledged young can be quite variable; occasional individuals are quite gray or rufous throughout. Yearlings can be distinguished by the dark neutral gray feathers of the back (also upper wing coverts) and contrasting cinnamon marginal wing coverts, one or more short scapular plumes, and small tufts of short, cinnamon-colored occiputal and breast plumes. Soft parts are dull, with legs and feet blackish and the lores and bill blackish or dark "horn"; the bill may be slightly lighter at the base but never approaches the distinctly bicolor coloration of the breeding adult.

(3) White-morph birds have white plumage at all ages, with soft parts as described above.

(4) "Pied" plumages: Occasional "pied" birds occur. I have never seen this condition in any immature plumage, and never in white-morph individuals. A typical pied bird has one or more white primaries, secondaries, and/or rectrices, usually in a bilaterally symmetrical pattern. A fine edging of white feathers along the margin of the bill and lores may also occur. More rarely, pied adults display irregular patches of white contour feathers on the body or throat (e.g., Scott 1887, Todd and Worthington 1911; condition also seen in museum specimens).

B. Vocalizations

The Reddish Egret is normally silent, but may call in or near the colony, and on foraging grounds. There has been no detailed study of their calls (but see Meyerriecks 1960). The most common vocalization is a throaty "awwwwh" or "AWWH-uhh." A third variant is "awwh-UHHH." These calls may be heard on foraging grounds or, particularly in the latter case, when an adult is departing the colony following a nest relief. Bill-snaps are quite audible during agonistic interactions. Very soft "awwh" calls accompany nest relief ceremonies and probably some courtship activities. Nestlings emit an

insistent, raspy begging call that with practice is distinguishable from that of nestlings of other species.

C. Local Field Characters

Reddish Egrets can be confused with smaller dark [Tricolored Heron (E. tricolor) and Little Blue Heron (E. caerulea)], and white [Snowy Egret (E. thula) and immature Little Blue Heron] herons, especially at a distance. During the nesting season, the bicolor pink-and-black bill, pink or flesh lores, and blue legs are good distinguishing marks, as are the shaggy plumes of the neck and head. But these marks are less helpful during the nonbreeding season, and no help at all if the bird is an immature. The best field marks then are the generally larger, stockier size of the Reddish Egret, grayer than the Little Blue (and lacking the white belly of the Tricolor). The bill is also noticeably longer and heavier than in the other species. White-morph birds can be very difficult to identify, with overall size, plume development, and soft part colors the best clues. The larger Great Egret (Casmerodius albus) is also similar, but has a longer neck, no head or breast plumes, and in North America a predominantly yellow bill in all plumages. Regardless of other characteristics, observers should look for the characteristically - and spectacularly - erratic foraging behavior of the Reddish Egret.

DISTRIBUTION AND POPULATION STATUS

The Reddish Egret occurs primarily along coastlines of the Gulf of Mexico and Caribbean Sea, with additional populations in the Bahamas and along the Atlantic coast of Florida and the Pacific coast of Mexico (Figure 1).

In the United States, breeding populations occur in Florida (both coasts), Texas, Louisiana and, recently, Alabama. The species is now a regular, if rare, nonbreeding visitor to Georgia, the Carolinas, Mississippi, and southern California. Farther north, and inland, the Reddish Egret is of accidental or casual occurrence.

For clarity, much of the detailed information on historic occurrence, distribution and population status has been assembled in chronological tables, as noted below. While some commentary is here provided to explain certain points as needed, the tables should be considered the primary statements about distribution and numbers in this report. Emphasis is placed on breeding populations, and not on vagrant or other nonbreeding reports except as they have population implications.

A. United States

(1) Florida: See summary in Table 1.

(a) Historic:

Before the ravages of plume hunting, Reddish Egrets were considered common breeders in Florida Bay (Audubon 1843, Maynard 1881), and abundant in Charlotte Harbor (Gambel 1848), Clearwater Harbor and Tampa Bay (Scott 1887). They were also found breeding at Pelican Island on the Atlantic coast (Bryant 1859) but probably disappeared there soon after, since subsequent observers failed to mention them. The species may also have bred at Merritt Island where, in 1872, despite failing to find a colony, Maynard (1881) considered the white morph common.

Scott (1887) vividly described the impact of plume hunting on the Florida Gulf coast, based on colony visits in 1880 and 1886 which offered "before" and "after" views of the population (see also Pierce 1962). Over the next 20 years, the Reddish Egret declined rapidly. For the decade after 1900 I have found reports of just three scattered sightings, all in Florida Bay (Bent 1904, 1926 [see also Job 1905]; Chapman 1908; Broadhead 1910).

Thereafter Reddish Egrets virtually disappeared from Florida (and some thought they did: Pearson 1918, Griscom *in* Allen 1939b; but see Allen 1954-55 for a contrasting view). Over the next 25 years there were three questionable reports of freshwater nesting (Baynard 1913, Howell 1932) and a few records of nonbreeding birds (Fargo 1926, 1928; Bent and Copeland 1927; Howell 1932). The first confirmed nesting record of the century did not occur until 1938 when a single nest was found in Florida Bay (Desmond 1939).

(b) Current:

Since 1938 Reddish Egrets have slowly increased in Florida, with the largest population in Florida Bay. Other populations have been established in the Lower Florida Keys (Greene 1946, Paul, unpubl. data) and, since 1970, on both coasts of Florida north to Tampa Bay and Merritt Island National Wildlife Refuge (Bancroft 1971; Paul et al. 1975, 1979). While numbers are smaller than a century ago, the species appears to have reoccupied its entire historic range in Florida. Currently I estimate the Florida breeding population to be 350-400 pairs, with at least 2/3 of the total still in Florida Bay and the Keys (see review of Florida Bay population history in Powell et al. 1989). Of the remaining 120 pairs, about 80 occur on the Gulf Coast (60 in the Tampa Bay system alone) and 40 on the Atlantic Coast.

(2) Louisiana and Alabama: See Table 2. Almost no information exists about the historical distribution of Reddish Egrets in Louisiana. Following the original description and listings of the species (Buffon 1783, Boddaert 1783, Gmelin 1789), four clutches of eggs collected by E. A. McIlhenny appear to be the first evidence of nesting in the state. McIlhenny's records may have been the basis for Beyer's claim that the species was a common breeder along the coast (Beyer 1900; Beyer, Allison and Kopman 1908). In a 1907 coastal colony survey, however, Kopman (1907) found none. Nevertheless, Bent (1926) listed Timbalier Island as a nesting site. Lowery (1955), apparently rejecting Beyer's and Bent's reports, stated that there were no nesting records for the state. Nesting was confirmed in 1958 at North Island (Lowery 1960). Aerial surveys by the National Audubon Society in the 1960s and early 1970s found nesting in Barataria and Timbalier Bays (Sprunt 1965, 1972). In an intensive aerial/ground survey in 1976, Portnoy (1977, 1978) estimated 151 pairs in nine colonies, from Raccoon Point (Terrebonne Parish) on the west to North Island (St. Bernard Parish) on the east.

More recently, Keller et al. (1984) recorded Reddish Egrets at five heronries by aerial survey, but did not estimate breeding numbers. Martin and Lester (1990), using both aerial and ground methods, found 38 breeding adults at eight colonies. They concluded that the population had declined at least 50% since Portnoy's survey.

In Alabama, Reddish Egrets are known to breed at one site, Cat Island (Table 2). They are not known to have nested there prior to 1979. Cat Island is less than 30 miles (50 km) from North Island but 440 miles (700 km) from the nearest Florida colony, so the Alabama birds are very likely to have come from the Louisiana population.

Banding data and sightings of color-marked birds confirm Lowery's (1974) deduction that the Louisiana-Alabama population derives from the Texas population.

(3) Texas: See summary in Table 3, also breeding population survey data in Tables 4-6.

(a) Historic:

Earliest reports noted Reddish Egrets from Galveston Bay and the Rio Grande. Audubon (1843) termed them abundant in Galveston Bay, but Dresser (1866) and Nehrling (1882) omitted them from their lists of birds of the area. Heermann (in Dresser 1866) considered them "not uncommon" near San Antonio, presumably a vague reference to coastal habitats. Baird, Cassin and Lawrence (1858) noted a specimen collected at the mouth of the Rio Grande, without further details. Fortunately, Sennett (1878, 1879) reported them common near Corpus Christi at colonies in Nueces Bay and the Laguna Madre, an impression echoed by Benners (1887) and Beckham (1888).

As in Florida, plume hunting decimated heron populations in Texas. However, we have no direct references to the impact on Reddish Egret numbers. More general comments indicate that herons and egrets were broadly affected in the Corpus Christi area (Chapman 1891, Rhoads 1892, Singley 1893, J. J. Carroll 1900). Some authors probably attempted to protect breeding sites known to them by being brief and vague; Singley and Carroll tersely acknowledged that Reddish Egrets occurred locally, with Singley polishing them off in 18 words and Carroll in six!

In 1918, T. G. Pearson found an estimated 1250 nesting pairs in the heronry at Second Chain of Islands (Pearson 1918). He followed this two years later with the discovery of the great colony at Green Island in the lower Laguna Madre (5,000-10,000 birds of five species, with the Reddish Egret the most abundant) and eight pairs at the South Bird Island colony in the northern Laguna (Pearson 1920, 1921). With these discoveries the species seemed to be making a strong comeback.

Pearson, however, overlooked (or rejected?) a vague report in an obscure journal. J. M. Carroll (1909) described in the Oologist his trip to an unnamed bird colony and listed 13 nesting species including the Reddish Egret. From that list, and the few details provided about the island, I believe that the locality was South Bird Island. This obscure reference, and the very large numbers of Reddish Egrets found by Pearson at Second Chain and Green Island, lead me to suspect that the species continued to nest in these remote parts of the Texas coast during the time that Pearson thought them extirpated. Closer to Corpus Christi, herons in areas like Nueces Bay might very well have been exploited - with resulting commentary by critics like those noted above.

Pearson's 1918 and 1920 boat trips were the first colony surveys of the Texas coast, but he did not cover the entire coast. In 1923 A. C. Bent nearly did, visiting heronries from Galveston Bay to the Laguna Madre (Bent 1924, 1926). It is not known whether he visited all sites with nesting Reddish Egrets (several other colonies were known 15 years later), but his data, and that of the Green Island warden R. D. Camp, form the basis for the earliest statewide estimate of Reddish Egrets: about 2700 nesting pairs (see Table 4). Of these, 97% occurred at Green Island and Second Chain, the two colonies found by Pearson, with nearly 80% at Green island alone.

(b) Current:

Periodic National Audubon Society surveys of Texas coast colonies began in 1934 and continued until the 1970s (Ogden 1978; see also Tables 4, 5). Since then, annual surveys have been conducted by the Texas Colonial Waterbird Society and Texas Parks and Wildlife Department (Tables 6a-d). As a result the breeding distribution of Reddish Egrets in Texas is very well known.

The most comprehensive of the 1930s surveys, in 1939, revealed a total of 3206 pairs. [This estimate has become the standard against which all subsequent assessments of population status have been based.] Two-thirds of the egrets occurred at a single site, Green Island, with a second population center in the Coastal Bend. Breeding Reddish Egrets were scarce north of San Antonio Bay. Subsequent surveys in 1950 and 1959 indicated that the population was declining. In 1959 the estimate of 1623 pairs indicated a 50% decline in 20 years.

The population crashed between 1959 and 1965, when just 552 pairs were found in a thorough aerial-and-ground survey (Sprunt 1965; pers. comm.). Just 15 pairs were found at Green Island. From South Bird Island north, however, the population had increased, either by immigration or local recruitment. This suggested a localized problem at Green Island, where in fact the entire colony had collapsed - from 5462 pairs in 1959 to 35 in 1965.

The cause of the crash is unknown. The pattern suggests severe disturbance by terrestrial predators, humans or other sources. However, reports by Audubon Warden John Larson Jr., an experienced observer, did not mention mammalian predators, and A. Sprunt IV (pers. comm.) asserts that no sign of raccoons was found during his inspection of the colony in 1965. A second possibility is that heavy use of DDT and other pesticides in the Rio Grande valley resulted in high ecosystem residues, with impacts on the prey base or even directly on wading bird reproduction (see **Pesticides**, p. 22).

In any case, the Green Island colony recovered after 1965. In 1972 the colony totalled about 4000 breeding pairs, including 524 pairs of Reddish Egrets (W. F. Fluman, pers. comm). Statewide, approximately 1200 pairs were recorded.

From 1974 through 1990, Reddish Egrets annually have been censused by the Texas Colonial Waterbird Society and cooperators (Table 6a-d). Estimated numbers have fluctuated between about 1000 and 2100 pairs ($\bar{X} \pm sd = 1437 \pm 301$). From 1974 through 1985, 1200-2200 pairs were recorded, with the peak occurring in 1979 when unusually high numbers were reported from Dressing Point and Sundown Island. The significance of this anomalous peak is not clear, but the observer was experienced and there is no reason to otherwise question the data for that year: apparently, 2100 pairs is a valid estimate. However, in most years about 1400-1700 pairs were recorded, until 1986 when just 1103 pairs were estimated.

Did the population really decline by 300-500 pairs? Estimates from subsequent years, while suggesting it, are highly variable and offer no clear conclusion. In my opinion, some inherent biases in survey methodology (see Appendix 2) make it likely that lower estimates may underestimate the breeding populations in most years. In addition, the recent estimates reflect another population crash at Green Island. In 1984, raccoons reached the colony and over the next two years caused nearly complete abandonment of the site. Reddish Egrets bottomed out at 4 pairs in 1987 (and did not exceed 20 pairs from 1986 to 1989). While many egrets moved to nearby islands, it is

possible that others escaped detection, nested in Mexico's Laguna Tamaulipas, or simply did not breed.

The most recent (1990) population estimate is again 1500 pairs. Green Island numbers are now recovering, with about 500 pairs in 1991 (M. Farmer, pers. comm.). These two developments offer grounds for cautious hope that any decline, if real, is now being reversed.

B. Mexico (Table 7)

Reddish Egrets are widely distributed in Mexico, but little of the coast has been systematically explored for colonial waterbirds. Few of the existing reports include estimates of breeding numbers. Further, in tropical and subtropical climates the nesting season may be very long, adding to the difficulties of finding breeding birds and accurately estimating local numbers. The account in Table 7 pieces together records from 150 years to suggest breeding distribution and a very rough estimate of breeding numbers, based primarily on aerial surveys. Comprehensive ground surveys are urgently needed.

C. Bahamas and West Indies (Table 8)

(1) Bahamas, Turks & Caicos - Reddish Egrets are widely distributed in the Bahamas, with occurrence reported from all of the major islands including Grand Bahama, Abaco, New Providence, Andros, Eleuthera, the Exumas, Cat Island, Long Island, Crooked Island, Acklins, San Salvador, Samana Cay, Plana Keys, Mayaguana, Inagua (Cory 1880; Northrop 1891; Ridgway 1891; Bonhote 1899, 1903; Allen 1905; Riley 1905; Chapman 1908; Todd and Worthington 1911; Allen 1954-55; Bond 1947, 1966, 1980; Radabaugh 1973; Buden 1987a,b), and several of the smaller ones (Little San Salvador, Conception Island, Rum Cay, Mira Por Vos Keys) (A. Sprunt IV, pers. comm. 1987; Buden 1990). The species has also been recorded at Turks and Caicos Islands, politically but not geographically distinct from the Bahamas (Cory 1891, Buden 1987a). It is resident and probably breeds throughout the Bahamas (confirmed on Abaco or Grand Bahama, Andros, Acklins, and Inagua, surely overlooked elsewhere). The species is probably uncommon overall, but locally common on Great Inagua and perhaps Andros (see Table 8).

(2). Greater and Lesser Antilles - Reddish Egrets are fairly widely distributed on the coasts of Cuba, but are only locally common (Garrido and Garcia Montaña 1975). Despite considerable coastal work by Garrido and cooperators, apparently little attention has been directed to wading bird populations and I know of no population estimates. On Hispaniola, Reddish Egrets are local in coastal lagoons and also in the hypersaline lakes that bisect the island. They are uncommon visitors to Jamaica (where breeding has possibly been overlooked), and rare vagrants in Puerto Rico, the Virgin Islands, and the Cayman Islands. They are accidental in the Lesser Antilles, with just two records known (Table 8).

D. Central and South America (Table 9)

(1) Belize: Reddish Egrets were not known to occur in Belize before 1957 (Russell 1964). Three birds found during an aerial wading bird survey on May 4, 1971 (A. Sprunt IV and C. E. Knoder, pers. comm.) suggested that nesting might be expected, a prediction not confirmed until the early 1980s when D. Weyer found about

15 pairs on small cays in Shipstern Lagoon (Scott and Carbonell 1986). In March 1990 at the same locality, A. Poole (pers. comm.) found about 100 pairs at four sites.

(2) Guatemala to Panama: Fewer than 20 records are known for all six countries combined. Nesting is not thought to occur, but the countries are poorly explored. The best places to look for nesting may be the coastal lagoons of the Caribbean coast of Honduras, the Pacific coast of Guatemala southeast to the Golfo de Fonseca, and wherever solar salt works occur.

(3) Colombia: Recorded in Colombia only since 1963, Reddish Egrets may be locally common along the Guajira Peninsula. However, the area is poorly explored. In June 1974 Sprunt (1976) found 104 birds at Manaure including young capable only of labored flight, a very strong indication of local breeding.

(4) Venezuela: Although Baird, Brewer and Ridgway (1884) vaguely noted Reddish Egrets occurring south to "northern South America," the first specific record in Venezuela known to me is in 1896 (see Table 9). Since then they have been found to occur rather widely along the coast and on the extralimital islands of the southern Caribbean Sea. No information is available on historic population trends. Early reviews suggested, probably incorrectly, that Reddish Egrets in Venezuela were nonbreeding ("wintering") visitors from more northerly breeding areas (e.g., Meyer de Schauensee 1966). In view of (a) the wide distribution of the species along the coast of Venezuela, (b) the "winter" nesting season typical of south Florida, the Bahamas, and Quintana Roo, and (c) the timing of recent nesting records from Colombia and Bonaire (see elsewhere in this report), I believe that nesting was simply long overlooked.

(5) Aruba, Bonaire, Curaçao: First recorded in 1930, Reddish Egrets were considered non-breeding visitors here (Voous 1965) until Spaans (1974) found a nest on Bonaire. Now considered a regular breeder on Bonaire but a scarce nonbreeder on Aruba and Curaçao (Voous 1983).

HABITAT

A. Breeding Habitat: Reddish Egrets nest in a variety of circumstances, from large mixed colonies to small colonies. Occasionally, solitary pairs are found. So far as I am aware they invariably choose islands, presumably to avoid terrestrial predators. They use mangrove keys in Florida, the Bahamas, West Indies, many sites in Mexico, and also in Colombia and Bonaire, normally nesting under the canopy and often over water (Allen, in Palmer 1962; Paul, pers. obs.). Some keys may be quite small, no larger than a single tree (esp. Rhizophora) and 2 m in diameter (in such sites pairs are solitary). Reddish Egrets nesting on natural islands in Texas usually nest in low shrubs or trees (e.g., Green Island, North Deer Island), but they may also choose sites on dry ground, in cactus (Opuntia sp.), or other very low vegetation. Bancroft (1927) reported Reddish Egret nests placed four feet off the ground in a dense growth of Salicornia sp. in Baja California.

Reddish Egrets also nest on manmade dredge spoil islands, notably in Florida and Texas. In Florida they favor mangroves or Brazilian pepper (Schinus terebinthefolius). In Texas, most spoil islands are sparsely vegetated and Reddish Egrets, like other herons in these colonies, nest on the ground, typically in low vegetation (e.g. Borrichia, Sesuvium, occasionally Spartina, sometimes among Solidago, Baccharis, etc.). Occasionally, they place their nests atop bare sand or shell beach ridges.

Prior to World War II, nesting in Texas was confined to fewer than 10 natural islands and a couple of spoil islands. Following the war, dredging of the Intracoastal Waterway and side channels for oil and gas exploration resulted in the creation of hundreds of small spoil islands. Some of these island chains allowed terrestrial predators greater access to colony sites, while others provided new nesting localities. Between 1974 and 1990, Reddish Egrets were recorded from nearly 80 coastal islands and three inland sites (see below).

There are just three reports of nesting on "mainland" sites. In the Matagorda Bay system Bent (1926) recorded Reddish Egrets at three colonies, one described as a "little motte of thorny trees and small bushes" and the others as dense tangles of mesquite-huisache woodland. Although technically not islands, these "habitat islands" were adjacent to coastal bays and clearly should be considered coastal sites. The inland reports are more controversial. (1) In 1987, 25 pairs were estimated by aerial survey at Willow Slough, Jefferson Co., in a colony of over 10,000 pairs of birds (Table 6c). (2) In 1988, five pairs were reported from the Lake Kemp #2 colony, in Baylor Co. (3) Also in 1988, 20 pairs were estimated by aerial survey at the Moyle colony, Brazoria Co. *There is no prior record of nesting in a freshwater locality in Texas* (and no fully satisfactory freshwater record anywhere else - see Florida section). These and any subsequent inland nesting reports cannot be accepted unless unequivocal supporting documentation is available.

If there is a generalization to be made, it is probably that Reddish Egrets do not have extremely narrow nest site requirements. A degree of isolation is paramount, but once a suitable island or key is found, egrets will use whatever sites (and nest materials) are available. Sites in trees or bushes -- i.e., off the ground -- probably have some characteristics that are preferred: shade, reduced chance of flooding or infestation by argasid ticks (King et al. 1977; Paul, unpubl. data) and fire ants, and reduced vulnerability to terrestrial predators if they do reach the colony.

B. Foraging Habitat: Reddish Egrets feed on barren sand or mud flats, typically in water less than 6" (15 cm) deep. In such areas, temperatures and salinities fluctuate dramatically according to seasonal and daily conditions. During prolonged drought or summertime heat, such flats frequently become hypersaline. These stressful conditions limit plant growth (Adams 1963, Hoese 1967, Phleger 1971, McMillan 1974, Woodhouse and Knutson 1982). Therefore, though a flat may be dotted with mangroves or Spartina, broad expanses of unvegetated substrate remain. In some areas an algal mat is present.

Reddish Egrets are often common in hypersaline areas. Particular examples include the Snake Bight region of Florida Bay (J. C. Ogden, pers. comm; Paul unpubl. data), Great Inagua (Allen 1954-55; Paul, pers. obs.), the Laguna Madre (D. R. Blankinship, pers. comm.; A. Sprunt IV, pers. comm.; Paul, pers. obs.; M. Farmer, unpubl. data), and the Laguna Tamaulipas (Paul, pers. obs.). One typical human use of such areas is the solar salt works, which occur at several localities where Reddish Egrets have been found - including in the Bahamas, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, and Bonaire. The existence of solar salt works in poorly studied areas should be considered an important clue in future searches for the Reddish Egret.

Conditions producing broad, barren, shallow flats are most often found along coastal lagoon systems where annual rainfall is low and evaporation rates are high.

Examples include the wind tidal flats of Laguna Tamaulipas in Mexico and the coastal bays of Texas, and the marl-mangrove banks of Florida Bay. (In fact, these conditions largely define the range of the species.) Along some of the barrier islands of these systems, as on Matagorda, San Jose, Mustang and Padre Islands in Texas, and islands of the southwestern Gulf coast of Florida, hurricanes often temporarily breach the sand barrier and produce overwash deltas. Aerial and ground surveys indicate that foraging Reddish Egrets commonly occur there (Paul, unpubl. data). "Cat's-eye ponds," which reside in the low swales between successive beach ridges at natural passes, are also used: north of their breeding range in Florida they frequently attract postbreeding wanderers (Paul, pers. obs.). In Florida Bay and the Bahamas, flooded salt barrens formed inside small mangrove keys are important. Tidal or "high-marsh" salt barrens, which form landward of the mangrove zone in Florida, have been underappreciated for their importance both to small fish during flood tides, and to wading birds like the Reddish Egret. On the Florida Atlantic coast, saltwater impoundments constructed for mosquito control produce habitats used by Reddish Egrets (although the habitats lost to this activity might also have been suitable). In Central America, river mouths partially blocked by a sand bar, thus producing small coastal lagoon systems (see Siles and Skutch 1989, fig. 2), appear to offer suitable habitat and should be checked.

Reddish Egrets occasionally use other habitats, including Gulf-front beaches and, in freshwater areas, sparsely vegetated sawgrass or Eleocharis marshes (Everglades National Park) or the margins of lakes or reservoirs. In Texas and Mexico, Reddish Egrets have been found inland at reservoirs and in most cases probably ascended rivers. Overall, very few Reddish Egrets egrets venture inland, and most that do are immatures.

The highly coastal nature of this bird is worth stressing. *The Reddish Egret is virtually an obligate feeder on broad, saline flats and bars.* Other factors must be considered, but in my opinion it is the continuing presence, health and long-term protection of these foraging areas that is the primary key to the future of the Reddish Egret.

POPULATION BIOLOGY

A. Reproductive Biology

1. Nesting season: In Texas, in most years, colonies typically form in March, with peak egglaying occurring during about March 15-April 10. Some nest starts occur later; McMurry (1971) reported egglaying occurring during May 8-June 17 in 1970 and May 23-June 17). Egglaying in renesting efforts may occur as late as July 15 (McMurry 1971).

In Florida Bay, nesting occurs virtually year-round but there are two strong "pulses." A few colonies in northeastern Florida Bay form in November, apparently in response to seasonally abundant food supply. Elsewhere in the bay, most nesting begins in February or March. Nests in the Lower Keys also appear to follow a primarily winter-spring schedule. Along the Atlantic and Gulf coasts of Florida, nesting begins in late February-April with late nests in May.

Indications of nesting schedule in other regions are detailed in Tables 7-9, and summarized below.

Bahamas: primarily winter or early spring (Todd and Worthington 1911, Buden 1987), but sporadic nesting even in summer (D. R. Blankinship, pers. comm.).

Cuba: no recent information but surely winter-early spring season predominates; colony found in September-October (Gundlach 1866).

Mexico: nesting variable, appears to be spring-summer on Pacific coast and irregularly earlier on Gulf and Caribbean coasts. Mar Muerto (Oaxaca-Chiapas), breeds March-April (Alvarez del Toro 1964) but large colony also active in July (Knoder et al. 1980); Baja Calif. and Sinaloa, June-July (Bancroft 1927, Knoder et al. 1980); Laguna Tamaulipas and L. Tamiahua, adults in colonies in April-June (Chapman 1914, A. Sprunt IV and C. E. Knoder, pers. comm.); Yucatan Penin., January-April (Griscom 1926, Paynter 1955), also July (A. Sprunt IV, pers. comm).

Bonaire: nests found December-February, May, August, September (Voous 1983).

Colombia: early spring season most likely, as Sprunt (1976) found newly fledged young in late June.

2. Clutch size: (a) Texas: Bent (1926) reported 3-4 eggs as the normal clutch, with a maximum of 7. McMurry (1971) found a mean clutch size of 3.12 ±.57 eggs (n=57) in 1970. Chaney et al. (1978) reported a mean clutch size of 3.54 eggs (n=28) from five scattered colonies. In samples of 27-144 nests at five colonies in 1975-77, Paul (unpubl. data) found clutch sizes ranging from 3.19 ±.60 to 2.63 ±.48. (b) Florida Bay: Clutch size was smaller than in Texas. At seven small colonies during 1978-80, mean clutch size varied from 2.33 to 3.00 with an overall mean of 2.75 (n=81) (Paul, unpubl. data)

3. Incubation: Bent (1926) estimated the incubation period to be 3-4 weeks. McMurry (1971), able to visit nests only weekly, estimated incubation to last 29-30 days (range 21-36). Paul (unpubl. data), using data only from nests where the laying and hatching dates of the last egg were known, estimated incubation to be 26 days. Both sexes incubate.

4. Nestling period: The "brood,", or "guard," stage, lasts until the young are about three weeks old. During this time at least one adult is in continuous attendance at the nest. Young leave the nest at 4-5 weeks, remaining in the branches (tree nests) or on the ground (ground nests) close by and returning to the nest to be fed. Young are capable of first flight at the age of 6 1/2 weeks, but continue to be fed by the parents for another 2-3 weeks (Paul, unpubl. data).

5. Nesting success:

(a) hatching success: Chaney et al. (1978) found 76% of all eggs surviving to hatching (=hatching success). In first nesting efforts, hatching success at 4 Texas colonies varied between 68.8% and 85.2%, while in a renesting effort hatching success was only 50.0% (Paul, unpubl. data). In Florida, hatching success at 4 colonies combined was 86.1%; at a 5th colony hatching success of 18.2% was attributed to Bald Eagle predation (Paul, unpubl. data). McMurry (1971) recorded first-nest hatching success of 47.6% in 1970 and just 33.3% in 1971. In my opinion these lower values were due to investigator disturbance, since two other studies were conducted concurrently on the same islands: prolonged impact on nesting birds seems unavoidable.

(b) fledging success: McMurry (1971) followed survival to fledging in 1970; 76.7% of hatched young survived to fledge. In Paul's Texas colonies, survival to fledging (7 weeks) varied from 75.0% to a low of 36.8%. The latter colony was disturbed by humans during the nestling stage, with significant mortality resulting. Fledging success at Florida Bay colonies was equally variable, by lower, with 62.5% the best figure and 4.2% the lowest. The latter was the result of a localized food shortage which caused extensive nestling starvation. Overall fledging success was just 36.2%. [The poorest fledging success, and the highest, were recorded at the same colony in successive years. Therefore these data reflect some of the conditions that affect nesting success in some years.]

(c) young per active nest: The most important indicator of nesting success is the number of young fledged per nesting attempt. In Texas, McMurry (1971) found 0.43 young/attempt fledged in 1970. Paul (unpubl. data) found 1.22 to 1.55 young/attempt in Texas, except for a disturbed colony where only 0.50 young/attempt survived. In Florida, Paul found extreme variation among nine colonies, with optimal conditions producing 1.82 young/attempt, and predation and food scarcity resulting in productivity as low as .09 young/attempt. Overall production averaged just 0.58 young/attempt. Reproductive rates appear to be generally lower than for most herons.

6. Age at first breeding: Color-banding studies in Texas clearly show that yearling (2nd year) Reddish Egrets rarely visit colonies, and do not breed. A few egrets breed in their 3rd year, but most apparently delay nesting until their 4th year of life (Paul, unpubl. data). Most other North American herons are believed to begin full nesting efforts by their 2nd or 3rd year (e.g. Rodgers 1978).

7. Adult survival: Annual survivorship is unknown. Valid estimates require saturation observation of marked birds in colonies for a period of years, a difficult, potentially disruptive, and expensive task especially with herons. Banding records indicate the maximum known age of a Reddish Egret to be 11 years, 3 months (Kennard 1975). Other herons are known to live as long as 22 years (Kennard 1975); further study might reveal similar longevity in Reddish Egrets.

8. Nest site fidelity: Very limited data during 1975-78 in Texas indicated that most color-marked egrets found breeding were in natal colonies. However, a 4-year study is not long enough if most birds only begin to breed as 3-year-olds. Site fidelity may be higher during periods of relative colony stability, but it should drop sharply when breeding distribution shifts - as happened in 1979 at the study colonies (Paul, unpubl. data).

B. Food habits

1. Diet: Reddish Egrets eat small fish and occasionally shrimp (Peneus sp.) or other items. Schorger (*in* Palmer 1962) listed needlefish in Florida Bay and, in Bonaire, the killifish Cyprinodon dearborni as diet items. More recently McMurry (1971) found the sheepshead minnow (C. variegatus), longnose killifish (Fundulus similis), pinfish (Lagodon rhomboides), striped mullet (Mugil cephalus), and ladyfish (Elops saurus) among 96 fish in regurgitated samples taken at a south Texas colony. The sheepshead minnow comprised 83% of the total, and the two killifish together 93%.

I analyzed regurgitated pellets collected from nestlings in Texas and Florida. Over 1500 items were obtained from Texas samples, and 5100 from Florida samples.

In Texas, fish constituted 96.7% of the diet, with shrimp and one crab the remainder. Seventeen species of fish were identified, with just six totalling over 92% of all items: sheepshead minnow (69.6%), striped and white (M. curema) mullet (10.6%), pinfish (5.4%), longnose killifish (4.3%), and tidewater silverside (Menidia beryllina) (3.3%) the most important species. In all, cyprinodontid killifish comprised 74.8% of the total.

In Florida Bay a more diverse prey base was found, with 32 species of fish, one crustacean and two insects identified. Killifish were again the dominant family represented, totalling 77.9% of all prey items identified. The sheepshead minnow totalled just over half (53.6%) Next most important were sailfin mollies (Poecilia latipinna) (13.5%), goldspotted killifish (Floridichthys carpio) (10.6%), and marsh killifish (Fundulus confluentus) (8.3%). Diet varied with season and foraging location, but those differences need not be described here.

Reddish Egrets eat small fish. Eight-five percent of intact individuals in Texas samples were less than 40 mm in length. Mean body mass of all Texas diet items was 1.3 grams, while in the Florida Bay sample mean body mass was 1.1 g. Sheepshead minnows were even smaller: 0.74 g in Texas, and 0.59 g in Florida Bay (Paul, unpubl. data).

Clearly, cyprinodontid killifish are an extremely important component of the Reddish Egret's diet in Texas and Florida, with the sheepshead minnow the single most important prey species. Gunter (1945) and Simpson and Gunter (1956) found it to be the most abundant cyprinodontid on the Texas coast. The genus Cyprinodon is renowned for its ability to tolerate fluctuating, or extreme, conditions of temperature and salinity (Strawn and Dunn 1967, Kristensen 1970, Bayly 1972). The sheepshead minnow frequently occurs in hypersaline conditions, and has been found at salinities exceeding 100 ppt (Simpson and Gunter 1956, Paul pers. obs.). I have also found it in shallow pools where midday water temperatures exceeded 45°C (113°F). The genus may be widely distributed in the range of the Reddish Egret; Paul (unpubl. data) has observed Reddish Egrets foraging on schools of Cyprinodon sp. in the Bahamas and, as previously noted, C. dearborni is a known prey item on Bonaire.

2. Behavior: Reddish Egrets pursue small schools of fish across barren shallow flats, typically running in short zigzag bursts punctuated by short pauses. Frequently they run with wings open, gliding short distances or even flapping as they abruptly maneuver after the fish. Only rarely do they use the slow Stand and Wait, and Wade/Walk Slowly techniques of most herons (Kushlan 1978, Rodgers 1983). Other North American herons employ active techniques, but none so often or so spectacularly as the Reddish Egret.

3. Foraging flocks: In foraging habitats, Reddish Egrets may occur in loose association with other long-legged wading birds, or alone. Their wide-ranging search technique often ensures that they forage by themselves, quickly passing by more sedentary birds of other species. An exception occurs when seasonal drydown conditions trap small fish in pools at very high density. At such times 200 or more individuals of a dozen or more species congregate to exploit this temporary condition; foraging Reddish Egrets then remain much closer to the group.

In some cases, typically late in or following the nesting season, large groups of Reddish Egrets occur on foraging flats. These *very tightly compressed flocks* are remarkable, and little is known about them. Several observers have reported them, only from Texas (Allen 1954-55; Bolen and Cottam 1975; H. C. Oberholser, unpubl. notes in Bureau of Biol. Survey files; G. Unland, pers. comm.; M. Farmer, pers. comm.; Paul, unpubl. data). Allen attributed the flocks to premigratory staging. Those I have seen have numbered up to 750 birds. In most cases they were standing in the small puddle remaining in a broad, drained tidal flat, apparently feeding on the small fish trapping in the pool. My suspicion, which deserves further study, is that most Reddish Egrets in such groups are young of the year, and that these inexperienced birds derive benefits of improved foraging by remaining in the flock. Perhaps they also locate preferred wintering habitats by migrating with a flock.

These flocks may he extremely significant factors in the biology of Reddish Egrets, at least in Texas, and further study is needed.

4. Foraging efficiency: Foraging efficiency is fairly low among herons feeding on comparable prey. Rodgers (1983) found that capture success was about 32% in adult Reddish Egrets, about the same as Tricolored Herons (31%) but much lower than Snowy Egrets (50%) and Little Blue Herons (60%). Immature Reddish Egrets were even less successful, with just 25% capture success. Similar results were found by Paul (unpubl. data), who studied foraging efficiency near Rockport TX in 1977: adults had higher capture rates (42% to 29%), lower strike frequency (2.8 strikes/min to 3.3 strikes/min), and higher capture rates (1.16 items/min to 1.00 items/min). These data explain why Reddish Egrets do not breed as yearlings.

5. Adaptive value of foraging behavior: Active foraging techniques are an adaptation to open habitats. Running and aerial pursuit are impossible in heavily vegetated conditions, and will not work if fish can simply hide in dense cover. But on barren flats there is little cover. Fish respond to disturbance by schooling and swimming away (Paul, pers. obs.) Reddish Egrets run first to locate schools of fish, and second to catch them. In addition, running effectively limits the hunter to shallow habitats; in depths greater than 6" (15 cm), Reddish Egrets slow down and in many cases resort to aerial pursuit.

In my opinion there is a unique "fit" among the preferred foraging habitats, prey species, and foraging behavior of Reddish Egrets. The Reddish Egret, alone among herons of North America, is peculiarly adapted to the barren shallow flats of coastal lagoons, barrier islands, and similar areas. Its foraging techniques are poorly adapted to the more vegetated wetlands of brackish and fresh-water systems. *This explains why Reddish Egrets are so restricted to coastal systems, and suggests that they would be very sensitive to alteration of broad saline flats near the mean high tide line. The species has no alternative habitat to exploit if these primary ones are lost.*

C. Movements and Migration: Throughout most of its range, the Reddish Egret is essentially resident; the species has long been considered "weakly" migratory (Cooke 1913). A northward postbreeding dispersal has been noted, however, in Florida and Texas (Bent 1926; Paul, unpubl. data), and a fall southerly migration occurs at least in the Texas-Louisiana population (Bent 1926; Telfair and Swepston 1987; Paul, unpubl. data). However, the magnitude of the movements is unknown.

A few band recoveries, however, illustrate the distance of migrations. Bent (1926) reported Texas-banded Reddish Egrets recovered near the Laguna Terminos,

Campeche, and inland at Cuicatlán, Oaxaca. Further banding by the Texas Parks and Wildlife Dept. (Telfair and Swepston 1987) and Paul (unpublished) indicates that Reddish Egrets even cross Mexico (perhaps at the Isthmus of Tehuantepec) and have been recovered in El Salvador and Guatemala. Migration therefore exposes an unknown fraction of the population to potential impacts like subsistence hunting, pollution and habitat loss, in countries beyond the reach of U. S. laws and regulations. The magnitude of these impacts, if any, is unknown.

Even less is known about seasonal movements in other populations. Reddish Egrets from Baja California and the Sea of Cortez are now annual visitors to southern California (Roberson 1980). No information is available about inter-island movements in the West Indies or along the coast of northern South America.

D. Associated Species

Reddish Egrets are part of a characteristic assemblage of some 25+ fisheating bird species found along Gulf of Mexico shorelines. Most of these (pelicans, cormorants, anhingas, herons, ibis, spoonbills, gulls, terns, skimmers) have been recorded nesting at some of the same colonies as Reddish Egrets. Certain species are quite likely to nest in association with Reddish Egrets, including Roseate Spoonbills, Snowy Egrets, and Tricolored Herons. In large, diverse colonies, a number of other species may also nest close by; this is particularly true at ground colonies where habitat diversity is limited. In the Yucatan Peninsula, Boat-billed Herons have also been found nesting with Reddish Egrets (L. P. Brown, pers. comm.).

Foraging Reddish Egrets may also be found in association with a wide variety of waterbirds, most often other herons and other long-legged wading birds. To the above list should be added migratory and wintering shorebirds including, particularly, the Threatened Piping Plover (M. Farmer, pers. comm.). In the southern Bahamas, Cuba, Hispaniola, Yucatán Peninsula, Bonaire, and Venezuelan coast (Chichiriviche Lagoon), Reddish Egrets often share hypersaline foraging areas with Caribbean Flamingos (Sprunt 1976, pers. comm.; Paul, pers. obs.).

Despite proximity to other egrets or individuals of other species, foraging Reddish Egrets typically forage alone. Their wide-ranging search-and-pursue technique assures that they soon pass by any nearby individuals. An exception to this rule occurs when large mixed-species foraging flocks form, to exploit super-abundant resources available when draining tidal flats trap fish in small pools. Closely associated species then include everything from White Pelicans to Least Terns and Black-necked Stilts (Paul, pers. obs.).

EVIDENCE OF THREATS TO SURVIVAL (PAST, PRESENT, POTENTIAL)

A. Destruction, modification, or curtailment of habitat or range:

(1) Dredge-and-fill projects: Dredging for residential development, industrial development, and shipping has occasionally created breeding and foraging habitats used by Reddish Egrets. Far more often, these activities have destroyed habitats, and this trend continues.

The largest colonies in Clearwater Harbor and Sarasota Pass of the 1880s (Scott 1887) are now prestigious waterfront communities (Paul, pers. obs.). The colony

islands of Johns Pass, near St. Petersburg, remain, but the shallow flats and sand bars of the barrier islands have been dredged and filled. These areas were important Reddish Egret colony sites in the 1880s (Scott 1887), but habitats that might fuel a local population recovery are permanently lost.

Far more important than historical accounts, however, are the present and future threats to Reddish Egrets posed by continued dredging and filling. Several specific examples should be mentioned.

(a) In Texas, Reddish Egrets from Corpus Christi south are critically dependent on the broad wind-tidal flats (Brown et al., 1980) of Mustang Island, Padre Island, and mainland shores from Baffin Bay to the Rio Grande. Development on Mustang Island, and disposal of material from maintenance dredging of navigation channels farther south, pose a particular threat to Reddish Egret foraging habitats. Current practice is to dispose of dredged material by placing it within a three-sided diked area that is open to the side away from the Intracoastal Waterway (M. Farmer, pers. comm.). Maintenance material is fine, and flows readily. Therefore much of it flows out of the diked disposal area, and across barren flats. More flows out with each rain. A small change in elevation on these extremely broad wind-tidal flats is enough to fundamentally change their hydrology (M. Farmer, pers. comm.), from a periodically flooded system that supports fish and egrets, to uplands above all but the most extreme storm-driven tides. Similar dredging during the late 1930s, to create the Brownsville Ship Channel, closed off South Bay and very possibly destroyed the value of the flats around Bahia Grande (see Pemberton 1922b, Pemberton *in* Oberholser and Kincaid 1974; Oberholser, unpubl. field notes in Bureau of Biol. Survey files). As one example of habitat losses in systems important to Reddish Egrets, wind-tidal flats and alluvial washover areas in the Mustang-northern Padre Island area decreased by 36% and 28%, respectively (calculated from White et al., 1983), between 1938 and 1974.

Even where foraging habitats are protected, adjacent development can have a deleterious effect. Fill placed next to a wetland inevitably washes gradually into it. Over time the wetland area is reduced. Also, during extremely high tides or storm events, areas landward of mean high water can be flooded. These are important temporary foraging habitats because the Reddish Egret forages in waters less than 6" (15 cm) deep. This places them at the margin of the pool, no matter where the margin is. Bulkheads and fill material eliminate that margin.

(b) Recent development proposals along the lower Laguna Madre have included a 15,000 acre development south of the Mansfield Cut on South Padre Island, a new causeway across the Laguna to serve it, and another large residential development near Pt. Isabel (R. Wahl, pers. comm.). The Laguna Madre is a shallow system with limited flushing action, and the plant and animal communities are adapted to those conditions. Massive changes to water quality are inevitable if such large projects are permitted. Dredging to provide water access to developments will increase, bulkheading to protect waterfront property will destroy shallow flats, and pressure to open up new areas will increase. Disturbance of fish and wildlife, including Reddish Egrets will increase.

(c) Similarly, the Mexican government has announced plans to build a large new resort facility at La Pesca, a sleepy village at the mouth of the Laguna Tamaulipas (R. Wahl, pers. comm.). The small fishing village, with its subsistence economy based on fishing, will only be one casualty. The chance is excellent that the Laguna will be greatly altered, first at the southern end and subsequently northward. Mangrove communities, shallow flats, and the hypersalinity that defines much of the Laguna system are at risk.

(d) Increasing interest in commercial shrimp ponds has led to the destruction of coastal wetlands in other countries (Paul, pers. comm.). In 1990 plans were announced to build 1500 acres of shrimp ponds near the Arroyo Colorado (J. Grantham, pers. comm.). Such facilities offer several threats to Reddish Egrets and other colonial waterbirds: (1) they may be constructed on habitat important to egrets; (2) effluent discharge may create pollution problems; (3) wading birds attracted to this new food source may be shot, with or without depredation permits. The Green Island colony is just 8 miles from the project. This project, and others like it in Mexico and elsewhere in the West Indies/Latin America (Scott and Carbonell 1986), pose an imminent threat to Reddish Egrets.

(2) In the Laguna Tamaulipas, use of the islands by squatters, fishermen, and cattlemen is increasing. The islands are burned to improve forage for cattle, thereby destroying native brush vegetation that might have provided nesting substrate. These activities threaten the several wading bird colonies known (A. Sprunt IV, pers. comm.; Paul, pers. obs.); burning may have caused the abandonment of a White Pelican colony in 1986 (D. R. Blankinship, pers. comm.).

(3) The cutting of mangroves for charcoal in the West Indies, Mexico and the Caribbean (Scott and Carbonell 1986) is one more cause of deterioration in coastal systems. As Reddish Egrets nest on mangrove keys and feed on mangrove flats, continued loss of this habitat should also be regarded as a threat to the species.

(4) Recently, the Texas Parks and Wildlife Department initiated a colony habitat management program that employs controlled burning to reduce vegetation, in order improve nesting habitat for wading birds (J. Grantham, pers. comm.). This misguided program may improve habitat for gulls, terns and skimmers, but it will destroy the habitats preferred by herons and other large waders. If fully implemented, this program will pose a direct threat to Reddish Egrets and other nesting species. It should be terminated, if it has not already been stopped.

(5) As of August 1991, two significant threats to future wetlands protection loom. First, under the guise of "improved regulatory efficiency" a draft revised federal wetlands delineation manual has been released. Second, proposed legislation now before Congress, if passed, will weaken the federal role in wetlands protection by changing the provisions of Section 404 of the Clean Water Act. With more restrictive wetlands definitions, an ill-advised scheme to rank wetlands by "importance," and the requirement that large areas be purchased with public monies if they are to be protected, it is very likely that large portions of the vital wind-tidal flats systems of south Texas may be excluded from regulatory protection.

(6) Continuing massive wetland losses in coastal Louisiana threaten both nesting islands and foraging habitats.

B. Overutilization for commercial, recreational, scientific, or educational purposes: In the last century, uncontrolled hunting for commercial use of the scapular plumes decimated Reddish Egret populations in the U. S., and possibly elsewhere (see treatment in Florida and Texas Status sections). Formerly also, some wading bird colonies including South Bird Island and Green Island in Texas (L. Rawalt and W. J. Fluman, pers. comm.) were used as gunnery targets by fighter pilots during World War II. These practices have ended. Other human "uses" are discussed below.

Human disturbance of colonies is one of the most widespread problems affecting the colonies where Reddish Egrets breed. Nature photographers, campers, picnickers, fishermen, shell collectors, coastal ecology classes (Paul, pers. obs.), treasure hunters, and researchers all can cause nest abandonment, or mortality, due to predation, exposure or disturbance. The release of dogs by picnickers is especially damaging.

A particular problem in south Texas and the Laguna Tamaulipas of Mexico is the construction of shacks on colony islands by fishermen (Paul, pers. obs.). Shacks attract, and ensure, continuing use of the islands by humans and their pets. Few people who visit islands know enough, or care enough, about bird colonies to so modify their activities that damage to bird nesting is avoided. Important bird colony islands should be closed to public access. One major colony deserving close attention is Shamrock Island, a privately owned island in Corpus Christi Bay. No shacks exist there currently, but the island is for sale and shacks could be built in the future. If so, their proximity to the colony could greatly affect nesting (R. Wahl, pers. comm.).

Human population growth has disproportionately affected U. S. coastlines. Eighty percent of Florida's growth, for example, is coming to the coast. Likewise, recreational boating has rapidly increased, and some waterways are now heavily congested. Boating traffic poses a direct threat to waterbird colonies in some areas; in Estero Bay, Fl., chronic disruption of colonies by boaters is blamed for almost total nesting failure in recent years (T. H. Below and D. Southall, pers. comm.). Increasing use of "jet-skis," extremely noisy, shallow-draft vessels, now appear to be adding to the problem: formerly inaccessible areas are now showing signs of severe disturbance in places like the Great White Heron National Wildlife Refuge in the Florida Keys (T. Wilmers, pers. comm.).

Still another form of human disturbance is low-level air travel. Airplanes buzzing islands can cause colonial waterbirds to flush suddenly, bouncing eggs from nests or leaving eggs and young vulnerable to predation and overheating. In my experience, helicopters are particularly disruptive. This problem appears to vary; some "urban" colonies are highly tolerant of regular low-level traffic, while the most remote colonies, or those with particularly wary species, are highly sensitive.

Illegal hunting of herons still occurs in the Bahamas (A. Sprunt IV, pers. comm.) and probably elsewhere in the West Indies and Central America. As the tamest of the herons (Paul, pers. obs.) Reddish Egrets may be particularly vulnerable to shooting by recreational or subsistence hunters. During the 1970s, egrets banded at Texas colonies were shot in Mexico, Guatemala, and El Salvador (Telfair and Swepston 1987), and there are periodic reports of shooting of wading birds from Florida and Texas (Paul, pers. obs.). The overall impact of shooting is unknown, but in a local species like the Reddish Egret, local harvest could have a disproportionate impact on the population.

Equally difficult to evaluate is the potential impact of egging on Reddish Egrets. In recent years, tern and skimmers colonies have been egged in Texas (J. Grantham, pers. comm.). Egging also continues in the Bahamas (terns, White-crowned Pigeons), Belize, and probably elsewhere in the West Indies (Scott and Carbonell 1986; A. Sprunt IV, pers. comm.). Reddish Egrets are not specifically known to have been affected by egging, but local impacts could occur as a result of subsistence foraging by local people. As a highly coastal species, the Reddish Egret has no inland "reservoir" to buffer the coastal nesters against this impact.

An accidental source of mortality, that potentially affects all coastal colonial waterbirds, is death due to entanglement in discarded fishing line. Monofilament snarls

are concentrated at the drift line along Gulf beaches. Pelicans and herons retrieve them for use in nest construction. There, hooks and line can entangle nesting birds. In some colonies, most colonial waterbird nests contain one or more lengths of fishing line, and others hang like invisible nets among the trees. This is extremely common in some Florida colonies (Paul, pers. obs.). While the Reddish Egret does not appear to be one of the more seriously affected species, potential impacts are clear.

Intensive biological studies requiring frequent or prolonged entry into breeding colonies pose a threat to Reddish Egrets, as to other colonial waterbirds. Observers may try to minimize their impact, but it is virtually impossible to eliminate all sources of mortality. Particularly for rare species, large-scale studies should be de-emphasized in favor of narrowly focused investigations of specific problems. For example, routine monitoring of nesting success of Reddish Egrets can be easily accomplished from a boat, by mapping nest locations and counting broods during the nesting season.

C. Parasites, disease, predation: Little is known about parasites or diseases affecting Reddish Egrets. In Texas, ticks (Ornithodoros capensis) occur in ground colonies of Brown and White Pelicans, herons, and other species, and have been implicated in colony abandonment by pelicans (King et al. 1977; D. R. Blankinship, pers. comm.). In the 1970s larval ticks were found commonly on nestling Reddish Egrets at Long Reef and Deadman Island in Aransas Bay (but not in Redfish Bay), and in sufficient numbers may have contributed to mortality (Paul, unpublished data). Ticks were not found on nestlings from Florida colonies, where all nests were in trees (Paul, unpubl.).

Conti et al. (1986) reported 21 species of ecto- and endoparasites, plus Salmonella and avian pox infections, from 36 Reddish Egrets examined in Texas and Florida colonies. No population implications could be confirmed from this eclectic sample, but Wiese et al. (1977) and Spalding (1990) have described heavy mortality in nestling herons due to eustrongylidosis, an infection caused by the parasitic nematode Eustrongylides sp. Although Eustrongylides was not among the six nematode species identified by Conti et al. (1986), nematodes are commonly found in regurgitated food samples and the possibility of significant impact to Reddish Egrets remains.

Terrestrial predators can have a devastating impact on colonially nesting birds, including herons. There are several recent examples involving Reddish Egrets in Texas: in Redfish Bay in 1975 (Paul, unpublished data), Redfish Bay again in the late 1980s (J. Grantham, pers. comm.), and Green Island from 1984 to 1989 (D. R. Blankinship and J. Grantham, pers. comm.) In the latter case, more than 4000 breeding pairs of 11 species declined to a low of 168 pairs in 3 years, and have only slowly returned since the removal of 12 raccoons in 1986 (J. Grantham, pers. comm.). In 1990, raccoon depredations in a colony of 3000 pairs of 15 species caused its complete abandonment (six raccoons were removed, and the colony recovered to 1/3 of its former size during 1991). Raccoons are probably the most serious terrestrial predator in Gulf coast colonies. Coyotes also reach colonies in Texas (W. J. Fluman, pers. comm.), and probably Mexico, and should be regarded as a significant potential threat.

In many cases, mammals gain access to coastal islands during extreme low tides. Dredging operations have occasionally aided predators by creating a shoal, or a series of small islands, that allow access to a colony formerly isolated from the mainland.

At Merritt Island National Wildlife Refuge, alligator trails were common on two colony islands in 1986 (Paul, pers. obs.). Rattlesnakes are widespread on coastal

islands and common on at least some colonies in Florida and Texas (B. H. Chapman, pers. comm.; Paul, pers. obs.). It is unlikely that snakes or alligators are significant predators on Reddish Egrets.

The primary aerial predators include the Bald Eagle, Fish Crow and, occasionally, Turkey Vulture in Florida, and the Great-tailed Grackle in Texas. Bald Eagles are capable of taking adult Reddish Egrets (Paul, pers. obs.), but most predation is probably on nestlings. Some eagles in Florida Bay seem to specialize in eating birds (A. Sprunt IV, pers. comm.), and indeed, nearly all the young Reddish Egrets at one colony I studied there were taken by eagles in two straight years. In an area with a very limited population such specialization could have serious impact. Fish Crows are common opportunists at colonies on both coasts of Florida, but not in Florida Bay (where Common Crows occur at some sites). Great-tailed Grackles have long been regarded as serious egg predators at heronries in Texas (e.g., Bent 1926). My impression is that their impact is probably greatest when the herons have been disturbed from their nests, particularly if the clutch is not yet complete. I found grackle predation to be insignificant during my work in Aransas and Redfish Bays, although grackles were common. Laughing Gulls, nesting on the same islands, did take a few eggs. Turkey Vultures may take young from the nest in seasons of food shortage, when nestlings are left unguarded at a younger age than normal (J. C. Ogden, pers. comm.).

One other predator should be noted. Fire ants are common inhabitants of spoil islands in both Texas and Florida, and in some instances may cause significant mortality (Paul, pers. obs.; K. A. King, D. R. Blankinship, and J. Grantham, pers. comm.). Whether they have seriously affected Reddish Egrets is not known, but the potential for harm should be noted.

D. Pesticides: King et al. (1978), in analysis of eggs collected in 1970, examined eggshell thinning and pesticide residues in 22 species of colonial birds in Texas. $\sum$DDT and PCB residues occurred in low levels in Reddish Egret eggs, and dieldrin was not detected. Eggshells averaged just 1% thinner than a pre-1943 sample. Highest $\sum$DDT residues and thinnest eggshells were found in eggs (species combined) from lower Laguna Madre colonies.

King did not specifically evaluate local contamination in Reddish Egrets alone, but made his data available to me for further analysis (Paul, unpubl. data). He collected Reddish Egret eggs from four sites, with most coming from two: Green Island, in the Lower Laguna Madre ($n=28$), and Long Reef in Aransas Bay ($n=17$). Eggshells from Green Island were significantly thinner ($t=2.87$, 42 df, $p<.01$) than those from Aransas Bay, and 6.3% thinner than the pre-1943 control. Aransas Bay eggs showed no shell thinning. Likewise, DDE residues were significantly higher in eggs from Green Island (one-tailed t with pooled variances, $t=2.49$, 8 df, $p<.025$), averaging 3.7 ppm and 1.3 ppm at the two sites.

King's data did not show excessively high levels of pesticide contamination at Green Island in 1970. However, previous studies have pointed out extremely heavy use of DDT and other organochlorine pesticides in Lower Rio Grande Valley, and high residues in local fish populations (Childress 1966-68, White et al. 1983) and even people (Burns 1974). Circumstantial evidence (Paul ms.) suggests that pesticide contamination might have been associated with the crash of the Green Island colony between 1959 and 1965, when DDT use apparently reached its peak and the Lower Laguna spotted seatrout population crashed (Breuer 1970; Childress 1966-68). This crash affected all species, and the data here summarized do not suggest that Reddish Egrets are more sensitive to insecticides than other wading birds.

It should be noted that the Arroyo Colorado, principal distributary of the Rio Grande and the primary drainage of the lower Valley agricultural district, empties into the lower Laguna Madre less than two miles south of Green island, and the primary Reddish Egret flight lines from the island are west and south, toward foraging areas north and south of the Arroyo (R.T. Paul, pers. obs.).

Because of its location, the Green Island colony may be more vulnerable to pesticide contamination than other colonies in Texas. A heron die-off in 1976 following rains totalling 9-11" in six days, suggested one mechanism: during prolonged drought, persistent, nonvolatile pesticides (e.g., DDT and Toxaphene) accumulate in the soil (Harris and Lichtenstein 1961); then a sudden, large rainfall event causes widespread flooding and a discharge of pesticides into the food chain. In 1976 a large fish kill followed the rain, but fish and herons were not collected for analysis until two weeks later. Toxaphene was the primary pesticide found in dead herons (X=14.8 ppm in brain tissue, n=4), and dead fish (7.7 ppm, whole body wet weight in a single combined sample) (Paul, unpubl. data). However these levels were insufficient to account for heron mortality (W. H. Stickel, pers. comm.).

A clear link between agricultural chemicals used in the Valley and occasional die-offs or colony crashes remains unproven. But the proximity of Green Island to the Arroyo Colorado, and the finding of elevated levels of ∑DDT and Toxaphene in herons at Green Island, suggest that such a link may exist. Further study is clearly needed.

No data exist on pesticide contamination in Reddish Egrets in other parts of their range.

E. Inadequacy of existing regulatory mechanisms

(1) Wetlands regulations still do not fully prevent the loss of coastal wetlands. Dredging, filling, and alteration of wetlands hydrology due to projects close by ("adjacent impacts") all continue to cause loss or degradation of habitats used by Reddish Egrets. These losses may accelerate if the federal role in wetlands protection is eroded by current proposals (see p. 20).

(2) Wind-tidal flats provide absolutely essential foraging habitat for Reddish Egrets in the Laguna Madre of Texas and Laguna Tamaulipas of Mexico. Current Corps of Engineers spoil disposal practices destroy them. The critical role of wind-tidal flats in the ecology of south Texas coastal systems in general, and the survival of the Reddish Egret in particular, needs to be recognized and properly reflected in COE policies.

(3) The federal animal depredations permitting process is ineffective. In Florida, thousands of American Robins annually are shot by strawberry growers. Tropical fish farmers admit shooting terns, cormorants, and herons. Yet not one farmer or fish farm operator has obtained a depredation permit (R. Thompson, USDA Animal Damage Control, pers. comm.). With shrimp farming likely to present a new food source for Reddish Egrets and other colonial waterbirds along American (and other countries') shorelines, a new source of mortality is certain to be introduced. The present program is incapable of stopping it.

(4) Lack of enforcement of, or loopholes in, existing laws allow the continued erection of shacks on important colony islands in Texas.

(5) A continuing, long-term shortfall in funding and staffing hampers all wildlife and wetlands protection processes, state and federal.

(6) In the U. S., most of the important Reddish Egret colonies are owned or leased by the National Park Service, the U. S. Fish and Wildlife Service, the states, or the National Audubon Society. Responsibility for protection and management resides with those bodies. Foraging habitats are owned by a variety of public and private owners, and much less well-protected. In Mexico and other countries, nesting and foraging habitats reside in both federal and private hands. However, few sites enjoy any real protection (summarized in Scott and Carbonell 1986). A number of important coastal sites have been protected by the establishment of national parks, preserves and sanctuaries (notable examples are the Inagua National Park in the Bahamas, and Sian Ka'an Biosphere Reserve in Mexico), but often these lack funding, trained staff, management plans, or fail to fulfill their management goals (see nation-by-nation reviews in Scott and Carbonell 1986). Probably, at most sites, protection exists largely to the extent that they are inaccessible.

F. Other natural or manmade factors affecting its continued existence:

(1) Three related factors must be noted: island erosion, sea level rise, and the threat of hurricanes. Erosion is a chronic threat to coastal islands. Dredge spoil islands, composed of unconsolidated sediments, may erode particularly quickly. Since a number of key wading bird colonies in Texas and Florida are on spoil islands, long-term management plans must address this issue. Sea level rise threatens both breeding sites and foraging habitats (White et al. 1983, 1986; Titus 1988). If even conservative estimates of sea level rise are correct, coastal wetlands will be pinched between increasingly severe wave action, and seawalls or other protection of private lands. While many species of birds are at risk, those species most dependent on coastal systems will be affected the most. The Reddish Egret will be among them. Finally, hurricanes pose a severe threat to species with a highly restricted, coastal distribution like the Reddish Egret. Although intense storms may kill adult birds, the primary impact is probably erosion of breeding sites (elsewhere I have pointed out the apparent benefit of hurricanes to foraging habitat).

(2) Scott and Carbonell (1986) have noted oil pollution, heavy metals and pesticide contamination, and thermal and domestic waste discharge into important coastal bays in Colombia, Venezuela, the Bahamas and Mexico. U. S. coastlines suffer generally from the same problems in varying degrees. Catastrophic oil spills like Ixtoc I in the 1980s, and chronic oil pollution as in Lake Maracaibo, Venezuela (Scott and Carbonell 1986), hold great potential for impact on Reddish Egrets. Direct mortality through heavy oiling of adults, egg loss through oil transmitted by the feathers of incubating birds (King and Lefever 1979, White et al. 1979), fouling of foraging areas, and mortality of prey are all potential impacts of oil spills.

SUMMARY OF SPECIES STATUS

The Reddish Egret is a maritime heron found primarily along coastlines of the U. S. Gulf Coast, West Indies, Mexico, Central America (rarely), Caribbean South America, and extralimital islands of the southern Caribbean Sea. The species is a habitat specialist, uniquely adapted (and limited) by foraging behavior to a narrow zone of poorly vegetated, saline coastal flats.

Nesting occurs on small islands in coastal bays and is generally similar to that of other herons. However, the breeding cycle lasts longer (except Great Blue Heron), and nesting success appears to be lower, than other herons. Delayed maturation (first breeding in 3rd or 4th year) is more pronounced than in all other North American herons. These factors, probably related to the energetic costs of active foraging, suggest that Reddish Egret populations are less resilient than those of other species.

The Reddish Egret is the rarest heron in North America, and probably the rarest in the West Indies. The world population is estimated to be, at most, 3000-5000 nesting pairs (Table 10). One-third to one-half of these are thought to occur in Texas, making this the largest single population segment known. Estimates for most other countries are virtually impossible to make, but at least 660 pairs are estimated for Mexico. Of about 2000 nesting pairs occurring in the U. S., 75% occur in Texas, with the remainder in Florida and Louisiana. The Texas population, now half the number estimated in the 1930s, has fluctuated erratically since the early 1970s with recent censuses possibly suggesting additional decline. Numbers in Florida suggest continuing slow increase, but the major nesting areas need to be resurveyed. The small Louisiana population may be decreasing, but further ground survey is needed to assess this properly.

Reddish Egrets appear to have slowly recolonized their historic range following the cessation of plume hunting. Because of their limited population, low reproductive rate, and specialized habitat requirements, they are vulnerable to a number of natural and human-caused threats, notably including habitat destruction, human disturbance of colonies, and predators. Dredge and fill activities associated with development and channel maintenance should be regarded as the single greatest threat to Reddish Egret populations, through their destruction of critical foraging habitats.

Increasing human populations along U. S. and international coastlines ensures that development pressures will not ease. Overpopulation is not just a foreign problem; Florida and Texas are two of the fastest growing states in the country. Florida's population is growing at a rate of nearly 3% annually, faster than many "third world" nations. Remote, harsh habitats that have previously escaped development pressures are now increasingly vulnerable. So too are the highly specialized species that have adapted to life there.

The Reddish Egret, as a specialist forager, will not adapt to new foraging areas if existing coastal flats are lost. Without strengthened protection of crucial areas like barrier islands and wind-tidal flats, the major populations will inevitably decline. A century ago along the Florida Gulf Coast, Reddish Egret numbers may have exceeded 2000 pairs (inferred from Scott 1887). The same area now harbors no more than 80. The habitat fragments remaining after seven decades of coastal development will not again support the original population.

The key to ensuring a stable population of Reddish Egrets is protection of foraging habitat. In my opinion, an imminent threat to the vast foraging areas of the Laguna Madre exists in various development and dredging proposals, now and in the future. With the major U. S. population of Reddish Egrets occurring in the Laguna, our ability to maintain this species will be measured by our effectiveness there.

MANAGEMENT RECOMMENDATIONS

The following recommendations should be considered as an overlapping set of proposals, intended to help ensure the long-term stability of Reddish Egret populations in the United States. Some recommended actions are already being implemented, at least in part. Some recommendations refer specifically to the bay systems of South Texas, by far the most important area for Reddish Egrets in the U. S., while others apply more generally.

Proper management of wildlife populations cannot be considered apart from research. Therefore I have included recommendations for further research and monitoring needs.

Finally, while these recommendations primarily concern the Reddish Egret, I must emphasize that single-species management is unrealistic, and not the approach urged here. Reddish Egrets are an integral part of certain coastal wetlands systems, and cannot survive if those systems are fundamentally altered. Management of Reddish Egrets therefore requires management and protection of the coastal lagoon systems on which they depend. The recommendations below are offered from that perspective.

A. Research and Monitoring Needs

1. Identify important foraging areas used by breeding egrets at "Key Colonies" (see below), and by nonbreeding egrets during August-February.

2. Investigate the ecology and hydrology of wind-tidal flats systems of south Texas, and their importance to Reddish Egrets.

3. Evaluate current rates of foraging habitat loss to residential development, dredging, shrimp farms, etc., especially in Corpus Christi Bay and the Laguna Madre.

4. Improve estimates of breeding populations by designing census programs specifically for this species. Surveys should be conducted during peak nesting activity. (This effort should supplement existing waterbird surveys where they already exist; recommended frequency is once every 3-5 years except annually if needed to clarify possible population declines.)

5. Monitor nesting productivity at selected sites in a standard manner. (Large-scale efforts involving extensive colony disturbance should be discouraged; wherever possible nesting success should be assessed from outside the colony, by mapping nests and counting young from a boat.)

6. Investigate the significance of large, tight foraging/migratory flocks.

7. Evaluate pesticide residues at the Green Island colony, including both chronic levels and the possible impacts of large rainfall events which may suddenly drain large amounts of pesticides into coastal bays.

8. Investigate impacts of fire ants and ticks on nestling mortality (a focussed study, on drier islands where egrets are nesting on the ground).

B. Management - United States

1. The Laguna Madre, the nation's only hypersaline lagoon, should be designated a Wetland of International Importance under the Ramsar Convention. Key areas should be identified for acquisition, and other areas protected via conservation easements and other devices. The existence of Padre Island National Seashore and Laguna Atascosa National Wildlife Refuge bordering the Laguna attest to its value, but without further protection the entire system remains vulnerable to degradation from activities in unprotected parts of the bay.

2. Further dredging, filling, and development of Reddish Egret foraging habitats should be prohibited.

3. Dredge material disposal practices in the Laguna Madre must be improved. Confined disposal sites should be located landward of wind-tidal flats systems. Offshore disposal is preferred wherever possible.

4. The longterm impact of sediment migration out of existing, partially-confined disposal areas in the Laguna Madre should be evaluated, and dikes modified to prevent further migration. Where feasible, wind-tidal flats impacted by past dredge material disposal should be restored.

5. All significant colonies should be identified and protected. While this is already accomplished for most Reddish Egret colonies in the four Gulf Coast states where they breed, several important colonies still need protection by government agencies or private conservation organizations. Notable examples include Shamrock Island in Corpus Christi Bay, and a number of islands in the Laguna Madre. Others, despite "official" protection, suffer from infrequent patrol or other enforcement activity. Human disturbance and encroachment of colonies should be prohibited. Camping, fishing, and other activities may be allowed outside the nesting season, if the islands are not important roost sites. Jet skis and airboats should stay a minimum of 100 yards from colonies at all times.

6. Fishing shacks should be prohibited on colony islands.

7. A "Key Colony" classification is proposed, to indicate breeding sites requiring highest priority protection. "Key Colonies" would be eligible for special restrictions on human use and disturbance, priority status in proposals to combat island erosion, extra attention from law enforcement agencies, etc. For Reddish Egrets, "Key Colony" criteria would vary according to the state or local population, and could include:

   a. all single islands or groups of islands with >50 breeding pairs of Reddish Egrets.

   b. the largest or most long-lived colony (or colonies) in bay systems with <50 pairs of Reddish Egrets.

   c. any colony of 500 pairs or larger (all species) that contains Reddish Egrets.

[As here envisioned, "Key Colony" management provisions would be limited to those species on state Endangered, Threatened, and Species of Special Concern lists, plus certain unlisted species that are very scarce and/or nest in very few colonies around a state (two Florida examples: Caspian Tern, with just 70 pairs at one colony, and Royal Tern, with possibly 5,000 pairs at about five sites)].

8. Where serious erosion of colonial waterbird colonies (especially "Key Colonies") has occurred, islands should be restored with clean sand and shell material from necessary dredging projects. Island configuration should be based on an understanding of prevailing wind and current conditions, and erosional patterns. Wherever possible, shorelines should be stabilized by planting native marsh plants (e.g., smooth cordgrass Spartina alterniflora) or by employing other techniques. This recommendation applies particularly to dredge material islands, but should be considered for badly eroding natural sites as well.

9. Terrestrial predators present a serious threat to nesting Reddish Egrets, and should be removed from colonies.

10. Comprehensive dredge material management plans should be prepared by interagency committees to evaluate future dredging and material disposal needs, in order to best consider impacts and beneficial uses of dredge material for Reddish Egrets and other colonial waterbirds. Existing agreements in North Carolina and Mobile Bay, AL offer important examples of this approach.

11. Construction of new chains of islands during oil and gas exploration should be discouraged. If this cannot be avoided, the new islands should be remote from mainland shores where predators are present.

12. Information about proper disposal of fishing line snarls, plastic 6-pack carriers, and other plastic trash should be distributed with all fishing licences and boat registrations.

13. Depredation permits for any species of waterbird should not be issued to operators of coastal shrimp and fish farms unless extremely stringent limitations are attached. Frequent compliance monitoring is essential. New facilities, if approved at all, must be designed with covered ponds and other features to keep fisheating birds out of the ponds.

C. Management - International

The Reddish Egret is a migratory bird. An important segment of the Texas population winters annually in Mexico. Other countries may also provide wintering habitat for significant numbers of Reddish Egrets reared in the U. S. Through the Migratory Bird Program of the Office of Migratory Bird Management, the USFWS should develop an international exchange program involving biologists from other countries with important Reddish Egret populations. State wildlife agencies, private conservation organizations, and others could contribute importantly to the program. Components could include:

1. Designation of the Laguna Tamaulipas as a Ramsar Site. This action would complement the designation for the Laguna Madre and underscore the international nature of Reddish Egret habitat issues. Further, the two systems are effectively the same, bisected by the Rio Grande delta. Biologically, the common designation makes sense.

2. Exchange of information about Reddish Egrets and other colonial waterbirds characteristic of coastal wetlands and lagoonal systems.

3. Training workshops for staff at existing parks and reserves.

4. Assistance in the preparation of reserve management plans.

5. Assistance in the design and conduct of cooperative colonial waterbird surveys (develop expertise in local biologists).

6. Identification of primary "wintering" areas of migrant Reddish Egrets and other colonial waterbirds.

7. Clarification of timing of breeding season.

8. Improved estimates of local breeding populations.

9. Identification and proposal of new sites for protection as parks and reserves.

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APPENDIX A

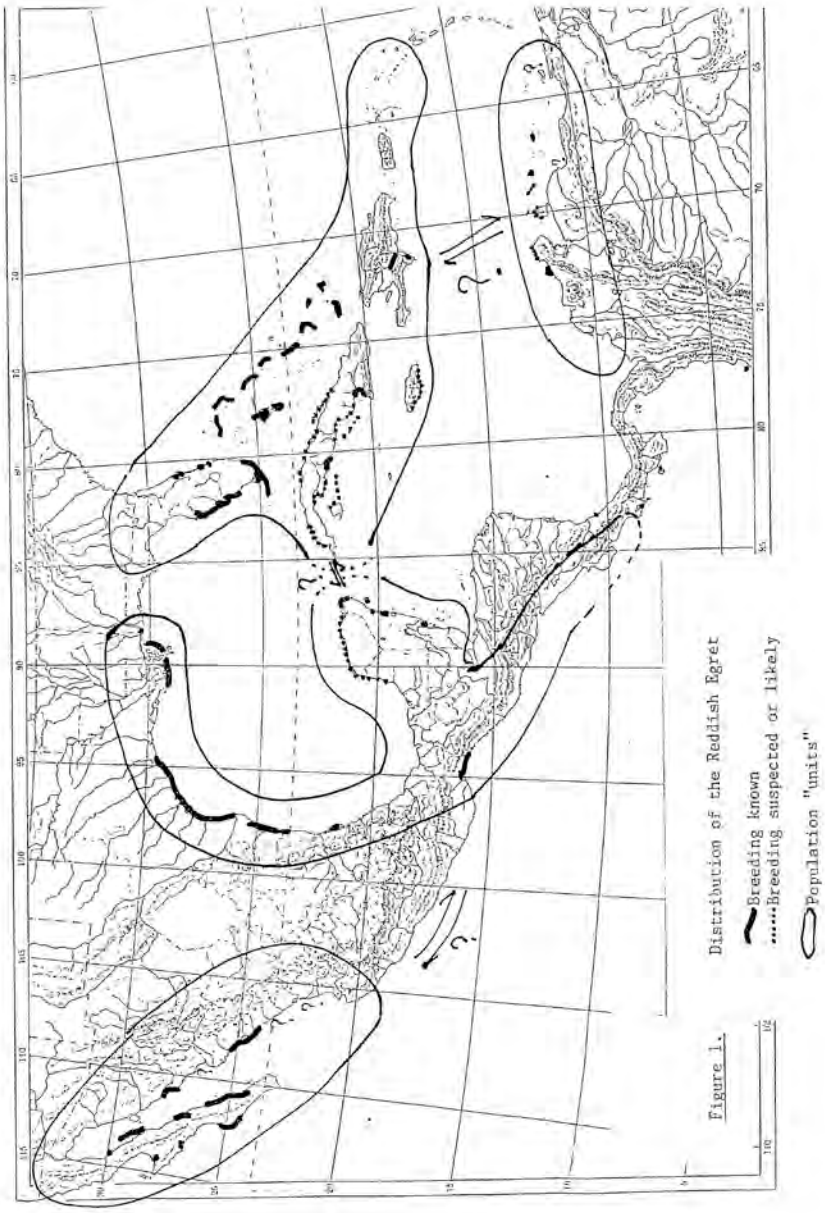
Distribution of the Reddish Egret
Breeding known
Breeding suspected or likely
Population "units"

Figure 1.

Table 1. REDDISH EGRETS IN FLORIDA

Year	Comments	Source
1824	*"Ardea pealii"* or white morph first collected, locality not specified.	Bonaparte 1826
1832	Abundant and nesting in Florida Bay.	Audubon 1835, 1843
1848	Found breeding "in great numbers" at Charlotte Harbor by Heermann.	Gambel 1848
1858	Both morphs breeding at Pelican Island in Indian River.	Bryant 1859
1869	White morph common at "Dummitt's," near Merritt Island on Indian River, but no nesting found.	Maynard 1881
1880	Abundant breeding bird in colonies near Clearwater, St. Petersburg, and in Old Tampa Bay.	Scott 1881, 1887
1886	Numbers near Clearwater and St. Petersburg decimated by plume hunters since 1880. Breeding sites near Sarasota, Charlotte Harbor, Matlacha Pass, Pine I. Sound also plundered.	Scott 1887, 1889, 1891; Jamison 1891
1889	Still "locally common" on Gulf Coast. A new breeding locality (St. Martin's Keys, 45 mi. n. Tarpon Springs) reported on the strength of observation by "a friend," apparently in error.	Scott 1889
1890	Colony on small key in Pine Island Sound included an estimated 60-70 Reddish Egret nests.	Jamison 1891
1892	Reddish Egret listed as "rare breeder" for Caloosahatchee region; no details [but probably near Punta Rassa-RTP].	Scott 1892
1902	Just two birds seen in two-day trip in Florida Bay, in areas where the species should have been seen.	Howe and King 1902
1903	Only scattered birds seen in Florida Bay, a former stronghold, by observers who were looking.	Job 1905, Bent 1926
1904	Surviving population in s. Fla. estimated at about 300 by Audubon Warden Guy Bradley. [Anomolously high -RTP]	Allen 1954-55
1906	Two birds "brought in" (shot?) at Islamorada; thought "not uncommon."	Broadhead 1910
1908	Six found fishing at Snake Bight, Florida Bay by Frank Chapman, 29 March.	Chapman 1908

1907, 1908	Considered "abundant" Alachua Co., with 1500 pairs estimated at Bird Island, Orange Lake, alone. [Impossible, and ignored by all reviewers since - RTP]	Baynard 1913
1911	One pair reported at Orange Lake by Baynard, apparently corroborated by P. B. Philipp. [Freshwater site, lack of details make this report questionable, but apparently accepted by Howell 1932 - RTP]	Philipp 1911
1926	Five pairs reported nesting along Kissimmee R. by Baynard. [No documentation, freshwater site: questionable - RTP]	Howell 1932
1937	Two birds found in Fla. Bay near Islamorada 23 April; apparently first sighting in former nesting area in years.	Davis 1937
1938	One nest found in Florida Bay 17 April; documented by many.	Desmond 1939
1944	Fla. Bay population estimated at 50 birds, with 38 counted at one key alone.	Baker 1944
1954	Now a regular breeder at several locations, but state population (= Fla. Bay plus Keys) not over 150 birds.	Allen 1954-55
1959	Fla. Bay population does not exceed 200 birds.	Allen, *in* Palmer 1962
1968	Fledglings observed at Frank Key in nw part of Fla. Bay. [First indication of northward range expansion as noted below - RTP]	J. C. Ogden, *pers. comm.*
1970	Successful nest found at Hemp Key, Pine Island Sound.	Bancroft 1971
1974	At least two nesting pairs at Alafia Bank, Tampa Bay.	Paul et al. 1975
	Statewide population estimated at 300 birds, with Fla. Bay still the primary nesting area.	Robertson and Kushlan 1974
1975	One nest found at ABC heronry near Marco I.	T. H. Below, *pers. comm.*
1976	Nesting confirmed at Arsenicker Keys, s. Biscayne Bay.	J. Tilmant, *pers. comm.*
1977	Revised estimate of 150 nesting pairs suggested for state, based on Robertson and Kushlan (1974).	Paul 1977
1978	Nesting confirmed at Riomar heronry near Vero Beach and Haulover, Merritt I. NWR.	Paul et al. 1979
1979	Nesting confirmed at Terra Ceia Bird Key near Bradenton.	Ogden 1979
1980	Field work of last 3 years shows Fla. Bay population to be at least 100-125 pairs, so 1977 statewide population estimate was low. Revise to 250-300 pairs.	Paul, *unpublished*; Powell et al. 1989

	35 nests found at 6 sites in February survey of selected portion of Lower Keys; loosely extrapolated estimate for entire Lower Keys area is 100 pairs.	Paul, *unpublished*
1981	Two nests found at Cortez Key in Sarasota Bay, and one at Tarpon Key nr. St. Petersburg, where nesting has been suspected for some years.	Paul 1981
1984	Fla. breeding population estimated at ≥300 prs.	Paul, *unpublished*
1985	Nesting confirmed at Pelican Island, Indian River (previously suspected in 1982).	Rodgers and Schwikert 1986
1986	Nesting newly confirmed at Broken I. (Charlotte Harbor), Placida (Gasparilla Sound.), and the n. Banana River (Merritt I. NWR).	Paul 1986
	Strong increase noted at Haulover (Merritt I.), where 41 young fledglings counted - indicates 20-30 pairs.	Paul 1986
1987	Nesting confirmed at three new Gulf coast sites: Rookery Bay near Naples, Estero Bay near Ft. Myers Beach, Roberts Bay near Sarasota.	Paul 1987
1988	Tampa Bay population has increased to an estimated 59 pairs at 3 colonies.	Paul 1988
1990	Current estimate, Fla. breeding population: 350-400 pairs (but no surveys of the major Fla. Bay and Lower Keys breeding populations since 1977-80).	Paul, *unpublished*
1991	Nesting confirmed at three new Gulf coast sites: Little Sarasota Bay, Clearwater Harbor, s. St. Joseph Sound.	Paul, *unpublished*

Table 2. REDDISH EGRETS IN LOUISIANA AND ALABAMA

Year	Comments	Source
	1. LOUISIANA	
1896	Four clutches collected by E. A. McIlhenny at Timbalier I., May.	egg data from U. S. Nat. Mus.*, Univ. Puget Sound, Cal. Acad. Sci., Western Foundation Vert. Zool.
1900	"common resident along the coast during summers" - implies nesting.	Beyer 1900
1904	One clutch of 2 eggs, coll. Mitchel Island LA, 5-9-1904, W. N. Walker. UMMZ #190759.	egg data from U. Michigan Mus. Zool.*
1908	"rather common as a breeder along the coast."	Beyer et al. 1908
1926	Timbalier I., LA listed among breeding localities.	Bent 1926
1955	"no nesting records for the species in Louisiana."	Lowery 1955
1958	Nesting confirmed at North Island in Chandeleur chain.	Lowery 1960
1965	Five prs estimated at North I. in aerial survey.	A. Sprunt IV 1965
1971	June survey tallied 44 adults seen at North and adj. islands. Nests present but uncounted.	Lowery 1974
1974	ca. 20 adults in colony. on Queen Bess I., Barataria Bay; nesting not confirmed	Ted Joanan, *pers. comm.*
early 70s	Scattered records indicate nesting at North I., Raccoon Pt., New Harbor, Freemason I. by total of approx. 25 prs.	Portnoy 1975
1976	151 nests estimated at 9 colonies in careful aerial and ground count; largest number at Lonesome I., where transect sampling yielded estimate of 105 prs. Other 46 all recorded in direct counts.	Portnoy 1978; *pers. comm.*
1983	Nesting at five sites detected by aerial survey; no estimates of nos. and no ground checks.	Keller et al 1984
	2. ALABAMA	
1965	Four birds seen in small heronry on Cat Island; nesting suspected but not confirmed.	Stewart 1965, Imhof 1976

1979	One nest confirmed at Cat Island 6-25-79	Jackson and Cooley 1979
1985	Three nests at Cat I.	Dindo and Marion 1986
1986	Two nests at Cat I.	Dindo et al 1987
1987	Annual nesting since 1985 at Cat I.	J. J. Dindo, *in litt.* 1987

* Clutch seen by R. T. Paul.

Table 3. REDDISH EGRETS IN TEXAS, 1837-1934

Year	Comments	Source
1837	Resident in Galveston Bay.	Audubon 1843
1858	Records one specimen taken at Matamoros on Rio Grande.	Baird, Cassin and Lawrence 1858
1864	According to Heermann, "not uncommon" near San Antonio and in E. Texas in summer. [no specific reference to nesting status - RTP]	Dresser 1866
1877	Common among islands and lagoons of Corpus Christi Pass in March.	Sennett 1878
1878	A few nesting at mouth of Nueces R., "hundreds" breeding at South Bird I., a few also at Pelican Islands of CC Pass.	Sennett 1879
1884	Found nesting, apparently near Corpus Christi.	Benners 1887
1893?	Common in Nueces and Corpus Christi Bays; a few seen at Hidalgo.	Singley 1893
1896	North Bird Island, Laguna Madre: clutch of eggs collected May 20 by D. B. Burrows	egg data from Western Foundation of Vert. Zool.
1900	Refugio Co.: Reddish Egret "not very common. Breeds."	J. J. Carroll 1900
1901	Aransas Co.: 2 clutches collected, May 12 and 24, by J.M. and J.J. Carroll (no further details on locality)	egg data from WFVZ
1909	"Bird Island," locality unnoted but from other details clearly South Bird Is.): Reddish Egrets noted among list of breeding birds	J. M. Carroll 1909
1918	Second Chain of Islands discovered: 1250 pairs est.	Pearson 1918
1920	Second Chain: 500 pairs (islands damaged by hurricane of 1919).	Pearson 1920, 1921
	Big (South) Bird Island: 2 nests seen, 8 prs est.	Pearson 1920, 1921
	Green Island discovered: colony of 5000-10000 birds of 5 species; Reddish Egrets "easily the dominating species"	Pearson 1920, 1921
1922	Green Island: 1800 pairs	R.D. Camp 1922
	Green Island: 2000 pairs	Pemberton 1922a

1923	Karankawa Bay: total of 50 pairs of Reddish Egrets, Great Blue and Louisiana Herons	Bent 1926
	Wolf Point: "a few pairs"	Bent 1926
	Roses (=Rhodes?) Point, Lavaca Bay: "a very few"	Bent 1926
	Second Chain: 7 nesting species, Reddish and Louisiana the most abundant. No number quoted.	Bent 1926
	Big (South) Bird Island: "quite a large colony"	Bent 1926
	Green Island: 20% increase over 1922	R.D. Camp, in Bent 1926
1925	Ayres Dugout, Mesquite Bay: "large colony"	R. W. Quillin, in Oberholser and Kincaid 1974
1926	Ransom Point Island: 300 pairs	R.W. Quillin notes in Bureau of Biological Survey files
	South Bird I.: 75-100 pairs	J. J. Carroll 1927
1927	West Bay Bird Island: nests with eggs May 15 mark eastern limit of nesting in Texas	J.J. Carroll, in Oberholser and Kincaid 1974
	Ransom Island (= Ransom Point Is.): hundreds nesting	A.J. Kirn notes in BBS files
	Brazos Santiago Pass: 1 nest, adult with eggs May 30	J. J. Carroll notes n, BBS files
1928	Farwell Island, nr Port O'Connor: 4 banded by J.W. Stiles (apparently first nesting record for this site)	J.W.Stiles notes in BBS files
	Ransom Point Island: large colony (Quillin), hundreds nesting (Kirn)	Quillin notes with egg sets (WFVZ), A.J.Kirn notes in BBS files
	"Brownsville, Mud Dump": 50 pairs observed May 28	J. J. Carroll, notes in BBS files
1929	Ransom Island (=Ransom Point Is.): 600 nests	A.J.Kirn notes in BBS files
1930	Farwell I: 120 banded by J. W. Stiles	BBS files
1931	Farwell I.: approx. 150 banded by Alston Clapp, Sr. and J. W. Stiles	BBS files
1932	Farwell I.: ≈150 young banded by Alston Clapp	BBS files
1934	West Bay Bird I: 3 young banded by Alston Clapp	BBS files

Shell I., San Antonio Bay: breeding birds, May 2	J.J. Carroll notes in BBS files
Dunham I., Aransas Bay: "thousands" in colony May 3	J. J. Carroll, in Oberholser and Kincaid 1974

Note: Not all nest records are reported for all years. Early records were frequently vague about localities, perhaps in part to protect them (from plume hunters, or in some cases, competing egg collectors!). Major colonies like Green Island, Second Chain, South Bird Island were probably active in all years.

Table 4: REDDISH EGRETS BREEDING IN TEXAS: Surveys of 1923 and 1934-1939

(All numbers represent breeding pairs)

COLONY	1923	1934[a]	1936	1937	1939[b]
Vingt-un Islands			1	0	0
West Bay Bird I.		25	1	6	0
Karankawa Bay	20c				
Wolf Point	10c				
Roses Point	10c				
First Chain of Islands			31	0	4
Shell Island		2	0	0	0
2nd Chain	500d		150	200	350
Ayres Island		0	0	0	250
Dunham Island		50	?	?	0
Lydia Ann Island			-	-	400
Harbor Island			-	-	12
Dagger Island			-	-	40
South Bird Island	50c	25	25	?	150
Green Island	2160e		2400	2400	2000
Three Islands			6	0	0
TEXAS TOTALS	**2750**		**2614+**	**2606+**	**3206**

Data from R. P. Allen (1939b, 1950) except as otherwise noted.

[a] nesting efforts at a few sites peaked in 1934, shown here; otherwise this was a year of partial survey and a statewide estimate is not possible.

[b] 1939 was most complete survey of the 1930s

[c] from Bent (1926).

[d] based on 1920 estimate by Pearson (1920).

[e] based on 1922 estimate of 1800 prs. +20% as per Camp (in Bent 1926).

Table 5. REDDISH EGRETS BREEDING IN TEXAS: 1950-1972

(All data represent breeding pairs)

COLONY	1950[a]	1959[b]	1965[c]	1972[d]
Pelican I. (Galveston)				2[e]
North Deer + spoil is.		21	22	"
West Bay Bird I.	0	0	4	0
Dressing Point		nd	35	100
Lavaca-Matagorda Bay spoil is.				52[e]
Grass I. spoil (San Antonio Bay)	65			
Second Chain	150	53	75	247
Long Reef, Aransas Bay		3	0	92
Lydia Ann Island	350	20	0	0
CC Causeway spoil, Redfish Bay			172	90
Hog L., Redfish Bay		6	0	0
Pelican I. (Corpus Christi)		nd	75	40
South Bird I.	50	120	151	40
Baffin Bay spoil is.				7
Pt. Mansfield spoil is.		0	1	0
Green Island	1400	1400	15	524[f]
Pt. Isabel spoil is.		nd	2	
TEXAS TOTALS	2015	1623	552	≥1194

National Audubon Society surveys. Data from

[a] Allen (1950)
[b] from Sprunt (1959)
[c] Sprunt (1965)
[d] Sprunt (1972), except as noted.
[e] Blacklock (1972)
[f] W. J. Fluman, pers. comm.

Table 6a. REDDISH EGRETS BREEDING IN TEXAS, 1974-1978

(Texas Colonial Waterbird Society Data)
(Numbers represent breeding pairs)

COLONY	1974	1975	1976	1977	1978
Rollover Pass	2	ns			
Smith Point Sp.					
Atkinson I.					2
Pelican Island			7		
Little Pelican I.					
Marker 52 Sp.	ns	41	40	10	4
Jigsaw		ns		15	
North Deer I.	39	18	20	3	20
South Deer I.			2		
McAllis Point					
Snake I.		2			
Bay Harbor Bar					
Hoecker's Pt.					
Carancahua Cove					
West Bay Bird I.			1	4	
Arcadia Reef					
San Luis Pass		1			
Cedar Lakes					
Dressing Point	160	125	125	40	10
Point Comfort					
Lavaca Bay Spoil	1	8	2	15	0
Matagorda Bay Sp.	40	32	75	15	5
Sundown Island	20	30	125	100	150
Σ Upper Coast	**262**	**257**	**397**	**202**	**191**
Seadrift I.	13	11	6	3	4
Turnstake I.		1		ia	
Steamboat I.				1	
2nd Chain	56	24	28	47	50
Aransas Refuge Sp.	ns		ns	ns	1
Third Chain					
Ballou I.	15	ia	ia	ia	ia
Long Reef/Deadman I.	68	133	153	80	58
Big Bayou Sp.	ns	161	54	120	123
CCBayouCauseway Is.	54	28	78	11	33
Danger I.	12	44	25	20	ia
Aransas Channel Sp.	0	2	2	5	ia
Hog I. complex	5	2			3
Stedman I.	ia	ia	ia		3
Ransom I./Sp.	ia		ia		ia
West Harbor I.	ns	ns	ns	ns	1
HarborI.EastShoreSp	ns	ns	ns	3	ns
W. Nueces Bay	10	10	31	11	4

E. Nueces Bay	1		2		1
Pelican I. (CC)	56	64	70	16	52
Shamrock I.	6	14	4	21	18
Naval Air Sta Is.	1	ns	32	77	7
Kenedy Causeway	ns	3	2	5	3
Marker 2-17 Sp.	(1974-78:	combined	with Naval	Air Station	Islands)
Pita I-Humble Chan.				12	13
N of North Bird I.		ia			11
South Bird I.	88	95	40	72	46
South of SBI		20	23	8	7
Marker 69A					
M 75 (=77A)					
Marker 81	65	2	82	18	17
Marker 91					
Marker 103-117	110	304	113	78	37
M173=169=85A)					
∑ Central Coast	**560**	**918**	**745**	**608**	**491**
The Hole	ns			ns	5
S. Baffin Bay I.	ia	ia	ia		*0
South Land Cut	ns	15	42	25	34
Mansfield Odd Sp.	ns	1		ns	
NE Mansfield Int.		1			
Green Is. Cut Sp.					
Green Hill Sp.					
Green Island	**200	**250	**411	600	400
Arroyo Col. Int. Sp.	ns	1			
Three Is. Spoil		12	11	9	11
Laguna Vista Sp.	ns	ns	ns	1	10
Port Isabel Sp.	1	13	11	17	13
∑ Lower Coast	**201**	**293**	**475**	**652**	*473
Upper Coast	262	257	397	202	191
Central Coast	560	918	745	608	491
Lower Coast	201	293	475	652	*473
TCWBS corrections					(*typo -78)
TEXAS TOTALS	**1023**	**1468**	**1617**	**1462**	**1155**
TEXAS TOTALS with Green Island corrections	**1498**	**1818**	**1761**		

ia = inactive
ns = no survey
Blank cells = 0 Reddish Egrets in colony
* correction to TCWBS data - compiling error.
** Green Island population estimates believed low. Alternative estimates are: 1974: 675; 1975: 660; 1976: 555 (W. J. Fluman and R. T. Paul, unpubl. data).

Table 6b. REDDISH EGRETS BREEDING IN TEXAS, 1979-1983

(Texas Colonial Waterbird Society Data)
(Numbers represent breeding pairs)

COLONY	1979	1980	1981	1982	1983
Rollover Pass	6	4	10	4	2
Smith Point Sp.		NS			
Atkinson I.					
Pelican Island					
Little Pelican I.					
Marker 52 Sp.	NS	15			4
Jigsaw					NS
North Deer I.	6	15	NO DATA	*50	29
South Deer I.					
McAllis Point	2	NS			
Snake I.	3	NS			
Bay Harbor Bar		NS			
Hoecker's Pt.		NS			NS
Carancahua Cove	NS	NS			NS
West Bay Bird I.	NS		NS		
Arcadia Reef					
San Luis Pass					
Cedar Lakes	3	3		9	4
Dressing Point	*250	200	100	75	50
Point Comfort			5		
Lavaca Bay Spoil	5		15	2	
Matagorda Bay Sp.	40	25	40	50	35
Sundown Island	500	225	100	150	120
Σ Upper Coast	**815**	**487**	**270**	**340**	**244**
Seadrift I.	5		3		1
Turnstake I.	3	2			
Steamboat I.	1	IA		2	
2nd Chain	20	46	28	35	80
Third Chain				2	2
Long Reef/Deadman I.	20	27	62	76	73
Big Bayou Sp.	55	1	11	16	8
CCBayouCauseway Is.	2	0	0	7	0
Danger I.	IA	IA			
Aransas Channel Sp.	3	3	1	3	0
Hog I. complex	1				
Stedman I.					
Ransom I./Sp.	6	25	4	1	
West Harbor I.					
HarborIsEastShoreSp	13				
W. Nueces Bay	8	4	15	4	23
E. Nueces Bay	0	0	0	13	5
Pelican I. (CC)	67	56	34	86	137

Shamrock I.	78	50	55	45	41
Naval Air Sta Is.	7		2	9	15
Kenedy Causeway	2	6	4	6	2
Marker 2-17 Sp.	5	5	6	8	3
Pita I-Humble Chan.	11	16	7	12	11
N of North Bird I.					
South Bird I.	55	15	10	40	6
South of SBI	1	2	8	8	8
Marker 69A					
M 75 (=77A)					
Marker 81	21	29	17	45	40
Marker 91				1	1
Marker 103-117	42	45	20	41	36
M173=169=85A)					
∑ Central Coast	**426**	**332**	**287**	**460**	**492**
Marker 139-153			2		2
Padre I. Spoil				1	
S. Baffin Bay I.	3		1	4	2
South Land Cut	37	26	86	118	94
Mansfield Odd Sp.					
NE Mansfield Int.	13	6	11	9	60
SW Mansfield Int.					
Green Is. Cut Sp.					
Green Hill Sp.					
Green Island	775	880	742	700	660
Arroyo Col. Int. Sp.					
Three Is. Spoil	27	29	14	50	142
Laguna Vista Sp.	2		10	10	6
Port Isabel Sp.	7		0	8	11
Dead Pecker Hill	5				
∑ Lower Coast	**869**	**941**	**866**	**900**	**977**
Upper Coast	815	487	270	*340	244
Central Coast	426	332	287	460	492
Lower Coast	869	941	866	900	977
TCWBS corrections	(*-100)			(*-350)	
TEXAS TOTALS	**2110**	**1760**	**1423**	**1700**	**1713**

IA = inactive
NS = no survey
Blank cell = 0 Reddish Egrets in colony, or inactive site
* in body of table indicates TCWBS data modified
(-100 correction at Dressing Point *fide* K. A. King)
(-350 correction at North Deer Island *fide* D. R. Blankinship)

Table 6c. REDDISH EGRETS BREEDING IN TEXAS, 1984-1988

(Texas Colonial Waterbird Survey Data)
(Numbers represent breeding pairs)

COLONY	1984	1985	1986	1987	1988
Willow Slough	ND			**25	
Rollover Pass	5	1	3	1	1
Smith Point Sp.			1	2	3
Atkinson I.		ND			
Little Pelican I.		2		4	4
Marker 52 Sp.	IA		2		
Jigsaw	ND	ND	ND	IA	
North Deer I.	28	20	20	51	50
South Deer I.			1		
Snake Is.		1	IA		IA
Bay Harbor Bar			1		
Hoecker's Pt.					2
Carancahua Cove					2
West Bay Bird I.	2		1		6
Arcadia Reef					1
San Luis Pass					
Cedar Lakes			9	30	29
Dressing Point	100	80	200	75	85
Lavaca Bay Spoil	2	6+1	2	5	4
Matagorda Bay Sp.					
Sundown Island	90	125	105	100	50
Σ Upper Coast	**(227)**	**(236)**	**(*345)**	**(*268)**	**(237)**
Seadrift I.	3	0	ND	0	IA
San Antonio B. Sp.	ND		ND	ND	1
Turnstake I.			ND	inactive	
Steamboat I.	2		ND	1	3
2nd Chain	61	64	68	150	56
Third Chain			2		
Ballou I.	IA	IA	IA	IA	IA
Long Reef/Deadman I.	46	42	23	5	51
Big Bayou Sp.	1		5	IA	IA
CCBayouCauseway Is.	3	7	2	3	22
Danger I.	IA	IA			
Aransas Channel Sp.			IA	IA	
Hog I. complex		IA	IA	IA	IA
Ransom I./Sp.			2		IA
West Harbor I.					
HarborI.EastShoreSp.					
W. Nueces Bay	11	1	4	5	12
E. Nueces Bay	1	10	2	1	7
Pelican I. (CC)	169	177	27	18	15

Shamrock I.	7	52	45	41	**NO DATA**
Naval Air Sta Is.	20	14	6	15	**ND**
Kenedy Causeway	2	**ND**	lumped?	1	
Marker 2-17 Sp.	15	**IA**	40	lumped?	lumped?
Pita I-Humble Chan.	11	11	14	25	16
N of North Bird I.	2	5	inactive		
South Bird I.	34	12	21	23	14
South of SBI	10	31	16	51	36
Marker 69A	16	6	10		4
M 75 (=77A)	(M75) 1	(M75) 14	(M77A) 0	(M77A) 0	(M77A) 0
Marker 81	38	33	20	18	16
Marker 91		4	10	7	5
Marker 103-117	40	1		30	**IA**
M173=169=85A)	**IA**	(M169) 2	(M85A) 0	(M85A) 0	(M85A) 0
Σ Central Coast	**(493)**	**(486)**	**(317)**	**(394)**	**(258)**
Marker 139-153					4
Padre I. Spoil		3		**IA**	
S. Baffin Bay I.	16	17	42	30	40
South Land Cut	71	81	**NO DATA**	79	72
Mansfield Odd Sp.					
NE Mansfield Int.	106	269	123	252	110
SW Mansfield Int.			8		
Green Is. Cut Sp.		12	6	30	31
Green Hill Sp.		1	2	24	1
Green Island	182	50	10	4	20
Arroyo Col. Int. Sp.			**NO DATA**	50	150
Three Is. Spoil	187	204	236	328	138
Laguna Vista Sp.	95	89	10	2	4
Port Isabel Sp.	23	19	4	21	5
Dead Pecker Hill					
Σ Lower Coast	**(680)**	**(745)**	**(441+)**	**(820)**	**(575)**
Upper Coast	227	236	*345	*268	237
Central Coast	493	486	317	394	258
Lower Coast	680	745	441	820	575
TCWBS corrections - - -			(*-50)	(*-25)	
TEXAS TOTALS	**1400**	**1467**	**1103**	**1482**	**1070**

IA = inactive
ND = no survey, no data
Blank cells = 0 Reddish Egrets in colony
* or bold face in body of table indicates correction to TCWBS data, or major concern

** **25 pairs** at Willow Slough, 1987: Aerial survey of colony of 10,200 pairs. There is no previous report of Reddish Egrets nesting in freshwater areas in Texas. Record cannot be accepted without additional details or verification by ground survey.

Table 6d. REDDISH EGRETS BREEDING IN TEXAS, 1989-1990

(Texas Colonial Waterbird Survey Data)
(Numbers represent breeding pairs)

COLONY	1989	1990
Lake Kemp #2	*5	
North-Central Σ	**5**	
Rollover Pass	3	3
Smith Point Sp.	2	3
Atkinson I.	1	
Little Pelican I.	2	4
North Deer I.	20	20
McAllis Point	3	
Snake Is.	4	
Dana Cove	1	
West Bay Bird I.	8	
Drum Bay	4	1
Moyle	*20	
Cedar Lakes	15	28
Dressing Point	30	45
Lavaca Bay Spoil	2	17
Matagorda Bay Sp.		1
Sundown Island	50	75
Σ Upper Coast	**165**	**197**
Seadrift I.	ND	12
San Antonio B. Sp.	ND	
Turnstake I.	ND	
Steamboat I.	ND	7
2nd Chain	64	75
Third Chain		15
Long Reef/Deadman I.	135	120
Little Bay		14
Big Bayou Sp.	IA	
CCBayouCauseway Is.	17	36
W. Nueces Bay	10	10
E. Nueces Bay	4	9
Pelican I. (CC)	36	12
Shamrock I.	NO DATA	75
Naval Air Sta Is.		20
Kenedy Causeway	4	3
Marker 2-17 Sp.	7	6
Pita I-Humble Chan.	27	25
South Bird I.	6	24

South of SBI	23	130
New Spoil Bank #12		1
Marker 69A	5	
Marker 81	2	10
Marker 91	11	2
Marker 103-117	IA	
M173=169=85A)	1	
Σ Central Coast	**352**	**606**
Marker 139-153	0	3
Padre I. Spoil	0	
S. Baffin Bay I.	58	54
South Land Cut	28	49
Mansfield Odd Sp.	0	
NE Mansfield Int.	22	52
SW Mansfield Int.	0	5
Green Is. Cut Sp	13	7
Green Hill Sp.	6	25
Green Island	20	220
Arroyo Col. Int. Sp.	111	38
East Arroyo Sp.		1
Three Is. Spoil	217	220
South Three Is. Sp.		4
Laguna Vista Sp.	2	10
Port Isabel Sp.	5	9
Σ Lower Coast	**482**	**697**
North-Central	*5	
Upper Coast	*165	197
Central Coast	352	606
Lower Coast	482	697
TCWBS corrections	-25	
TEXAS TOTALS	**979**	**1500**

IA = inactive
ND = no data, no survey
* indicates correction to TCWBS data (deletion of undocumented fresh-water nesting records)

Table 7. REDDISH EGRETS IN MEXICO

Region/States	Status, Records, Sources
General comments	Breeding distribution probably fairly well known, but not nesting seasons. In view of long nesting season in s. Fla., population estimates from one-shot surveys, esp. in Yucatan Penin. region, should be considered conservative.
I. Gulf Coast: Tamaulipas, Veracruz, Tabasco	A few nesting in a large mixed-species colony in Laguna Tamiahua in 1910 (Chapman 1914, 1933). Allen (1954-55) suspected nesting in Laguna Tamaulipas south of Brownsville but offered no specific records. In June 1975, 52 pairs were estimated by aerial survey at four colonies in Laguna Tamaulipas and one in Laguna de San Andres (A. Sprunt IV, *unpubl. data*). In May 1976, 74+ pairs were found in seven colonies in aerial survey of the same area (Sprunt and Knoder 1980 and R. T. Paul, *unpubl. data*). Probably still nests also at Lag. Tamiahua, where one adult was found in the colony in 1973 (A. Sprunt IV, *pers. comm.*).
II. Yucatan Penin.: Campeche, Yucatan, Quintana Roo	First recorded 1841 (Stephens 1843). Reported from Progreso in 1865 (Schott, in Lawrence 1869), and Cozumel in 1885 (Salvin 1889), where it was common enough that Salvin's collector took at least 15 specimens. A young of the year collected at Cozumel in 1901 had traces of down on its head (USNM#167359, examined by RTPaul), a strong indication of local nesting. A colony of 50 pairs was found in January 1926 at Culebra Key, Bahia de la Ascención, Q.R. (Griscom 1926), and still active in 1949 (Paynter 1955). Allen (1954-55) thought this possibly the only colony in the region. Now also known to breed n. of Cancún at Isla Morena (but abandoned in 1985 due apparently to human disturbance - D. R. Blankinship, *pers. comm.*), the adjacent Isla Holbox (75 prs in 1972 - A. Sprunt IV, *unpubl. data*), and Isla Contoy (100 prs - Scott and Carbonell 1986), also farther s. near Boca Paila (L. P. Brown, *pers. comm.*). To be looked for elsewhere; good candidate sites include the coastal lagoons near Celestún (Cam.), Rio Lagartos (Yuc.), additional sites in Bah. de la Ascención; perhaps also the Chinchorro Bank where the species has been previously recorded (Paynter 1955). Listed as locally common resident for Yucatan Penin. by MacKinnon de Montes (1989).

III. Sea of Cortez and Baja California: Baja California (Norte + Sur), Sonora, Sinaloa, Nayarit, Colima	First recorded 1859 (Ridgway 1883). Considered year-round resident but not abundant at Mazatlán (Grayson, *in* Lawrence 1874). Generally common at Cabo San Lucas and La Paz, rare at San José del Cabo in 1882 (Belding 1883). "Tolerably common" at Santa Margarita I. (Bryant 1889), "not uncommon" at the then northernmost known Baja locality of San Quintín (Anthony 1893). Nesting recorded at San Luis Island (Cooke 1913, van Rossem 1926), Angel de la Guarda and Granite Islands (Maillard 1923), Laguna Ojo de Liebre (Bancroft 1927), Tóbari Bay, Guacimas Bay in 1930 (Bancroft, unpubl. egg data), Bahia Magdalena, Laguna San Ignacio, locally in coastal lagoons of s. Sonora and Sinaloa (Friedmann et al. 1950). In Sonora, not thought to nest north of Tóbari Bay (Phillips et al. 1964). July 1972 aerial survey of 3 Baja sites - Bahia Magdalena, Laguna San Ignacio and Lag. Ojo de Liebre - plus Bahia de Santa Maria, Sinaloa yielded total estimate of 180 nests, with only scattered birds found along coasts between these population centers (Knoder et al. 1980). Bent (1926) followed Cooke (1913) in listing San Blas, Tepic (Nayarit) among reported breeding localities, but I know of no recent confirmation. Five seen at Laguna de Cuyutlán, Colima, in May 1959 near or in a large waterbird colony (Schaldach 1963) suggest nesting well south of other records for the region, but this remains unconfirmed.
IV. Gulf of Tehuantepec: Oaxaca, Chiapas	First recorded 1869 (Lawrence 1876). Common permanent resident from Minitán and Ventosa east to Chiapas, in Lagunas Superior/Inferior and Mar Muerto. Nesting confirmed; up to 64 birds seen in colony in March 1964 (Alvarez del Toro 1964, Binford 1989). In July 1972 aerial survey, colony estimated at 150 nests (Knoder et al. 1980). One of the key population centers for the Reddish Egret on the Pacific coast.
V. Summary	Suggested minimum population estimates based on above data: for Gulf-Caribbean coast, 300 pairs (compare to estimate of "not over 500" pairs by Sprunt and Knoder 1980); for Pacific coast, 330 pairs + more at known sites omitted from surveys. Totals for both coasts are certain to be underestimates, as is grand total of ≥ 630 pairs.

Table 8. REDDISH EGRETS IN THE BAHAMAS AND WEST INDIES

Country/Island	Status, Records, Sources
(General comments)	Widely distributed in Bahamas and Greater Antilles but generally uncommon to rare; locally common in Cuba, Inagua, Caicos Is. Very rare in Lesser Antilles (Bond 1956).
Bahamas	First recorded by Cory (1880) from unstated locality, probably Abaco. Later listed occurrence on Grand Bahama, Abaco, New Providence and Andros (Cory 1892) . Cory travelled widely and considered this species more common than other herons. At Andros, also considered abundant by Northrop (1891). Found nesting at Inagua in 1909 (Todd and Worthington 1911). "Not uncommon" (Bond 1956). Widely distributed throughout southern Bahamas, where an uncommon to common resident (Buden 1987a). Largest numbers are on Great Inagua (Allen 1954-55) and probably Andros (e.g. Bonhote 1903, Chapman 1908). 200 pairs recently estimated for Inagua (Scott and Carbonell 1986). Scattered records in northern islands suggest wide distribution there too (many references).
Turks & Caicos	Several specimens collected by Cory (1891, 1892); few observers since but occasionally reported (e.g., A. Sprunt IV *pers. comm.*, Buden 1987a). Resident and probably widespread, if uncommon, on salt flats of the islands.
Cuba	First recorded by Gundlach in 1841(Gundlach 1895). Later he found them relatively uncommon on both north and south coasts, but nesting at the Río Cauto (Gundlach 1862, 1875). Barbour (1923) thought the species "not uncommon", and abundant at the Ensenada de Cochinos. "Fairly common" at Cayo Largo (Bond 1950). Allen (1954-55) however considered the species rare after considerable field work on both coasts. Still considered rather rare, although widely distributed, in coastal lagoons of Cuba and Isle of Pines; known to be locally common only in Ensenada de Cochinos (Garrido and Garcia Montaña 1975).
Jamaica	Rare (Bond 1956). Increasing number of sightings in scattered s. coast localities since 1980 (numerous reports in Broadsheet). Not known to breed, but possibly overlooked.
Hispaniola	Rare resident; presumed to breed in Dominican Republic by Wetmore and Swales (1931) and Hellmayr and Conover (1948) but no documentation. Recorded from Lago Enriquillo, Monte Cristi, Laguna de Oviedo, Laguna Salada, and several other sites by J. A. Ottenwalder and Vargas Mora (*pers. comm.*); listed as breeding species at latter two localities by Scott and Carbonell (1986). Four records from Haiti known to me, from interior saline lagoons and Artibonite R. delta (Danforth 1929).

Puerto Rico	Five records (Raffaele 1989).
Virgin Islands	One record (Raffaele 1989).
Cayman Islands	First record 1984, 2 birds present most of year (Bradley 1985). One other record (Fletcher 1985). Nonbreeder.
St Martin	One record (Voous and Koelers 1967).
Montserrat	One record (Bond 1984).

Table 9. REDDISH EGRETS IN CENTRAL AND SOUTH AMERICA

Country	Status, Records, Sources
(General comments)	Generally uncommon to rare, but recent observations suggest they may have been overlooked. Local centers of abundance appear to occur in Belize, Venezuela, Colombia, Bonaire; latter three probably part of a contiguous population. Little information on population numbers.
Belize	First recorded sighting in 1957 (Russell 1964). In 1984 nesting reported at Shipstern Lagoon (12 prs) and Cayos Pajaros (4-5 prs) (D. Weyer, *in* Scott and Carbonell 1986). Recently discovered nesting on Cayo Rosario (S. Hecker, *pers. comm.*); in a March 1990 survey A. Poole (*pers. comm.*) found 75 prs at Cayo Rosario, about 15 prs at Shipstern lagoon, and 4-7 prs each at Bird Cay and Mosquito Cays. Total estimate for Belize currently 100 prs. Increasing, or just overlooked in the past?
Guatemala	Very scarce. Just six records known to me. First report (Salvin 1865, 1866) noted both phases at lagoon at Chiapam, on Pacific coast near Mexican border. Birds may be part of population centered at Mar Muerto, Oaxaca-Chiapas. Breeding not yet reported, should be looked for on any islands in small lagoons of Pacific coast - e.g., Manchon Lagoons (see Scott and Carbonell 1986).
Honduras	First record was of one bird at a salt works on the Golfo de Fonseca near Choluteca, Pacific coast, 12-12-75 (R. S. Ridgely, *pers. comm.*). A few Pacific coast sightings since (Ridgely and Gwynne 1989). To be looked for in salt works and coastal lagoons, esp. Lag. de Caratasca on Caribbean coast, and Golfo de Fonseca on Pacific side.
El Salvador	Four records since 1927 (Dickey and van Rossem 1938), including one of a bird banded at Aransas Pass, TX in 1976 (Paul, *unpubl. data*). Not known to breed. To be looked for in Golfo de Fonseca and other coastal lagoons.
Nicaragua	First record was of one bird at saltworks at "Puerto Somoza," 2-21-76 (R. S. Ridgely, *pers. comm.*). A few other Pacific coast sightings since, generally at solar salt ponds (Ridgely and Gwynne 1989).
Costa Rica	First recorded 1973 from Golfo de Nicoya (Stiles and Smith 1977). A few records since on both coasts; considered a migrant on Caribbean coast and rare but probably regular winter resident on the Pacific side. Not considered a local breeder (Stiles 1983, Stiles and Skutch 1989, Ridgely and Gwynne 1989).

Panama	One sighting, from Isla Coiba on Pacific Coast, 4-12-76 (Ridgely and Gwynne 1989).
Colombia	First recorded 1963 at Mayapo, Guajira Peninsula (Hilty and Brown 1986). Subsequently seen at Isla Salamanca in 1972 (T. B. Johnson and J. I. Borrero H., *pers. comm.*), and in 1974-5 at Salamanca and also Riohacha. Farther east at Manaure on 6-27-74, Sprunt (1976, *pers. comm.*) found 104 birds including barely fledged young. Reported resident at Bahia de Cartagena and Ciénaga de la Virgen (L. G. Naranjo, *in* Scott and Carbonell 1986). To be looked for farther east on Guajira Penin. One Pacific coast record, at Buenaventura (S. Hilty and I. J. Abramson, *pers. comm.*, Hilty and Brown 1986).
Venezuela, incl. extralimital islands	Baird, Brewer and Ridgway (1884) vaguely noted occurrence in n. South America. Confirmed in 1896 from Paraguaná Penin. (2 specimens at Mus. Nat. D'Hist. Naturelle, Paris; C. Voison, *pers. comm.*). Since reported from several mainland sites, notably Paraguaná, Chichirivíchi, and Cumaná, and a number of islands including Isla Margarita, Los Roques, La Tortuga, La Orchila, Las Aves (Barnes and Phelps 1940; Fernando Yepez and Benedetti 1940; Gines and Yépez Tamayo 1960; Cory 1909; Phelps and Phelps 1958; Yépez Tamayo 1955, 1963-64). At Isla Margarita, species considered reasonably abundant (Fernando Yepez and Benedetti 1940), and probably resident (Yépez Tamayo 1963-64). Latter reported up to 70 birds at once. Also reported as common at Caimare Chico (Zulia State, n. of Maracaibo) and nesting at Los Roques (Scott and Carbonell 1986). Population sizes not known, but local centers appear to be Isla Margarita and adjacent islands, Chichirivíchi, Paraguaná Penin., Los Roques and adjacent islands, possibly the Golfo de Maracaibo.
Aruba, Bonaire, Curaçao (Netherlands Antilles, Leeward Group)	First recorded 1930 from Curaçao and Bonaire (Rutten 1931). Resident and nesting, more common on Bonaire than other islands (Voous 1983, Spaans 1974). Population probably contiguous with that of Las Aves, Los Roques, Paraguaná, Chichirivichi; perhaps also Guajira Penin. of Colombia. Numbers not known but species generally considered uncommon.

Table 10. CURRENT STATUS OF REDDISH EGRETS: SUMMARY TABLE

(all data expressed in numbers of breeding pairs)

State or Country	Estimated Nos.	Comment
Florida	350-400	apparently increasing, but no check of key s. Fla. breeding centers since 1980.
Alabama	<5	present since 1979.
Louisiana	≤150?	increased 1958-1976; possibly 50% decline since. Detailed ground survey needed.
Texas	1500	Population approximately 1400-1700 pairs since 1974, but possible irregular decline since 1987. 1990 estimate is 1500 prs. SEE TEXT.
Mexico	660-1000 (min-max?)	New colonies probably still to be found in several areas. No data to suggest trends, except Quintana Roo where apparently has not decreased.
Belize	100	Better coverage of area; also increasing?
Bahamas	200 (Inagua only)	No other estimates but possibly as many spread around the other islands. Probably not declining.
Turks & Caicos	?	Sparse; widely distributed. Trend unk.
Cuba	?	Potentially significant population, but only sporadic reports. Trend unknown.
Hispaniola	likely, but not documented	Possibly nests at several sites. Sightings in 70s, 80s suggest rare but perhaps not declining.
Jamaica	none known	Increasing number of sightings since 1970 suggest breeding overlooked.
Colombia	?	Breeding known from one locality but others likely; records from 70s and 80s due to better coverage of area. Trend unknown.
Venezuela	?	Distribution well known but no estimates of breeding numbers. Trend unknown.

APPENDIX B

Evaluation of Survey and Census Methodology of the Texas Colonial Waterbird Survey.

1. The survey

Although supplemented by aerial survey, all coastal colonies are visited on the ground (by boat if the sites are on islands). Nests, adults attending nests, or broods are counted directly if the vegetation and island topography allow, or carefully estimated. Wherever possible this is done from the side of the colony, or even from the boat, to avoid disturbance to the colony.

Factors influencing the decision to enter a colony should include: time of day, sun intensity, heat, rain, visibility of nests, ease of access within colony, nesting density, and the presence of certain highly sensitive species. The goal is obviously to gain the most precise information possible, with a minimum of disturbance to nesting birds.

Large, diverse colonies - especially those occurring in dense vegetation - may require other approaches. Some observers walk looping transects through the colony, counting or estimating nesting numbers of each species as they go. Teams of two or three people may average their estimates. Another technique is the "flight-line" survey of Erwin and Ogden (1980) and Erwin (1981), in which adult birds flying to and from their nests during the peak of the nesting season (incubation and guard stages) are counted in a standard manner. The data are converted to "traffic per hour," which can be converted to an estimate of nests. This technique is particularly useful at Green Island, where the vegetation is extremely dense and both visibility and access virtually nil. Transect counts or other repeated crossing of the colony would be extremely disruptive.

2. Survey timing

Populations of 26 colonial species are monitored in this survey. A single sampling period must be chosen that overlaps the peak of nesting effort of as many species as possible. By design, all field work is to be carried out during the last week of May and the first week of June, or as close as possible to those dates. This standardizes the effort, and avoids double counts of renesting pairs.

3. Methodological problems (many of these are inherent in any census technique)

(a) Observer variation, within and among years.

(b) Among-colony asynchrony over a 400-mile coastline.

(c) Within-colony asynchrony: do all individuals breed at once?

(d) Weather, which affects timing of nesting (see (f) below), access to the colonies, and choice of census technique once the observer has arrived.

(e) Year-to-year variation in nesting season affects ability to make valid comparisons.

(f) For any single species, the sampling period may occur before or after peak nesting. In either case the census misses a significant fraction of the nesting population. In the case of Reddish Egrets, egglaying normally peaks in mid-to-late March. Colony surveys in April will record the greatest number of nests. Few adults will be seen at the colonies in late May, and surveys conducted then may significantly underestimate the nesting effort. But in years when weather delays nesting or causes nest failure and subsequent renesting, most egrets will have eggs or small young at the time of the TCWBS survey.

(g) Partial survey: were all colonies censused? This is not possible for species that are extremely cryptic, or that have widespread inland populations. But detailed assessment of population trends in uncommon, exclusively coastal species like the Reddish Egret can be greatly hampered by incomplete survey. Population totals, once printed on a page, acquire an authority beyond the limitations of the field work.

(h) Errors of transcription: typographical errors in survey summaries can result in incorrect assessment of nesting localities as well as population totals. As in (g), the greatest effect is on analyses of populations of rare species.

(i) Estimation errors at large colonies obviously have a larger impact on statewide population estimates. Up to half of the state's entire population of Reddish Egrets occurs at one site, Green Island. Variations in population estimates, like those suggested for 1974-1976 (Table 6d), can greatly influence conclusions about population trends.

(j) Sudden changes in distribution may affect our ability to find nesting birds. (One chronic example: Least Tern.) This is a particular problem at large colonies like Green Island, where colony desertions raise the question of where else they might nest: at other islands in the lower Laguna Madre? farther north? the Laguna Tamaulipas? Are they nesting at all?).

4 Conclusions

(a) All properly conducted censuses will generate conservative estimates of true populations.

(b) From (2-f) above, I suggest that higher estimates are more likely to be accurate than low ones. Ironically, the "good" years with a large, successful nesting effort may be those which June census efforts most underestimate. (As one example, Jesse Grantham (pers. comm.) has pointed out that 1988 was an early year for Reddish Egrets. The statewide estimate was 1070 pairs.)

(c) Because apparent declines necessarily provoke the greatest concern about the population trend in a scarce species, we must look most carefully at the data, and its limitations, in those years. But potential inaccuracies demand cautious interpretation of data that may seem to indicate rather erratic population changes.

(d) Our ability to distinguish real declines is limited. This hampers our ability to respond quickly to threats to a population. Greater accuracy is needed if trends in populations of certain species are to be followed more carefully.

(e) The TCWBS survey, as an attempt to monitor many species at once, cannot be redesigned to meet the needs of one or another species. A separate but complementary survey, keyed specifically to the nesting season of Reddish Egrets, would allow greater accuracy.

Emails from Ann Hodgson

From: HODGSON, Ann
To: Imperiled
Cc: WRAITHMELL, Julie; Rodgers, James
Subject: Status of Reddish Egrets in Tampa Bay, and statewide estimate
Date: Friday, October 29, 2010 5:09:12 PM
Attachments: Status of Reddish Egret from 1974 2008 draft report.pdf

In our recent report "The Status of Reddish Egret in Tampa Bay, Florida, USA from 1974-2008" (draft in review by the U. S. Fish and Wildlife Service), we summarized the status of Reddish Egrets in the Tampa Bay area (Hodgson and Paul in review). In the mid-1980s, 30 pairs of Reddish Egrets at 3 colonies were reported in Pinellas County and Tampa Bay: Alafia Bank Bird Sanctuary, Nina Griffith Washburn Sanctuary (Terra Ceia Bird Key in Terra Ceia Bay), and Tarpon Key National Wildlife Refuge (Paul and Woolfenden 1985). This was about 10% of the estimated state population of 300 pairs (Powell et al. 1989). From 1985 through the present, National Audubon Society Sanctuaries staff continued systematic surveys of known colonies in the Tampa Bay region. Ninety-eight nesting pairs were located in 2004, with an average of 60 pairs over the last 10 years. Reddish Egrets have been found nesting at colonies that either were not surveyed in earlier years, or that they have occupied since 1985 and, in most years, they nest in small numbers at 13 colony islands in Tampa Bay and Pinellas County. The Audubon surveys have documented Reddish Egret re-occupation, although in low numbers, of a significant portion of their historical range on the gulf coast of peninsular Florida. Between 2004 and 2008, the number of nesting pairs (98) in the region declined 73.5% (to 26 pairs) and 5 (30.8%) sites were not occupied (see Figure 5. Nesting pairs of Reddish Egrets in St. Joseph Sound, Clearwater Harbor, Tampa Bay, and northern Sarasota Bay, Florida, USA, from 1974 to 2008).

The statewide population was estimated at 375 pairs from the 1990s through 2000 (Paul 1991, Lowther and Paul 2002, Hodgson et al. 2006). In the mid-2000s, the estimate was reduced to 250-300 pairs (Green 2006). These estimates did not include recent surveys of the Florida Keys or the Indian River Lagoon and Merritt Island National Wildlife Refuge, but it is not likely that the number of nesting pairs at both these areas has increased significantly compared to earlier estimates.

Human disturbance has become the most significant cause of nesting failure annually, accompanied by anthropogenically-induced predator population increases and urban development affecting the number and ecological integrity of wetland foraging sites. Our report provides a suite of habitat and population management recommendations that should be implemented to conserve Reddish Egret populations in the Tampa Bay, and similar, estuarine ecosystems. Due to their narrow estuarine foraging and breeding niche, slow rebound from extirpation, and low population numbers, Reddish Egrets should be considered a species at high risk in the Tampa Bay and Pinellas County region, as well as throughout Florida and the rest of its range.
Please call me at 813 623-6826 with any questions.

best, Ann

Ann B. Hodgson, Ph. D., P.W. S.
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The Status of Reddish Egret in Tampa Bay, Florida, USA from 1974-2008

Ann B. Hodgson
Ann F. Paul

29 June 2010

Audubon of Florida
Florida Coastal Islands Sanctuaries
410 S. Ware Boulevard, Suite 702
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Challenge Cost Share Agreement Grant #401818G564

U.S. Fish and Wildlife Service Contracting and Grant Services Division

1875 Century Boulevard, Suite 240, Atlanta, GA 30345

Audubon OF FLORIDA

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Reddish Egret adult (right) with 2 young-of-the-year.

EXECUTIVE SUMMARY

Reddish Egret (*Egretta rufescens rufescens*) bred commonly in Tampa Bay through the late 1800s but were extirpated by the widespread slaughter of colonial waterbirds for the plume trade around the late 1880s, and from the entire state of Florida by 1900.

Howell (1932) never saw Reddish Egrets during his work in Florida, which continued until 1927. A first Florida nest was found in eastern Florida Bay in 1938 (Desmond 1939), followed by a slow population increase in Florida Bay (Baker 1944, Allen 1955, Allen 1962). The first Tampa Bay nest was discovered at the Alafia Bank Bird Sanctuary in Hillsborough Bay in 1974 (Paul et al. 1975). In 1977, a survey of dredged spoil material islands on both coasts of Florida found that Reddish Egrets nested only at the Alafia Bank, where 25 adults (or possibly 12 pairs) were found nesting in shrubby mangroves (Schreiber and Schreiber 1978).

In the mid-1980s, 30 pairs of Reddish Egrets at 3 colonies were reported in Pinellas County and Tampa Bay: Alafia Bank Bird Sanctuary, Nina Griffith Washburn Sanctuary (Terra Ceia Bird Key in Terra Ceia Bay), and Tarpon Key National Wildlife Refuge (Paul and Woolfenden 1985). This was about 10% of the estimated state population of 300 pairs (Powell et al. 1989). From 1985 through the present, National Audubon Society Sanctuaries staff continued systematic surveys of known colonies in the Tampa Bay region. A maximum of 98 nesting pairs were located in 2004, with an average of 60 pairs over the last 10 years. Reddish Egrets have been found nesting at colonies that either were not surveyed in earlier years, or that they have occupied since 1985 and, in most years, they nest in small numbers at 13 colony islands in Tampa Bay and Pinellas County. The Audubon surveys have documented Reddish Egret re-occupation, although in low numbers, of a significant portion of their historical range on the gulf coast of peninsular Florida.

The statewide population was estimated at 375 pairs from the 1990s through 2000 (Paul 1991, Lowther and Paul 2002, Hodgson et al. 2006). In the mid-2000s, the estimate was reduced to 250-300 pairs (Green 2006). These estimates did not include recent surveys of the Florida Keys or the Indian River Lagoon and Merritt Island National Wildlife Refuge.

Human disturbance has become the most significant cause of nesting failure annually, accompanied by anthropogenically-induced predator population increases and urban development affecting the number and ecological integrity of wetland foraging sites.

We provide a suite of habitat and population management recommendations that should be implemented to conserve Reddish Egret populations in the Tampa Bay, and similar, estuarine ecosystems. Due to their narrow estuarine foraging and breeding niche, slow rebound from extirpation, and low population numbers, Reddish Egrets should be considered a species at high risk in the Tampa Bay and Pinellas County region, as well as throughout Florida and the rest of its range.

Figure 1. The Tampa Bay watershed.

INTRODUCTION

The species richness of colonial waterbirds that nest in the Tampa Bay estuarine system is unique, as many birds of temperate North America breed here, as well as some typically "tropical" birds (Reddish Egrets and Roseate Spoonbills) that do not nest further north, and some species that nest only in low numbers anywhere in Florida (Caspian, Royal, Sandwich, and Gull-billed terns) (Howell 1932, Paul and Woolfenden 1985, Paul and Schnapf 1997, Paul and Paul 2003, Hodgson, Paul and Rachal 2006).

Reddish Egrets (*Egretta rufescens rufescens*) were prominent in Florida's avifauna when early ornithologists and illustrators explored the state. John James Audubon found Reddish Egrets abundant and nesting in Florida Bay during his trip there in April 1832 (Audubon 1835, 1843). Heerman reported that they were breeding "in great numbers" in Charlotte Harbor (Gambel 1848). In 1858, Bryant found both morphs breeding at Pelican Island in the Indian River (Bryant 1859). In 1869, the white morph was "common" near Merritt Island on the Indian River, but nesting was not found (Maynard 1881).

Reddish Egret bred commonly in Tampa Bay through the late 1800s, but were extirpated from the bay and the entire state of Florida by 1900 by the widespread slaughter of colonial waterbirds for the plume trade (Paul et al. 1975). W. E. D. Scott, an ornithologist from Princeton University who visited the gulf coast of peninsular Florida in the 1880s, found them in large numbers at Indian Key, Johns Pass, Double Branch Creek, and Rocky Creek in 1880. Upon a return trip to Florida in 1886, he noted widespread slaughter and disruption of these colonial waterbird colonies by plume hunters and saw very few Reddish Egrets on the peninsular gulf coast where they had been abundant just six years before (Scott 1881, 1887, 1889, 1891).

"It is true that there are still small isolated colonies of Herons breeding this year on one mangrove island, and driven to another in the succeeding years. But the great Heron Rookeries of Tampa Bay, Samsota [sic] Bay, Charlotte Harbor, and the Thousand Islands, where the countless myriads of Herons were so noticeable a feature in the landscape as to attract the attention of any one from a long distance, no longer exist (Scott 1892)."

After the apparent extirpation of Reddish Egrets in Florida, and possibly Louisiana and Texas, by the plume hunters active in the 1880s, several decades elapsed before they bred in Florida. Led by the American Ornithologists Union, Florida Audubon Society, the National Association of Audubon Societies, women's clubs across Florida and the eastern United States, legislation to protect native bird species from unregulated hunting was passed in 1918 and the fashion of elaborately feathered hats became *passé* (Graham 1990). As the plume hunting trade declined, colonial waterbirds populations began to increase in Florida.

Chapman (1908) saw 6 Reddish Egrets feeding near the mouth of Snake Creek in the Bight, Florida Keys, on his way to the Cuthbert Bayou Bird Colony on March 29, 1907. Scattered records of birds sighted in Florida Bay through 1908 were noted (Job 1904, Chapman 1908, Broadhead 1910, Bent 1926). Howell (1932) never saw Reddish Egrets during his work in Florida, which continued until 1927. Two birds were found in Florida Bay near Islamorada on April 23, 1937 (Davis 1937). A first Florida nest was found in eastern Florida Bay on April 17, 1938 (Desmond 1939), followed by a slow population increase in Florida Bay (Baker 1944, Allen 1954, Palmer 1962). Audubon scientists based in the Florida Keys at the Tavernier Science Center were, at that time, conducting

research on Great White Heron nesting, and thoroughly surveyed the region, so this was very likely the first nest record in Florida of this species for decades. Sprunt (1954) stated, "Florida status: now confined to the Keys as a breeding species." The range of nesting Reddish Egrets in Florida gradually began to expand, with nesting birds observed at Frank Key in northwest Florida Bay in 1968 (Paul 1991). They were found nesting at Hemp Key in Pine Island Sound in 1970, the first evidence that the species was slowly re-occupying former range on the west coast of peninsular Florida (Bancroft 1971). They reoccupied the Alafia Bank in Tampa Bay in 1974 (Paul et al 1975), the ABC Heronry near Marco Island in 1975 and the Arsenicker Keys in south Biscayne Bay in 1976 (Paul 1991). In April 1978, a pair nested on Riomar Island in the Indian River near Vero Beach and in June the same year, another pair nested on Haulover Canal in the Merritt Island National Wildlife Refuge (Paul et al. 1979). These records represented the first nesting on the east coast of Florida since the 1800s. They became strongly established in the 1980s on both coasts in central Florida: Washburn Sanctuary in Terra Ceia Bay in 1979 (Odgen 1979), Cortez Key in northern Sarasota Bay and Tarpon Key in Boca Ciega Bay in 1981 (Paul 1981), Pelican Island in the Indian River in 1985 (Rodgers and Schwikert 1986), the Broken Islands in Charlotte Harbor, Placida in Gasparilla Sound and the north Banana River in Merritt Island in 1986 (Paul 1986), Rookery Bay near Naples, Estero Bay near Fort Myers Beach, and Roberts Bay in southern Sarasota Bay in 1987 (Paul 1987), Oslo Island in the Indian River Lagoon (Toland 1991), Clearwater Harbor and south St. Joseph Sound in 1991 (Holland 1991).

Bird protection in Tampa Bay was initiated when President Theodore Roosevelt established Passage Key National Wildlife Refuge in 1905. The refuge was patrolled by deputized wardens hired by the United States Biological Survey but funded by the Florida Audubon Society and the National Association of Audubon Societies (Graham 1990). In 1934, Audubon wildlife wardens began protecting Green Key, the historic Audubon sanctuary in southern Hillsborough Bay, and the Alafia Bank, spoil islands located at the mouth of the Alafia River (about two miles north). In addition to Green Key and the Alafia Bank, Audubon wardens also were protecting Terra Ceia Bird Key, Gadsden Point (near present-day Port Sutton), and Gull Island (near the Big Bend channel) in Hillsborough Bay. In 1968, the pelicans, herons and egrets, and ibis that had been nesting at Audubon's Green Key Sanctuary moved to the Alafia Bank Bird Sanctuary, leased by Audubon from the landowner (now the agricultural conglomerate Mosaic). However, Reddish Egrets did not breed at any of these islands at that time, as they were still absent from the local breeding population.

Most regional colonies, on both natural and dredged spoil material islands, were surveyed initially during the 1970s through the early 1980s (Nesbitt et al. 1982); however, Reddish Egrets were not known to breed in Tampa Bay after their extirpation until they nested in 1974 at the Alafia Bank in Hillsborough Bay, the northeast section of Tampa Bay (Paul et al. 1975). Of 40 dredged spoil material islands surveyed in the Intracoastal Waterways of the east and west coast of Florida and Tampa Bay in 1977, Reddish Egrets still nested only on the Alafia Bank Bird Sanctuary (Schreiber and Schreiber 1978).

Statewide population estimates followed the expanding nesting locations, with estimates made by a series of ornithologists. By 1944, the Florida Bay population had expanded to 50 birds, with 38 counted at Cowpens Key alone (Baker 1944). By 1954, Reddish Egrets were regularly seen nesting at several locations in the Keys and Florida Bay, but the statewide population was estimated at less than 150 birds (Allen 1954, 1955), and in 1959 it was estimated at less than 200 birds (Palmer 1962). Robertson and Kushlan (1974) estimated a statewide population of 300 birds, with Florida Bay still serving as the primary nesting site. In 1977, an estimate of 150 nesting pairs statewide was proposed (Paul 1977), which was revised to 250-300 pairs in 1980 (Powell et al. 1989).

The first bay-wide assessment of colonial waterbird and shorebird populations for the Tampa Bay region showed 30 pairs of Reddish Egrets at 3 colonies [the Alafia Bank Bird Sanctuary, Terra Ceia Bird Key (the National Audubon Society's Nina Griffith Washburn Sanctuary), and Tarpon Key National Wildlife Refuge], based on a synthesis of recent surveys of nearly all breeding colonies in the region (Paul and Woolfenden 1985). By 1989, Reddish Egrets occurred at 11 colonies along the Florida gulf coast. Six of these nesting sites were on the west central gulf coast: Alafia Bank in Hillsborough Bay, Ozona Spoil East in St. Joseph Sound, I-25 Bird Sanctuary in Clearwater Harbor, Tarpon Key National Wildlife Refuge in Boca Ciega Bay, Washburn Sanctuary in Terra Ceia Bay, and Midnight Pass Bird Island in Little Sarasota Bay (Runde et al. 1991). The Tampa Bay population was about 10% of the estimated state population of 300-400 pairs (Powell et al. 1989, Paul 1991)), with the majority of the local population nesting at the Alafia Bank.

Listing Status

Reddish Egrets are the rarest heron in North America, with an estimated world population of 2,000-4,000 pairs (Lowther and Paul 2002). They are listed globally, nationally, and locally as a species whose conservation status is tenuous: International Union for Conservation of Nature and Natural Resources (IUCN) Red List (category: near threatened, population trend: decreasing); Department of the Interior, U.S. Fish and Wildlife Service (focal species of management concern); Florida Fish and Wildlife Conservation Commission (Species of Special Concern); Florida Committee on Rare and Endangered Plants and Animals (Rare); Florida Natural Areas Inventory (Global Ranking G4, State Ranking S2); and National Audubon Society, Inc. and American Bird Conservancy WatchList (Red List).

Important Bird Areas

BirdLife International and the National Audubon Society, its partner in North America, have identified 35 Important Bird Areas (IBAs) in Florida, sites that are ranked of global significance as critical for bird conservation and biodiversity protection (National Audubon Society 2010). In west-central Florida, 3 globally-ranked IBAs that provide nesting and foraging habitat for Reddish Egrets are the Gulf Islands GEOPark (Three Rooker Island, the Anclote Keys, Honeymoon Island, and Caladesi Island), Hillsborough Bay (the Richard T. Paul Alafia Bank Bird Sanctuary, and other spoil islands), and Lower Tampa Bay (Egmont Key and Passage Key National Wildlife Refuges, and Fort De Soto County Park). In addition, Audubon of Florida has identified 100 locations that are state-ranked IBAs (Audubon of Florida 2003). Regional state-ranked sites important for Reddish Egrets include those globally listed plus Clearwater Harbor-St. Joseph Sound, Johns Pass, Cockroach Bay-Terra Ceia Bay, and Sarasota and Roberts Bays IBAs.

Study Objectives

Our objectives were 1) to summarize the occurrence and distribution of nesting Reddish Egrets in St. Joseph Sound, Clearwater Harbor, the Tampa Bay estuary, and northern Sarasota Bay from 1974 through 2008, 2) to assess the effects on nesting and foraging habitats of the four named hurricanes that crossed through Tampa Bay in 2004, 3) to describe relative impacts of habitat availability, habitat quality, weather, predation, and human activity on reproductive success, and 4) to provide a suite of management recommendations for the conservation of the breeding population in Tampa Bay and the gulf coast of Florida.

STUDY AREA

We studied Reddish Egrets from 1974 to 2008 in St. Joseph Sound, Clearwater Harbor, Tampa Bay, and northern Sarasota Bay, on the west coast of peninsular Florida, USA. Our study area extended from St. Joseph Sound (SJS; latitude 28.1200, longitude -82.8390) in Pinellas County, east through Hillsborough Bay (HB; latitude 27.8483, longitude -82.4106) in Hillsborough County, south to northern Sarasota Bay around Cortez Key (CK; latitude 27.3000 , longitude -82.5120) in Manatee County (Figure 2).

The distribution of the Reddish Egret population in our study area has depended on habitat availability and human perturbations. In the Tampa Bay ecosystem, colonial waterbirds nest on islands where they are secure from terrestrial predators, and large numbers of birds of many species may breed at a single site. We surveyed at least 98 sites colonies used by nesting colonial waterbirds on the Gulf of Mexico shorelines, islands in the estuaries and bay systems, and riverine and inland lake locations (Table 1). However, only 22 were accepted by Reddish Egrets as suitable nesting habitat. Of the colony sites used by other colonial waterbirds, the beach colonies and 15 palustrine and riverine sites were not selected by Reddish Egrets, which nest almost exclusively on isolated, generally small islands located in the estuary or bay systems.

Figure 2. Map and location of colonial waterbird (wading birds, larids, shorebirds) nesting sites in St. Joseph Sound, Clearwater Harbor, Tampa Bay, and northern Sarasota Bay, Florida, USA, 1974-2008.

Table 1. Bay segment, taxa, number of species, number of pairs, ownership and management status, and location (latitude and longitude) of 98 bird colonies in St. Joseph Sound, Clearwater Harbor, Tampa Bay, and northern Sarasota Bay, Florida, USA, 1974-2008.

Colony Number	Name	Bay Segment	Taxa	Species (#)	Pairs (#)	Abandoned after 1981	New since 1984	Ownership / Management	Protected status	Active within last 5 yrs?	Latitude	Longitude
1	South Anclote Bar State Park	SJS	Ch	2	5-25		X	FDEP- FL State Parks	Y	Y	28.1560	-82.8400
2	Three Rooker Island State Park	SJS	Ch, Cl	16	3550		X	FDEP- FL State Parks	Y	Y	28.1200	-82.8390
3	Honeymoon Island State Park	SJS	Ch	2-3	10-250		X	FDEP- FL State Parks	Y	Y	28.0945	-82.8354
4	St. Joseph Sound Marker 28	SJS	-	-				FDEP-AP			28.0893	-82.8045
5	St. Joseph Sound Marker 27	SJS	Cl	0-5			X	FDEP-AP	N	N	28.0825	-82.8020
6	St. Joseph Sound Marker 26	SJS	P, Cl, Ch	9	310		Y	FDEP-AP / FCIS	Y	Y	28.0755	-82.7998
7	St. Joseph Sound Marker 22	SJS	Cl	2	5-10		X	FDEP-AP	N	Y	28.0678	-82.7971
8	St. Joseph Sound Marker 21	SJS	Cl	2	5-10	X		FDEP-AP	N	N	28.0618	-82.7930
9	Ozona Spoil East	SJS	P, Cl, Ch	9	50		X	FDEP-AP / FCIS	Y	Y	28.0731	-82.7831
10	Smith Bayou North	SJS	Cl	6	10-15		X	private	Y	Y	28.0588	-82.7792
11	Caladesi Island State Park	SJS	Ch	2-3	10-250			FDEP- FL State Parks	Y	Y	28.0478	-82.8176
12	Dunedin Sand Key West	SJS	P, Cl, Ch	11	250		X	Pinellas County / FCIS	Y	Y	28.0381	-82.7946
13	Pope Channel Island Bird Sanctuary	SJS	Cl	1	50		X	FDEP-AP	N	N	27.9911	-82.8055
14	Memorial Causeway I-25 Bird Sanctuary	CH	P, Cl, Ch	13	1300			City of Clearwater / FCIS	Y	Y	27.9663	-82.8145
15	Marker 14	CH	-	-	-		X	FDEP-AP	-	-	27.9606	-82.8067
16	Sand Key Park	CH	Ch	2	10-250		X	Pinellas County	N	Y	27.9606	-82.8314
17	Sheraton Sand Key	CH	Ch	2	10-250		X	private	N	Y	27.9570	-82.8320
18	Clearwater Harbor Marker 10	CH	Ch	3	1-50	X	X	FDEP-AP / FCIS	Y	Y	27.949	-82.8197
19	Marker 8 NCH/Compass Key	CH	-			X		FDEP-AP			27.9426	-82.8240
20	Clearwater Harbor Marker 5	CH	Ch	3	1-50	X	X	FDEP-AP / FCIS	Y	Y	27.9352	-82.8272
21	Clearwater Harbor Marker 3	CH	Ch	3	1-50	X	X	FDEP-AP / FCIS	Y	Y	27.9288	-82.8308
22	Belleair Beach (two islands)	CH	P, Cl, Ch	11	150		X	City of Belleair Beach	Y	Y	27.9132	-82.8422
23	Indian Rocks Beach	CH	P, Cl, Ch	9	1-100		X	City of Indian Rocks Beach / FCIS	Y	Y	27.8991	-82.8415

Colony Number	Name	Bay Segment	Taxa	Diversity (#)	Pairs (#)	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Active within last 5 yrs?	Latitude	Longitude
24	Indian Rocks Beach South	CH	Cl, Ch	7	35		X	FDEP-AP / FCIS	Y	Y	27.8924	-82.8404
25	Dogleg Key	BCB	P, Cl	12	300		X	FDEP-AP / FCIS	Y	Y	27.8021	-82.7618
26	Johns Pass, Little Bird Key	BCB	Cl	1	2			Suncoast Seabird Sanctuary	Y	Y	27.7932	-82.7777
27	Johns Pass, Middle Bird Island	BCB	Cl	2	5		X	FDEP-AP	Y	Y	27.7913	-82.7738
28	Johns Pass, Eleanor Island	BCB	Cl			X		City of Treasure Island	Y	N	27.7878	-82.7738
29	South Pasadena Marker 34	BCB	L			X	X	City of Pasadena		N	27.7431	-82.7299
30	Sunset Beach	BCB	L			X	X	City of Treasure Island	N	N	27.7391	-82.7565
31	Don CeSar Colony	BCB	P, Cl	8	50		X	Private	N	Y	27.7059	-82.7352
32	Bayway Spoil	BCB	L			X		Developed	N	N	27.7094	-82.6995
33	Indian Key NWR	BCB	Cl					USFWS NWR	Y	Y	27.7011	-82.6909
34	Little Bird Key NWR	BCB	Cl	5	15		X	USFWS NWR	Y	Y	27.6852	-82.7169
35	Cow and Calf Islands	BCB	P, Cl	2	9		X	FDEP-AP	N	Y	27.6856	-82.6916
36	Darling Key	BCB	P, Cl	3	17		X	FDEP-AP	N	Y	27.6765	-82.6813
37	Jackass Key NWR	BCB	P, Cl	4	30		X	USFWS NWR	Y	Y	27.6693	-82.7177
38	Tarpon Key NWR	BCB	P, Cl			X		USFWS NWR	Y	N	27.6666	-82.6932
39	Whale Island NWR	BCB	P, Cl			X	X	USFWS NWR	Y	N	27.6626	-82.6930
40	Shell Key County Preserve	BCB	Ch	5	5-500			FDEP-AP / Pinellas County	Y	Y	27.6645	-82.7445
41	Mule Key NWR	BCB	P, Cl			X	X	USFWS NWR	Y	Y	27.6619	-82.7178
42	Listen Key NWR	BCB	Not a colony			X	X	USFWS NWR	Y	N	27.6596	-82.7179
43	Sister Key	BCB	Cl	1	1-10	X	X	FDEP-AP / Pinellas County	N	Y	27.6503	-82.7312
44	Ft. DeSoto Park	LTB	L, Ch	5	1-100	X	X	Pinellas County	Y	Y	27.6488	-82.7433
45	Egmont Key NWR/State Park	LTB	P, Cl, Ch	10	36,500		X	USFWS NWR / FDEP- FL State Parks	Y	Y	27.5894	-82.7614
46	Little Bayou Bird Island	MTB	P, Cl	10	140		X	FDEP-AP / FCIS	Y	Y	27.7196	-82.6312
47	Coffeepot Bayou Bird Island	MTB	P, Cl	14	610		X	Private, Pelican Fund & FCIS through 2006. Bird Island LLC and	Y	Y	27.7916	-82.6241

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Colony Number	Name	Bay Segment	Taxa	Species (#)	Pairs (#)	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Active within last 5 yrs?	Latitude	Longitude
					volunteers after 2006							
48	Gandy Radio Tower	OTB	Cl	1	1-10	X	X	Unknown	N	N	27.8772	-82.5902
49	Howard Frankland	OTB	L			X		FDOT	N	N	27.9046	-82.6335
50	Cooper's Point	OTB				X		Pinellas County / City of Clearwater	N	N	27.9730	-82.6891
51	Alligator Lake	OTB	P, Cl	12	745			City of Safety Harbor / Pinellas County	Y	Y	27.9813	-82.6990
52	Philippe Park	OTB	Cl			X		Pinellas County	N	N	28.0053	-82.6778
53	Mobbly Bay Powerlines	OTB	P	1	20		X	Progress Energy	N	Y	28.0038	-82.6677
54	Courtney Campbell Causeway	OTB	Cl	5	25	X	X	FDOT	N	N	27.9736	-82.5958
55	Wilson Property/Grand Hyatt	OTB	Cl	1	5-10	X		Private	N	N	27.9654	-82.5514
56	Sunset Park	OTB	Cl	1	5-10	X		City of Tampa	N	N	27.9374	-82.5201
57	Westshore	OTB	Cl	1	5-10	X		City of Tampa	N	N	27.9002	-82.5361
58	McKay Bay	HB	-	-	-	X	X	City of Tampa / TPA	Y	N	27.9371	-82.4143
59	Hooker's Point	HB	L	1	50	X	X	TPA	Y	N	27.9076	-82.4338
60	Tampa Port Authority Spoil Island 2D	HB	Ch	9	2,150			TPA / FCIS	Y	Y	27.8805	-82.4313
61	Fantasy Island	HB	Ch	1	1			TPA / FCIS	Y	Y	27.8683	-82.4253
62	Spoil Area C	HB	L, Ch			X	X	Mosaic	Y	N	27.8571	-82.4003
63	Richard T. Paul Alafia Bank Bird Sanctuary	HB	P, Cl, Ch	16	6,230			Mosaic / FCIS	Y	Y	27.8483	-82.4106
64	Tampa Port Authority Spoil Island 3D	HB	Ch	2	23			TPA / FCIS	Y	Y	27.8331	-82.4352
65	Port Redwing/Schultz Nature Preserve	HB	L, Ch	2	5-10	X	X	TPA	Y	N	27.8132	-82.3951
66	Fishhook Spoil Island	HB	Ch	2	13			TPA / TECO	Y	Y	27.8024	-82.4152
67	Apollo Beach Oystercatchers	HB	Ch	2	15		X	Private	N	Y	27.7733	-82.4318
68	Mouth of Little Manatee River	MR	P, Cl			X		FDEP Cockroach Bay Aquatic Preserve	N	N	27.7160	-82.4823
69	Cockroach Bay Preserve	MTB	P, Cl, Ch	9	40-100		X	Hillsborough County	Y	Y	27.6955	-82.5078

Colony Number	Name	Bay Segment	Taxa	Diversity (#)	Pairs (#)	Abandoned after 1994	New since 1994	Ownership / Management	Protected status	Active within last 5 yrs?	Latitude	Longitude
								ELAPP				
70	Hole in the Wall, Cockroach Bay Preserve 1	MTB	Cl.	1	15		X	Hillsborough County ELAPP	Y	N	27.5811	-82.5163
71	Hole in the Wall, Cockroach Bay Preserve 2	MTB	Cl.	1	5		X	Hillsborough County ELAPP	Y	N	27.5799	-82.5198
72	Hole in the Wall, Cockroach Bay Preserve 3	MTB	Cl.	1	5		X	Hillsborough County ELAPP	Y	N	27.5784	-82.5169
73	Piney Point Rock Ponds	MTB	P, Cl.	14	2,800		X	SWFWMD / Hillsborough County ELAPP	Y	Y	27.5505	-82.5462
74	Manbirtee Key	MTB	Cl, Ch, L	4	150			MCPA / FCIS	Y	Y	27.6359	-82.5740
75	Two Brothers Island	LTB	Cl.			X		Private	N	N	27.5935	-82.5847
76	Skyway Bridge Least Tern colony	LTB	L			X	X	FDOT	N	N	27.5808	-82.6090
77	Miguel Bay Colony	LTB	P, Cl.				X	FDEP-AP / FCIS	Y	Y	27.5708	-82.5996
78	Passage Key National Wildlife Refuge	LTB	P, Cl, L, Ch			X		USFWS-NWR	Y	Y	27.5545	-82.7404
79	Nina Washburn Sanctuary	TCB	P, Cl.	15	50-1000			FCIS	Y	Y	27.5527	-82.5998
80	Washburn Junior/Terra Ceia Bay Little Bird Key	TCB	P, Cl.	14	400		X	FDEP Terra Ceia Aquatic Preserve / FCIS	Y	Y	27.5285	-82.6015
81	Dot Dash Dit Colony	MR	P, Cl.	13	2,360			FDEP State Lands/ FCIS	Y	Y	27.4993	-82.5243
82	Health Yellow-crowned Night-Heron Colony	HC	Cl.	1	5		X	Private	N	Y	27.8772	-82.3129
83	Office/Ferman Bird Colony	HC	P, Cl.	8	75		X	Private	Y	Y	27.9448	-82.3417
84	Robles Park	HC	Cl.	4	30		X	City of Tampa	N	Y	27.9740	-82.4550
85	Corporex Colony	HC	P, Cl.	7	100		X	Private	N	Y	27.9786	-82.3857
86	East Lake Island	HC	P, Cl.	5	20		X	Florida Audubon Society	Y	Y	27.9922	-82.3764
87	Temple Crest/Orange Lake/Wargo Bird Colony	HC	P, Cl.	8	50		X	City of Tampa / TPA	N	Y	28.0193	-82.4174
88	River Cove Yellow-crowned Night-Heron colony	HC	Cl.	1	5		X	Hillsborough County	N	Y	28.0192	-82.4466

Colony Number	Name	Bay segment	Taxa	Diversity (H)	Pairs (n)	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Active within last 5 yrs?	Latitude	Longitude
89	Citrus Park Bird Colony	HC	P, Ci	9	500		X	Private	N	Y	28.0699	-82.5834
90	Heron Point	PaC	P, Ci	7	50		X	Private	N	Y	28.2157	-82.4349
9	Saddlebrook	PaC	P, Ci	3	50		X	Private	Y	Y	28.2277	-82.3297
92	Cypress Creek Preserve	HC	P, Ci	11	3,300		X	ELAPP	Y	Y	28.1629	-82.3975
93	Cross Creek Colony	HC	P, Ci	2	8		X	Private	N	Y	28.1424	-82.3520
94	Medard County Park	HC	P, Ci	10	475		X	Hillsborough County	Y	Y	27.9218	-82.1630
95	Alafia River Corridor Preserve	HC	P, Ci	5	45	X	X	ELAPP	Y	N	27.8756	-82.1053
96	Wood Lake/Somerset Lake	PoC	P, Ci	14	1,150		X	City of Lakeland / Private	N	Y	28.0036	-81.9311
97	Cortez Key Sanctuary	SB	P, Ci	14	50			FDEP State Lands/ FCIS	Y	Y	27.3000	-82.5100
98	Bishop Bayou Bird Island	SB	P, Ci	11	20				N	Y	27.3000	-82.5120

Abbreviations:

1. Bay segments: SJS=St. Joseph Sound, CH=Clearwater Harbor, BCB=Boca Ciega Bay, HB=Hillsborough Bay, LTB=Lower Tampa Bay, MTB=Middle Tampa Bay, OTB=Old Tampa Bay, TCB=Terra Ceia Bay, MR=Manatee River, SB=Sarasota Bay.
2. Counties: HC=Hillsborough County, PaC=Pasco County, PoC=Polk County, MC=Manatee County.
3. Taxa: P=Pelecaniformes, Ci=Ciconiiformes, Ch=Charadriiformes, L=Laridae.
4. Ownership/Management: FDEP-AP=Florida Department of Environmental Protection State Parks or Aquatic Preserve Program, AOF FCIS=Audubon of Florida Coastal Islands Sanctuaries, USFWS=U.S. Fish and Wildlife Service National Wildlife Refuge, FDOT=Florida Department of Transportation, TPA=Tampa Port Authority, TECO=Tampa Electric Company, ELAPP=Hillsborough County Environmental Lands Acquisition and Protection Program, MCPA=Manatee County Port Authority.

METHODS

Field Methods

We [National Audubon Society Florida Coastal Islands Sanctuaries (FCIS)] conducted systematic surveys of colonial waterbird colonies during the annual peak of the nesting season to estimate the regional nesting effort by Reddish Egrets. In west-central Florida, Reddish Egrets nest from early March through June or July, depending on weather and site conditions. We estimated the peak of nesting activity annually; dates of field surveys varied inter-annually. We timed our surveys to occur during the incubation or guard stage period to arrive at the number of nesting pairs in the region (Hunter et al. 2005). We selected the survey method (direct nest counts or flight-line counts) best suited to nest visibility and the site conditions at each colony (Buckley and Buckley 1976; King 1978; Erwin and Ogden 1980, Portnoy 1980; Erwin 1981, Frederick et al. 2004). We counted egrets [single birds or pairs in breeding condition observed at nests (Meyerriecks 1960, Lowther and Paul 2002), and chicks in all developmental stages] that we found at suitable nesting habitat, based on our knowledge of the island sites from previous surveys to explore the habitat (Hodgson et al. 2006). Numbers of colonies surveyed varied inter-annually contingent on colony activity, personnel, weather, and other constraints.

We compiled 35 years of field notes and tabulated the number of nesting pairs at each colony and productivity (chicks/nest) when possible, habitat conditions at each site, and management issues. We mapped the number of pairs at each colony, relative importance (in increments of 5 pairs) of each colony, duration of occupancy, and colony persistence using ArcView 9.3 geographic information system (GIS) software. English and scientific names follow the *Check-list of North American Birds 7th edition* (American Ornithologists' Union 2009). Animal welfare protocol: we did not capture birds and avoided disturbing nesting birds or young.

RESULTS

Population distribution

Reddish Egrets radiated from nesting at the Alafia Bank in eastern Hillsborough County in 1974 to 21 other sites, all of which were islands in Tampa Bay, Pinellas County, and northern Sarasota Bay (Table 1). Each site was used at least once during the study period, with persistent nesting at 11 sites (Figures 4a-4d). Some nesting colony sites were abandoned over the years due to various causes of habitat loss, predation, or disturbance, and 9 colonies were used for nesting in 2008.

1974–1980

In the early 1970s, the National Audubon Society's "Tampa Bay Sanctuaries" (which became the Florida Coastal Islands Sanctuaries) regularly surveyed only the Alafia Bank (then and now the largest colonial waterbird colony on the west-central gulf coast), Washburn Sanctuary, and Cortez Key (Tables 2, 3, 4). Other colonies in the region were not regularly surveyed by Audubon during this period. Two pairs of nesting Reddish Egrets were found in 1974 at the Alafia Bank (Paul et al. 1975) (Figure 4a). This was the first evidence of Reddish Egrets nesting in the Tampa Bay estuary, and this far north on the west coast of peninsular Florida, since their extirpation in the late 1880s. Dredged spoil material islands were surveyed along the ICWW on the east and west coasts of Florida and in Tampa Bay in 1977, and Reddish Egrets were found nesting only at the Alafia Bank (Schreiber and Schreiber 1978). The nesting population at the Alafia Bank increased to 10 pairs in 1980. In 1979, Reddish Egrets nested at Washburn Sanctuary in Terra Ceia Bay (Ogden 1979), about 35.4 km south of

the Alafia Bank and 104.6 km north of Hemp Key in Pine Island Sound where they had been found nesting 8 years earlier (Bancroft 1971).

1981–1990

Audubon conducted regular surveys at the Alafia Bank, Tarpon Key and Whale Island National Wildlife Refuges (NWR), Washburn Sanctuary, and Cortez Key during this decade. The first statewide atlas of breeding sites for herons was completed by the Florida Game and Freshwater Fish Commission in the early 1980s and Reddish Egrets were recorded nesting in the region only at the Alafia Bank (Nesbitt et al 1982). In 1981, 1 pair was found at Tarpon Key NWR and 3 pairs at Cortez Key, expanding the nesting range to two new estuaries, Boca Ciega Bay and northern Sarasota Bay. In 1982, 1 nest was found by Audubon at Washburn Sanctuary, reconfirming nesting there (Figure 4b).

In the 10-year period, the regional population increased from 19 pairs in 1981 to 66 pairs in 1990, a 350% increase. This exponential growth was attributed to locally-fledged adults reaching sexual maturity (typically at 4 years of age) and recruiting into the nesting population. Nesting was consistently established at 4 sites in 4 bay sections separated by a distance of about 40 km, with 95% of the nesting birds located at the Alafia Bank.

1991–2000

In 1991, the bird colony abandoned Tarpon Key National Wildlife Refuge because of raccoon predation, but Reddish Egrets and other species returned to nest there again in 1993, followed by dwindling numbers for several years because of raccoon (*Procyon lotor*) predation. In 1998, 1 pair nested at Little Bird Key NWR, and Whale Island NWR had 4 pairs nesting in 2000; in both cases these were probably birds seeking an alternate nesting location as the raccoon predation at Tarpon Key increased. None of the other NWR islands (Indian Key, Jackass Key, Mule Key, or Listen Key) had Reddish Egrets in that decade (Figure 4c).

Reddish Egrets nested on Clearwater Harbor I-25 Bird Colony and St. Joseph Sound Marker 21 in northern Pinellas County in spring 1991, with 1 pair found on each island (Holland 1991). These may have been displaced pairs from Tarpon Key, and the nests represented a return to a portion of the breeding range that egrets had not occupied for 100 years. In 1993, annual Audubon surveys of St. Joseph Sound and Clearwater Harbor were initiated. Nesting continued at Clearwater Harbor I-25 Bird Sanctuary during the period, and 8 pairs nested on Marker 26 in 2000.

In Johns Pass, 3 pairs nested at Dogleg Key in 1996 and one pair on Bird Rookery Key in 2000. These records confirmed Reddish Egrets as a nesting species in the Johns Pass region, where they had occurred so abundantly in 1880 (Scott 1881, 1887).

In 1994, a few pairs of Reddish Egrets first nested on Coffeepot Bayou in St. Petersburg (1-3 pairs) and Alligator Lake in Safety Harbor (1-4 pairs), and, in eastern Tampa Bay, 2 pairs were found at the Piney Point colony in 1995.

During the 10-year period, nesting numbers at Washburn Sanctuary (3-15 pairs) and Cortez Key Sanctuary (1-3 pairs) fluctuated. The population at the Alafia Bank declined from 63 pairs in 1990 to 30 pairs in 1991 and during the decade averaged 44.3 pairs. The regional population increased 120% to 85 pairs in 2000, with 58% of the nesting located at the Alafia Bank. By 2000, Reddish Egrets nested in all Tampa Bay segments, northern Sarasota Bay, Clearwater Harbor, and St. Joseph Sound, although in low numbers at most sites, re-occupying habitats used by the species 120 years earlier.

2001–2008

In 2002, 2 pairs nested at Three Rooker Island State Park in northern St. Joseph Sound, the furthest north they had been found nesting along the west coast of Florida since the 1880 survey (Figure 4d). Marker 26 hosted the most nesting pairs in St. Joseph Sound, and I-25 Bird Island the most in Clearwater Harbor. SJS Marker 26

and Clearwater Harbor Island 1-25 Bird Sanctuary combined routinely supported up to 11 pairs (~12.8% of the regional population in 2000). One pair nested on Smith Bayou North in 2003 and 2006 and Sand Key Dunedin West in 2005.

In Johns Pass, 4-6 pairs moved between Little Bird Key and Bird Rookery Key until 2006, and then apparently relocated to Dogleg Key.

Of the Pinellas National Wildlife Refuge islands, 1-3 pairs of Reddish Egrets (probably displaced from Tarpon and Whale) nested on Little Bird Key NWR in 2002, and Tarpon Key and Whale Island were abandoned by nesting colonial waterbirds in 2003. Little Bird Key NWR was abandoned in 2007 due to the presence of raccoons. In addition, Indian Key NWR, the former Maximo colony where W. E. D. Scott noted so many colonial waterbirds and especially Reddish Egrets, did not have a bird colony during the 35-year period (except for 2 pairs of Tricolored Herons suspected nesting there in 2007) because of predation.

Reddish Egrets nested every year during the 8-year period at Coffeepot Bayou Bird Island, averaging 6 pairs/year. Alligator Lake also had annual nesting, with up to 8 pairs in 2004, averaging 4 pairs/year. At the Alafia Bank, numbers fluctuated from 60 pairs (2005) to 5 (2008), averaging 35 pairs. Some (1-8 nests) nested at Piney Point Rock Ponds every year after 2001. Once the presence of raccoons at Washburn Sanctuary, Washburn Junior, and Cortez Key Sanctuary was detected, we removed them, allowing some Reddish Egrets that had failed early in the season to nest there, although in low numbers.

Likely the presence of nesting Reddish Egrets at Bishop Bayou in northern Sarasota Bay in 2002 and 2004 was due to birds seeking an alternative nest site since raccoons were present, at least for a portion of the early nesting season, at Cortez Key Sanctuary in those years. Washburn Sanctuary was abandoned due to unknown reasons in 2006, although it is likely that a terrestrial predator was the cause.

In 2008, Reddish Egrets nested at 9 (27.2%) of the 22 potential sites they had used at least once in the 35-year study period; 10 (39 %) were in Hillsborough County, 15 (57 %) in Pinellas County, and 1 (4%) in Manatee County. Seven sites (SJS Markers 27 and 22, Smith Bayou North, Bishop Bayou, John's Pass Little Bird Key and Bird Rookery Key, and Miguel Bay) were used only once during the period. M27, M22, and Miguel Bay were probably disused because of human disturbance, while the others were avoided because of raccoon predation.

Population trend

Nesting increased from 2 pairs nesting at only one site in 1974 to 98 pairs nesting at 13 sites in 2004. Most (49%) of these pairs nested at the Alafia Bank until 2008, when this colony crashed and had only 26 pairs (-91.7% decrease).

During the 35 year study period, the population showed steep declines between several consecutive nesting seasons. Inter-annual fluctuations between a pair of nesting seasons appeared stochastic [30 pairs in 1982 declined to 20 pairs (-33%) in 1983; 66 pairs in 1990 declined to 39 pairs (-40%) in 1991; 81 pairs in 1996 declined to 66 pairs (-18%) in 1997; 73 pairs in 1998 declined to 66 pairs (-9%) in 1999, and 85 pairs in 2002 declined to 67 pairs (-21%) in 2003.

Figure 3. Reddish Egret swallowing a small fish.

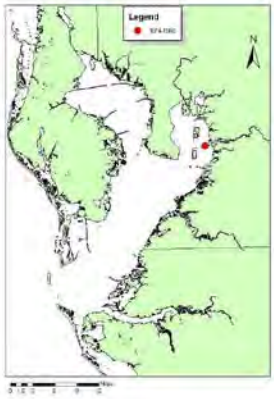


Figure 4a. Nesting sites of Reddish Egrets in Tampa Bay Florida, USA, from 1974-1980.

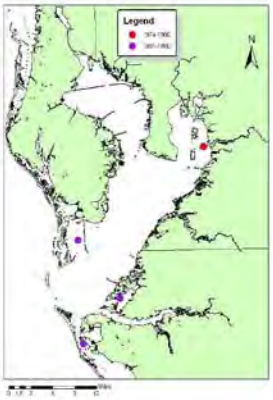


Figure 4b. Nesting sites of Reddish Egrets in Tampa Bay Florida, USA, from 1981-1990.

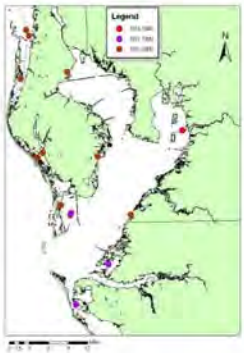


Figure 4c. Nesting sites of Reddish Egrets in Tampa Bay Florida, USA, from 1991-2000.

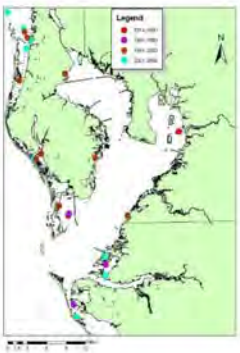


Figure 4d. Nesting sites of Reddish Egrets in Tampa Bay Florida, USA, from 2001-2008.

Between 2004 and 2008, the number of nesting pairs (98) in the region declined 73.5% (26 pairs) and 5 (30.8%) sites were not occupied.

During the study period, nesting averaged 48.3 nesting pairs/year, and from 1999-2008, the period in which we were consistently surveying known nesting sites, nesting averaged 74.7 pairs/year, 17% of the estimated state population. (Figure 5, Table 2, 3).

Of 2,308 young-of-the-year fledglings observed locally in the 35-year study period, 231 (10.0%) were white morph birds and 2,077 (90.0%) were dark morph Reddish Egrets.

Two hundred eighty-eight nestlings (86 1-young nests, 77 2-young nests, and 16 3-young nests) were counted in 179 nests, which was a mean brood count of 1.61 nestlings/nest:

$$n = ([1*86]+[2*77]+[3*16])$$

$$= 288 \text{ young}/179 \text{ nests}$$

$$= 1.61 \text{ nestlings/nest}$$

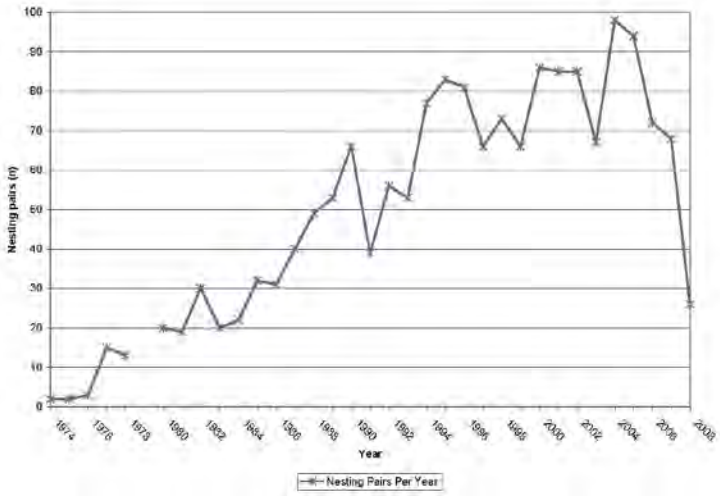


Figure 5. Nesting pairs of Reddish Egrets in St. Joseph Sound, Clearwater Harbor, Tampa Bay, and northern Sarasota Bay, Florida, USA, from 1974 to 2008.

Of 22 colonies that supported nesting at least once (1 pair) during the study period, all had <5 pairs/year average nesting except Washburn Sanctuary (5.4 pairs), and Alafia Bank (31.9 pairs) (Table 2, Figure 6).

Table 2. Average occupancy (number of nesting pairs/year) of Reddish Egrets in all years each colony had nesting at 22 locations in St. Joseph Sound, Clearwater Harbor, Tampa Bay, and northern Sarasota Bay, from 1974-2008.

Colony Number	Name	Bay Segment	Average Occupancy (nesting pairs/year)
1	Three Rooker Island	St. Joseph Sound	1.3
2	Marker 27	St. Joseph Sound	0.3
3	Marker 26	St. Joseph Sound	4.6
4	Marker 21	St. Joseph Sound	0.1
5	Smith Bayou North	St. Joseph Sound	0.3
6	Dunedin Sand Key West	Clearwater Harbor	0.3
7	I-25	Clearwater Harbor	4.1
8	Dog Leg Key Bird Island	Upper Boca Ciega Bay	0.9
9	Little Bird Key, John's Pass	Upper Boca Ciega Bay	1.1
10	Bird Rookery Key, John's Pass	Upper Boca Ciega Bay	0.6
11	Little Bird Key NWR	Upper Boca Ciega Bay	0.6
12	Tarpon Key NWR	Lower Boca Ciega Bay	2.0
13	Whale Key NWR	Lower Boca Ciega Bay	0.9
14	Coffeepot Bayou	Middle Tampa Bay	4.2
15	Alligator Lake	Old Tampa Bay	2.8
16	Alafia Bank	Hillsborough Bay	31.9
17	Piney Point	Middle Tampa Bay	2.2
18	Miguel Bay Island	Lower Tampa Bay	0.3
19	Washburn Sanctuary	Terra Ceia Bay	5.4
20	Little Bird Key (Washburn Jr.)	Terra Ceia Bay	3.4
21	Cortez Key Sanctuary	Sarasota Bay	1.8
22	Bishop Bayou Bird Island	Sarasota Bay	0.8

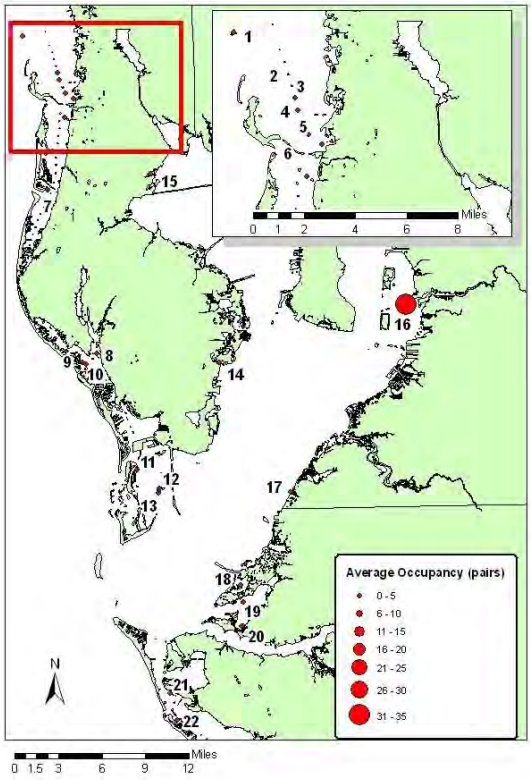


Figure 6. Average occupancy (number of nesting pairs) of Reddish Egrets in all years each colony had nesting at 22 locations in St. Joseph Sound, Clearwater Harbor, Tampa Bay, and northern Sarasota Bay, Florida, USA, from 1974-2008.

Nesting site descriptions

Reddish Egrets nested within bird colonies on estuarine or marine islands, among other herons, or near pelicans, cormorants, ibis, or spoonbills; rarely, they selected solitary nest sites. Nests were characteristically in densely foliated mangroves (red mangrove *Rhizophora mangle*, or black mangrove *Avicennia germinans*), or Brazilian pepper (*Schinus terebinthifolius*) shrubs or trees, on small islands that had no mammalian predators (raccoons) (Figure 2). Alligator Lake was the only site in a freshwater lake.

Nests were typically about 1 m diameter; constructed of interwoven small branches; with a shallow central depression; placed 1 – 3 m above the waterline or island surface; over creeks, inlets, or above small interior lagoons on islands where trees overlapped; typically at the edge of islands where the nests were concealed by foliage but adult birds could peer out. The natural islands had persistent mangrove canopies, except portions of some islands that were cold-damaged during the freeze in 1989. Most dredged spoil material islands were deposited between the 1940s and 1960s and developed arboreal cover following the vegetation succession model for dredged spoil material islands in Tampa Bay (Lewis and Lewis 1978). Habitat conditions at each site are discussed in the following sub-sections.

St. Joseph Sound—

St. Joseph Sound and Clearwater Harbor were beyond the Tampa Bay watershed but were included to provide a thorough review of regional nesting. They regularly nested at Three Rooker Island State Preserve and SJS Marker 26 Bird Colony Island, and nested one time each on SJS Marker 27, SJS Marker 22, SJS Marker 21, and Smith Bayou North Island Bird Sanctuary.

Three Rooker Island State Preserve was an undeveloped Gulf of Mexico barrier island managed by the Florida Park Service as part of the Gulf Islands GEOPark. Habitats on this island changed dynamically as the shoreline was re-deposited annually in response to storms and tides. Both white and dark morph Reddish Egrets nested in small numbers among a heron and White Ibis colony on the southern end of the island, where a small lagoon developed surrounded by 3-4m black and white (*Laguncularia racemosa*) mangroves and cabbage palms (*Sabal palmetto*) (Figure 7).

Figure 7. Brood of two white morph Reddish Egret nestlings on Three Rooker Island.

Dredged spoil material islands located to the east of the Intracoastal Waterway (ICWW) in St. Joseph Sound were generally rocky and slowly eroding. Spoil islands Markers 29 to 21 were vegetated with Brazilian pepper and some Australian pine trees. Reddish Egrets were first observed by FCIS in St. Joseph Sound (SJS) on SJS Marker 21, a small spoil island, in 1991 (Holland 1991). The nested on SJS Marker 27 in 2005, and regularly on SJS Marker 26 Bird Island in the Brazilian pepper near the small mangrove cove on the southwestern corner. This island was the largest wading bird colony in St. Joseph Sound and annually supported 400 pairs of cormorants, Great Blue Herons, Great Egrets, and small herons, including a few Reddish Egrets of both color morphs.

The Smith Bayou islands, located just west of Homeport Marina and Mar Marina in Palm Harbor, were privately owned and managed. Reddish Egrets nested on the south shoreline of the north island in the mangroves in 2003 and 2006. Great Blue Herons, Great Egrets, Yellow-crowned Night-Herons, and Green Herons also nested on this island in low numbers.

Reddish Egrets were observed in 1988 (June 17) nesting on Ozona Spoil East (Runde et al. 1991). Audubon surveys were not conducted in Clearwater Harbor and St. Joseph Sound that year. None of the Audubon surveys conducted in St. Joseph Sound from 1991-2008 found Reddish Egrets nesting on Ozona Spoil East. This dredged spoil material island was rimmed with mangroves on the western shoreline, bordered by Brazilian peppers and cabbage palms, and supported a small colony of cormorants, Great Egrets, and small herons.

Much of the St. Joseph Sound shoreline was undisturbed, and provided foraging for Reddish Egrets on the wide intertidal mud and seagrass flats, and sandbars along the natural shoreline and around Honeymoon Island, Three Rooker Bar, Anclote Key, and the north and south Anclote bars.

Clearwater Harbor.—

Reddish Egrets nested on two islands in Clearwater Harbor, Dunedin Sand Key West and Clearwater Harbor I-25 Bird Sanctuary. Dunedin Sand Key West (also known as West Kings Island) was located south of the Dunedin Causeway (State Road 586) and east of the ICWW. It was the western of two sandy spoil islands owned by Pinellas County and managed by FCIS. A few pairs of Reddish Egrets of both color morphs frequently nested on the island, with pelicans, cormorants, and other herons. The sandy bluff on the western shoreline of this island had a small stand of slash pine (*Pinus elliotti*) through the late 1990s, but the pines died as the bluff eroded from boat wakes propagated from the Intracoastal Waterway. The bluff sloped to a sandbar on the east end of the island that provided foraging. Vegetation was prickly pear cactus (*Opuntia* spp.), Brazilian pepper, and mangroves, with patchy saltmeadow cordgrass (*Spartina patens*) and saltgrass (*Distychlis spicata*).

Clearwater Harbor Island I-25 Bird Sanctuary was a dredged spoil material island owned by the City of Clearwater and managed as a bird sanctuary by FCIS, located south of the Memorial Bridge Causeway (Highway 60), west of the Intracoastal Waterway, and east of Clearwater Beach. Reddish Egrets were observed nesting at Clearwater Harbor I-25 Bird Sanctuary in 1988 (May 6) (Runde et al. 1991). We did not find them in 1982 and 1986 when we surveyed, and did not survey the island in 1988. Since 1991, they have nested there regularly in the dense mangrove cover and this was the largest wading bird colony in Clearwater Harbor. Reddish Egrets nested on the north side of the island, in mangrove trees that branched over a small creek draining a small interior lagoon. Both white and dark morph birds were observed nesting here. A rocky breakwater located on the south side of the island help to protect the island from erosion from storm waves and boat and ship wakes from the main channel to Clearwater Pass, and at low tides, approximately 20 acres of shallow inter-tidal flats with dense stands of seagrass provided foraging for herons and egrets (Figure 8).

Figure 8. Rock wave break at Clearwater Harbor Island I-25 Bird Sanctuary.

The shorelines of the mainland and the backsides of the barrier islands of Clearwater Beach, Sand Key, Belleair Shores, and Indian Rocks Beach were generally dredged or filled to

provide waterfront homes, marinas, and urban uses, with seawalls and deep water access for boats. Some undeveloped natural shoreline areas remained, interspersed with the dredged or filled waterfront residential areas and marinas, where Reddish Egrets foraged on intertidal flats.

Dredged spoil material islands in south Clearwater Harbor eroded rapidly, but where they remained (islands west of Markers 6, 8, and 10 were just above the water line at mid-tide and the recreational island Compass Key) they provided small sandbar foraging sites for Reddish Egrets. In north Clearwater Harbor (north of the Memorial Bridge Causeway), the estuary shoreline of the extreme north end of Clearwater Beach (privately owned) and Caladesi Island State Park, including Moonshine Island, remained undeveloped, and were used by foraging Reddish Egrets. On the west side of the ICWW, dredged spoil material islands owned by the State of Florida and managed by the Pinellas Aquatic Preserve were intensively used by recreational boaters and campers, but shorelines were used by foraging Reddish Egrets. The Dunedin shoreline north of Stevenson Creek was planted with mangroves and cordgrass in 1998-2000 and provided some shallow foraging habitat for Reddish Egrets, as did the Memorial Bridge and Dunedin Causeways.

Boca Ciega Bay.—

In some years, small numbers of pelicans, cormorants, and herons nested on the northern island (Little Bird Key/Johns Pass Island) owned by the Suncoast Seabird Sanctuary. The middle island (Bird Rookery Key) was created from spoil material deposited from dredging the channel into Treasure Island, and this island supported most of the nesting birds until 1993, when the colony was abandoned because of the presence of raccoons. All three islands were dense mangroves surrounded by shallow seagrass and intertidal sand and mud flats on the west side. One or 2 Reddish Egret pairs nested on Bird Rookery Key intermittently (2000, 2002, 2004, and 2006) either at the mouth of a tiny inlet on the north side or one on the west side. The southern island, Eleanor Island, owned by the City of Treasure Island, was not used as a nesting site by Reddish Egrets.

In 1880, Scott (1887) found two islands (Little Bird Key and Eleanor Island) at Johns Pass where there was an active bird colony. On his second visit to Florida, W. E. D. Scott reached John's Pass on Saturday, May 1, 1886.

> *"It was important to reach here early, as I particularly wished to observe a rookery which has been ever present in my mind since visits to the same point in April, 1880.*
>
> *At that time I made two visits of a day and night each to this same rookery, and among the myriads of birds that were breeding and roosting, the particular abundance of the Roseate Spoonbill, the Reddish Egret, and all of the common Herons, as well as the White Ibis, will never be forgotten. It is enough to state without going into great detail, that in one flock at that time were at least two hundred wonderfully colored Spoonbills, and that the numbers of the other species were many times greater.*
>
> *The numerous islands inside of the outer keys at this point are mostly wooded with one or more of the several kinds of mangrove, and vary in area from one to several hundred acres. The two nearest the mouth of the pass are small; the larger one may have an area of seven and the small of not more than two acres. They formed the site of the rookery. Looking carefully over both I could see no birds when we anchored, but as the sun began to get low in the west, a few, possibly fifty in all, shy and suspicious Herons straggled in to roost on the smaller of the two Keys, and a flock of Fish Crows (Corvus ossifragus) were the only visitors at the larger. Most of the Herons were A. ruficollis tricolor, but there were several A. egretta, A. candidissima, and A. caerulea, and perhaps a dozen A. rufa, and three of*

the so-called A. pealei. No Spoonbills, not a single White Ibis--in fact an utter transformation from the happy and populous community of only a few years before (Scott 1887)."

Dogleg Key Bird Island, located east of Johns Pass, where Cross Bayou and Long Bayou empty into Boca Ciega Bay, was the Johns Pass bird colony site in recent years (1995, 2006, 2007, and 2008). Dogleg Key annually supported about 300-500 pairs of pelicans and herons, including a few pairs each of Reddish Egrets and Roseate Spoonbills.

The Pinellas National Wildlife Refuge (Tarpon Key, Whale Island, Little Bird Key, Listen Key, Jackass Key, Mule Key, and Indian Key) islands were natural mangrove islands surrounded by expansive intertidal flats. Tarpon Key National Wildlife Refuge (NWR) was the third largest waterbird colony (3,000 pairs of Brown Pelicans and Double-crested Cormorants, herons, egrets, ibis, and spoonbills) in Florida until 2003, when raccoon predation caused the colony to abandon it and nearby Whale Island. This colony was the "descendant" of the famous Maximo Colony at Indian Key, 4.5 km north of Tarpon Key, noted for the extraordinary colony and particularly the Reddish Egrets that nested there in 1880 (Scott 1887). No colonial waterbird nesting has been noted at Indian Key NWR during the 35-year study period except for possible nesting by 2 pairs of Tricolored Herons in May 2007 (FCIS field notes), but raccoon tracks have regularly been noted on the island, and the refuge manager was unable to control them. Little Bird Key NWR provided a relief site for nesting pelicans, cormorants, herons, egrets, and spoonbills when Tarpon Key and Whale Island were abandoned, but this colony was abandoned in 2009, again due to the presence of at least 1 raccoon.

On Wednesday, June 2, 1886, W. E. D. Scott visited the Maximo Colony (now the Indian Key National Wildlife Refuge):

"About three miles from the extreme end of Point Pinellas, in Boca Ciega Bay, is the group of islands that once formed what is known as Maximo Rookery. These islands are so close together, being only divided by shoal and narrow streams of salt water at high tide, that practically they form a single low island. This is at least two hundred acres in extent, and is covered with a dense growth of the several kinds of mangroves and forms a point particularly attractive to birds either as a roosting or breeding place. I had been here six years before, and it fairly teemed with bird life then. Every tree and bush on this large area contained at least one nest, and many contained from two to six or eight nests whenever the size of the tree permitted. A perfect cloud of birds were always to be seen hovering over the island in the spring and early summer months, and conspicuous among them were Brown Pelicans, Man-o'-War birds, Reddish Egrets, Florida Cormorants, Louisiana Herons, American Egrets, Snowy Herons, Little Blue Herons, Great Blue Herons, and both kinds of Night Herons. I have tried to give them in the order of their abundance, though it is difficult to say, in such an immense congregation, which species predominated. Beside, in comparatively smaller numbers, and yet by hundreds, were White Ibises and Rosy Spoonbills. So far as I was then able to determine, all these species bred here save the Roseate Spoonbill and Man-o'-War bird, the latter being present to prey on the Pelicans and Cormorants, taking from them, whenever possible, the food intended for the young birds. It was truly a wonderful sight, and I have never seen so many thousands of large birds together at any single point.

We anchored the sloop just off the island and I went ashore to see what birds I might find. From the water, as we approached, only a few

Cormorants were to be seen, possibly seventy-five in all, and though I spent several hours looking over the various parts of the island I found no other large birds breeding--absolutely not a single pair of Herons of any kind; five or six Louisiana Herons feeding on a small sand flat at one of the extremities of the island were all the Herons observed in the vicinity.

When I previously visited this point A. Lechevallier had located on the mainland about three-quarters of a mile away; here he had built a house and was killing birds on the island for the feather market. He or his assistants had been there a little over a year, and I am told by persons living near, whom I have every reason to believe, that it took these men five breeding seasons to break up, by killing and frightening the birds away, this once incomparable breeding resort. Of course there were other plume hunters who aided in the slaughter, but the old Frenchman and his assistants are mainly responsible for the wanton destruction. He regarded this as his particular preserve, and went so far as to order outsiders, who came to kill Herons and other birds, off the ground. The rookery being destroyed, he had now given up his residence here (Scott 1887)."

Middle Tampa Bay – West Shore.—

Coffeepot Bayou Bird Island was a small (0.25 ha) mangrove island centered in Coffeepot Bayou, in northeastern St. Petersburg. Pelicans, Anhingas, cormorants, herons, and Roseate Spoonbills (first observed in 2008) nested there annually, with increasing numbers (c. 600 nests/year) and species richness (14 species in 2008, including 3-5 pairs of Reddish Egrets).

Middle Tampa Bay – East Shore.—

Tampa Electric Company, followed by the Southwest Florida Water Management District (SWFWMD), have protected Piney Point Rock Ponds Bird Colony which, since 1995, grew to 2,500-3,000 pairs of nesting colonial waterbirds and 14 species. This was the second largest waterbird colony in Hillsborough County, with the nesting Anhingas, cormorants, herons and egrets, and White and Glossy ibis colony situated in a group of connected borrow pit ponds located just north of the Hillsborough-Manatee County line and 0.5 km east of Lower Tampa Bay (Figure 9). The ponds were connected at highest high tides through a shallow ditch to Tampa Bay, and nesting was concentrated on low overburden piles covered with mangroves. Several alligators in the ponds deterred mammalian predation. In 2008, 5 pairs of Reddish Egrets nested on the west side of the colony.

Figure 9. Piney Point Rock Ponds colony, Hillsborough Bay, Florida, USA.

Old Tampa Bay.—

Alligator Lake was the only freshwater lake known in the world where Reddish Egrets nest. The perched lake was adjacent to Old Tampa Bay and had two islands and a palustrine forest near the dam outlet where Anhingas (about 50 pairs), herons (10 species), and White Ibis nested. Most of the colony including 3-5

pairs/year of Reddish Egrets and numerous small herons (Snowy Egrets: 50 pairs, Little Blue Herons: 40 pairs, and Tricolored Herons: 75 pairs) nested on the west island where the nesting substrate was short Carolina willows (*Salix caroliniana*) and elderberry (*Sambucus canadensis*) (Figure 10).

Figure 10. White morph Reddish Egret (left side of colony) at Alligator Lake, Safety Harbor, Florida, USA.

Hillsborough Bay.—

The Richard T. Paul Alafia Bank Bird Sanctuary (Alafia Bank) was leased by the National Audubon Society from Mosaic and has been managed as a bird sanctuary by FCIS since 1934 (Mills 1934). These dredged spoil material islands were deposited initially in 1931 when the Alafia River shipping channel was dredged. The islands developed a complex coastal plant community, dominated by Brazilian pepper and lead tree on the uplands and mangroves along the shoreline, which provides a variety of habitats attractive to nesting birds. They were modified by erosion, plant succession, and additional spoil material added to the "Sunken Island extension" in the late 1980s.

By the end of the 1960s, the nesting bird colony from the Green Key Audubon Sanctuary located 3.2 km south had relocated to the Alafia Bank, and it was the largest and most diverse mixed-species colony in Florida, with 25,000 pairs of breeding birds of thirteen species (Ogden 1978). In the late 1970s and early 1980s, the colony had 10,000-15,000 pairs annually, but had the highest species richness of any colony in Florida, with 16-20 species (including Reddish Egrets, Roseate Spoonbills, and Glossy Ibis) breeding there annually. From 1985-2009, the annual nesting population ranged 6,000-18,000 pairs, variably influenced by ENSO events, although it remained the largest waterbird colony in the state.

Reddish Egrets nested on Bird Island until the winter freeze of 1989 when the mangroves on Bird Island were killed, then moved to Sunken Island in spring 1990. The trees on Sunken Island were not damaged because they were further west in Hillsborough Bay and temperatures were buffered by the surrounding bay water. Reddish Egrets nested in clusters on the west end of the Alafia Bank, in both Brazilian pepper trees and mangroves among White Ibis, Roseate Spoonbills, Great Egrets, the small herons, and Black-crowned Night-Herons. Recently favored locations included tall mangroves at the west end of Sunken Island, in mangroves above two small creeks that drain the Extension into the Extension Cove, and in Brazilian pepper trees on the north side of Sunken Island.

Terra Ceia Bay.—

Nina Griffith Washburn Sanctuary (Terra Ceia Bird Key), a 3 ha natural mangrove island and 300 feet of encircling bay bottom, was donated to the National Audubon Society to be managed as a bird sanctuary in 1970. The island was located on the southwest corner of Terra Ceia Bay east of Palmetto and west of Rattlesnake Key. Reddish Egrets were first observed nesting at Washburn Sanctuary in 1979 (Ogden 1979). The preferred nesting sites were mangroves growing over a small creek that drained a small interior lagoon and mangroves surrounding tiny lagoons scattered across the island (Figure 11). The colony persisted as the second largest mixed colonial waterbird colony in the area until 2004 when it collapsed from unknown causes (likely the presence of a terrestrial predator). A few pairs of herons, spoonbills, and other colonial waterbirds have continued to nest there, but most of the colony moved to Little Bird Key.

Figure 11. Nina Griffith Washburn Sanctuary, Terra Ceia Bay, Florida, USA.

Little Bird Key ("Washburn Junior"), was a small mangrove island located in the southeast end of Terra Ceia Bay. It provided an alternate nesting site for colonial waterbirds, including 3-5 pairs of Reddish Egrets nesting in mangroves on the shoreline, when Washburn Sanctuary was not active.

Lower Tampa Bay.—

Manhattee Key (formerly Port Manatee Key) was the island created from material dredged from the shipping channel in the 1970s. The island was re-graded in 2002 to create nesting habitat for Least Terns and gulls on the northern plateau, and a central tidal channel bordered by low marsh and mangroves. [*Note*: a small stand of mangroves was located at the southeast end of the island, where a pair of Reddish Egrets fledged 1 young in 2010 (M. L. Rachal, FCIS, pers. obs.)].

Passage Key National Wildlife Refuge was established in 1905 by President Theodore Roosevelt as the second federal bird protection area in the United States. Herons, but never Reddish Egrets, nested in trees on the barrier island for decades (Howell 1932). Most of the island had eroded by the 1990s, and a few Brown Pelicans, herons, terns, skimmers, and Laughing Gulls continued nesting among short seagrapes, halophytic forbs, and grass until the island submerged during the winter of 2005-2006. The National Wildlife Refuge system retained ownership of the island's boundary.

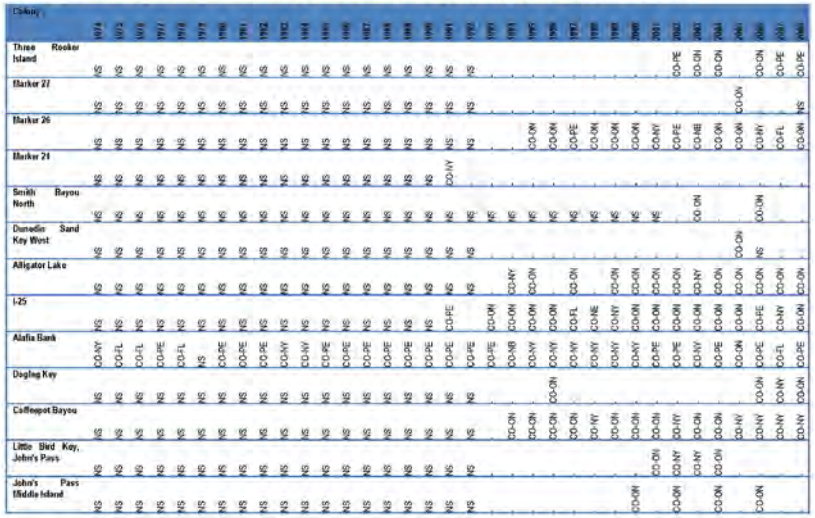
Egmont Key National Wildlife Refuge was a large barrier island that had shorebirds, pelicans, and larids, and a few White Ibis and small herons, but never had nesting habitat for Reddish Egrets. The south end of the refuge was closed to people in mid-1990s, and as Passage Key went under the birds started moving to Egmont Key. The waterbird colony at Egmont Key has expanded yearly, and this is now one of the largest nesting sites annually in Florida. About 63% of the regional bird population nested here in 2008 (especially important for Brown Pelicans [942 pairs], Laughing Gulls [over 25,000 pairs], Royal [5,572 pairs] and Sandwich [1,144 pairs] terns, and Black Skimmers [165 pairs] in 2008).

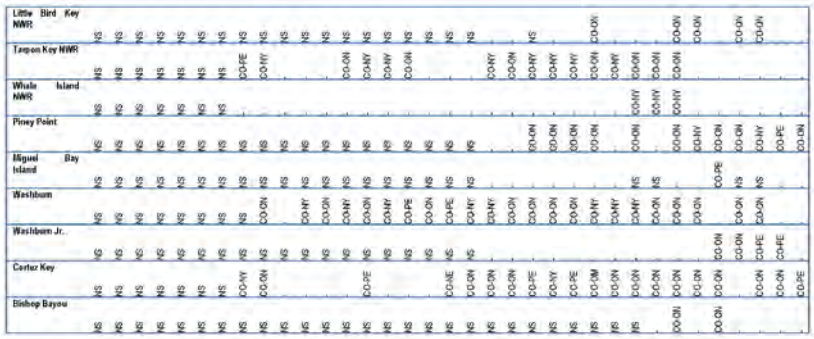
Northern Sarasota Bay.—

Cortez Key Audubon Sanctuary and the Bishop Bayou Bird Island in northern Sarasota Bay were near the other sites in Lower Tampa Bay where Reddish Egrets nested. Cortez Key was a natural mangrove island located 200 m offshore of the fishing community of Cortez in Manatee County. Both white and dark morph Reddish Egrets nested there since 1981, although in some years the colony was abandoned due to raccoons, which can swim easily to the island. Other species that nest there were Brown Pelicans, Double-crested Cormorants, herons and egrets, and Roseate Spoonbills.

Reddish Egrets nested at Bishop Bayou, a small mangrove island located south of Longboat Pass, west of the ICWW and Sister Keys, in 2002 and 2004, among a waterbird colony composed of pelicans, cormorants, herons and egrets, and 1 pair of Wood Storks. The egrets were probably displaced from Cortez Key during years when raccoons reached that island and were not trapped out until after the nesting season had started, so that a late starting colony returned to the island to nest, but some birds had already started nesting at Bishop Bayou.

Table 3. Breeding bird behavior codes of Reddish Egrets at nesting sites in Tampa Bay, Florida, USA, from 1974-2009.





Notes: NS = no survey; breeding bird codes CO-NY; CO-ON, CO-PE, CO-OM, CO-FL, CO-NE (from Florida Breeding bird atlas).

Table 4. Nesting sites and years of Reddish Egret pairs, 1974-2008, in Tampa Bay, Clearwater Harbor, St. Joseph Sound, and northern Sarasota Bay, Florida, USA.

Year	Three Rooker Island	Marker 27	Marker 26	Marker 21	Smith Bayou North	Dunedin Sand Key West	I-26	Dodieg Key	Little Bird Key, John's Pass	John's Pass Middle Island	Little Bird Key NWR	Tarpon Key NWR	Whale Island NWR	Coffeepot Bayou	Alligator Lake	Alafia Bank	Piney Point	Miguel Bay Island	Washburn	Washburn Jr	Cortez Key	Bishop Bayou	Total Pairs
1974	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	0	-	-	-	2
1975	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	0	-	-	-	2
1976	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	0	-	-	-	3
1977	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	15	-	-	0	-	-	-	15
1978	-	-	-	-	-	0	-	-	0	-	0	0	-	-	-	13	-	-	0	-	-	-	13
1979	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-
1980	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	0	-	-	-	20
1981	-	-	-	-	-	0	-	-	-	-	-	1	0	-	-	15	-	-	0	-	3	-	19
1982	0	-	-	-	-	0	0	-	0	0	-	2	0	-	-	25	-	-	1	-	2	-	30
1983	-	-	-	-	-	-	-	-	-	-	-	0	0	-	-	20	-	-	0	-	0	-	20
1984	-	-	-	-	-	-	-	-	-	-	-	0	0	-	-	20	-	-	2	-	0	-	22
1985	-	-	-	-	-	-	-	-	-	-	-	0	0	-	-	30	-	-	2	-	0	-	32
1986	-	0	0	0	0	0	0	0	0	0	0	3	0	-	-	25	-	-	3	0	0	-	31
1987	-	-	-	-	-	-	-	-	-	-	-	6	0	-	-	30	-	-	3	-	1	-	40
1988	-	-	-	-	-	-	-	-	-	-	-	4	0	-	-	35	-	-	10	-	0	-	49
1989	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	40	-	-	12	-	0	-	53
1990	-	-	-	-	-	-	-	-	-	-	-	0	0	-	-	63	-	-	3	-	0	-	66
1991	0	0-	0	1	-	0	1	-	-	-	0	0	0	-	-	30	-	0	6	-	1	-	39
1992	0	-	-	0	-	-	0	-	-	-	-	0	0	-	-	48	-	0	7	0	1	-	56
1993	0	0	0	0	-	0	1	0	0	0	0	10	0	0	0	30	0	0	10	0	2	-	53
1994	0	0	0	0	-	0	3	0	0	0	0	8	0	1	2	45	0	0	15	0	3	-	77
1995	0	0	1	0	-	0	4	0	0	0	-	4	0	1	1	60	1	0	9	0	2	-	83
1996	0	0	2	0	-	0	8	3	0	0	0	4	0	1	0	45	1	0	14	0	3	-	81
1997	0	0	0	0	-	0	2	0	0	0	0	3	0	2	2	50	2	0	3	0	2	-	66
1998	0	0	6	0	-	0	8	0	0	0	1	4	0	2	0	40	2	0	8	0	2	-	73
1999	0	0	4	0	-	0	4	0	0	0	0	3	0	3	3	45	0	0	3	0	1	-	66
2000	0	0	8	0	-	0	3	0	0	1	0	1	4	3	4	50	3	-	6	0	3	-	86
2001	0	0	6	0	-	0	5	0	1	0	0	2	3	3	2	45	0	-	10	0	8	0	85
2002	2	0	8	0	0	0	7	0	4	1	1	1	1	6	5	36	1	0	5	0	3	4	85
2003	1	0	6	0	1	0	4	0	3	0	3	0	0	3	4	30	2	0	7	0	3	0	67
2004	2	0	10	0	0	0	10	0	1	1	0	0	0	8	8	48	2	1	0	5	1	1	98
2005	0	1	5	0	0	1	2	0	0	0	1	0	0	10	1	60	3	-	5	5	0	-	94
2006	1	0	2	0	1	-	3	2	0	2	1	0	0	7	4	40	1	-	3	3	2	0	72
2007	1	0	3	0	0	0	6	4	0	0	0	0	0	10	5	21	8	0	0	4	6	0	68
2008	2	0	3	-	-	0	3	3	0	0	0	0	0	3	1	5	5	0	0	0	1	0	26

Effects of four hurricanes in 2004

Hurricanes Charley (14 August, Category 4, regional wind speed of 80 mph), Frances (4-5 September, Category 2, regional wind speed 65 mph), Ivan (offshore Florida on 15 September, Category 5 diminished to 3, wind speed of 100 mph and looped to return through Florida on 22 September with a regional wind speed of 45 mph) and Jeanne (26-27 September, Category 3, regional wind speed of 95 mph) made landfall or passed within 100 miles or closer of Tampa Bay with rain and wind affecting the region. Although FCIS did not survey for Reddish Egrets immediately after the hurricanes, there were no anecdotal reports of Reddish Egret mortality from local government employees or birders. Neither did we receive any calls concerning injured Reddish Egrets from the local licensed rehabilitation facilities, either the Suncoast Seabird Sanctuary on Indian Rocks Beach in Pinellas County, or Save Our Seabirds in Wimauma, in southern Hillsborough County.

The greatest concern from the convergence of four hurricanes in Tampa Bay in the late summer and fall of 2004 was the potential destruction of nesting habitat, particularly of dense mangrove stands at known nesting locations, and the secondary concern was damage to mangroves at common roosting sites. Hurricane wind speeds had generally diminished by the time the hurricanes hit the area and no serious damage (e.g., widespread wind-throw) occurred to mangroves used by nesting Reddish Egrets (Table 5). Some erosion of nesting islands occurred (e.g., the western end of the Sunken Island/Extension of the Alafia Bank Bird Sanctuary, which was observable based on a change detection analysis we had conducted). The strong winds stripped the leaves from trees, and salt water spray killed some of the lower branches of Brazilian peppers at some sites (e.g., Alafia Bank Bird Sanctuary shoreline), but this damage was not in preferred nesting habitat.

By spring 2005, trees had leafed out and there were few obvious impacts from the 2004 hurricanes on the mangrove nesting habitats in the region. Further south, in the region directly affected by Hurricane Charley when the storm came onshore near Sanibel and Charlotte Harbor, significant damage to trees, including mangroves on nesting colony islands, was very noticeable (A. Hodgson and A. Paul, pers. obs.) and nesting colonial waterbirds did abandon some traditionally used nesting colony sites (such as Useppa Bird Keys in Charlotte Harbor).

In spring 2004, Reddish Egrets nested at 13 colonies widely distributed in Tampa Bay, Pinellas County, and northern Sarasota Bay, and the nesting population in the Tampa Bay region was 98 pairs, the largest recorded during the study period. The nesting season (March-August 2004) was finished before the first hurricane occurred in mid-August, and the young-of-the-year birds and adults had generally dispersed from their natal colonies but were resident in the bay. In 2005, the nesting season following the fall 2004 hurricanes, Reddish Egrets nested at 11 colonies, all but the 2 Sarasota Bay colonies, which likely had a raccoon. The nesting population was 94 pairs, because Cortez Key and Bishop Bayou were empty.

The inter-annual difference in nesting pairs among the two nesting seasons was less than the difference in the preceding or subsequent nesting seasons. The greatest differences in number of nesting Reddish Egrets occurred at 1-25 Bird Sanctuary, Alligator Lake, Washburn Sanctuary, and the Alafia Bank Bird Sanctuary. There was no apparent reason, because these locations were the most distant nesting sites from each other in the system, and were in four separate sub-regions of the bay system.

The locus of the nesting effort remained at the Alafia Bank Bird Sanctuary in Hillsborough Bay, but 15 fewer pairs nested on the northern Pinellas County coast (including St. Joseph Sound, Clearwater Harbor, and Alligator Lake), and 19 more pairs were found at Coffeepot Bayou, the Alafia Bank Bird Sanctuary, and Washburn Sanctuary in Terra Ceia Bay. No particular changes in the local site conditions were observed that might have caused birds to avoid traditional sites and it is more likely that intrusive disturbances during the start of the nesting season

deterred birds from nesting at certain sites. Overall, there was no apparent effect from the hurricanes in fall 2004 on the distribution of the regional population or numbers of nesting pairs.

Table 5. Effects of 4 hurricanes in 2004 on Reddish Egret nesting habitat, nesting effort in 2005, and relative importance of nesting sites in Tampa Bay, Florida, USA. Colony potential scale: 0 (no nesting), 1 (1-<5 prs.), 2 (5-10 prs.), 3 (>10 prs); PNWR = Pinellas National Wildlife Refuge.

Bay Segment	Colony	Hurricane Effects	2004 Nesting Pairs (n)	2005 Nesting Pairs (n)	Colony Potential
SJS	Three Rooker Island	Erosion	2	0	1
SJS	Marker 27	Erosion	0	1	1
SJS	Marker 26	Erosion	10	5	2
SJS	Marker 22	Erosion	0	0	0
SJS	Marker 21	Erosion	0	0	0
SJS	Smith Bayou North	No effects	0	0	1
SJS	Ozona Spoil East	No effects	0	0	1
SJS	Dunedin Sand Key West	No effects	0	1	1
CH	I-25	No effects	10	2	2
BCB (Johns Pass)	Little Bird Key (Johns Pass Island)	No effects	1	0	1
BCB (Johns Pass)	Bird Rookery Key	No effects	1	0	1
BCB (Johns Pass)	Eleanor Island	No effects	0	0	0
BCB (Johns Pass)	Dogleg Key Bird Island	No effects	0	0	1
BCB	Tarpon Key PNWR	No effects	0	0	3
BCB	Whale Island PNWR	No effects	0	0	1
BCB	Little Bird Key PNWR	No effects	0	1	1
BCB	Listen Key PNWR	No effects	0	0	0
BCB	Jackass Key PNWR	No effects	0	0	0
BCB	Mule Key PNWR	No effects	0	0	0
BCB	Indian Key PNWR	No effects	0	0	3
MTB – West Shore	Coffeepot Bayou	No effects	8	10	2
MTB – East Shore	Piney Point	No effects	2	3	2
OTB	Alligator Lake	No effects	8	3	2
HB	Alafia Bank Bird Sanctuary	Erosion	48	60	3
TCB	Miguel Bay Island	No effects	1	0	1
TCB	Washburn Sanctuary	No effects	0	5	3
TCB	Little Bird Key (Washburn Jr.)	No effects	5	5	2
LTB	Manbirtee Key (Port Manatee Key)	Erosion	0	0	1
LTB	Egmont Key NWR	Erosion	0	0	0
LTB	Passage Key NWR	Erosion	0	0	0
NSB	Cortez Key Sanctuary	No effects	1	0	3
NSB	Bishop Bayou Bird Island	No effects	1	0	1

Other concerns were the erosion of tidal flats where egrets typically foraged, and mortality of forage fishes. In subsequent surveys, minor erosion but no large-scale damage to foraging sites (intertidal mud, sand, and seagrass flats, sandbars, and salt barrens) used by Reddish Egrets was observed, and these habitats were not affected apparently by the hurricanes. No assessment of forage fish mortality was made by the Florida Fish and Wildlife Conservation Commission (Luis Barbieri, Florida Fish and Wildlife Conservation Commission, pers. comm.).

DISCUSSION

Habitat and Population Changes

Most nesting sites selected conformed to the typical arboreal sites on isolated estuarine islands preferred by Reddish Egrets (Lowther and Paul 2002). Unlike Texas and some other arid areas, egrets did not nest on the ground or in short low-growing vegetation in Tampa Bay or anywhere in Florida. Alligator Lake, a perched fresh water or perhaps oligohaline lake separated from Old Tampa Bay by a weir, was a unique site because it is the only known freshwater nesting site for Reddish Egrets worldwide.

We assumed that the regional population increase was initially due to the gradual expansion of the state's Reddish Egret population as the number of individuals increased in southern Florida and adult birds advanced north. Although we believe that Reddish Egrets were absent from the Tampa Bay region into the early 1970s and first colonized the area in 1974, even if a few local pairs were present earlier than that, they were widely scattered. Once Reddish Egrets occupied Tampa Bay and the gulf coastline of Florida, the nesting population in the region increased exponentially until 2004. In the first 4 years, the population increase presumably was immigrant adults. After 1977, part of the population increase was presumably due to recruitment of recently sexually mature birds hatched in the region, plus additional immigrants from other areas in the state, including Florida Bay and the east coast (Indian River Lagoon colonies).

Reddish Egrets expanded nesting from 1 bay segment to all bay and gulf segments of the study area in the first 25 years, then in the last 10 years added a short northern range expansion in St. Joseph Sound, and began using additional colonies near already occupied sites. They used both natural and dredged spoil material islands indiscriminately. Most (95%) nested each year at the Alafia Bank Bird Sanctuary, with a few pairs consistently at 9 other sites.

Two factors, habitat availability and predators, were influential as Reddish Egrets re-colonized the area. Mangroves, or Brazilian pepper at some sites, were well established at the natural island sites in the early 1970s, and the availability of nesting substrate did not change significantly over the study period, although some freeze kill occurred in 1989. This did not cause Reddish Egrets to abandon any location, however, except their short shift on the Alafia Bank. None of the dredged material islands were present before egrets were extirpated from the area, but they were readily accepted as nesting habitat where their configuration and arboreal canopy was suitable. In fact, all the spoil islands in St. Joseph Sound and Clearwater Harbor were new sites – Three Rooker Island was the only natural island in the chain. While most of the dredged spoil material islands followed the typical Tampa Bay model of island succession, once mangroves were established, which was before the 1970s, the maturation of the upland plant community did not affect nesting success.

Urban development affected the number and ecological integrity of nesting and foraging sites as much of the coastal shoreline was being dredged and filled since the 1960s. Boca Ciega Bay was more altered than any other area and will never support the large population of Reddish Egrets observed there in the 1880s because the islands were filled over to build housing, intertidal flats were dredged and filled eliminating much of the historical foraging areas, the distance between the land and the islands was narrowed making them easily

vulnerable to predators, and the urbanized raccoon population is about 10 times greater than the natural density.

Some sites were abandoned due to the presence of raccoons or for unknown reasons. Two major waterbird nesting colonies have been abandoned during the last fifteen years. Some of the Reddish Egrets that had nested at the Tarpon Key and Whale Island National Wildlife Refuges colony apparently moved to nest at nearby Little Bird Key National Wildlife Refuge. Raccoons were persistent at Tarpon Key and Whale Island National Wildlife Refuges and caused the nesting colony abandonment there despite attempts to remove them by NWR refuge managers. However, Little Bird Key National Wildlife Refuge attracted raccoons also, and has not been used by nesting birds since 2008. We were never able to find a predator on Washburn Sanctuary, although raccoons or another predator were suspected, after it was abandoned in 2004, but that was the most plausible explanation for some of the birds that nested at Washburn Sanctuary moving to Terra Ceia Little Bird Key. A few other widespread sites had raccoons periodically, which explained some years in which egrets did not nest. The elevated regional population of meso-carnivores, particularly raccoons, must be controlled for these colonies to be re-occupied.

Particularly worrisome is the sudden drop in nesting in the last four years at Alafia Bank, which has been the most important Reddish Egret nesting site for 40 years. Most of the egrets have abandoned the site, although a consistently large colony of other waterbirds nested successfully in the same years. The decline is doubtfully related to general reproductive failure, since the long-term data suggest that egrets laid 3 egg clutches, then lost 1-2 nestlings, presumably depending on forage availability or, periodically, extreme weather events. Over the long-term, the third chick was lost in nearly all nests, and the second and third nestlings were lost in nearly 50% of the nests we sampled, probably due to starvation or fratricide as they were out-competed by their siblings. This chick loss pattern persisted in recently successful nests at other sites.

In addition to anthropogenically-induced predator population increases, direct human disturbance has become a significant cause of nesting failure annually at many colonies. We opine that Reddish Egrets are being deterred during courtship at the Sunken Island Extension sandbar, their traditional courting site, by several "nature photographers" that started pressuring the Extension cove in 2005 and 2006, then disrupted the site further during the early days of the nesting cycle when pair bond reaffirmation is critically important. The constant pressure from these photographers has reduced the number of egrets and pelican nesting around the cove by the sandbar in the last few years. Similarly, pressure from fishermen fishing for redfish on the shoreline of Miguel Bay Island caused the colony's collapse in 10 days in 2007.

Another possible explanation for nesting decline was forage availability, but forage fish populations were not severely diminished in the past several years, and we conducted no analyses (Robert McMichael, Florida Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, pers. comm.). Also, foraging habitat around the Alafia Bank and other sites is generally unchanged within the past 10 years, which overlaps the decrease, so it is unlikely that forage availability is driving the population crash. We could speculate that the Hillsborough Bay population of Reddish Egrets may have reached a maximum number that could be supported by the foraging habitat available within flying distance from nests at the Alafia Bank, but this would not explain the previous inter-annual variability compared to the 2006-2008 crash.

The statewide population estimate was progressively increased to 300-400 pairs, and was repeated invariantly until recently (Paul 1991, Paul 1996, Lowther and Paul 2002), when the estimate was reduced to 250-300 pairs (Green 2006). Based on interpretations of Reddish Egrets populations reported in Florida by Scott (1887, 1889, 1891) and others, Paul

(2002) speculated the current population may be only 10% of the population that occurred in the state prior to the 1880s, when the impacts of hunting for the feather trade reached a peak. Further, the statewide estimates have not increased since the 1990s, suggesting that habitat is the limiting factor, and more pairs cannot be supported.

Management Recommendations

Habitat and population management recommendations should be implemented to conserve Reddish Egrets in Tampa Bay and Pinellas County and similar estuarine ecosystems. Our recommendations are based on our cumulative experience in bird colony management and are congruent with recommendations listed in the Southern United States Regional Waterbird Plan (Hunter et al 2005).

The common causes of nesting failure are mammalian predators or disturbance by humans. Nesting sites must be protected from both, but the strategies differ. The public's behavior near bird colonies can be modified through passive and active colony protection programs. Over the past several decades, Audubon has implemented direct sanctuary management by posting bird colonies with informational and regulatory signs to educate people about their appropriate conduct near a colony, accompanied by (although costly and conducted on a limited basis) patrol of major colonies using uniformed wildlife wardens to interdict human intrusion as the most effective method of preventing human disturbance. Patrol programs work when the public is cooperative and not intent on violating wildlife laws, or taking advantage of the inequitable protections to navigation that allow persons to encroach on colonies. Increased enforcement of trespass and wildlife conservation laws is needed through greater interagency cooperation among law enforcement agencies responsible for enforcing wildlife protection laws, training officers lacking wildlife law enforcement experience, and employing more officers as the number of the boating public recreating near bird colonies increases.

Educational outreach to increase the public's compliance with staying out of areas posted "no trespassing" and "no landing" has been effective on a limited basis. Some strategies include producing informational Boater's Guides, conducting classes on bird conservation for new boaters, placing information in the media and on various internet websites that attract fishermen and other public boating near bird colonies. Public education programs must be conducted continuously, as the region continues to develop and naïve new residents and tourists, who lack knowledge of regional conservation initiatives and species protection concerns.

Audubon developed the Project ColonyWatch colony protection program using volunteers in the mid-1990s, and trained citizen scientists to observe bird colonies and report disturbances to the Audubon sanctuary management program. Since the mid-2000s, a bird colony stewarding program has been developing in Florida which recruits volunteers to stay by shorebird colonies during the day, particularly weekends and holidays, and intervene if persons get too close to the nesting birds. These volunteer programs have been effective, primarily for beach-nesting bird colonies on the barrier beaches accessible without a boat, but require continued education of locally responsible, motivated volunteers and enlistment of public agency support of bird conservation requirements.

Direct human disturbance has become a significant factor at waterbird colonies across Florida. Management techniques to reduce disturbance include:

- installation of "no trespassing" and "no landing" signs,
- regular warden patrol especially on holidays and weekends when the boating public is most active,
- expanded efforts to educate the public through the media, talks to public groups,
- staff-led field trips, and
- publication of site-specific handouts and free distribution of thousands of copies of numerous Boater's Guides (*Tampa Bay Boater's Guide*, *Hillsborough Bay Boater's Guide* – both English and Spanish versions,

Boca Ciega Bay Boater's Guide, Clearwater Harbor/St. Joseph Sound Boater's Guide, and *Manatee County Boater's Guide*)

On-going, regular and annual surveys allow bird colony managers to monitor nesting populations, respond quickly to the presence of predators or some other management emergency, develop regional plans with other agency managers to address conservation of rare and listed species, and are critical to regional management of colonial waterbirds.

Much habitat has been destroyed in the Tampa Bay area since the late 1950s as large sections of the bay were dredged and filled to build navigation channels, promontories for waterfront homes, and deepwater access for boats. Habitat restoration projects should be accomplished that provide incremental improvements to habitats, especially nesting habitat, salt barrens, intertidal sand and mud flats, and sandbars, as well as mangroves and marshes along shorelines. Dredge and fill activities to create boat dock access to residential or commercial properties where shallow intertidal areas suitable for wading waterbird foraging remain are real threats to maintaining stable populations and should be prevented. Intact natural habitat should be acquired and managed appropriately to conserve the native resources.

Many factors that influenced bird abundance in Tampa Bay were identified 25 years ago (Paul and Woolfenden 1985). Most of those remain important, while the context of others has changed. In the following section, we discuss the effects of abiotic and biotic stressors on Reddish Egrets.

Factors Affecting Reproductive Output

Abiotic Stressors

Weather events: freezes, storms, and hurricanes

Tampa Bay periodically has freezes that can kill or severely "prune" cold-sensitive mangrove and Brazilian pepper trees, the preferred nesting substrate of local Reddish Egrets. Freezes, even if they do not kill the tree, typically cause leaf drop leaving a bare tree for several months into the nesting season, which affects the selection of nesting islands or locations on those islands, and may cause egrets to choose an alternate site.

The December 1934 freeze affected nesting at Green Key "as about 50% of the foliage on Green Key was destroyed" (Schultz 1936).

> *"The colony on Green Key had a very successful season considering various unfortunate circumstances which prevented the birds from breeding in as large numbers as the year before. In the first place, the devastating freeze of the preceding winter injured the mangroves far more than we anticipated at first and we feel that the thinness of the foliage discouraged many birds from nesting on the key this year (Mills 1935)."*

More recently, the 1989 freeze killed the mangroves on the east end of Bird Island at the Alafia Bank, which had been the preferred nesting location for the pelican, ibis, and heron colony for 20 years. Bird Island was abandoned the following spring and the birds moved to nest on Sunken Island, 1.6 km to the west, where the black and white mangroves were not killed because they were buffered by the surrounding water mass, and where Brazilian pepper trees also provided nesting substrate.

Severe storms, often with several consecutive days of cold rain and strong winds, during the nesting season can affect nesting success. Early season storms that occur during courtship may delay nest initiation. Storms occurring after the onset of nesting may interrupt a first nesting attempt but adults will generally try to nest again that season. Winds from storms occurring after nesting has begun may destroy nest platforms, cold stress may cause the death of embryos or young, the adults may not be able to forage for minnows in the turbulent water, or the associated high tides may flood foraging habitats to depths greater that adults can efficiently hunt

in, resulting in the death of nestlings due to a combination of thermal exposure and starvation resulting from their parents' difficulty in foraging during strong storm events. Storms occurring later in the nesting season in which nestlings die typically end the nesting attempts for the year. The strong winds of a tropical depression or hurricane making landfall directly over west-central Florida could kill any age class of Reddish Egrets directly.

Habitat destruction is a potential result of wind storms and hurricanes. A hurricane struck South Florida in 1935 that destroyed habitat and drove the birds out of the area.

> *"According to a National Association (of Audubon Societies) press release, Mr. Alexander Sprunt, supervisor of southern sanctuaries for the Association, made an airplane flight over the devastated areas in the Keys on October 3, 1935, and reported that 'the entire eastern half of the great white heron range has been wiped out. At present there are not only no birds, but no places for them to nest if there were birds.' In a similar flight in February, Mr. Sprunt counted 211 great white herons, whereas in the October flight, he could see but 146 of these rare and fast disappearing birds." (Florida Naturalist 1936)*

Reddish Egrets are somewhat "traditional" in the nesting sites that they choose. Sites where they have nested successfully in the past are investigated first during courtship, and are used again if they are suitable. If nesting sites are unavailable, egrets may select an alternate site nearby, if it meets their requirements. For example, trees were destroyed on mangrove and spoil islands in Charlotte Harbor and Pine Island Sound during Hurricane Charley in 2004. The hurricane affected nest colony selection by the herons and egrets, pelicans, and ibis for the next season and beyond, as the Useppa Bird Keys were abandoned for a nearby alternate location, and the nesting colony was less populated (FCIS field notes).

Erosion on nesting sites and foraging habitats during strong storms and hurricanes also affects habitats. Change detection analysis of erosion at the Alafia Bank Bird Sanctuary showed significant erosion loss of island shorelines in recent years (FCIS field notes). Studies of dredged spoil islands in Florida document that erosion affects these islands, the vegetation succession that occurred on them, and bird use (Schreiber and Schreiber 1978 and Lewis and Lewis 1978).

A high-activity hurricane era has been in place since 1995. Hurricane seasons during 1995-2009 have averaged 14.5 named storms, 8 hurricanes, and 4 major hurricanes, with an average Accumulated Cyclone Energy (ACE) index of 160 percent of the median. This high level of activity contrasts to the low activity period between 1971-1994, when year averages were only 8.5 names storms, 5 hurricanes, and 1.5 major hurricanes and an ACE index of only 75 percent of the median (Goldenberg et al. 2001).

Dredging

In 1985, Paul and Woolfenden pointed out that dredge-and-fill activities have both positively and negatively affected waterbirds. Some dredged spoil material islands now provide nesting habitat for Reddish Egrets (e.g., Marker 26, I-25, Dogleg Key, and the Alafia Bank). On the other hand, large areas of coastal mangroves, and intertidal shorelines historically important as foraging sites have been lost, bay bottoms have been layered with silt or replaced by islands, and much of the natural coastal drainage patterns have been altered, particularly in Tampa, St. Petersburg, Clearwater, and Boca Ciega Bay by dredging and the construction of seawalls. Seagrass productivity and demersal fish populations were lost.

Pesticides and heavy metals

The effects of pesticides on Brown Pelicans and some other species are well understood, but

bioaccumulation in Tampa Bay fish populations is not well understood. Heavy metal residues were the subject of a preliminary investigation in McKay Bay but more information is needed in view of the potential contaminant sources along heavily industrialized shorelines, especially in Hillsborough Bay (Gude 1977). These chemicals are potential problems for birds feeding on organisms in Tampa Bay, and concentrations in selected prey species or bioaccumulation in Reddish Egrets themselves are not known.

Oil spills

Oil spills are potentially one of the most dramatic problems affecting coastal bird populations. Reddish Egrets forage by dancing vigorously through shallow water, partially immersed in water. Spills cause bird mortality by direct contact or by oil ingestion during preening or during foraging, and can kill prey species or coat intertidal vegetation and mudflats (Clapp et al. 1982). Oiled birds can transfer oil to eggs during incubation, reducing hatching success (King and Lefever 1979; White et al. 1979; Parnell et al. 1984). Bird cleaning techniques have improved significantly and were used to salvage many birds in the 1993 oil spill.

Entanglement

Entanglement in fishing line and other rope or line type debris presents a significant danger to birds as they forage along shorelines where line is entangled in the outer branches of mangroves, or if they collect fishing line to make their nests. Entanglement in fishing line or trash is a regular cause of bird mortality. The Florida Fish and Wildlife Conservation Commission have identified entanglement with line as the primary cause of death of adult Brown Pelicans in Florida (Steve. A. Nesbitt, Florida Fish and Wildlife Conservation Commission, pers. comm.), and we have retrieved many carcasses of small herons that became entangled in a nesting colony.

Fishing line (both monofilament line and the newer, even more dangerous braided line types) and trash removal projects at nesting islands should be conducted in the fall when birds are generally not nesting.

Another anthropogenic cause of mortality is inappropriate disposal of bait fish or fish carcasses around fishing piers and commonly used fishing beaches. For example, a Reddish Egret at the Apollo Beach Nature Preserve has recently learned to beg from fishermen who, as they replace their bait fish, cast it to the bird. The tolerance of this egret for nearby humans and its habituation to receiving cast-off baitfish and offal makes it vulnerable to alimentary tract rupture caused by ingesting inedible bony fishes or carcasses tossed to it by fishermen, entanglement in fishing line or trash, or physical harm by malicious people.

Biotic Stressors

Human Disturbance

In addition to anthropogenically-induced predator population increases, human disturbance affecting the number and ecological integrity of nesting sites has become a significant cause of Reddish Egret nesting failure annually. Nesting colony disruption that causes individual nests or the entire colony to fail during a nesting season erases the annual nesting effort. Even worse is the short-term or long-term abandonment of a colony site because of persistent disturbance.

Although egrets cannot be hunted, disturbance at nesting colony sites is a regular occurrence with comparable effects. Bird sanctuaries owned, leased or managed by government agencies and private landowners are regularly visited by fishermen and boaters who are unaware of the damage that their visits can cause and of the fact that they are only one of multiple visits by others equally unaware with cumulative, often mortal, effects. Patrol by Audubon wardens and agency personnel to deter disturbance is incomplete. Funding is too scarce to station officers and wardens at nesting sites twenty-four hours a day seven days a week during the six month nesting season. Often, while wardens are patrolling one side of a nesting island, trespassers enter the

islands and disturb birds on the other side (FCIS warden reports, many years).

Kayakers and nature photographers, generally considered by others and themselves as "enlightened naturalists," have been observed on multiple occasions trespassing on posted nesting colony sites to rest, etc. (kayakers), or to approach courting birds disturbing them at a vulnerable behavioral stage during courtship or in the nesting process, adults on the nest, or the nests themselves to take a particularly desired photograph for personal use or sale (amateur and professional photographers).

Figure 12. White Ibis flock disturbed off sandbar photo.

Even researchers and biologists have occasionally been discovered to ignore "no trespassing" or "no landing" signs, landing and walking around a bird colony during the nesting season, or approaching nesting birds so closely that the adult parent birds abandon their nests, as they conduct their work in the wrong place at the wrong time (FCIS warden reports, many years). The damage that their trespassing causes could be avoided by coordination of work products, researching ownership and management of their field study sites, and scheduling work with sanctuary or preserve managers outside of the nesting season.

Alternate sites to traditionally-used nest sites may be equal in providing successful opportunities for nesting, depending on human activity (camping, fishing, nature tours, kayaking, etc.) who also have traditionally used islands and are reluctant to stop their regularly established use. Also, human intrusion increases opportunities for raccoons or other mammalian predators to reach the island and its vulnerable nesting birds. Audubon Sanctuary Managers have identified the islands that are used year after year in the region and have worked to improve the management of those sites through direct ownership, lease, or cooperative management agreements with the partner land managers, to protect nesting egrets and the other birds that nest in the same colony. Alternate sites will likely not have colony management prescriptions in place, and that may affect the success of any egrets or other colonial waterbirds that attempt to nest there.

Why is disturbance a problem for Reddish Egrets?

Disturbances can directly cause the death of the eggs or chicks by forcing the adult parent birds to leave the nest, leaving them susceptible to predation by Fish Crows, Black-crowned Night-Herons, or other aerial predators that are always near or present in the bird colony and that are quick to take advantage of any disturbance situation, or by thermal exposure to cold or heat stress. The adults, when they are present at the nest, are able to defend eggs and young against aerial predators. One member of the attending pair is always at their nest during the approximately twenty-six day incubation period and the "guard" stage for the next three weeks after hatching when the young nestlings are too immature to thermo-regulate or defend themselves from predatory birds.

Trespassing people list a variety of reasons for their presence on posted bird nesting sanctuaries, but generally do not recognize that their presence may cause distress to courting birds, puts nesting birds and their young at risk due to exposure to predation or temperature stress, or causes young-of-the-year birds to panic and become injured or disoriented. Trespassers on posted bird colony sites do not realize that they are only one of many people who put their own needs first over the requirement to obey posted signs and the law and to protect vulnerable birds

during a critical life stage, and that the cumulative effect of all these disturbances can be fatal to wildlife.

The Tampa Bay region and Pinellas County have a large number of registered boaters who can access the estuarine islands where Reddish Egrets nest (Table 6).

Table 6. Number of vessel registrations for 2009, six most active counties in Florida (Florida Fish and Wildlife Conservation Commission 2010).

County	# of Vessel Registrations 2009
Miami Dade	58,586
Pinellas	44,941
Lee	42,835
Hillsborough	42,773
Broward	42,131
Palm Beach	37,778

Commercial and recreational fishermen using flats boats or air boats sometimes cruise very close to nesting colony islands, causing adult birds to fly off their nests in panic. This thoughtless behavior stresses nesting birds, and can actually result in eggs or young being bounced out of the nest as adults take off in emergency flight.

Red Tide

Red tides, the result of a bloom of marine algae (most commonly *Karenia brevis*) that occur naturally in Gulf of Mexico waters, produce brevetoxin that can kill fish, sea turtles, birds, and mammals and cause human distress. In early 1974, a serious red tide was associated with mortality of several thousand waterfowl, primarily Lesser Scaup (Schreiber et al. 1975, Forrester et al. 1977, Anderson 2000). There is no information on the effects of that unique event on the Reddish Egret population at the time. Similar red tides causing large-scale bird mortality have not been reported during the study period in Tampa Bay. The direct effects of red tide events on birds may not be obvious, but the effects on the forage fish that they require may be important in maintaining the Reddish Egret population. Efforts led by the Tampa Bay Estuary Program and local governments to control pollutants, including fertilizer, entering Tampa Bay and the estuaries of Pinellas County may be crucial in protecting fish populations and the birds that depend on them.

Parasites

Limited information is available on parasites in Reddish Egrets in general, but several endo- and ectoparasites were identified: acarina mite, feather lice (3 species), tapeworms, flukes (five species), nematodes (five species), spiny-headed worms, hippoboscid fly, and tick (Lowther and Paul 2002). Argasid ticks were known to occur in the nests of ground-nesting birds in the Gulf of Mexico (King et al. 1977), occasionally in concentrations leading to nest abandonment; however, ticks have not been studied in Tampa Bay colonies, and have never been attributed to be the cause of colony abandonment locally. The extent to which these or other parasites may affect Reddish Egret populations in Florida is not known and relevant studies should be conducted.

Epizootics

Botulism killed ducks and shorebirds foraging in large numbers in the flooded interior of Tampa Port Authority Spoil Island 3D in the early 1990s, but no Reddish Egrets were apparently affected. Reddish Egrets have died of "severe pox-virus infection" (Conti et al. 1986). Overall, little is known about epizootics that could affect the local colonial waterbird population and relevant studies should be conducted.

Predators

Mammalian predators, especially raccoons, but also opossums, skunks, foxes, coyotes, and feral cats, have relatively high fecundity and reproductive capacity. Predation on nests (eggs and small chicks) by meso-carnivores, or on older young by night herons, other spp., fish

crows, or possibly black vultures is a significant threat. Exclusion or removal of predators from sites is best approach to controlling meso-carnivore predation. In Florida, populations of these mammals are much larger currently than estimated populations in earlier decades (Parker Hall, USDA APHIS Wildlife Services, pers. comm.), due to removal of top-level predators and the capability of these predators to survive in urban and suburban human communities, use of garbage and other food sources. The ample food resources supplied in the urban and suburban communities allow fecund females to support large litters.

Although this threat has not been encountered in this region yet, unauthorized release of pet snakes and lizards by disaffected former owners has become a major problem for wildlife populations in other areas of Florida. Herptilian predators such as arboreal iguanas and possibly exotic snakes are an emerging threat and should be handled similarly. Native snakes are typically commensal with colonies and should not be removed or killed, as they generally exert some control over invasive rodent populations that can also be predatory on nesting birds, particularly non-native black rats (*Rattus rattus*), which have become established on many colonies.

Once predators reach a nesting island, they typically cause abandonment of the nesting colony by all the nesting birds.

Organized predator control programs to reduce local meso-carnivore (raccoon opossums, feral cats, coyotes, or other species) populations on the mainland will reduce immigration to nesting colony islands. Meso-carnivore control programs should adhere to USDA APHIS Wildlife Services and other's policies on relocating nuisance wildlife for wildlife damage control.

Wetland Loss

The loss of coastal estuarine and inland palustrine wetlands by drainage or alteration has been a significant cause of local population declines of colonial wading birds. The effects of reduction of stormwater inflow to Florida Bay on forage availability and reduced nesting success of Roseate Spoonbills were described by Lorenz et al. (2002). A similar potential exists to affect the small demersal fishes that are the primary forage species for Reddish Egrets in the Tampa Bay watershed as new minimum flows and level standards are set for the major and secondary tributary rivers. Dredging and filling, creation of hardened seawalls, and other managed shorelines also decrease the potential of shoreline habitats to migrate inland as sea level rise occurs.

MANAGEMENT IMPLICATIONS

Reddish Egret populations expanded initially to re-occupy historic nesting islands that had been unoccupied for decades (the few natural islands remaining in the region), and readily occupied mangrove-dominated dredged spoil material islands that emulated natural habitats. Both island types provided suitable nesting habitat if they supported a robust canopy of mangroves, or occasionally, Brazilian pepper, which has a similar springy branching structure. Egrets apparently had no hesitancy in colonizing islands in new locations – all the dredged spoil material islands were new since the 1940s. Furthermore, Reddish Egrets successfully exploited the new sites, and readily forage in intertidal zones on the edges of human-created dredged material islands. The use of spoil islands showed that Reddish Egret nesting habitat can be created potentially.

Reddish Egret populations have expanded regionally and persisted at a low but relatively stable level but may not increase further. It is possible that significant and continuing regional degradation of alteration of shoreline habitats, bay bottom, and freshwater inputs may now be limiting foraging habitats or possibly forage availability. Progressive urbanization threatens to further reduce the carrying capacity of the Tampa Bay system for Reddish Egrets. Management of known nesting sites to improve habitats and eliminate disturbance, continuing to survey the reproductive population, a public education program that emphasizes ethical

behavior while fishing, boating, or observing birds and other wildlife species, and further biological studies will be necessary to ensure the continued existence of this rare heron in west-central Florida.

Research needs for Reddish Egrets include developing better estimates of productivity; correlation of annual productivity with demersal fish abundance; determining the distribution and habitat use on the gulf coast and throughout the state through banding re-sight and satellite transmitters; investigating plumage color and population genetics, and estimating survivorship disparity.

The Reddish Egret remains the rarest heron in North America and, because of its absolute rehance upon estuarine habitats, the heron most at risk. Due to the current low population of the Reddish Egret in Tampa Bay, Pinellas County and Florida, its distribution limited to the estuaries, the slow rate of recovery from extirpation from Florida in the late 1880s, its narrow foraging niche, and the vulnerability of individual birds to stochastic events as hurricanes, disturbance at nesting sites, or chemical pollution (oil spill), Reddish Egrets should be recognized as an imperiled species regionally and statewide.

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From: HODGSON, Ann
To: Imperiled
Cc: WRAITHMELL, Julie
Subject: Status of colonial waterbird populations in the Tampa Bay area from 1984-2009
Date: Friday, October 29, 2010 5:20:28 PM
Attachments: Hodgson-twenty_five_years-06-21-10.pdf

Attached is our recent report:

TWENTY-FIVE YEARS AFTER BASIS: AN UPDATE ON THE CURRENT STATUS AND RECENT TRENDS OF COLONIAL WATERBIRD POPULATIONS IN TAMPA BAY

Ann B. Hodgson, Audubon of Florida, Florida Coastal Islands Sanctuaries, 410 S. Ware Boulevard, Suite 702, Tampa, Florida 33619, ahodgson@audubon.org

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Representatives of 4 orders dominate the avifauna of Tampa Bay: pelecaniformes (pelicans, cormorants, anhingas); ciconiiformes (herons, ibis, spoonbills, storks); anseriformes (waterfowl); and charadriiformes (shorebirds, gulls, and terns). The first bay-wide assessment of colonial waterbird populations was presented at BASIS by Paul and Woolfenden (1985). Twelve of the 22 colonies they reported have been abandoned since due to various causes of habitat loss or disturbance and c. 59,000 pairs (mostly Laughing Gulls) nested on 5 colonies that no longer support very large populations. After 1985, 50 new colonies became active, including 15 inland colonies, of which 16 were abandoned later. Using annual breeding bird surveys, we provide recent trends in the populations of 30 bird species breeding in Tampa Bay, 13 of which receive enhanced conservation protection through their listing by federal or state agencies. The Tampa Bay breeding population totals 30,000-58,000 nesting pairs, averaging 39,000 annually. The 2009 nesting population (all species) was 58,500 at 44 colonies. Up to 50% of the total colonial waterbird nesting occurs in Hillsborough Bay; the remainder is distributed at colony sites around Tampa Bay. Human disturbance has become the most significant cause of nesting failure annually, accompanied by anthropogenically-induced predator population increases and urban development affecting the number and ecological integrity of estuarine and palustrine wetland foraging sites. We provide a suite of habitat and population management recommendations that should be implemented to conserve the bay's avifauna. Please cite the information as:

Hodgson, A. and A. Paul. 2010. Twenty-Five Years after Basis I: An Update on the Current Status and Recent Trends in Bird Colonial Waterbird Populations of Tampa Bay, in: Cooper, S.T. (ed.). 2010. Proceedings, Tampa Bay Area Scientific Information Symposium, BASIS 5: 20-23 October 2009. St. Petersburg, FL. 538 pp.

Please call if you have further questions.
best, Ann

Ann B. Hodgson, Ph. D., P.W. S.

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TWENTY-FIVE YEARS AFTER BASIS: AN UPDATE ON THE CURRENT STATUS AND RECENT TRENDS OF COLONIAL WATERBIRD POPULATIONS IN TAMPA BAY

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ABSTRACT

Representatives of 4 orders dominate the avifauna of Tampa Bay: pelecaniformes (pelicans, cormorants, anhingas); ciconiiformes (herons, ibis, spoonbills, storks); anseriformes (waterfowl); and charadriiformes (shorebirds, gulls, and terns). The first bay-wide assessment of colonial waterbird populations was presented at BASIS by Paul and Woolfenden (1985). Twelve of the 22 colonies they reported have been abandoned since due to various causes of habitat loss or disturbance and c. 59,000 pairs (mostly Laughing Gulls) nested on 5 colonies that no longer support very large populations. After 1985, 50 new colonies became active, including 15 inland colonies, of which 16 were abandoned later. Using annual breeding bird surveys, we provide recent trends in the populations of 30 bird species breeding in Tampa Bay, 13 of which receive enhanced conservation protection through their listing by federal or state agencies. The Tampa Bay breeding population totals 30,000-58,000 nesting pairs, averaging 39,000 annually. The 2009 nesting population (all species) was 58,500 at 44 colonies. Up to 50% of the total colonial waterbird nesting occurs in Hillsborough Bay; the remainder is distributed at colony sites around Tampa Bay. The Cockroach Bay-Terra Ceia Bay, Hillsborough Bay, Johns Pass, and Lower Tampa Bay Important Bird Areas are listed by Audubon of Florida among its 100 Important Bird Areas in Florida. Lower Tampa Bay and Hillsborough Bay were designated by Birdlife International and the National Audubon Society, Inc. in 2003 and 2009, respectively, as "Important Bird Area of Global Significance". Human disturbance has become the most significant cause of nesting failure annually, accompanied by anthropogenically-induced predator population increases and urban development affecting the number and ecological integrity of estuarine and palustrine wetland foraging sites. We provide a suite of habitat and population management recommendations that should be implemented to conserve the bay's avifauna. Hodgson and Paul

INTRODUCTION

The species richness of colonial waterbirds that nest in the Tampa Bay estuarine system is unique, as many birds of temperate North America breed here, as well as some typically "tropical" birds (Reddish Egrets, Roseate Spoonbills) that do not nest further north, and some species that nest only in low numbers anywhere in Florida (Caspian, Royal, Sandwich, and Gull-billed terns) (Howell 1932, Paul and Woolfenden 1985, Paul and Schnapf 1997, Paul and Paul 2005, Hodgson, Paul and Rachal 2006).

Within Tampa Bay, colonial waterbirds (pelecaniformes [pelicans, cormorants, anhingas]; ciconiiformes [herons, ibis, spoonbills, storks]; and charadriiformes [shorebirds, gulls, and terns]) nest preferably on small islands that are off-shore, separated by open water and deep channels with tidal currents that discourage predatory mammals from swimming to them, and

have no resident mammalian predators. Large numbers of birds of many species may breed at a single site. Generally, sites occupied by larids are sparsely vegetated sand or shell beaches or dredged spoil material, while pelecaniform and ciconiiform birds nest where shrubs or trees are available (Schreiber and Schreiber 1978). Thirteen species are currently listed by the state and federal wildlife management agencies to receive elevated regulatory protection. Several other species that nest in the watershed, although not formally listed, are very rare (Willet, Wilson's Plover, Gull-billed, Caspian, Royal, and Sandwich terns) and warrant comparable protection. The importance of Tampa Bay's bird community has been widely recognized by national and international authorities. The Cockroach Bay-Terra Ceia Bay, Hillsborough Bay, Johns Pass, and Lower Tampa Bay Important Bird Areas (IBAs) are listed by Audubon of Florida among its 100 Important Bird Areas in Florida, and BirdLife International and the National Audubon Society recognized Lower Tampa Bay and Hillsborough Bay as globally-significant IBAs in 2003 and 2009, respectively.

In this paper, we briefly summarize the current status and population trends of 30 species of birds nesting in the Tampa Bay system, mostly colonial but also some territorial nesters that often select sites within a mixed species colony, review current management programs to protect them, and provide conservation recommendations to maintain stable populations in the future.

METHODS

We (Florida Coastal Islands Sanctuaries [FCIS]) surveyed colonial waterbird colonies and territorial shorebirds from 1985 to 2009 in Tampa Bay, using direct nest counts or flight line counts, and counting nesting pairs and productivity (chicks/nest) when possible (Buckley and Buckley 1976; King 1978; Erwin and Ogden 1980, Portnoy 1980; Erwin 1981, Paul et al. 2004). Laughing Gulls were censused using a circular plot technique and extrapolating nesting density among areas of similar nesting density (Patton and Hanners 1984). We added colony locations to the survey schedule as they were discovered. We also included 15 bird colonies that occur on the bay's periphery at inland locations within the Tampa Bay Estuary Program's watershed boundaries in Hillsborough, Pasco, and Polk counties, but not colonies outside the watershed in Clearwater Harbor and St. Josephs Sound, although they contribute to the regional population (Agency on Bay Management 1995). Numbers of colonies surveyed varied inter-annually contingent on colony activity, personnel, weather, and other constraints. English and scientific names follow the Check-list of North American Birds 7th edition (American Ornithologists' Union 1998) and 50th Supplement (Chesser et al. 2009).

RESULTS

In Tampa Bay, 58,424 nesting pairs of colonial birds (all species), 42.7% of which were Laughing Gulls, bred at 44 colonies in 2009 (Table 1). The 10 year (2000-2009) mean number of nesting pairs (all species) was 44,141 (SD 10,946.57), and the mean number of active colonies was 32 (SD 6.88) (Table 2).

Of the 71 colonies mapped in the Tampa Bay watershed, 22 were discussed in BASIS, of which 12 (54.5%) were abandoned ("winked out") later for various reasons (altered habitats [e.g., urban development, plant succession], predators, human disturbance) since 1985, including 5 colonies that supported most of the gull population (Figs. 1, 2, 3). In the past 25 years we located and surveyed 50 new sites undescribed in 1985; however, 16 colonies (32.0%) subsequently collapsed and were abandoned. Cumulatively, the inland colonies supported 10.0% of the regional population. Of the initial 22 colonies, all but six were islands (Paul and

Woolfenden 1985). Five were small colonies of Yellow-crowned Night-Herons or Great Blue Herons nesting high in tall oak trees or slash pines near the bay, and the last site was the shore of the Howard Frankland Causeway, where the Florida Department of Transportation planted the roadside in the early 1990s to discourage Black Skimmers from nesting and causing traffic hazards. All recently-active colonies were islands, except the Mobbly powerlines, scattered oystercatcher territories in Apollo Beach, and the Cockroach Bay borrow pit.

In 1985, the Alafia Bank Bird Sanctuary, Washburn Sanctuary, and Tarpon Key National Wildlife Refuge were the three largest mixed colonies of pelecaniforms, herons and ibis in the region. In 2009, pelicans nested at only four sites, Washburn Sanctuary had very few pairs since 2004, and Tarpon Key was abandoned in 2005, so that the three largest colonies with similar species composition were Egmont Key National Wildlife Refuge and State Park (33,700 pairs, of which 300 were pelicans and >25,000 were larids), the Richard T. Paul Alafia Bank Bird Sanctuary (10,500 pairs, only 150 pairs of pelicans), and Alligator Lake (745 pairs), which had no pelicans.

Table 1. Colony characteristics and management status of colonial waterbird colonies in Tampa Bay, Florida, USA, in 2009.

Colony Number	*Name*	Bay Segment	Taxa	Species (*n*)	Pairs (*n*)	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Regional *population* (%)	Active within last 5 yrs?	*Latitude*	*Longitude*
25	Dogleg Key	BCB	P, Ci	12	296		X	FDEP-AP / FCIS	Y	0.51	Y	27.8021	-82.7618
26	Johns Pass, Little Bird Key	BCB	Ci	1	2			Suncoast Seabird Sanctuary	Y	0.00	Y	27.7932	-82.7777
27	Johns Pass, Middle Bird Island	BCB	Ci	2	5			FDEP-AP	Y	0.01	Y	27.7913	-82.7739
28	Johns Pass, Eleanor Island	BCB	Ci			X		City of Treasure Island	Y	0.00	Y	27.7878	-82.7738
29	South Pasadena Marker 34	BCB	L			X	X	City of Pasadena		0.00	N	27.7431	-82.7299
30	Sunset Beach	BCB	L			X	X	City of Treasure Island	N	0.00	N	27.7391	-82.7565
31	Don CeSar Colony	BCB	P, Ci	6	50		X	Private	N	0.09	Y	27.7059	-82.7352
32	Bayway Spoil	BCB	L			X		Developed	N	0.00	N	27.7094	-82.6995
33	Indian Key NWR	BCB	Ci			X	X	USFWS NWR	Y	0.00	Y	27.7011	-82.6909
34	Little Bird Key NWR	BCB	Ci	5	16		X	USFWS NWR	Y	0.03	Y	27.6852	-82.7169
35	Cow and Calf Islands	BCB	P, Ci	2	9		X	FDEP-AP		0.02	Y	27.6856	-82.6916
36	Darling Key	BCB	P, Ci	3	17		X	FDEP-AP		0.03	Y	27.6765	-82.6813
37	Jackass Key NWR	BCB	P, Ci	4	30		X	USFWS NWR	Y	0.05	Y	27.6693	-82.7177
38	Tarpon Key NWR	BCB	P, Ci			X		USFWS NWR	Y	0.00	N	27.6666	-82.6932
39	Whale Island NWR	BCB	P, Ci			X	X	USFWS NWR	Y	0.00	N	27.6626	-82.6930
40	Shell Key County Preserve	BCB	Ch					Florida / Pinellas County	Y	0.00	Y	27.6645	-82.7445
41	Mule Key NWR	BCB	P, Ci			X	X	USFWS NWR	Y	0.00	Y	27.6619	-82.7178
42	Listen Key NWR	BCB	P, Ci			X	X	USFWS NWR	Y	0.00	N	27.6596	-82.7179
43	Sister Key	BCB	P, Ci			X	X	Florida / Pinellas County		0.00	N	27.6503	-82.7312
44	Ft. DeSoto Park	LTB	L, Ch			X	X	Pinellas County	Y	0.00	N	27.6488	-82.7433
45	Egmont Key NWR/State Park	LTB	P, Ci, Ch	10	36,521		X	USFWS NWR / Florida State Parks	Y	62.51	Y	27.5894	-82.7614

Colony Number	*Name*	Bay Segment	Taxa	Species *(n)*	Pairs *(n)*	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Regional population (%)	Active within last 5 yrs?	*Latitude*	*Longitude*
46	Little Bayou Bird Island	MTB	P, Ci	10	140		X	FDEP-AP / FCIS	Y	0.24	Y	27.7196	-82.6312
47	Coffeepot Bayou Bird Island	MTB	P, Ci	14	612		X	Private	Y	1.05	Y	27.7916	-82.6241
48	Gandy Radio Tower	OTB				X	X	Unknown	N	0.00	N	27.8772	-82.5902
49	Howard Frankland	OTB	L			X		FDOT	N	0.00	N	27.9046	-82.6335
50	Cooper's Point	OTB				X		Pinellas County / City of Clearwater	N	0.00	N	27.9730	-82.6891
51	Alligator Lake	OTB	P, Ci	12	745			City of Safety Harbor / Pinellas County	Y	1.27	Y	27.9813	-82.6990
52	Philippe Park	OTB	Ci			X		Pinellas County	N	0.00	N	28.0053	-82.6778
53	Mobbly Bay Powerlines	OTB	P	1	19		X	Progress Energy	N	0.03	Y	28.0038	-82.6677
54	Courtney Campbell Causeway	OTB	L			X	X	FDOT	N	0.00	N	27.9736	-82.5958
55	Wilson Property/Grand Hyatt	OTB	Ci			X		Private	N	0.00	N	27.9654	-82.5514
56	Sunset Park	OTB				X		City of Tampa	N	0.00	N	27.9374	-82.5201
57	Westshore	OTB				X		City of Tampa	N	0.00	N	27.9002	-82.5361
58	McKay Bay	HB				X	X	City of Tampa / TPA	Y	0.00	N	27.9371	-82.4143
59	Hooker's Point	HB				X	X	TPA	Y	0.00	N	27.9076	-82.4338
60	Tampa Port Authority Spoil Island 2D	HB	Ch	9	2,152			TPA / FCIS	Y	3.68	Y	27.8805	-82.4313
61	Fantasy Island	HB	Ch	1	1			TPA / FCIS	Y	0.00	Y	27.8683	-82.4253
62	Spoil Area C	HB	L, Ch			X	X	Mosaic	Y	0.00	N	27.8571	-82.4003
63	Richard T. Paul Alafia Bank Bird Sanctuary	HB	P, Ci, Ch	16	6,234			Mosaic / FCIS	Y	10.67	Y	27.8483	-82.4106
64	Tampa Port Authority Spoil Island 3D	HB	Ch	2	23			TPA / FCIS	Y	0.04	Y	27.8331	-82.4352

Colony Number	*Name*	Bay Segment	Taxa	Species *(n)*	Pairs *(n)*	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Regional population (%)	Active within last 5 yrs?	*Latitude*	*Longitude*
65	Port Redwing	HB	L, Ch			X	X	TPA	Y	0.00	N	27.8132	-82.3951
66	Fishhook Spoil Island	HB	Ch	2	13			TPA / TECO	Y	0.02	Y	27.8024	-82.4152
67	Apollo Beach Oystercatchers	HB	Ch	2	15		X	Private	N	0.03	Y	27.7733	-82.4318
68	Mouth of Little Manatee River	MR	P, Ci			X		FDEP Cockroach Bay Aquatic Preserve	N	0.00	N	27.7160	-82.4823
69	Cockroach Bay Preserve	MTB	Ch	1	30		X	ELAPP	Y	0.05	Y	27.6955	-82.5079
70	Hole in the Wall, Cockroach Bay Preserve 1	MTB	Ci				X	ELAPP	Y	0.02	Y	27.6811	-82.5183
71	Hole in the Wall, Cockroach Bay Preserve 2	MTB	Ci	1	20		X	ELAPP	Y	0.02	Y	27.6799	-82.5198
72	Hole in the Wall, Cockroach Bay Preserve 3	MTB	Ci				X	ELAPP	Y	0.02	Y	27.6764	-82.5169
73	Piney Point	MTB	P, Ci	14	2,795		X	SWFWMD	Y	4.78	Y	27.6505	-82.5462
74	Manbirtee Key	MTB	Ci, Ch	4	24			MCPA / FCIS	Y	0.04	Y	27.6359	-82.5740
75	Two Brothers Island	LTB	Ci			X		Private	N	0.00	N	27.5935	-82.5847
76	Skyway Bridge Least Tern colony	LTB	L			X	X	FDOT	N	0.00	N	27.5808	-82.6090
77	Miguel Bay Colony	LTB	P, Ci				X	FDEP-AP / FCIS	Y	0.00	Y	27.5708	-82.5995
78	Passage Key	LTB	P, Ci, L, Ch			X		USFWS NWR	Y	0.00	Y	27.5545	-82.7404
79	Nina Washburn Sanctuary	TCB	P, Ci	7	52			FCIS	Y	0.09	Y	27.5527	-82.5999
80	Washburn Junior/Terra Ceia Bay Little Bird Key	TCB	P, Ci	14	407		X	FDEP Terra Ceia Aquatic Preserve / FCIS	Y	0.70	Y	27.5285	-82.6015
81	Dot Dash Dit Colony	MR	P, Ci	13	2,360			Private / Florida / FCIS	Y	4.04	Y	27.4993	-82.5243
82	Heath Yellow-crowned Night-Heron Colony	HC	Ci	1	5		X	Private	N	0.01	Y	27.8772	-82.3129
83	Office/Ferman Bird Colony	HC	P, Ci	8	74		X	Private	Y	0.13	Y	27.9448	-82.3417

Colony Number	*Name*	Bay Segment	Taxa	Species *(n)*	Pairs *(n)*	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Regional *population* (%)	Active within last 5 yrs?	*Latitude*	*Longitude*
84	Robles Park	HC	Ci	4	31		X	City of Tampa	Y	0.05	Y	27.9740	-82.4550
85	Corporex Colony	HC	P, Ci	7	94		X	Private	N	0.16	Y	27.9786	-82.3857
86	East Lake Island	HC	P, Ci	5	14		X	Florida Audubon Society	Y	0.02	Y	27.9922	-82.3784
87	Temple Crest/Orange Lake/Wargo Bird Colony	HC	P, Ci	8	51		X	City of Tampa / TPA	N	0.09	Y	28.0193	-82.4174
88	River Cove Yellow-crowned Night-Heron colony	HC	Ci				X	Hillsborough County	N	0.02	Y	28.0192	-82.4486
89	Citrus Park Bird Colony	HC	P, Ci	9	486		X	Private	N	0.83	Y	28.0699	-82.5834
90	Heron Point	PaC	P, Ci	7	57		X	Private	N	0.10	Y	28.2157	-82.4349
91	Saddlebrook	PaC	P, Ci	3	48		X	Private	Y	0.08	Y	28.2277	-82.3297
92	Cypress Creek Preserve	HC	P, Ci	11	3,294		X	ELAPP	Y	5.64	Y	28.1629	-82.3975
93	Cross Creek Colony	HC	P, Ci	2	8		X	Private	N	0.01	Y	28.1424	-82.3520
94	Medard County Park	HC	P, Ci	10	477		X	Hillsborough County	Y	0.82	Y	27.9218	-82.1630
95	Alafia River Corridor Preserve	HC	P, Ci	5	46		X	ELAPP	Y	0.08	Y	27.8756	-82.1053
96	Wood Lake/Somerset Lake	PoC	P, Ci	14	1,151		X	City of Lakeland / Private	Y	1.97	Y	28.0036	-81.9311
	Totals				58,424	27	48			100.00			

Taxa: P-pelecaniformes, Ci-ciconiiformes, Ch-charadriiformes, L-larids.

Values are number of species, nesting pairs, and % of 2009 regional nesting population.

Abbreviations: ELAPP – Environmental Lands Acquisition & Protection Program, FDEP-AP - Florida Department of Environmental Protection Aquatic Preserves, FDOT – Florida Department of Transportation, MCPA – Manatee County Port Authority, TPA – Tampa Port Authority, USFWS NWR - U. S. Fish & Wildlife Service National Wildlife Refuge.

Figure 1. Bird colonies in the Tampa Bay, Florida, USA, ecosystem from 1984-2009 (colonies 1-24 are excluded because they are not in the Tampa Bay watershed).

Figure 2. Bird colonies in Boca Ciega Bay, Florida, USA, from 1984-2009.

Figure 3. Bird colonies in Terra Ceia Bay, Florida, USA, from 1984-2009.

Table 2. Nesting pairs (no./species) of 30 colonial waterbirds and shorebirds and assessment of recent population trends in Tampa Bay, Florida, USA, from 2000-2009.

Species	Mean	SD	Population trend
Brown Pelican	1,024	326.15	45 is the major nesting site since 2004 when 79 and 38 collapsed; widespread also at several smaller colonies, declining
Double-crested Cormorant	455	68.48	Widely distributed at 7 sites; shifted from 79 and 38 when they collapsed; stable
Anhinga	334	93.11	Widely distributed at 7 sites; stable
Least Bittern	2	1.69	Uncommon – nesting at 4 or more freshwater sites with large cattail stands; under-surveyed
Great Blue Heron	217	61.80	Widely distributed at 10 heronries, and various misc. sites; stable
Great Egret	740	148.15	Nesting at 18 sites, >100 prs at 63, 81, 25, 47, and I-25 (Clearwater Harbor) in that order; stable
Snowy Egret	923	193.63	c. 75% decline since 1970s (Ogden 1978), stable last 10 yrs; 73 increased to 300 prs
Little Blue Heron	315	88.92	Nesting at 73, 63, and 94, and other sites; declined since 1950s with freshwater wetland loss, stable last 10 yrs
Tricolored Heron	788	178.87	Widespread at all mixed heronries; c. 60% of the population at 3 colonies: 73, 63 and 51; stable
Reddish Egret	57	21.19	Nesting at 6 sites: 63 largest group; 51 – only known freshwater site; c. 16% of state popn in Tampa Bay
Cattle Egret	4,146	2,836.85	Abundant at 63, 73, 51, 92, and 81; increasing since 1980s.
Green Heron	29	12.01	Nesting at 11 sites, notably 73, and other solitary locations; stable
Black-crowned Night-Heron	112	52.27	Nesting at the major heronries, notably 73, and inland sites; stable
Yellow-crowned Night-Heron	73	39.58	Nesting in mixed heronries, other small groups in tall coastal trees in residential areas; declining since 1980s; recent decline more rapid
White Ibis	9,180	3,464.63	Most common endemic wading bird; dependent on El Niño cycles and prey concentrated as freshwater wetlands draw down; most nesting at 63 and 73
Glossy Ibis	285	102.58	Nesting only at 63, 73, and 92; formerly approx. 50% were at 79; require shallow freshwater wetlands, stable to declining
Roseate Spoonbill	329	111.26	Exponential increase at 63 since 1975; radiated to 11 sites in the past 5 yrs; popn not stabilized
Wood Stork	212	116.93	Nesting only at 81, plus inland colonies 92, 93, 86, 95, and 89
Snowy Plover	0.4	1.26	Rarely nesting at 44, 40, 45 and usually unsuccessful due to disturbance
Wilson's Plover	25	20.68	Spottily distributed in salterns and suitable bare habitat; 74 recently important; stable, prob. under-surveyed
American Oystercatcher	91	13.58	C. 72 prs in Hillsborough Bay on spoil island shorelines (60, 63, 64, 66), the rest at widespread sites; stable, approx. 21% of state popn nests in Tampa Bay
Black-necked Stilt	32	31.35	Nesting sporadically at 60, 64, 69 around drying algae mats; rare
Willet	34	14.43	Rare and inconspicuously distributed in salt marshes and dune vegetation; under-surveyed
Laughing Gull	19,698	8,741.13	Nesting only at 60, 64 and 45; approx. 50% decline since early 1980s. Tampa Bay hosts c. 20% of entire southeast U. S. popn
Gull-billed Tern	8	5.69	A few pairs annually, often with Black Skimmers, nearly annually at 60 or 64

Species	Mean	SD	Population trend
Caspian Tern	83	10.57	Most nesting at 60, 64; formerly 63; Hillsborough Bay colony is the state's largest
Royal Tern	3,618	1,857.76	Nesting formerly at 63 and 78; now at 45 and Hillsborough Bay 60 or 64; increasing since 1990s
Sandwich Tern	811	341.14	All at 45 in 2009; formerly Hillsborough Bay (60, 64, or 63); pass. increasing
Least Tern	116	91.38	Most natural habitat lost, recently c. 80% are rooftop nesters; declining; most nesting on beaches unsuccessful due to human disturbance
Black Skimmer	406	192.24	In the last five years, skimmers nested at 60, 64, 45, 78, 40, and 29; stable, but in some years, zero nesting success

Values are mean and standard deviation of nesting pairs; see Table 1 for colony identification numbers.

DISCUSSION

Species richness (30 species) of the regional colonial waterbird population did not change in Tampa Bay from 1985 to 2009, with every endemic species and introduced Cattle Egrets represented. This community remains the largest and most significant colonial waterbird population in Florida outside of the Everglades. The Laughing Gull population has diminished by around 50% since the 1980s and is now concentrated in Hillsborough Bay and Egmont Key. These populations have persisted despite significant and continuing alteration of shoreline habitats, bay bottom, and freshwater wetlands, although recent population declines in Brown Pelicans, Laughing Gulls, Least Terns, and Snowy Plovers suggest that, as elsewhere in Florida, progressive urbanization threatens to further reduce the ecological integrity of the Tampa Bay ecosystem. Roseate Spoonbills and Reddish Egrets, extirpated as nesting species from Tampa Bay until the mid-1970s, have increased significantly, while widely expanding their distribution among suitable habitats in the bay, and Wood Stork, and Royal and Sandwich tern populations have increased slightly. The other pelecaniformes, ciconiiformes, charadriiformes and larids have remained relatively stable. The inland colonies are particularly important for small herons and Wood Storks.

Five additional species are found uniquely in coastal habitats: Clapper Rails, Mangrove Cuckoos, Gray Kingbirds, Black-whiskered Vireos, and Prairie Warblers. Clapper Rails occur in low and high marsh and require expansive areas of continuous cover, areas which are diminishing as the shoreline has been developed. Black-whiskered Vireos have virtually disappeared from Tampa Bay since c. 1991. Mangrove Cuckoos were found annually in mangroves in Boca Ciega Bay, Weedon Island, and Terra Ceia Bay in some years, but are infrequent now. Prairie Warblers are more widely distributed along Tampa Bay mangrove shorelines. Although Gray Kingbirds may also nest in uplands beyond the mangroves, all five species are primarily coastal birds whose populations have decreased in recent years. The four estuarine passerines are susceptible to nest parasitism by increasing populations of Brown-headed Cowbirds.

Paul and Woolfenden (1985) identified a number of biotic and abiotic stressors that influence bird abundance in Tampa Bay. In the decades leading up to the 1980s, coastal habitat loss dominated. In the 1990s, with the large increase in registered watercraft, the most significant issues to have emerged are anthropogenic disturbances from the increasing numbers of recreational boaters and beachgoers that: "…present a vast potential for annual disturbance of breeding birds", as predicted by Paul and Schnapf (1997:94), continued dredge and fill activities that have had both beneficial and negative effects for colonial waterbirds and beach-nesting species, continued loss of palustrine wetlands (particularly short hydroperiod and ephemeral "prairie ponds"), the trend toward reducing the spatial distribution of palustrine wetlands by condensing them into stormwater ponds and mitigation banks from the natural patterns that birds cue to throughout the landscape, and extremely high populations of meso-carnivores (raccoons, to a lesser extent opossums and, potentially, coyotes and invasive exotic herptiles).

Management Initiatives

Through site-specific management initiatives by FCIS at Audubon-owned and leased sanctuaries, Audubon's Project ColonyWatch, which engages volunteers to observe and protect colonies in cooperation with site managers, and a continuous effort to expand colony management partnerships among agencies and private landowners, most of the now active colonies have been posted, are managed during the year to control predators and remove entangling fishing line during the Tampa Bay Watch and Audubon Monofilament Cleanup, are regularly surveyed to establish colony species composition and productivity, and are intermittently patrolled. However, with the dramatic increase in public recreation on the water, this program is insufficient to fully protect most colonies. In the past five years we have also implemented a series of inter-agency workshops for law enforcement marine units about the biology, habitat requirements, and laws protecting colonial waterbirds.

Management Recommendations

Environmental education – In collaboration with land managers and management partners, continue to produce and distribute to the public boaters guides describing the bay's natural resources and protected areas, and present informational talks about the bay's avifauna.

Colony management - Continue current management activities, and establish and enforce spatial buffers around colonies to prevent site disturbance. Increase enforcement of wildlife protection laws.

Habitat management - Manage existing sites to provide required habitats; the spoil islands in the Hillsborough Bay Important Bird Area support some of the largest colonies of pelicans, herons, ibis, gulls, and oystercatchers in the state. Many nesting colony sites have been abandoned and fewer new sites will be available in the future given the development density. Currently functioning sites must be carefully protected.

Habitat restoration – Continue to acquire land and restore coastal ecosystems to replace the large areas of coastal mangroves, salterns, intertidal mudflats, and freshwater wetlands that have been lost; restore tidal creeks and re-establish altered coastal drainage patterns.

Wetland protection - The loss of both coastal estuarine and inland palustrine wetlands by drainage or alteration has been a dominant cause of population declines of colonial birds regionally and statewide. Locally, habitat fragmentation, seasonal wetland draw downs, and consolidation of freshwater wetlands decreases wetland functioning in the landscape, and

reduces forage availability, which particularly affects successful nesting of White Ibis, small herons, and Wood Storks.

Sea level rise – Participate in the dialogue about climate change and potential effects of sea level rise; include in future conservation planning initiatives acquisition of lands and sites that will not be affected by increasing water levels.

Maintaining the vibrant, diverse colonial waterbird population in Tampa Bay in the future will be more challenging than during the past three decades since BASIS, and much more difficult than in the decades preceding widespread coastal development. Despite 25 years of intensive public outreach and environmental education activities by Audubon and others, sedulous volunteers in Audubon's Project ColonyWatch and in the Florida Shorebird Alliance providing colony guardianship, and expanded coordination between non-governmental, local, county, state, and federal wildlife protection programs, human disturbance is an incessant threat to the persistence of local bird colonies. More protective regulations, more enforcement, and heightened public cooperation will all be needed to protect the spectacular, charismatic bird populations of Tampa Bay.

ACKNOWLEDGMENTS

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From: HODGSON, Ann
To: Imperiled
Cc: WRAITHMELL, Julie; Rodgers, James
Subject: RE: BRPE trend data
Date: Tuesday, November 02, 2010 1:24:07 PM
Attachments: Audubon Tampa Bay colony descriptions and map.doc

The data presented below were acquired at colonial waterbird colonies throughout the Tampa Bay region (Pinellas, Hillsborough, Manatee, Sarasota, and Polk counties) during annual colonial waterbird nesting surveys conducted by Audubon of Florida's Florida Coastal Islands Sanctuaries in cooperation with land management partners, as shown on the attached table and map.

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Petersburg, FL. 538 pp.

Table 1. Colony characteristics and management status of colonial waterbird colonies in Tampa Bay, Florida, USA, in 2009.

Colony Number	*Name*	Bay Segment	Taxa	Species *(n)*	Pairs *(n)*	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Regional *population* (%)	Active within last 5 yrs?	*Latitude*	*Longitude*
25	Dogleg Key	BCB	P, Ci	12	296		X	FDEP-AP / FCIS	Y	0.51	Y	27.8021	-82.7618
26	Johns Pass, Little Bird Key	BCB	Ci	1	2			Suncoast Seabird Sanctuary	Y	0.00	Y	27.7932	-82.7777
27	Johns Pass, Middle Bird Island	BCB	Ci	2	5			FDEP-AP	Y	0.01	Y	27.7913	-82.7739
28	Johns Pass, Eleanor Island	BCB	Ci			X		City of Treasure Island	Y	0.00	Y	27.7878	-82.7738
29	South Pasadena Marker 34	BCB	L			X	X	City of Pasadena		0.00	N	27.7431	-82.7299
30	Sunset Beach	BCB	L			X	X	City of Treasure Island	N	0.00	N	27.7391	-82.7565
31	Don CeSar Colony	BCB	P, Ci	6	50		X	Private	N	0.09	Y	27.7059	-82.7352
32	Bayway Spoil	BCB	L			X		Developed	N	0.00	N	27.7094	-82.6995
33	Indian Key NWR	BCB	Ci			X	X	USFWS NWR	Y	0.00	Y	27.7011	-82.6909
34	Little Bird Key NWR	BCB	Ci	5	16		X	USFWS NWR	Y	0.03	Y	27.6852	-82.7169
35	Cow and Calf Islands	BCB	P, Ci	2	9		X	FDEP-AP		0.02	Y	27.6856	-82.6916
36	Darling Key	BCB	P, Ci	3	17		X	FDEP-AP		0.03	Y	27.6765	-82.6813
37	Jackass Key NWR	BCB	P, Ci	4	30		X	USFWS NWR	Y	0.05	Y	27.6693	-82.7177
38	Tarpon Key NWR	BCB	P, Ci			X		USFWS NWR	Y	0.00	N	27.6666	-82.6932
39	Whale Island NWR	BCB	P, Ci			X	X	USFWS NWR	Y	0.00	N	27.6626	-82.6930
40	Shell Key County Preserve	BCB	Ch					Florida / Pinellas County	Y	0.00	Y	27.6645	-82.7445
41	Mule Key NWR	BCB	P, Ci			X	X	USFWS NWR	Y	0.00	Y	27.6619	-82.7178
42	Listen Key NWR	BCB	P, Ci			X	X	USFWS NWR	Y	0.00	N	27.6596	-82.7179
43	Sister Key	BCB	P, Ci			X	X	Florida / Pinellas County		0.00	N	27.6503	-82.7312
44	Ft. DeSoto Park	LTB	L, Ch			X	X	Pinellas County	Y	0.00	N	27.6488	-82.7433
45	Egmont Key NWR/State	LTB	P, Ci, Ch	10	36,521		X	USFWS NWR / Florida	Y	62.51	Y	27.5894	-82.7614

Colony Number	*Name*	Bay Segment	Taxa	Species *(n)*	Pairs *(n)*	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Regional *population* (%)	Active within last 5 yrs?	*Latitude*	*Longitude*
	Park							State Parks					
46	Little Bayou Bird Island	MTB	P, Ci	10	140		X	FDEP-AP / FCIS	Y	0.24	Y	27.7196	-82.6312
47	Coffeepot Bayou Bird Island	MTB	P, Ci	14	612		X	Private	Y	1.05	Y	27.7916	-82.6241
48	Gandy Radio Tower	OTB				X	X	Unknown	N	0.00	N	27.8772	-82.5902
49	Howard Frankland	OTB	L			X		FDOT	N	0.00	N	27.9046	-82.6335
50	Cooper's Point	OTB				X		Pinellas County / City of Clearwater	N	0.00	N	27.9730	-82.6891
51	Alligator Lake	OTB	P, Ci	12	745			City of Safety Harbor / Pinellas County	Y	1.27	Y	27.9813	-82.6990
52	Philippe Park	OTB	Ci			X		Pinellas County	N	0.00	N	28.0053	-82.6778
53	Mobbly Bay Powerlines	OTB	P	1	19		X	Progress Energy	N	0.03	Y	28.0038	-82.6677
54	Courtney Campbell Causeway	OTB	L			X	X	FDOT	N	0.00	N	27.9736	-82.5958
55	Wilson Property/Grand Hyatt	OTB	Ci			X		Private	N	0.00	N	27.9654	-82.5514
56	Sunset Park	OTB				X		City of Tampa	N	0.00	N	27.9374	-82.5201
57	Westshore	OTB				X		City of Tampa	N	0.00	N	27.9002	-82.5361
58	McKay Bay	HB				X	X	City of Tampa / TPA	Y	0.00	N	27.9371	-82.4143
59	Hooker's Point	HB				X	X	TPA	Y	0.00	N	27.9076	-82.4338
60	Tampa Port Authority Spoil Island 2D	HB	Ch	9	2,152			TPA / FCIS	Y	3.68	Y	27.8805	-82.4313
61	Fantasy Island	HB	Ch	1	1			TPA / FCIS	Y	0.00	Y	27.8683	-82.4253
62	Spoil Area C	HB	L, Ch			X	X	Mosaic	Y	0.00	N	27.8571	-82.4003
63	Richard T. Paul Alafia Bank Bird Sanctuary	HB	P, Ci, Ch	16	6,234			Mosaic / FCIS	Y	10.67	Y	27.8483	-82.4106

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Colony Number	*Name*	Bay Segment	Taxa	Species *(n)*	Pairs *(n)*	Abandoned after 1984	New since 1984	Ownership / Management	Protected status	Regional *population* (%)	Active within last 5 yrs?	*Latitude*	*Longitude*
64	Tampa Port Authority Spoil Island 3D	HB	Ch	2	23			TPA / FCIS	Y	0.04	Y	27.8331	-82.4352
65	Port Redwing	HB	L, Ch			X	X	TPA	Y	0.00	N	27.8132	-82.3951
66	Fishhook Spoil Island	HB	Ch	2	13			TPA / TECO	Y	0.02	Y	27.8024	-82.4152
67	Apollo Beach Oystercatchers	HB	Ch	2	15		X	Private	N	0.03	Y	27.7733	-82.4318
68	Mouth of Little Manatee River	MR	P, Ci			X		FDEP Cockroach Bay Aquatic Preserve	N	0.00	N	27.7160	-82.4823
69	Cockroach Bay Preserve	MTB	Ch	1	30		X	ELAPP	Y	0.05	Y	27.6955	-82.5079
70	Hole in the Wall, Cockroach Bay Preserve 1	MTB	Ci				X	ELAPP	Y	0.02	Y	27.6811	-82.5183
71	Hole in the Wall, Cockroach Bay Preserve 2	MTB	Ci	1	20		X	ELAPP	Y	0.02	Y	27.6799	-82.5198
72	Hole in the Wall, Cockroach Bay Preserve 3	MTB	Ci				X	ELAPP	Y	0.02	Y	27.6764	-82.5169
73	Piney Point	MTB	P, Ci	14	2,795		X	SWFWMD	Y	4.78	Y	27.6505	-82.5462
74	Manbirtee Key	MTB	Ci, Ch	4	24			MCPA / FCIS	Y	0.04	Y	27.6359	-82.5740
75	Two Brothers Island	LTB	Ci			X		Private	N	0.00	N	27.5935	-82.5847
76	Skyway Bridge Least Tern colony	LTB	L			X	X	FDOT	N	0.00	N	27.5808	-82.6090
77	Miguel Bay Colony	LTB	P, Ci				X	FDEP-AP / FCIS	Y	0.00	Y	27.5708	-82.5995
78	Passage Key	LTB	P, Ci, L, Ch			X		USFWS NWR	Y	0.00	Y	27.5545	-82.7404
79	Nina Washburn Sanctuary	TCB	P, Ci	7	52			FCIS	Y	0.09	Y	27.5527	-82.5999

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80	Washburn Junior/Terra Ceia Bay Little Bird Key	TCB	P, Ci	14	407		X	FDEP Terra Ceia Aquatic Preserve / FCIS	Y	0.70	Y	27.5285	-82.6015
81	Dot Dash Dit Colony	MR	P, Ci	13	2,360			Private / Florida / FCIS	Y	4.04	Y	27.4993	-82.5243
82	Heath Yellow-crowned Night-Heron Colony	HC	Ci	1	5		X	Private	N	0.01	Y	27.8772	-82.3129
83	Office/Ferman Bird Colony	HC	P, Ci	8	74		X	Private	Y	0.13	Y	27.9448	-82.3417
84	Robles Park	HC	Ci	4	31		X	City of Tampa	Y	0.05	Y	27.9740	-82.4550
85	Corporex Colony	HC	P, Ci	7	94		X	Private	N	0.16	Y	27.9786	-82.3857
86	East Lake Island	HC	P, Ci	5	14		X	Florida Audubon Society	Y	0.02	Y	27.9922	-82.3784
87	Temple Crest/Orange Lake/Wargo Bird Colony	HC	P, Ci	8	51		X	City of Tampa / TPA	N	0.09	Y	28.0193	-82.4174
88	River Cove Yellow-crowned Night-Heron colony	HC	Ci				X	Hillsborough County	N	0.02	Y	28.0192	-82.4486
89	Citrus Park Bird Colony	HC	P, Ci	9	486		X	Private	N	0.83	Y	28.0699	-82.5834
90	Heron Point	PaC	P, Ci	7	57		X	Private	N	0.10	Y	28.2157	-82.4349
91	Saddlebrook	PaC	P, Ci	3	48		X	Private	Y	0.08	Y	28.2277	-82.3297
92	Cypress Creek Preserve	HC	P, Ci	11	3,294		X	ELAPP	Y	5.64	Y	28.1629	-82.3975
93	Cross Creek Colony	HC	P, Ci	2	8		X	Private	N	0.01	Y	28.1424	-82.3520
94	Medard County Park	HC	P, Ci	10	477		X	Hillsborough County	Y	0.82	Y	27.9218	-82.1630
95	Alafia River Corridor Preserve	HC	P, Ci	5	46		X	ELAPP	Y	0.08	Y	27.8756	-82.1053
96	Wood Lake/Somerset Lake	PoC	P, Ci	14	1,151		X	City of Lakeland / Private	Y	1.97	Y	28.0036	-81.9311
	Totals				58,424	27	48			100.00			


Pasco County
Polk County
Hillsborough County
Pinellas County
Old Tampa Bay
Middle Tampa Bay
Lower Tampa Bay
Upper Boca Ciega Bay
Lower Boca Ciega Bay
Hillsborough Bay
Terra Ceia Bay
Manatee County
Manatee River
Gulf of Mexico
N
0 5 10 Kilometers
Legend
Basis I Colonies
Post Basis I Colonies
Abandoned Colonies
Tampa Bay Watershed Basins
Audubon OF FLORIDA

Copy of the Reddish egret BSR draft report that was sent out for peer review

Biological Status Review
for the Reddish Egret
(*Egretta rufescens)*

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of September 1, 2010. Public information on the status of the reddish egret was sought from September 17, 2010 to November 1, 2010. A three member biological review group met on November 3-4, 2010. Group members were James A. Rodgers (FWC lead), Peter C. Frederick (University of Florida), Jerry Lorenz (National Audubon Society), Mark Cook (South Florida Water Management District), and John C. Ogden (Research Director at Audubon of Florida). In accordance with rule 68A-27.0012, F.A.C, the Reddish Egret Biological Review Group was charged with evaluating the biological status of the reddish egret using criteria included in definitions in 68A-27.001(3), F.A.C., and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels Version 3.0 (2003)* and *Guidelines for Using the IUCN Red List Categories and Criteria Version 8.1 (2010)*. Please visit http://myfwc.com/WILDLIFEHABITATS/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Biological Review Group concluded from the biological assessment that the reddish egret met the population size and trend and population very small or restricted criteria for listing. Based on the literature review, information received from the public, and the biological review findings, FWC staff recommends listing the reddish egret as state threatened.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

BIOLOGICAL INFORMATION

Taxonomic Classification – Reddish egrets (*Egretta rufescens*) are members of the Family Ardeidae, along with other egrets, herons and bitterns. The species has two distinct color morphs: white and dark. The more common dark morph and name sake is characterized by a reddish head and neck and a gray body, whereas the less common white morph has an entirely white plumage. Both forms have pink bills with black tips, and blue to grayish-black legs. Some authorities recognize two subspecies: the nominate *E. r. rufescens* on the east coast of North America and in the Caribbean, and *E. r. dickeyi* along the Pacific coast of the southern U.S. and Mexico (Lowther and Paul 2002). Previously, the species was placed in the monotypic genus *Dichromonassa*.

Geographic Range and Distribution – Reddish egrets occur along the coastlines of Florida, Alabama, Louisiana, Mississippi, and Texas (Rodgers et al. 1996, Lowther and Paul 2002). They are found on the eastern coast of Mexico, and the Baja Peninsula on the Pacific

coast. Their range extends through the Caribbean islands, Cuba, Belize, and the Bahamas, and south along Central America to northern Colombia and Venezuela. The species is generally resident at breeding locations and not considered migratory as are other species of wading birds (Rodgers et al 1996, Mikuska et al. 1998).

Life History References – Rodgers et al. 1995, Toland 1999, Lowther and Paul 2002, Florida Fish and Wildlife Conservation Commission 2003, IUCN 2009.

BIOLOGICAL STATUS ASSESSMENT

Threats – Reddish egret populations suffered huge losses during the plume trade of the late 1800s and early 1900s and are still considered one of the rarest heron species (Kale et al. 1992, Rodgers et al. 1996, Lowther and Paul 2002). Current threats to reddish egrets are not well understood, but coastal development, recreational disturbance at foraging and breeding sites, environmental degradation, loss of genetic diversity and interchange, and increased pressure from predators are of primary concern (Powell et al. 1989, Lowther and Paul 2002, Hunter et al. 2006, Bates et al. 2009). The reddish egret was one of fourteen species identified as regional priority species in need of Critical Recovery or Immediate Management in the 2006 Southeast U.S. Waterbird Conservation Plan (Hunter et al. 2006). The species is listed as Near Threatened on the IUCN Red List of Threatened Species, and labeled as "red", or species of greatest conservation concern, on Audubon's Watchlist due to its moderately small population and suspected population declines (Butcher et al. 2007, IUCN 2009).

Statewide Population Assessment – Reddish egret populations gradually increased through the 20th century as a result of protection measures and hunting prohibitions. However, current population estimates are still estimated at only 10% of the pre-plume hunting population size (Lowther and Paul 2002). While the non-breeding range of the species extends along both the Atlantic and Gulf of Mexico coasts of the state, breeding sites are located along the southern half of the state into Florida Bay and the Lower Keys (Paul and Dunstan 1975, Paul et al. 1979, Rodgers and Schwikert 1986, Toland 1991, Toland 1999). The species initiated breeding in South Carolina in 2005 (Ferguson et al. 2005). Estimates for the Florida population of reddish egrets were 350-400 pairs in the early 1990s (Lowther and Paul 2002). Because of its dark plumage and tendency to nest under the nesting canopy of trees, it is difficult to survey for reddish egrets during statewide aerial surveys (Rodgers et al. 2005, Conroy et al. 2008).

Status Review - In its review of the reddish egret's status, the Biological Review Group made the following assumptions and conclusions:

- Generation time: Most birds breed at 3-4 years of age. Maximum known age of a recovered banded bird was 12 years but maximum longevity probably is about 25 years. Calculation of generation time is based on the mid-point of onset of breeding to maximum age at death: (25-4)=21/2=11 years; thus generation time is 11+4=15 years of age. Therefore, the time period for evaluation of change/trend analysis is 3x15=45 years or beginning of the period at 1965.
- Extent of Occurrence (EOO): The species most frequently occurs along coastal areas from Titusville south to the Keys and north to the Tampa Bay region in Florida, an area of about 2,400 km^2 of mangrove/estuarine habitat. At most there is about double the

2,400 km^2 of shallow, open-waer foraging habitat, which is the limiting factor for the distribution of the species. Thus, the EOO is a maximum of about 5,600 km^2.

- Area of Occupancy (AOO): This is less than EOO as the species is not evenly distributed along the coasts and in Florida Bay; thus, habitat actually available, used, or suitable (e.g., large areas of coastline are either developed or not available due to human recreation) for foraging, etc., is probably <2,000 km^2.

Biological Status Review for the reddish egret—The review group concluded the reddish egret met the population size and trend criteria C1, C2 and population very small or restricted criteria D1, D2. See Table 1 for details.

Regional Application—The review group concluded there was no change in the recommendation for the reddish egret. See Table 2 for details.

LISTING RECOMMENDATION

Staff recommends that the reddish egret be listed as a Threatened species because it met criteria for listing as described in 68A-27.001(3) F.A.C.

SUMMARY OF THE INDEPENDENT REVIEW

To be added later.

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Table 1. Biological status review information findings for the reddish egret in Florida.

Biological Status Review Information Findings		Species/taxon:	Reddish Egret	
		Date:	11/04/10	
		Assessors:	Rodgers, Ogden, Lorenz, Cook, Frederick	
		Generation length:	15 years	
Criterion/Listing Measure	**Data/Information**	**Data Type***	**Criterion Met?**	**References**
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	While the species experienced population decreases prior to 1965, there is no evidence of population decrease during the 1965-2010 period. Rather, the species exhibited a slow increase in numbers up to 2000s. Surveys indicate circa 300-400 pairs (600-800 individuals) in statewide population. Some indication of a relatively slow, steady decline in Keys and Florida Bay during the 2000s.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	See A1 above.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	No evidence species will decrease in the next 45 years unless major alteration in coastal/Florida habitat quality.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	Tampa Bay and Indian River Lagoon populations stable but Keys/Florida Bay populations are slowly decreasing due to unknown reasons. Sea level rise probably will not cause significant decrease of foraging habitat (=limiting factor for distribution of species since nesting habitat is not limited) and mangroves might increase in area by moving inland.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2)	About 5,600 km^2.	O	Y	See EOO on notes tab.

OR				
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	Probably <2,000 km^2.	O	Y	See AOO on notes tab.
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Numerous individual colonies (circa 50+) with small number of nests (mostly <25 nests) at each colony but there only appears to be 5 natural clusters (=locations) of colonies: Tampa Bay, Indian River Lagoon, North Florida Bay, Lower Keys, and a continuous area along the SW coast.	O	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	No evidence of any of these variables.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No evidence.	O	N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Current population is circa 300-400 pairs (600-800 individuals). However, 2007-08 surveys in Florida Bay found only about 56 nests, a decrease from the 1990s.	O	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR	Florida Bay population has decreased from the 1990s because of unknown reasons and an amount amount during the last 45 years. Based on total population of 600-800 individuals, a 10% decrease in the future would only be about a decrease of 60-80 individuals. It is reasonably likely this percent decrease could be met in Florida Bay alone.	E/I	Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	A decline has occurred in Florida Bay.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
a. Population structure in the form of EITHER	Total population is only about 600-800 individuals.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	East coast, west coast, and Florida Bay birds considered as one population.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
b. Extreme fluctuations in number of mature individuals	No evidence.		N	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(D) Population Very Small or Restricted, EITHER				

(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	Total population is only about 600-800 individuals.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	See B2.a for identification of 5 clusters or locations.		Y	Paul 1991, Hodgson and Paul 2010, Lowther and Paul 2002.
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	None completed to date.		N	

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meet at least one criteria	C1, C2, D1, D2
Is species/taxon endemic to Florida? (Y/N)	No
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meets at least one criteria above	C1, C2, D1, D2

Table 2. Biological status review information for the regional assessment of the reddish egret.

1	Species/taxon:	Reddish Egret
2	Biological Status Review Information Date:	11/4/10
3	Regional Assessment Assessors:	Rodgers, Ogden, Lorenz, Cook, Frederick
4		
5		
6		
7		
8	Initial finding	Supporting Information
9		
10	2a. Is the species/taxon a non-breeding visitor? (Y/N/DK). If 2a is YES, go to line 18. If 2a is NO or DO NOT KNOW, go to line 11.	No, resident breeding species.
11	2b. Does the Florida population experience any significant immigration of propagules capable of reproducing in Florida? (Y/N/DK). If 2b is YES, go to line 12. If 2b is NO or DO NOT KNOW, go to line 17.	Do not know. It is not clear what would be significant movement by the species into Florida and what numbers were suspected/inferred to have moved into the state from Cuba/Bahamas in order to rescue the Florida population. At most, movement into Florida would be a slow process during the 3 generation time period and it may require >2055 to have an impact on Florida population. Movement from Texas is an unknown entity. In conclusion, it is uncertain if there would be enough immigrants within 45 years to prevent extirpation of the species in Florida.
12	2c. Is the immigration expected to decrease? (Y/N/DK). If 2c is YES or DO NOT KNOW, go to line 13. If 2c is NO go to line 16.	
13	2d. Is the Florida population a sink? (Y/N/DK). If 2d is YES, go to line 14. If 2d is NO or DO NOT KNOW, go to line 15.	
14	If 2d is YES - Upgrade from initial finding (more imperiled)	
15	If 2d is NO or DO NOT KNOW - No change from initial finding	
16	If 2c is NO or DO NOT KNOW- Downgrade from initial finding (less imperiled)	
17	If 2b is NO or DO NOT KNOW - No change from initial finding	No change in initial finding.
18	2e. Are the conditions outside Florida deteriorating? (Y/N/DK). If 2e is YES or DO NOT KNOW, go to line 24. If 2e is NO go to line 19.	
19	2f. Are the conditions within Florida deteriorating? (Y/N/DK). If 2f is YES or DO NOT KNOW, go to line 23. If 2f is NO, go to line 20.	
20	2g. Can the breeding population rescue the Florida population should it decline? (Y/N/DK). If 2g is YES, go to line 21. If 2g is NO or DO NOT KNOW, go to line 22.	
21	If 2g is YES - Downgrade from initial finding (less imperiled)	

22	If 2g is NO or DO NOT KNOW - No change from initial finding	
23	If 2f is YES or DO NOT KNOW - No change from initial finding	
24	If 2e is YES or DO NOT KNOW - No change from initial finding	
25		
26	Final finding	No change in initial finding.

APPENDIX 1. Biographies of the members of the Reddish Egret Biological Review Group.

Mark I. Cook has a M.S. in Ecology from the University of Durham, UK and Ph.D. in Ecology from Glasgow University, UK. He is a senior environmental scientist with the South Florida Water Management District. His expertise is in the behavioral ecology, conservation biology, habitat quality and reproductive success, and restoration ecology related to wading bird foraging and reproductive performance especially applied to hydrologic management and restoration issues in the Everglades. He has published numerous papers on the food ecology of wading birds.

Peter C. Frederick received a Ph.D. in Zoology from the University of North Carolina. He is Research Professor at the University of Florida. His expertise is in the areas of wetland ecology, ecotoxicology, and avian ecology of wading birds, especially with the wood stork, great egret, and white ibis and the Everglades. He has published numerous papers on waterbird ecology, pesticide contamination, population biology, and habitat requirements of wading birds in Florida.

Jerome J. Lorenz received a M.S. in Zoology from Miami University and a Ph.D. in Marine Biology and Fisheries from the University of Miami. Since 1989 Jerry has been a staff scientist for the Audubon Society and has been primary investigator of the National Audubon Society's Florida Bay Estuarine Research Project since 1992. This project focuses on the impact of water management in the southern Everglades on the coastal ecosystems of Florida Bay. In 2005, he became the state research director for Audubon of Florida. He serves as a member on numerous advisory committees and has published numerous papers.

John C. Ogden received a B.S. degree in Zoology from the University of Tennessee. He has held positions as research ecologist with the Everglades National Park and National Audubon Society, environmental scientist with the South Florida Water Management District working on the everglades restoration, and most recently as research director with Audubon of Florida. His expertise is in the ecology of wading birds, especially the wood stork, and has served on the USFWS recovery teams for the wood stork, California condor, and American crocodile. He serves on numerous advisory committees and has published over 100 technical papers.

James A. Rodgers received a M.S. from Louisiana State University and a Ph.D. from the University of South Florida. Since joining the FWC in 1980, he has worked on snail kites, double-crested cormorants, several species of wading birds including little blue herons and wood storks, development of buffer distances for waterbirds, pesticide contamination, and population genetics of birds. He was elected a Fellow of the American Ornithologist Union in 2009 and has published numerous papers on the breeding and nesting ecology of waterbirds.

APPENDIX 2. Summary of letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010.

Most information received by FWC staff was anecdotal and consisted of general observations of presence or absence. Information from Ann Hodgson (Tampa Bay Sanctuaries, NAS) for the status of the species in the Tampa Bay region was used in the review of the species by the BSR panel on November 3-4, 2010.

APPENDIX 3. Information and Comments Received from Independent Reviewers.

To be completed later.