Conservation Action Plan for the Reddish Egret (*Egretta rufescens*)

2022 Update

Strategies For Sustaining And Restoring Populations Rangewide Across The Annual Cycle

REDDISH EGRET INTERNATIONAL WORKING GROUP

ACKNOWLEDGEMENTS

This plan was conceived and coordinated under the auspices of the Reddish Egret International Working Group as an update to the original conservation action plan for Reddish Egret prepared by Wilson et al. (2014). For nearly a decade, the original plan has played a pivotal role in synergizing the efforts of partners throughout the range into a more cohesive and comprehensive whole in the collective pursuit to conserve this elegant but vulnerable wading bird. It is the authors' wish that this revision fittingly captures the spirit and passion of working group members and their parent organizations, builds on the momentum spurred by the original plan, and further unites all stakeholders in a common cause and renewed commitment to advance the conservation of Reddish Egrets over the next decade.

The authors wish to thank the many individuals from private conservation organizations, government agencies, academia and elsewhere who contributed to this plan through their participation in strategy discussions, online webinars, and in-person workshops, and who provided input and feedback during development and critique of earlier drafts. While too numerous to name here, Appendix D recognizes many of these individuals. We specifically wish to recognize Salvador Narváez Torres and Carlos Barriga Vallejo, Pronatura Noreste, for organizing the November 2018 workshop in Merida, Yucatan, Mexico, and Sam Collins and the Louisiana Department of Wildlife and Fisheries Rockefeller State Wildlife Refuge for hosting the January 2019 workshop in Cameron, Louisiana, U.S. These workshops were vital to engaging local and regional experts not only as a foundation for this updated plan, but as those whose buy-in and ownership are essential in implementing its recommendations. We are very grateful to Ian Davidson, Bridget Collins and the National Fish and Wildlife Foundation for recognizing the need for this update and providing key financial support to aid in its development, and to the United States Fish and Wildlife Service (Neotropical Migratory Bird Conservation Act) for supporting the Merida workshop. Finally, we remain indebted to Debra Reynolds, Division of Migratory Birds, United States Fish and Wildlife Service, for expert design and layout assistance, without which completion of this plan would not have been possible.

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EXECUTIVE SUMMARY

Almost a decade ago, the completion of the first conservation plan for Reddish Egret (*Egretta rufescens*; Wilson et al. 2014) established a vision and framework for collective action to further secure the long term future of this vulnerable and threatened species. The stage was the entire range of the species, the script was the plan, and the players were the selfless and dedicated partners who found community and common purpose under the umbrella of the Reddish Egret International Working Group. After eight years, the steepest parts of the challenge lie ahead, and much remains to be accomplished. However, much has also been gained. Key information needs have been met, collaborations strengthened and expanded, colony site and other basic datasets assimilated, priorities outlined, monitoring efforts refocused, and projects funded. Specific accomplishments include multiple studies to better understand movements of juveniles and adults (Geary et al. 2015, Koczur et al. 2018a), a revised genetic assessment (Shahroki et al. 2020), winter surveys and telemetry studies in Mexico, new surveys and research into breeding ecology in the U.S., and an update to the species account in Birds of the World.

Despite the successes, witnessing – or better yet, measuring – beneficial conservation change at the scale of a species can seem perpetually out of reach. And while the ultimate intent is to enhance the long-term viability of egret populations and the habitats they integrally depend upon, progress in the near term can feel tragically slow and far removed from any eventual influence in "moving the needle." These realizations don't lessen the importance of taking actions, however, no matter how far removed they may at times appear. As long as there is strategy, local actions supporting a greater cause, cumulative impact, and flexibility to adapt as time and circumstance dictate, then even daunting challenges and the changes they necessitate can be won. Indeed, they can not be won without them.

This update to the Conservation Action Plan for Reddish Egret articulates seven principal strategies that are rooted on this premise, and that build upon the directions outlined in the original plan and experience gained in implementing it. Importantly, this update attempts to refine recommendations with regard to the contemporary context of knowledge, needs and opportunities, and better facilitate local implementation in support of rangewide goals. The core focus remains the enhancement of populations by abating direct impacts to the welfare of birds, and by assuring abundant and secure breeding and foraging habitats. Within the primary strategies, specific recommendations and actions are identified that comprise the means for realizing an ambitious goal to increase the rangewide population by 10% by 2032.

The seven primary strategies are to:

1. Implement systematic, long-term population monitoring to improve conservation and management decision making at all scales;
2. Strengthen legal protections for the species where appropriate;
3. Increase the amount of priority habitats under long-term protection;
4. Reduce disturbance and predation impacts related to human activity and modification of the environment;
5. Enhance and support management, stewardship and restoration of priority habitats;
6. Engage and influence key audiences to garner further conservation support and capacity; and
7. Improve support and capacity for Reddish Egret International Working Group to bolster reach and effectiveness.

As before, the development of this update and many of the key needs identified are a product of adhering to the principles and practices of the Open Standards for the Practice of Conservation (CMP 2007), which encourage practitioners to explicitly and objectively link proposed actions in reasoned support of desired conservation outcomes. The underlying "results chains" are presented throughout this update in depicting

where and how seemingly disparate and localized interventions are envisioned to combine in supporting an overall trajectory of improvement in the three key conservation targets: populations, breeding habitats, and foraging habitats.

Conservation is about many things, but ultimately it revolves around capacity and commitment. Capacity is perpetually at a premium, yet commitment to the cause of coastal ecosystem preservation, bird conservation, and specifically conservation of emblematic species such as Reddish Egret is growing each year. Because new resources arrive all too infrequently, much in the way of enhanced capacity to implement the recommendations of this plan must come by means of improved efficiencies and effectiveness, collaboration and leveraging of individual capacities, and pragmatic use of scientific knowledge to make the most of those precious resources that we do have the luxury of investing. And while individual commitment – and passion – are never in short supply, broader institutional, political, and societal level commitment is needed in fostering attention to more fundamental conservation challenges that affect Reddish Egrets but that can not and should not be approached entirely from an insular, species level platform. Climate change, environmental contamination, and a burgeoning human footprint on natural landscapes are chief among these. Clearly, securing the long-term future of this stately and graceful wading bird presents a sweeping challenge – though it is one that ultimately depends on individual will and action.

Please join us!

In addition to strengthened conservation capacity, international collaboration and commitment will be cornerstones to the successful implementation of this plan. Ray Hennessy, rayhennessy.com

INTRODUCTION & BACKGROUND

The Reddish Egret (*Egretta rufescens*) is among the rarest, most vulnerable and least known of the 30-plus species of herons and egrets (Ardeidae) in the Americas. Closely tied to coastal zones along Pacific Mexico and Central America, the Caribbean Sea, the Gulf of Mexico, and the West Indies (Figure 1; Koczur et al. 2020), the species subsists almost entirely within a narrow fringe of tidally influenced environments subject to escalating pressures that derive in large part from human activities. A habitat specialist, Reddish Egrets are nowhere abundant, confined to and patchily distributed across beaches, flats, lagoons, overwash ponds and similar environs that afford shallow and relatively undisturbed foraging conditions, as well as cays, islands and other isolated features with mangroves or other vegetative structure suitable for nesting. Mariculture, shipping and industry, coastal development, recreational use, sea level rise, and environmental contamination pose ubiquitous threats to these habitats. Through conversion, degradation, disturbance, and broader impacts to ecosystem structure and function, these threats have been implicated in influencing survival, productivity and fitness of Reddish Egrets and other coastal birds (Custer 2000, Kushlan and Hafner 2000, Kushlan et al. 2002). While the pathways and extent to which these pressures may ultimately limit Reddish Egret populations are difficult to elucidate, their prevalence suggests that the individual and cumulative weight is mounting and increasingly unfavorable to the long-term welfare of this distinctive species.

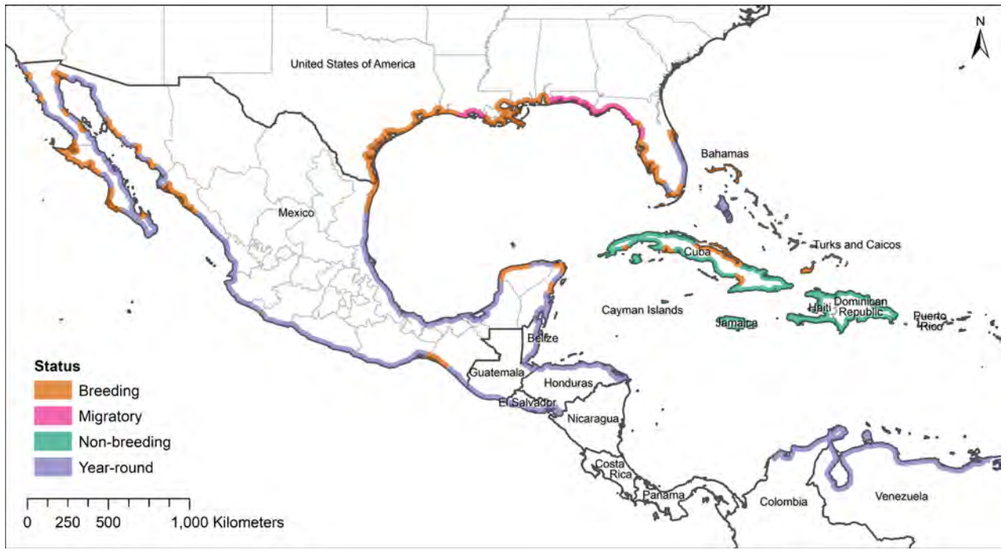


Figure 1. Rangewide distribution of Reddish Egret. Breeding – areas with confirmed nesting; Migratory – seasonal occurrence during spring and fall only; Non-breeding – seasonal occurrence during winter and other nonbreeding seasons; Year-round – occurrence throughout the year, but nesting is not confirmed. Breeding very recently documented on Caribbean coast of Colombia (see text).

Reddish Egrets were historically depicted as a common and resident species in the United States (U.S.) along the Gulf Coast from Florida to Texas (Koczur et al. 2020). In the late 19th and early 20th centuries, populations of Reddish Egrets and other wading birds in the U.S. were decimated by the actions of plume hunters and demand for the millinery trade (Paul 1996, Kushlan 2018). The impact was compounded by subsequent decades of hydrologic alteration, habitat loss, and pesticide use (Kushlan 1997). Little is known about the historical status and distribution of Reddish Egrets in Mexico, Central and South America, and the Caribbean (see Paul 1991), but expanded human settlement and associated resource exploitation ostensibly precipitated similar, albeit perhaps less acute and more localized population depression in these regions. Although the species has recovered from precarious lows in key areas (e.g., south Florida and Texas), populations throughout the range are believed to be substantially less abundant and widespread than historically (Powell et al. 1989, Paul 1996, Hunter et al. 2006, Koczur et al. 2020).

Early twentieth-century fashion statements were a significant factor in the decline of many waterbirds like the Reddish Egret. Library of Congress

Quantifying population status of Reddish Egrets remains challenging, especially in response to potential drivers. No systematic survey exists to evaluate the present population overall, but breeding colony data offer insights. Aggregation of local and regional colony data suggests an estimate of ~4,000 adult breeding pairs rangewide, and a total population not likely to exceed 10,000 individuals (Table 1). Not surprisingly, counts derived from colony monitoring may be influenced by timing, periodicity, effort, nesting chronology, colony dynamics and other variables that obscure underlying status and trend, especially when pooled. While not rigorously conclusive, these data suggest a potentially stable or moderately declining population rangewide, the latter being more consistent with known susceptibility to ongoing threats (BirdLife International 2022, Partners in Flight 2021).

Due to its small global population size, restricted distribution, reliance on specialized coastal habitats, losses in historical abundance, low fecundity, pervasive threats, and what appear to be ongoing declines, multiple state, federal and international authorities have consistently classified Reddish Egret as warranting elevated conservation attention (BirdLife International 2020, Partners in Flight 2021, USFWS 2021). It is for these reasons that in 2005, scientists and resource managers from the U.S., Bahamas and Mexico met and launched the Reddish Egret International Working Group (https://www.reddishegret.org; Working Group) as a platform for improving collaboration and promoting conservation of this vulnerable species. At its initial meeting in October of that year, the Working Group quickly determined that an updated status assessment was an initial priority because the majority of information regarding Reddish Egret populations in the U.S. and Mexico was at least a decade old (Paul 1991). The status assessment was completed in 2006 (Green 2006) and formed the basis for subsequent investments in research and data collection between 2006 and 2012 to fill critical information gaps (e.g., Bates et al. 2009, Fidorra et al. 2011, Green et al. 2011, Hill and Green 2011, Hill et al. 2012, Holderby et al. 2012, Palacios et al. 2018). Additionally, partner organizations participating in the Working Group continued to undertake management, protection, outreach and monitoring efforts to conserve Reddish Egret populations and habitats locally. Local and regional conservation plans were developed in guiding these actions, as for example for the Texas Gulf Coast (Vermillion and Wilson 2009), yet a comprehensive strategy was lacking.

In 2012, Working Group members from the U.S. and Mexico convened in Texas to draft an initial framework for the first Reddish Egret Conservation Action Plan, eventually completed in 2014 (Wilson et al. 2014; Original Plan). The Original Plan was developed to guide rangewide investments in Reddish Egret conservation and provided a set of collaboratively defined goals and priorities for doing so. Its development drew on the principles and practices of the Open Standards for the Practice of Conservation (CMP 2007; Open Standards). Among other benefits, adherence to Open Standards encourages practitioners to explicitly and objectively link proposed actions in reasoned support of mutually desired outcomes.

Actively on the hunt! Ten years after completion of the Original Plan, much remains to be accomplished in securing the long term future of Reddish Egrets. Ray Hennessy, rayhennessy.com

The Original Plan has served capably in spurring attention and guiding the individual actions of Working Group partners and other stakeholders in bird and coastal conservation. Importantly, it has afforded strategic context in the preparation of compelling grant proposals targeting Reddish Egrets and coastal systems awarded through the National Fish and Wildlife Foundation, Neotropical Migratory Bird Conservation Act, U.S. State Wildlife Grants, Sarteneja Alliance for Conservation and Development, and similar funding programs. It has also served in guiding the development of the Business Plan for Conservation of the Reddish Egret in Mexico (Álvarez et al. 2018), and a parallel business plan recently completed for the U.S. (Tarbox et al. 2020). These business plans aid greatly in expressing identified needs and recommendations as investment strategies framed in the anticipated costs and conservation benefits of specific proposed actions.

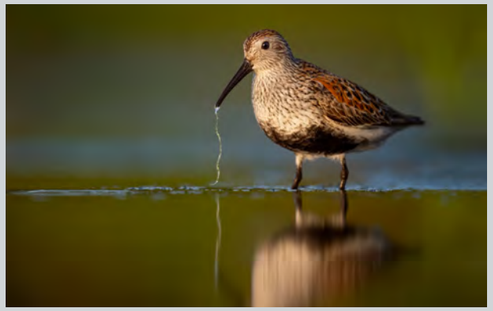
Nearly 10 years later, a great deal is yet to be accomplished in securing the long-term future of Reddish Egrets. And although much has remained the same regarding pressures on birds and natural habitats, our understanding has grown, and the tools, resources and players relevant to advancing Reddish Egret conservation have continued to evolve. Hence, the Working Group acknowledged that a revision prepared in the contemporary context of knowledge, needs and opportunities was necessary, yielding the present Conservation Action Action Plan for Reddish Egret, 2022 Update (Update). As previously, the Update follows the Open Standards process and maintains a focus on the enhancement of populations through mitigation of direct impacts to Reddish Egrets, and promotion of abundant and secure breeding and foraging habitats. Results chains are again presented in expressing known or presumed relationships among key conceptual elements in logical influence diagrams, depicting how proposed interventions are envisioned to counter key threats and support desired conservation outcomes. Although information from Mexico and the U.S. continues to frame much of the thinking, where possible the Update seeks to more specifically represent issues, needs and expertise from elsewhere in the range – the West Indies, Central America and northern South America.

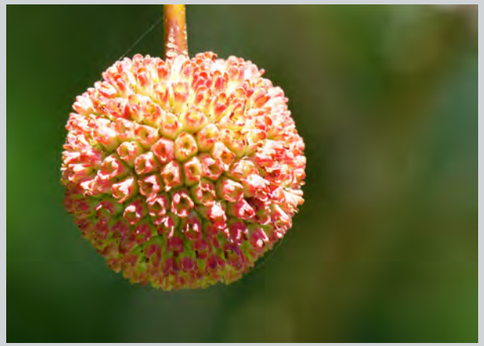
While the Update is deliberate in focusing on the individual needs of Reddish Egret as an at-risk species, we recognize that conservation enterprises are often best approached as multi-species or system oriented in optimizing outcomes for suites of species or habitats that each may be influenced by particular activities. As coastal obligates with fairly specific ecological sensitivities and requirements, Reddish Egrets are sentinels for the health of tidal flat ecosystems (Koczur et al. 2020). Conservation actions targeting Reddish Egrets possess important potential to beneficially impact multiple other species dependent on these systems – as well as the structure, function and resiliency of the systems themselves. It is our expectation that the recommendations identified in the Update, and the collective efforts of the Working Group more broadly, will serve most usefully to the extent they are effectively arrayed with myriad “other” conservation interests where synergy and efficacy present welcome opportunities for realizing compatible ends.

Dark morph Reddish Egret sporting stylish breeding plumes. .Jim Gray

REDDISH EGRET CONSERVATION BENEFITS OTHER SPECIES

Foraging and nesting habitats used by Reddish Egrets are important to a wide assemblage of other species including terns, skimmers, long-legged wading birds, sea and diving ducks, sandpipers, plovers, shrimp, crabs, sea turtles, and small schooling fish. Efforts to conserve tidal flats, associated shallows and seagrass beds, mangroves, offshore keys, and even artificial habitats like spoil islands on behalf of Reddish Egrets provide for a multitude of other coastal species, many of which are key resources in coastal ecosystem food chains and/or vulnerable and in need of heightened conservation attention themselves.





At-risk and other management interest species that co-inhabit Reddish Egret nesting and foraging environments (from top left clockwise): Sheepshead Minnow, Robert Aguilar, Smithsonian Environmental Research Center; Dunlin, Ray Hennessy, rayhennessy.com; Leatherback hatchling, GTM NERR; Mixed flock, Ernesto Gomez; and Buttonwood, Simon Marshall, Creative Commons

At-risk and other management interest species that co-inhabit Reddish Egret nesting and foraging environments.

Taxa	Common Name	Scientific Name	Status
Birds	West Indian Whistling-Duck	*Dendrocygna arborea*	BCC [1]
	Mottled Duck	*Anas fulvigula*	NAWMP [2], WL [3]
	Redhead	*Aythya americana*	NAWMP
	White-crowned Pigeon	*Patagioenas leucocephala*	BCC, WL
	Mangrove Cuckoo	*Coccyzus minor*	BCC, WL
	American Oystercatcher	*Haematopus palliates*	BCC, WL
	Wilson's Plover	*Charadrius wilsonia*	BCC
	Snowy Plover	*Charadrius nivosus*	BCC, WL
	Piping Plover	*Charadrius melodus*	ESA [4]
	Long-billed Curlew	*Numenius americanus*	BCC, WL
	Hudsonian Godwit	*Limosa haemastica*	BCC, WL
	Marbled Godwit	*Limosa fedoa*	BCC, WL
	Red Knot (Atlantic)	*Calidris canutus rufa*	ESA
	Red Knot (Pacific)	*Calidris canutus roselaari*	BCC
	Dunlin	*Calidris alpina*	BCC
	Short-billed Dowitcher	*Limnodromus griseus*	BCC, WL
	Lesser Yellowlegs	*Tringa flavipes*	BCC, WL
	Willet	*Tringa semipalmata*	BCC, WL
	Western Gull	*Larus occidentalis*	BCC, WL
	Least Tern	*Sternula antillarum*	BCC, WL
	Roseate Tern	*Sterna dougallii*	ESA, WL
	Elegant Tern	*Thalasseus elegansi*	WL
	Black Skimmer	*Rynchops niger*	BCC, WL
	Magnificent Frigatebird	*Fregata magnificens*	WL
	"Great White" Heron	*Ardea herodias occidentalis*	BCC
	Little Blue Heron	*Egretta caerulea*	BCC, WL
	Roseate Spoonbill	*Platalea ajaja*	WL
	Mangrove Vireo	*Vireo pallens*	WL
Reptiles	Loggerhead Sea Turtle	*Caretta caretta*	ESA
	Green Sea Turtle	*Chelonia mydas*	ESA
	Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	ESA
	Hawksbill Sea Turtle	*Eretmochelys imbricata*	ESA
	Leatherback Sea turtle	*Dermochelys coriacea*	ESA
Fish	Yucatan Molly	*Poecilia verifera*	VU [5]
	Giant Killifish	*Fundulus grandissimus*	VU
	Yucatan Killifish	*Fundulus persimilis*	EN
	Golden Silverside	*Menidia colei*	VU
	Saltmarsh Topminnow	*Fundulus jenkinsi*	VU
Plants	Star grass	*Halophila engelmannii*	NT

1 2021 U.S. Fish & Wildlife Service, Birds of Conservation Concern 2021 (BCC; USFWS 2021)
2 North American Waterfowl Mgt. Plan Priority Species (NAWMP)
3 2016 State of the Birds Watch List (WL; NABCI 2016)
4 Threatened or Endangered under U.S. Endangered Species Act (ESA)
5 IUCN Redlist (EN – endangered, VU – vulnerable, NT – near threatened)

It can be challenging to implement an ambitious plan that proposes actions necessary to conserve a species whose welfare depends on effective coordination across such a broad geopolitical landscape. Nonetheless, we feel that as long as local level actions are appropriately framed in support of the overall strategies identified in the Update, the challenge can be at least partially overcome by regionalizing implementation. Figure 2 envisages one approach to regionalized implementation where management units, business planning, and political divisions serve to step down the Update to increasingly more discrete, and presumably more operative geographies. Such regionalization, of course, presents its own constraints, and demands concerted communication to ensure that synergies with respect to collective outcomes are maintained.

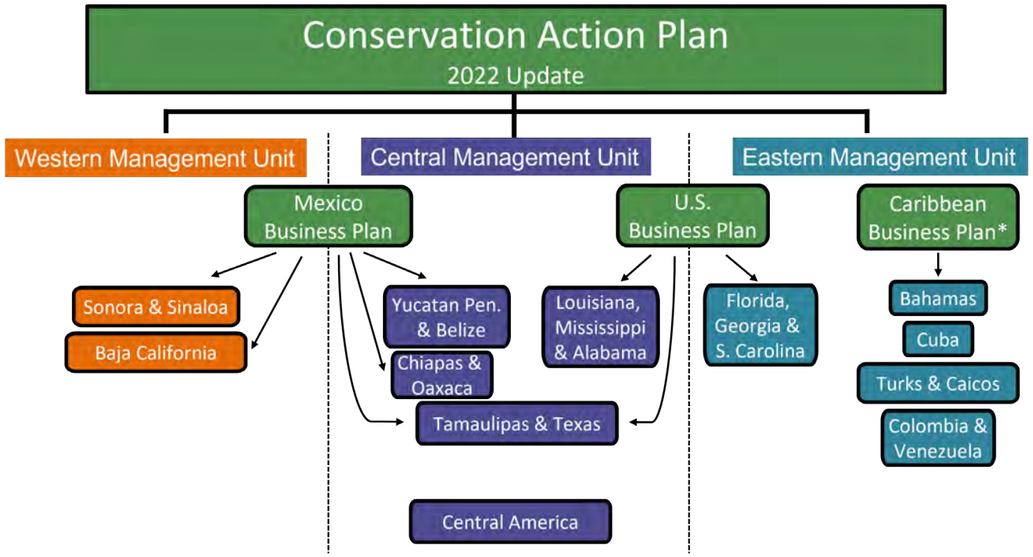
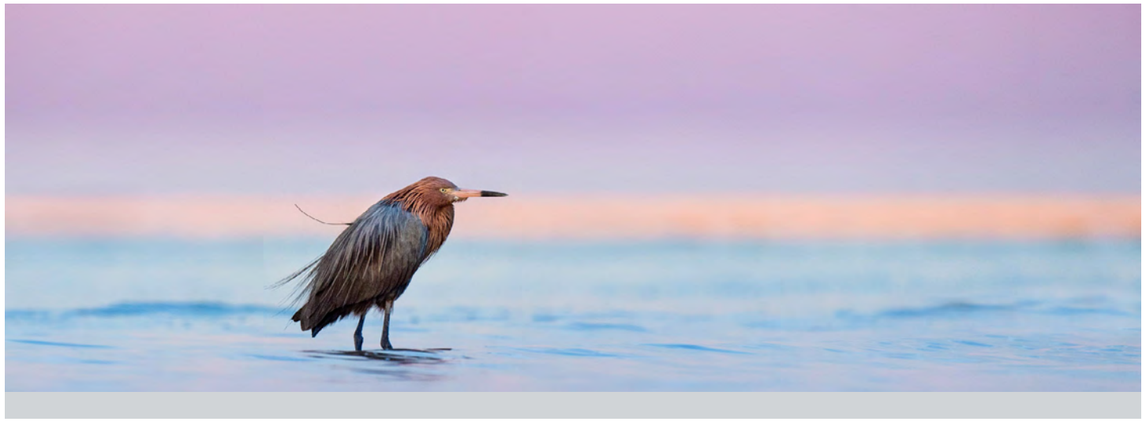


Figure 2. Conceptual step-down envisioned for regionalizing implementation of the Update based on business planning, political and regional divisions, and Reddish Egret management units.

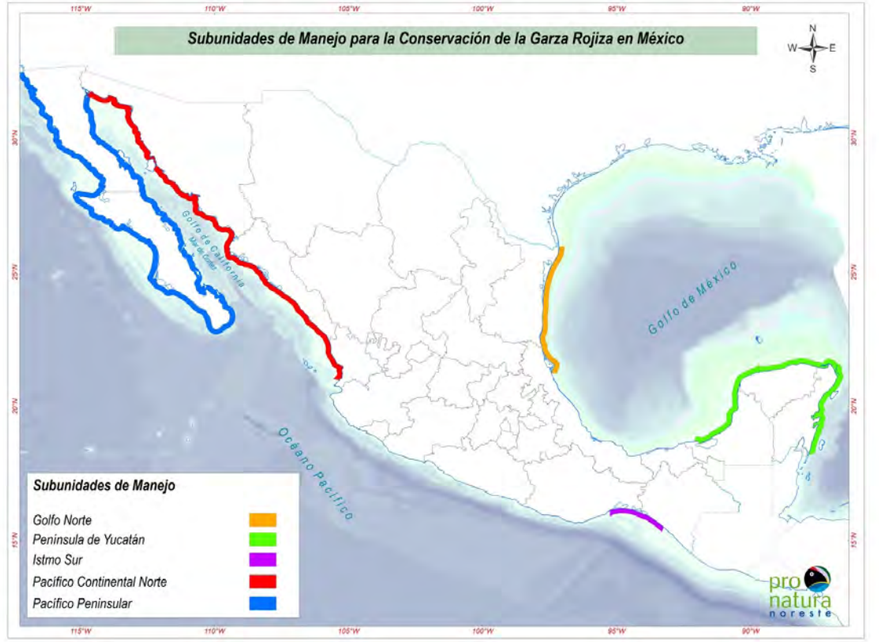


A foraging Reddish Egret enjoys a moment of color-coordinated solitude. Ray Hennessy, rayhennessy.com

STEPPING DOWN THE RANGEWIDE PLAN

Regionalized step-down of the rangewide plan has already proceeded in Mexico, where the Business Plan for Conservation of the Reddish Egret in Mexico (Álvarez et al. 2018) establishes a framework for conservation investments to benefit the species within five primary geographies. Partners working in these regions pool capacity and commitment, collaborating to fulfill more locally relevant priorities in support of overarching plan recommendations. Key partners include Pronatura (Noreste, Noroeste, Sur, Veracruz and Yucatan), the Comision de Areas Naturales Protegidas (CONANP), U.S. Fish and Wildlife Service, Universidad Autónoma de Baja California Sur, Rio Grande Joint Venture, El Colegio de la Frontera, and Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California.

Pied morph Reddish Egret in mangrove colony, Yucatan, Mexico. Ernesto Gomez



Map credit Pronatura Noreste AC.

SCOPE & VISION

It is clearly essential to identify and take actions that contribute meaningfully to species conservation irrespective of political boundaries and geographic separation. With the Update the Working Group aspires to increasingly facilitate strategy, communication, and collaboration on behalf of Reddish Egrets as widely as practical throughout their distribution. Whereas the scope of the original plan was limited in primary extent to Mexico, Bahamas and the U.S., the Update intends to more comprehensively represent all known portions of the species' range, acknowledging that information is still relatively limited for portions of Central and South America, and the West Indies. Future revisions of this plan will undoubtedly benefit as information is gained and new expertise is enlisted regarding Reddish Egrets in these latter regions.

Members of the next generation of Reddish Egrets wait patiently for another meal from their parents. Clay Green

Functionally and organizationally, the scope of the Update is less formally defined. Though not intentional, the expertise of those developing the plan lends an inherent emphasis on habitat management and protection, monitoring, research, disturbance mitigation, and other "conventional" nexuses for effecting conservation of Reddish Egrets and their habitats. There are, of course, a host of other factors that are much further removed from birds and bird habitats per se, but that profoundly influence Reddish Egret conservation nonetheless (e.g., burgeoning human populations, associated demands for resources and infrastructure, carbon emissions, policy, recreational practices). While the Update touches on these in recognizing fundamental sources of certain threats and their corresponding influence on conservation outcomes, they are often less tractable and beyond the expertise and capacity of the Working Group to explore and implement effective interventions for.

Hence, the Update speaks most directly to stakeholders poised to respond through largely conventional approaches to bird conservation that more directly address birds and habitats – federal and state wildlife agencies, conservation non-profits, natural resource industries, academia, etc. It should not go unstated, however, that the most important and sustainable gains will not be made alone through traditional stakeholders employing conventional responses. The suite of broader, societal level influences that are ultimately driving the impacts we observe on species and habitats – and which are not the typical focus of our conservation endeavors – are in desperate need of innovative and concerted attention. Strategic communication and outreach to ever broader audiences and constituencies will be essential for promoting understanding, empathy, engagement and response to many of these more fundamental drivers of ecosystem change.

VISION
Abundant and thriving Reddish Egret populations, restored and sustained as integral components of coastal systems across the full breadth of their global distribution.

CONSERVATION TARGETS

Open Standards (CMP 2007) defines *conservation targets* as the ecosystems/habitats, ecological processes, or taxa that are the ultimate focus of conservation attention. Conservation targets afford a basis for establishing goals, defining actions to support attainment of those goals, and measuring progress.

The Working Group's primary interest pertains to the welfare and sustainability of Reddish Egret as a species. For purposes of the Update this target is expressed as the global Reddish Egret population, comprising all individuals. We are also concerned with the diversity of habitats necessary to sustain Reddish Egrets throughout the annual cycle, not simply as means, but as worthy conservation ends themselves – particularly those habitats associated with nesting and foraging. Consequently, the Update is structured around three central conservation targets: Reddish Egret populations, breeding habitats, and foraging habitats.

THREE CORE CONSERVATION TARGETS

Reddish Egret Population

All individuals comprising the global population at any time, irrespective of age or breeding status.

Group of juveniles. Justin LeClaire

Breeding Habitats

The range of habitats immediately associated with Reddish Egret courtship, nesting and the rearing of young.

Reddish Egret nest. Clay Green

Foraging Habitats

The range of habitats utilized by Reddish Egrets at any time of year for feeding or attempting to secure food.

Catching dinner. David Sikes

MANAGEMENT UNIT FRAMEWORK

The Original Plan (Wilson et al. 2014) designated Eastern, Central, and Western Management Units, rooted in part on geographic patterns of genetic similarity and isolation described by Hill et al. (2012), as well as the regionally variable context for ecology, threats, and collaboration throughout the range. The east to west designation of management units aided in partitioning the plan into more discrete components and in promoting Reddish Egret conservation based on regional uniqueness.

Subsequent research has shown that the genetic relationships are more complex, with some "populations" within a management unit being more genetically isolated from the remainder of individuals of the unit. For example, birds in Chiapas and Oaxaca, Mexico, show high degrees of isolation from other breeding populations

within the Central Management Unit and from other management unit (Shahrokhi et al. 2020). Meanwhile, recent tracking studies lend support to aspects of population structure suggested by the original management units, as for instance in the Central Management Unit with movement of birds between the Caribbean and Pacific coasts of the Isthmus of Tehuantepec (Lamb et al. 2018). In developing the Update, potential revisions to management units were deliberated. However, all were retained as previously defined (Figure 3) in recognition that genetic distinctions remain imperfectly understood, and consistency of the management unit framework offers advantages in furthering regionalized implementation efforts. Key sections of the Update are broken out by Eastern, Central and Western Management Unit except where information pertains generally to all of them.

DELINEATING MANAGEMENT UNITS

Reddish Egret management units were established with the primary intent of facilitating regional implementation on the basis of broad geographic similarities in ecosystems/habitats, threats, collaboration potential, and to less certain degrees, population structure. These units, as defined in the Update, remain unchanged from the Original Plan.

Eastern Management Unit – the states of Florida, Georgia and South Carolina in the U.S.; the West Indies; and the northern coast of South America.

Central Management Unit – the central and western Gulf of Mexico coast from Alabama in the U.S. to the Yucatan Peninsula in Mexico, southward into Central America, and including the Pacific coast of Mexico in Chiapas and Oaxaca.

Western Management Unit – primarily northwest Mexico including the states of Sinaloa, Sonora, and the Pacific and Gulf coastlines of Baja California and Baja California Sur; also states along the central Pacific coast of Mexico during nonbreeding seasons.

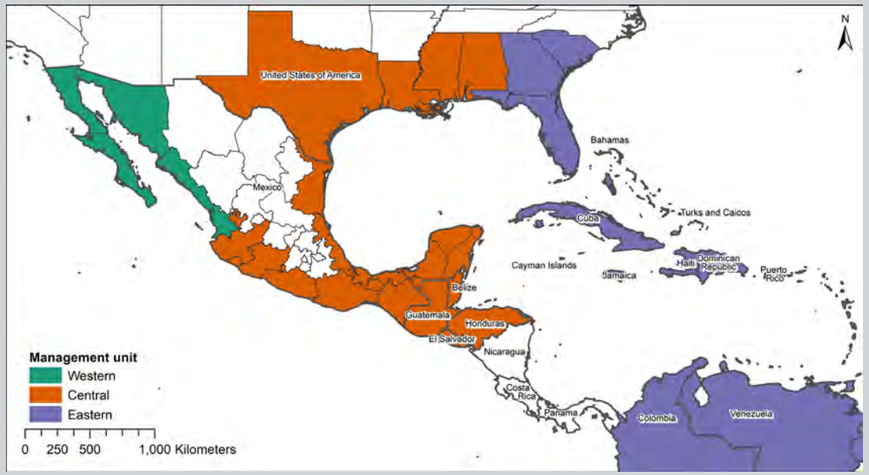


Figure 3. Reddish Egret Management Units.

DESCRIPTION AND STATUS OF CONSERVATION TARGETS

REDDISH EGRET POPULATION

There is currently no systematic or rigorous means of evaluating the population status of Reddish Egret rangewide. Estimates compiled from published literature and from colony monitoring programs as of 2021 suggest an aggregate of ~ 4,000 adult breeding pairs rangewide, and less than 10,000 individuals total (Koczur et al. 2020). This represents the smallest global population of all 21 species of western hemisphere Ardeids for which estimates exist, and is among the smallest for all North American birds (Partners in Flight 2021).
Table 1 summarizes population estimates regionally within each management unit. These estimates should be interpreted cautiously, as survey designs and effort vary across regions and management units. For example, Florida populations may be higher as detectability and a protracted breeding season complicate estimations (Cox et al. 2019b); this may also be true elsewhere in the Eastern (e.g., Caribbean) and Central Management Units (e.g., Yucatan, Belize, Central America). Additionally, some estimates are >10 years old and may not accurately reflect current population sizes (Green et al. 2011).

Trend information is regionally variable and suggestive at best. Colony counts in some areas show apparent stability in breeding numbers, but there is concern over declines elsewhere. The population overall appears to be 'stable to moderately declining' (Koczur et al. 2020; BirdLife 2022).

Table 1. Summary of Reddish Egret population estimates (breeding pairs) by management unit and region compiled from published literature and independent colony monitoring programs as of 2021.

Management Unit	Region	Estimate (pairs)	Source / Notes
Eastern	Bahamas	80-100	Green et al. 2011
	Cuba	155+	Gonzalez et al. 2016
	USA – Florida	480	Cox et al. 2019b
	USA – Georgia, S. Carolina	< 5	Ferguson et al. 2005
	Other Caribbean	<50	no recent data
Central	Belize	80[1]	Santoya 2021
	Colombia	50-60	Ruiz et al. 2018
	MX – Chiapas, Oaxaca	320	Palacios et al. 2018
	MX – Tamaulipas	100	Green & Newstead 2006**
	MX – Yucatan Peninsula	800	Palacios 2009**
	USA – Alabama	5-10	Koczur 2020**
	USA – Louisiana	70-80	S. Collins 2017**
	USA – Texas	1424	TX Colonial Waterbirds 2021**
	Other Central America	unknown	no recent data
Western	MX – Baja California	600	Palacios et al. 2018
	MX – Sinaloa	58	Palacios et al. 2018
	MX – Sonora	132	Palacios et al. 2018

[1] *adult individuals, pair data were not summarized*

** *unpublished colony survey data; principal and year*

Reddish Egrets are consistently recognized as a species warranting elevated concern due to their small global population size and other vulnerabilty factors such as historical losses, reliance on specialized coastal habitats, persistent threats, life history traits (e.g., colonial breeding), and the potential for ongoing declines. Globally, the International Union for the Conservation of Nature (IUCN) classifies Reddish Egret as "Near Threatened",

meaning it nearly meets criteria for being threatened with extinction or may meet these criteria in the near future (BirdLife International 2020). Continentally, Reddish Egret is highlighted in North America as a high concern taxon on the State of the Birds Watch List (NABCI 2016).

At national levels, the U.S. Fish and Wildlife Service designates Reddish Egret as a national priority in the Birds of Conservation Concern (USFWS 2021), signifying that without additional conservation attention the species is likely to become a candidate for listing under the U.S. Endangered Species Act. Reddish Egret was recently listed as Endangered in Mexico (Anexo Normativo III de la NOM-059-SEMARANT-2010, 14 November 2019). Tiering from IUCN guidelines, Belize includes Reddish Egret on its National List of Critical Species. There does not appear to be similar national recognition or uniform means of doing so elsewhere in the range.

In regional planning, the Southeast U.S. Waterbird Conservation Plan categorizes Reddish Egret as a high priority species in need of Immediate Management (Hunter et al. 2006). In U.S. State Wildlife Action Plans, Reddish Egret is designated as a Species of Greatest Conservation Need in South Carolina, Florida, Alabama, Mississippi, Louisiana and Texas (SEAFWA 2021).

Reddish Egrets are federally protected in all areas of the U.S. and Mexico under domestic laws implementing the binational Convention for the Protection of Migratory Birds and Game Mammals of 1936, as amended. In the U.S., the Migratory Bird Treaty Act sets forth regulations per this convention, and protects and prohibits unauthorized take of Reddish Egrets. Similar protections are in place for Mexico under the General Law of Wildlife (Ley General de Vida Silvestre) and General Law of Ecological Balance and Environmental Protection (Ley General de Equilibrio Ecològico y la Protecciòn al Ambiental). The Endangered designation in Mexico specifically prohibits any form of harvesting or use without special authorization. In the U.S., state governments share in the responsibility for protecting migratory birds and may afford further protections. Texas, Louisiana, Alabama and Florida all include Reddish Egret on their state list of threatened wildlife, each conferring unique legal status and restrictions. In Bahamas, Belize, Colombia, Costa Rica, Cuba, Dominican Republic, Nicaragua, Venezuela and other range nations, formal protected status, associated restrictions, and capacity to enforce vary.

MONITORING & ASSESSING POPULATION STATUS

Despite widespread interest and concern, evaluating the rangewide status of Reddish Egret populations proves challenging. Independent survey efforts variously track status of breeding colonies, usually numbers of breeding pairs or individuals, but these are not synchronized nor comprehensive, and do not always afford systematic coverage at the site scale. Accuracy and comparability of data derived from colony surveys may be affected by timing, methodology, periodicity, effort, nesting chronology, colony dynamics (e.g., interchange of birds), and other variables, obscuring underlying status and trend. Challenges may also exist with regard to detectability, such as with dark morph individuals nesting within the sub-canopy of tree or shrub vegetation.

Top: Conducting breeding colony surveys at Isla Pajaros, Chiapas, Mexico. Edgar Amador

Bottom: Dark and white morph adults nesting in Opuntia at Zigzag Island, Texas. Clay Green

Eastern Management Unit

This unit comprises populations in the eastern U.S. (Florida, Georgia, and South Carolina), the West Indies, and the northern coast of South America (Figure 3, Table 1). Most Reddish Egret breeding in this unit in the U.S. is in Florida. On Florida's west coast breeding occurs from Tampa Bay south to Florida Bay and the Florida Keys, where colonies are small (< 5 pairs) and scattered across mangrove-dominated islands. On Florida's east coast, Reddish Egrets nest mainly at Merritt Island National Wildlife Refuge and within the Indian River Lagoon. The remainder of peninsular Florida does not currently support breeding. Recent statewide estimates for Florida total 480 breeding pairs (Cox et al. 2019b). There appears to be some dispersal of Florida birds northward after breeding, with regular observations in the Florida panhandle and Georgia (eBird 2021). Annually, small numbers of non-breeding Reddish Egrets occur north along the U.S. Atlantic into the Carolinas, with wanderers as far north as New Jersey and Ontario, Canada. Breeding on the U.S. Atlantic coast has occurred as far north as South Carolina (Cape Romain National Wildlife Refuge; Ferguson et al. 2005), but this does not seem to be regular as there has been no documented breeding there since.

In the Caribbean, Reddish Egrets occur widely as breeders and also during non-breeding seasons. Great Inagua, Grand Bahama, the Biminis and New Providence comprise the primary breeding areas in the Bahamas, with the majority of pairs breeding on Great Inagua. The estimate for Bahamas is 80 breeding pairs (Kushlan and Steinkamp 2007, Green et al. 2011).

Cuba is an important breeding region, hosting an estimated 155 pairs (Gonzalez et al. 2016). Subsequent documentation of new colonies suggests this number may be conservative (A. Gonzalez, pers. comm.). Turks and Caicos likely supports at least 50 breeding pairs (K. Wood, personal communication), though no recent formal surveys have been performed. Current status on Jamaica and Hispaniola remains uncertain, despite historical breeding. Small numbers breed elsewhere in the West Indies (e.g., Bonaire). During non-breeding seasons, Reddish Egrets are regular on multiple islands in the Lesser Antilles, and on the northern coast of South America in Colombia and Venezuela, but the breeding source of these birds is unknown. Breeding remains unconfirmed but suspected in Venezuela (Koczur et al. 2020), whereas in Colombia there is recent documentation of nesting from from La Guajira on the Caribbean coast (C. Ruiz-Guerra, pers. comm.). Reddish Egrets in South America may be connected to breeding populations in the Dutch Caribbean, or possibly the greater Caribbean basin.

Central Management Unit

This unit comprises the central and western coast of the Gulf of Mexico from Alabama in the U.S. to the Yucatan Peninsula, and south into Central America, and includes the Pacific coast of Mexico in Oaxaca and Chiapas (Figure 3, Table 1).

In the U.S., Alabama currently hosts breeding Reddish Egrets at one to two sites, Isle aux Herbes and Marsh Island (Koczur, pers. comm.). There is no known nesting in Mississippi although non-breeders are regular there (Turcotte and Watts 1999). Louisiana hosts approximately 70-80 breeding pairs (Collins, unpubl. data, Remsen et al. 2019) dispersed across multiple sites including recent colonization of Rabbit Island in southwestern Louisiana (Selman and Davis 2015). In Texas, breeding is documented at approximately 70 coastal sites, with most occurring along the middle and lower Texas coast. The majority of the population nests in a few large colonies, with ~10 colonies representing 50-80% of the state's annual breeding population (Texas Colonial Waterbird Society, unpubl. data). The largest colony is at Green Island in the lower Laguna Madre which historically supported over 1,000 pairs, now numbering <600 pairs. The present total breeding estimate for Texas is 1424 pairs (Texas Colonial Waterbird Society, 2021 unpubl. data).

Reddish Egrets are patchily distributed across coastal portions of eastern and southern Mexico, with breeding colonies in the Laguna Madre de Tamaulipas, the Yucatan Peninsula, and the Pacific Coast of the

Isthmus of Tehuantepec. Reddish Egrets breeding in this latter region (i.e., Chiapas and Oaxaca) are included in the Central Management Unit based on inter-change across the Isthmus with sites in the western Gulf of Mexico (Lamb et al. 2018). Breeding populations in the Central Management Unit of Mexico are estimated at just over 1200 pairs. In hosting breeding populations as well as significant proportions of nonbreeding birds from breeding areas in Texas (and possibly birds from the West Indies), Mexico plays a particularly important role within the Central Management Unit.

Connectivity and movement among breeding populations of Reddish Egrets are complex, yet are important to understand for effective conservation and management. Clay Green

The extent of breeding and population size in Belize is not fully understood, but recent effort has detected 289 individuals including 80 adults in a single survey (Santoya 2021). Birds breeding in Belize are likely part of an inter-connected population that includes those breeding in the Yucatan Peninsula of Mexico. The distribution and status of Reddish Egrets along the Caribbean coast of Central America south of Belize remains unknown.

Patterns of connectivity within the Central Management Unit are becoming increasingly well documented, and may also exist between the Central and other management units. Banding re-sights and telemetry of hatch-year birds reveal physical interchange of birds between Texas and Tamaulipas (Geary et al. 2015), while molecular analyses suggest strong genetic relationships within this region (Hill et al. 2012, Shahrokhi et al. 2020). About one-half of adult birds marked in Texas migrated to two key wintering areas in Mexico: Laguna de San Andrés, a wetland complex north of Tampico (Tamaulipas), and Laguna Superior on the Pacific coast of Oaxaca (Koczur et al. 2018a). Additionally, Reddish Egrets breeding in Texas have been documented wintering in Campeche, including at Laguna de Terminos (Koczur et al. 2018a). Interestingly, Laguna de Terminos is a known interchange site for populations of other waterbird species from Pacific Mexico and the Gulf of Mexico. This suggests the possibility for more extensive mixing of Reddish Egrets, for example among those breeding as far away as Texas (Central Management Unit) and Sinaloa or further north (Western Management Unit). Although some connectivity is suspected between the Caribbean coasts of Yucatan and Central America with Cuba (Eastern Management Unit), the extent, if any, is unclear. Connectivity between Pacific Mexican and Central American populations is generally not well understood, but see following section. Within Central America, it is presumed that there is no interchange between birds from the Pacific and Caribbean coasts.

Western Management Unit

This management unit primarily comprises Reddish Egret breeding sites in northwest Mexico, from Sinaloa and Sonora around to the west coast of the Gulf of California, and along the Pacific Coast of the Baja peninsula (Figure 3). Populations for Baja California, Sonora and Sinaloa are estimated at approximately 600, 132 and 58 breeding pairs, respectively (Palacios et al. 2018) (Table1). There is potential for breeding in Nayarit and Colima, Mexico, but it has not been formally documented (Palacios et al. 2018).

Little is known about the post-breeding dispersal and migration of Reddish Egrets to/from breeding sites in the Western Management Unit, but movement of banded individuals north to southern California and Arizona in the U.S. has been documented (Green, M.C., unpubl. data). Marked individuals at breeding sites have been seen all along the central Pacific coast of Mexico and south into Central America during nonbreeding. For example, hatch year birds from Baja California Sur have been re-sighted in Nayarit (Western Management Unit) and Chiapas (Central Management Unit) and those from Sinaloa have been documented in El Salvador (Central Management Unit; Green, M.C., unpubl. data).

TREATING SUBSPECIES

Payne (1979) described two subspecies of Reddish Egret, *Egretta rufescens rufescens* and *E. r. dickeyii*. Birds from the northwestern portion of the range are typically attributed to *dickeyii* (Koczur et al. 2020), with others lumped under r*ufescens*. The validity of these entities has not been evaluated further, although recent molecular evidence supports the notion of genetic differentiation in northwest Mexico, as well as elsewhere within the range (Shahrokhi et al. 2020). Given the general difficulty in ascribing subspecies limits, and considerable evidence of individual movement and the potential for genetic interchange throughout the Reddish Egret distribution, the Update does not emphasize subspecies. Instead, the management unit framework is intended to facilitate relevant conservation attention, and in the case of the Western Management Unit is consistent with treating *dickeyii* as a distinct entity.

Even though genetic differences exist, Reddish Egrets throughout the range are outwardly similar in morphology and appearance. William Majoros

REDDISH EGRET BREEDING AND FORAGING HABITATS

Reddish Egrets are unique among western hemisphere Ardeids in being restricted almost entirely to habitats along or immediately adjacent to coastlines. Unfortunately, these same habitats are subject to high human land use pressures and have been significantly altered throughout the Reddish Egret range. These pressures are detailed in latter sections of the Update, but include aquaculture, resource extraction, industrial use, recreation and disturbance, hydrologic alteration, and consumptive uses – all of which influence the availability and suitability of breeding and foraging habitats, or impact Reddish Egrets more directly. Climatic shifts are expected to further exacerbate these influences and generate threats of their own.

Approximately 40% of the human population in Mexico and the U.S. now reside in coastal areas, with even greater proportions in the Caribbean and Central and South America (www.oceanconference.un.org). Translating into hundreds of millions of people, this degree of human habitation creates immense demands for infrastructure and living space, and restricts the natural footprint of coastal systems. Within the U.S. alone, coastal habitats are experiencing a net loss of ~60,000 acres annually (Dahl and Stedman 2013) from subsidence, sea level rise, land conversion, and dredging. Reddish Egret breeding and foraging habitats may be particularly susceptible given that the species seems to have fairly specialized habitat requirements related to feeding and nesting.

Breeding

Breeding habitats typically involve sites that are free from human encroachment and reasonably isolated from mammalian predators. Nesting substrates and specific vegetative cover differ across the range (Koczur et al. 2020), but invariably serve to shelter nests, eggs and chicks from exposure or otherwise make them less accessible to damage or loss.

In the Eastern Management Unit, breeding habitat is primarily mangrove (*Avicennia germinans, Laguncularia racemose, Rhizophora mangle*) in Florida and the Caribbean. Within Florida, breeding sites may comprise offshore natural mangrove islands and shrubby, artificially constructed dredge material islands in impoundments or bays (Cox et al. 2019a, 2019b). In the Caribbean, breeding is principally on natural mangrove islands (Green et al. 2011, Gonzalez et al. 2018).

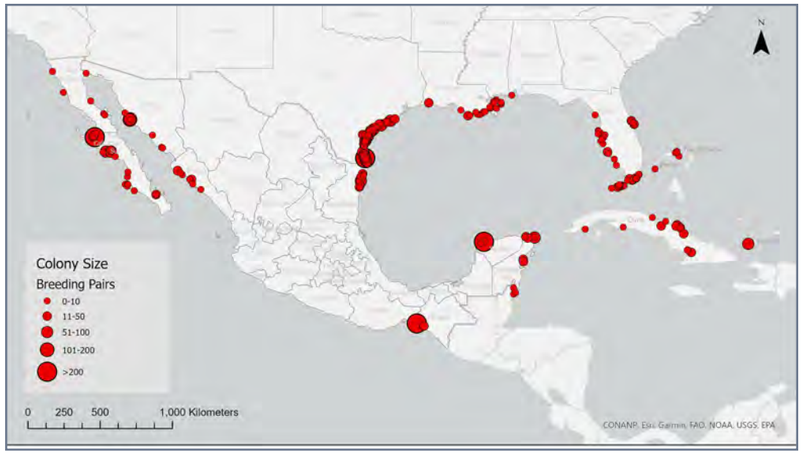


Figure 4. Distribution and relative size of Reddish Egret breeding colonies where known. Note absence of confirmed colonies or data in Central and South America. See Appendix A for colony listing by site.

In the Central Management Unit, breeding habitat in Alabama, Louisiana, and Texas generally consists of low-lying dredge material islands vegetated by cordgrasses and rushes (*Spartina* spp., *Juncus* spp.), short shrubs (*Borrichia* spp., *Baccharis* spp.), or prickly pear cactus (*Opuntia* spp.) (Holderby et al. 2012, Koczur et al. 2018b, Collins et al. 2021). The Laguna Madre of Texas and Tamaulipas hosts the largest concentration of nesting islands in this region, both dredge spoil and natural islands. Several large colonies occur on natural islands vegetated with taller Tamaulipan thorn scrub in the north (e.g., Matamoros Islands), and mangrove in the south (e.g., Rio Soto La Marina) (Holderby et al. 2012, Koczur et al. 2018b). Nesting habitat in the Yucatan region and further south into Belize appears to be largely in mangroves, as is the case for colonies in Oaxaca and Chiapas, Mexico (Koczur et al. 2020, Palacios et al. 2018).

In the Western Management Unit, nesting habitat in northwest Mexico is variable, primarily mangrove (~70% of colonies), but also various types of scrub habitat (coastal sage, cactuses, agave), halophytes, and even rocky ground where little vegetation exists and boulders are used as protection and shading for the nest (Palacios et al. 2018).

It is extremely challenging to qualify much less quantify the "status" of Reddish Egret breeding habitats across the range, or even within management units. Both site level (e.g., ownership, degree of protection or management, presence of essential characteristics, disturbance) and landscape or regional level factors (e.g., adjacent land uses/pressures, sustainability of nearby foraging sites, connectivity, climatic shifts) influence stability and suitability of breeding habitats. These factors vary considerably in time and space and are difficult to consistently and systematically evaluate over broad geographies involving multiple countries. Overall, the present status of breeding habitats is considered relatively stable, but future prospects appear tenuous given global climate change and anticipated rise in global sea levels.

Appendix A compiles Reddish Egret colony location information from the Bahamas, Cuba, Mexico, and the U.S. Protection and ownership data are incomplete and not presented in Appendix A. These represent important information needs highlighted later in the Update. Although protected sites are more secure from development or conversion, protection alone may not ensure the persistence of suitable breeding habitats in situ, that adjacent land use changes don't diminish site quality, or that other threats (e.g., disturbance, predation) are not problematic. Furthermore, climate change, specifically rising mean sea level, poses

concerning potential to compromise colonies regardless of ownership, status, and management. Mitigating or otherwise averting climate driven impacts will demand community or societal level commitments beyond the capacity of any one ownership or interest to effectively address, adding a pervasive uncertainty regarding the long term viability of extant breeding sites.

Juvenile dark morph Reddish Egret in mangrove habitat, Florida, USA. Jim Gray

FORAGING

Coastal habitat specialists, Reddish Egrets forage exclusively in shallow (<25 cm depth; Green 2005) wind-driven tidal and intertidal flats, hypersaline lagoons, and open beaches and reefs. In some regions (e.g., Baja California Sur, Bahamas), solar salt ponds and salterns are used. In Texas, Reddish Egrets forage in areas of unconsolidated sediment and patchy seagrass while avoiding areas dominated by seagrass (Koczur et al. 2018a, 2018b). In Florida, foraging Reddish Egrets also avoid areas dominated by seagrasses and show preference for tidal flats and salt marsh, although habitat use for foraging varies considerably (Koczur et al. 2018a). Similar use of unconsolidated sediment and patchy seagrass has been documented in Cuba (A. Gonzalez, pers. obs.). Prey is primarily small fish, with crustaceans taken opportunistically. Main prey species include sheepshead minnow (*Cyprinodon variegatus*) in Texas, Florida, and the Bahamas; Yucatan pupfish (*Cyprinodon artifrons*) in Yucatan; and American shadow goby (*Quietula y-cauda*) in Baja California Sur (Holderby et al. 2014). Prey species observed in Bahamas and Yucatan are also reported for Cuba in addition to mojarras (*Geres* spp.) and cichlids (e.g., *Oreochromis* spp., A. Gonzalez, pers. obs).

There is some evidence that relatively specific physical and hydrologic conditions required by Reddish Egrets could effectively limit available foraging habitat at certain periods. For example, high nesting success noted in Texas (Holderby et al. 2012) seems to be followed by low post-breeding survival (Geary et al. 2015), suggesting that foraging conditions that sustain adults and young through nesting may not remain sufficient after breeding concludes. Indeed, foraging habitat in the Laguna Madre of Texas decreased in extent by 50% from summer to winter (Bates et al. 2016). Whether foraging habitats could be similarly limiting elsewhere remains unclear and would benefit from further study. It is also unclear whether proximity of foraging habitats to otherwise available breeding sites could limit the suitability of the latter, although Reddish Egrets appear capable of traversing long distances between the two. In Texas, for instance, nesting Reddish Egrets traveled an average of ~15 km to foraging areas with considerable variation in distance traveled (3.8 – 44.2 km) (Koczur et al. 2018b).

While more is known in some regions than others, current understanding regarding the extent and distribution of foraging habitat throughout the range of the Reddish Egret is generally poor. Recent mapping and analysis of the spatio-temporal distribution of foraging habitat in the Laguna Madre of Texas (Bates et al. 2016) may provide a basis for assessing foraging habitat across the range and identifying potential priority foraging areas within each management unit. Food resources, site characteristics, and foraging conditions remain highly variable in time and space, complicating such an effort. An improved understanding of threats facing foraging habitats – and pathways by which survival and productivity of Reddish Egrets may be impacted – will be needed, as conservation actions to date have typically addressed threats to breeding and breeding habitats.

THREAT RATINGS & OVERVIEW

The Update organizes threats into 11 categories or sources, all of which are anthropogenic in nature or are exacerbated by human influence. Empirical data regarding these threats and the specific pathways by which they operate are limited, but it is clear that they directly and indirectly impact Reddish Egrets and their breeding and foraging habitats. Individually and collectively, they represent significant potential to adversely affect survival and productivity, and ultimately population persistence of Reddish Egrets. All of these threats are pervasive and known or suspected to be problematic in all three management units, though their scope, severity and impact are variable in each:

- Climate Change Related
- Coastal Development
- Coastal Engineering
- Human Disturbance
- Ranching & Agriculture
- Marine Vessels
- Energy Infrastructure & Development
- Environmental Contamination
- Elevated Predation & Invasive Predators
- Habitat Alteration from Invasive Species
- Aquaculture & Salt Production

The above threats were rated as a means to objectively evaluate and differentiate the relative influence of each on each of the three conservation targets – populations, breeding habitat, and foraging habitat. In doing so we developed rating criteria and applied them systematically to qualitatively assign threats to one of several categories. At in-person workshops, experts in Reddish Egret ecology and conservation participated in structured exercises to classify threats in each management unit as either Very High, High, Moderate, or Low based on scope, severity and irreversibility of impacts to each conservation target (see inset). Individual ratings (e.g., for scope, severity and irreversibility) were combined using rule sets that permitted summarization at useful levels (e.g., by threat, by conservation target, etc.). Threats and ratings from the Original Plan were reevaluated to reflect contemporary conditions and understanding, as well as input from a broader group of stakeholders from a larger extent of the species' distribution.

Use of ant bait to treat invasive Red-imported Fire Ant (Solenopsis invicta) on Laguna Vista Spoil in the Lower Laguna Madre, Texas. Coastal Bend Bays and Estuaries Program

RATING SCOPE, SEVERITY, & IRREVERSIBILITY

Consensus-building workshops helped consolidate individual knowledge and expertise regarding the relative influence of identified threats. Categorical thresholds were established for evaluating scope, severity and irreversibility of each threat on each conservation target within each management unit:

Scope – proportion of the conservation target expected to be affected by a given threat within ten years (three generations) given current circumstances and trends. *Very High* = destroying/degrading or eliminating 71-100%; *High* = 31-70%; *Moderate* = 11-30%; *Low* = 1-10% of the target.

Severity – degree of expected impact to the conservation target from a given threat within 10 years (three generations) given current circumstances and trends. For breeding and foraging habitat, severity was evaluated as the proportion of habitat within the scope of a particular threat expected to be destroyed or significantly degraded. For populations, severity was evaluated as the proportion of the population within the scope of a particular threat expected to be eliminated. V*ery High* = destroying/degrading or eliminating 71-100%; *High* = 31-70%; *Moderate* = 11-30%; *Low* = 1-10% of the target.

Irreversibility – The degree to which the effects of a threat can be reversed and the target restored if the threat no longer existed. *Very High* = effects cannot be reversed and target unlikely to be restored or restored in >100 years (e.g., wetland converted to shopping center); *H*igh = effects can technically be reversed and the target restored, but significant practical constraints exist or it would require 21-100 years (e.g., wetland converted to agriculture); *Moderate* = effects can be reversed and target restored with reasonable resource commitment or within 6-20 years (e.g., ditching and draining a wetland); *Low* = effects are readily reversible and the target can be restored at relatively low cost or within 0-5 years (e.g., off-road vehicle disturbance on a beach).

Threats to Reddish Egret include (clockwise from top left): cactus moth, Peggy Greg, USDA ARS; human disturbance, Justin LeClair; fire ant, Martin LaBar, Creative Commons, and altered hydrology, Ernesto Gomez

Table 2 presents the individual and summarized threat ratings. Overall, across all conservation targets and management units, threats related to climate change, coastal development, and coastal engineering were rated highest. This was largely driven by the Very High to High ratings for these threats on breeding and foraging habitats. Correspondingly, of the three conservation targets, threats to breeding and foraging habitats were generally rated higher overall (i.e., across all threats) than for Reddish Egret populations, which rated Moderate overall in all management units. Among all conservation targets and management units, foraging habitat in the Central Management Unit earned the highest rating across all threats (Very High), with High or Very High ratings for each of four individual threats including energy infrastructure and development.

Table 2. Individual and summary threat ratings by conservation target (populations, breeding habitat, foraging habitat) and management unit (East, Central, West). "Triplets" within each cell depict scores for scope, severity and irreversibility. Summary rules, Miradi Software (2022).

THREAT	POPULATIONS			BREEDING HABITAT			FORAGING HABITAT			
	East	Central	West	East	Central	West	East	Central	West	SUMMARY
Climate Change Related				Very High	High	Moderate	Very High	High		Very High
Coastal Development				Moderate	High	High	Moderate	Very High	Moderate	High
Coastal Engineering					Moderate		Moderate	High	High	High
Human Disturbance	Moderate	Moderate	High				Low	Low	Low	Moderate
Ranching & Agriculture		Low		Moderate	Moderate			Low		Moderate
Marine Vessels				Moderate	Moderate		Moderate	Moderate	Moderate	Moderate
Energy Infrastructure & Development		Moderate			Low		Low	High	Low	Moderate
Environmental Contamination	Moderate	Moderate	Moderate				Low	Moderate	Moderate	Moderate
Elevated Predation & Invasive Species	Moderate	Moderate	Moderate							Moderate
Habitat Alteration from Invasive Species	Low	Low		Low	Moderate					Low
Aquaculture & Salt Production					Low		Low	Moderate	Low	Low
SUMMARY	Moderate	Moderate	Moderate	High	High	Moderate	High	Very High	Moderate	

THREATS SUMMARY

Following is a brief description of each threat and the associated summary rating. See Appendix B for additional detail.

CLIMATE CHANGE RELATED – VERY HIGH

Threats related to global climate change include habitat displacement and alteration from sea level rise and subsidence, increased frequency and intensity of storms and flooding, and temperature extremes (Scavia et al. 2002, Webster et al. 2005, Hoyos et al. 2006, Knutson et al. 2010, Holland and Bruyère 2014, Sweet and Park 2014). The loss of breeding and foraging habitats due to inundation, wind damage, and erosion are the primary concern. The direct physical effects of rising temperatures on Reddish Egrets and their food resources are not addressed further in the Update.

COASTAL DEVELOPMENT – HIGH

Coastal development is a high threat to Reddish Egret breeding and foraging habitat. VA Sea Grant

Coastal development includes direct loss and alteration of breeding and foraging habitats associated with residential, commercial and industrial construction, as well as the expansion of roads, highways, recreational facilities and other associated infrastructure. Coastal development and sprawl is a contributing factor influencing the occurrence and severity of other threats (LaDee et al. 2008) that may exacerbate the initial adverse impacts of development. For instance, increased population density along coastlines as a function of development may increase vulnerability to predation (Crooks and Soulé 1999) and human disturbance (Foster et al. 2009), and may stimulate need for further coastal engineering projects (i.e., to support or protect community interests). Increased potential for environmental contamination – both acute and chronic – is likely in areas with higher densities of residential, commercial and industrial land uses.

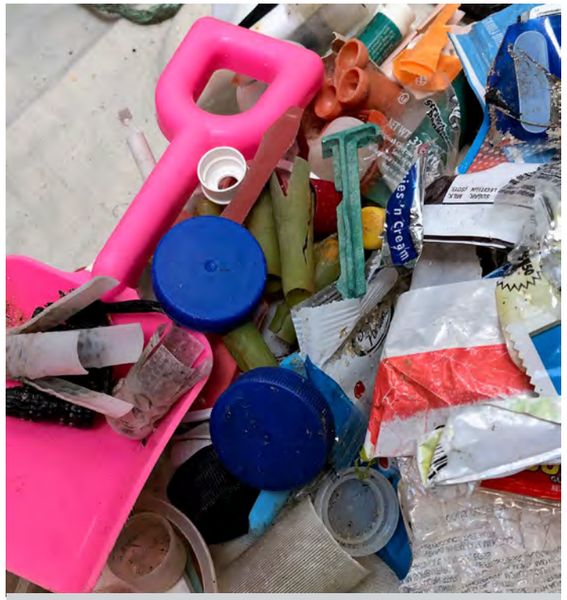
COASTAL ENGINEERING – HIGH

Coastal engineering includes ecosystem manipulation such as shoreline armoring to slow erosion or prevent flooding, altered hydrology (e.g., channelization, impoundments, dams), as well as dredging and placement of dredged materials associated with maintenance of shipping and transportation channels. Hydrologic changes from these activities (e.g., changes in water depth, inundation, damage to tidal flats; Mariotti and Fagherazzi 2013) and secondary impacts such as decreased water quality (Caldwell 1985, Onuf 1994) may render foraging habitat suboptimal to unsuitable and decrease the amount of available nesting habitat (Williams 1999).

HUMAN DISTURBANCE – MODERATE

Human disturbance threats arise primarily from recreational activities (e.g., fishing, boating, eco-tourism) that result in people getting too close to nesting islands or foraging birds (Vos et al. 1985, Carney and Sydeman 1999, Foster et al. 2009). We also include in this category human disturbance and direct losses associated with traditional collection of eggs and chicks for use as bait, specifically associated with nesting habitat in some regions of Mexico (e.g., Tamaulipas, Sinaloa) but possibly occurring elsewhere within the range. While this activity appears to be very localized and has only been documented occasionally, it is nonetheless

unlawful and unregulated. The effects of human disturbance to colonial nesting birds are wide-ranging (Faulhaber et al. 2016) and include reduced use or entire abandonment of nest sites (Tremblay and Ellison 1979, Muller and Glass 1988), increased stress or energy expenditure (Bouton et al. 2005), abandonment of active nests (Bouton et al. 2005), and increased risk of predation (Verbeek 1982, Hockin et al. 1992).



Plastics and other debris may be readily ingested by wading birds like Reddish Egrets. NOAA

RANCHING & AGRICULTURE – MODERATE

Ranching and agricultural activities may alter and degrade Reddish Egret habitats through clearing of native vegetation, incompatible management practices (including inappropriate use of fire), and livestock impacts (e.g., loss of soil and vegetation, sedimentation, trampling). In some areas of the Laguna Madre of Tamaulipas and perhaps elsewhere in Mexico, anecdotal observations suggest that fire may be specifically employed to remove or destroy cactuses and woody substrates used by nesting Reddish Egrets to open up additional areas for grazing. Agricultural activities can also generate impacts associated with environmental contamination, for example of foraging habitats (e.g., sediment, nutrient, and pesticide runoff).

MARINE VESSELS – MODERATE

Threats in this category arise primarily from the impact of wakes associated with recreational fishing and boating, and commercial vessels such as ships and barges in canals and near shore areas. Chronic wave action may erode nesting islands and vegetation and alter/damage foraging habitats (Nanson et al. 1994, Maynord 2005, Houser 2010, Zaggia 2017).

ENERGY INFRASTRUCTURE & DEVELOPMENT – MODERATE

Threats from energy infrastructure and development in coastal areas occur onshore and offshore. These include impacts from contemporary as well as legacy oil and gas exploration and production activities, new and planned development of wind energy (e.g., facilities, transmission lines, substations), and a number of ancillary impacts related to increased vessel and barge traffic (waves, disturbance), seismic activity, canal dredging, saltwater intrusion, releases from vessels and other accidental spills.

ENVIRONMENTAL CONTAMINATION – MODERATE

Contaminant threats include industrial pollution, solid waste, agrochemicals, sedimentation, and marine debris (e.g., monofilament, plastics). Pollution can directly affect individual birds leading to reduced fitness, injury, and/or death. The deleterious effects of large scale pollution events are well documented (e.g., Deepwater Horizon Natural Resource Damage Assessment Trustees 2016). Plastics and other debris are readily ingested by wading birds (Francis et al. 2020) and can also entangle birds with both nonlethal and lethal consequences (reviewed by Ryan 2018). Contaminants can also degrade breeding and foraging habitat in the form of marine debris and through effects on prey species and aquatic vegetation.

ELEVATED PREDATION & INVASIVE PREDATORS – MODERATE

Predation of adults, eggs, and nestlings is relatively common at wading bird colonies (Frederick and Collopy 1989) but high rates of predation can completely destroy large colonies (Rodgers 1987) and limit population growth (Erwin et al. 2001). Excessive predation at nests or of juvenile and adult birds can occur because of native birds and mammalian predators (e.g., Raccoon [*Procyon lotor*], Coyote [*Canis latrans*]) or from non-native introduced species (e.g., unrestrained cats [*Felis catus*], feral hogs [*Sus scrofa*], Red Imported Fire Ants [*Solenopsis invicta*]), and dogs [*Canis lupus*]).

HABITAT ALTERATION FROM INVASIVE SPECIES – LOW

This threat is focused on invasive species that affect the condition and suitability of breeding habitat, as distinct from non-native invasive species that directly injure or kill Reddish Egret eggs, nestlings, and adults included under the preceding category. Invasive species impacting habitat are generally invasive plants that encroach upon otherwise suitable native vegetation used as nesting substrates, as well as invasive invertebrates (e.g., *Cactoblastis* moth) that affect vegetation used as nesting substrate. In regions like Texas and Tamaulipas where Reddish Egret colonies may occur in association with *Opuntia* spp., presumably for protection from predators, the loss of cactuses to the moth could have severe impacts on nesting habitat suitability and lead to exposure of eggs and young. Similar kinds of impacts to foraging habitats as a function of invasive organisms impacting food availability or other aspects of habitat suitability are not known.

AQUACULTURE AND SALT PRODUCTION – LOW

Shrimp aquaculture and salt production practices threaten Reddish Egrets via altered hydrology and water pollution. Nevertheless, areas used for salt production may provide high quality alternative foraging habitat and as such present a conservation opportunity, especially in the face of likely foraging habitat loss due to sea level rise.

Shrimp aquaculture facility in Mexico. Aquaculture as well as salt production can pose threats through habitat loss and conversion but may provide new potential foraging opportunities for Reddish Egrets. Creative Commons.

CONCEPTUAL MODEL

In Open Standards (CMP 2007), conceptual models are employed to depict linkages between proposed conservation strategies and their influence in mitigating the primary threats to conservation targets that have been identified. These relationships typically express through "contributing factors", which are the root causes or drivers of the identified threats and may include economic, political, institutional, social and cultural influences. For example, "elevated predation" is not a particularly actionable *threat* against which to devise effective conservation interventions. However, human practices leading to increased waste and the presence of non-native predators in the environment are important *drivers* that may promote elevated predation rates and which can be more tangibly addressed. Portraying the multitude of known or suspected contributing factors in a conceptual model aids in fleshing out many of the mechanisms that "contribute to" the existence of a particular threat and which provide a context for considering practical conservation strategies to combat them.

The conceptual model that Working Group partners developed (Figure 5) demonstrates the linkages among seven broad conservation strategies, the 11 primary threats, and the nine conservation targets (i.e., Reddish Egret populations, breeding habitat, and foraging habitat for each of three management units). Its important to consider that this is only a model, representing one group of experts' knowledge and perceptions regarding the expressed relationships. There are undoubtedly other elements and relationships influencing the conservation targets that this model does not adequately depict, and there are increasingly more proximate (and ultimate) levels by which to identify and consider contributing factors. For instance, a fundamental factor like human population growth is certainly responsible for precipitating many of the problems and threats confronting species and ecosystems. The model does not intend to comprehensively capture all such linkages and instead strives to present most of the primary relationships at an economy of scale that facilitates practical interpretation and use. The seven broad conservation strategies and objectives for implementing them are outlined in the subsequent section.

Beautiful and elegant, an adult pauses, immaculate in repose. Ray Hennessy, rayhennessy.com

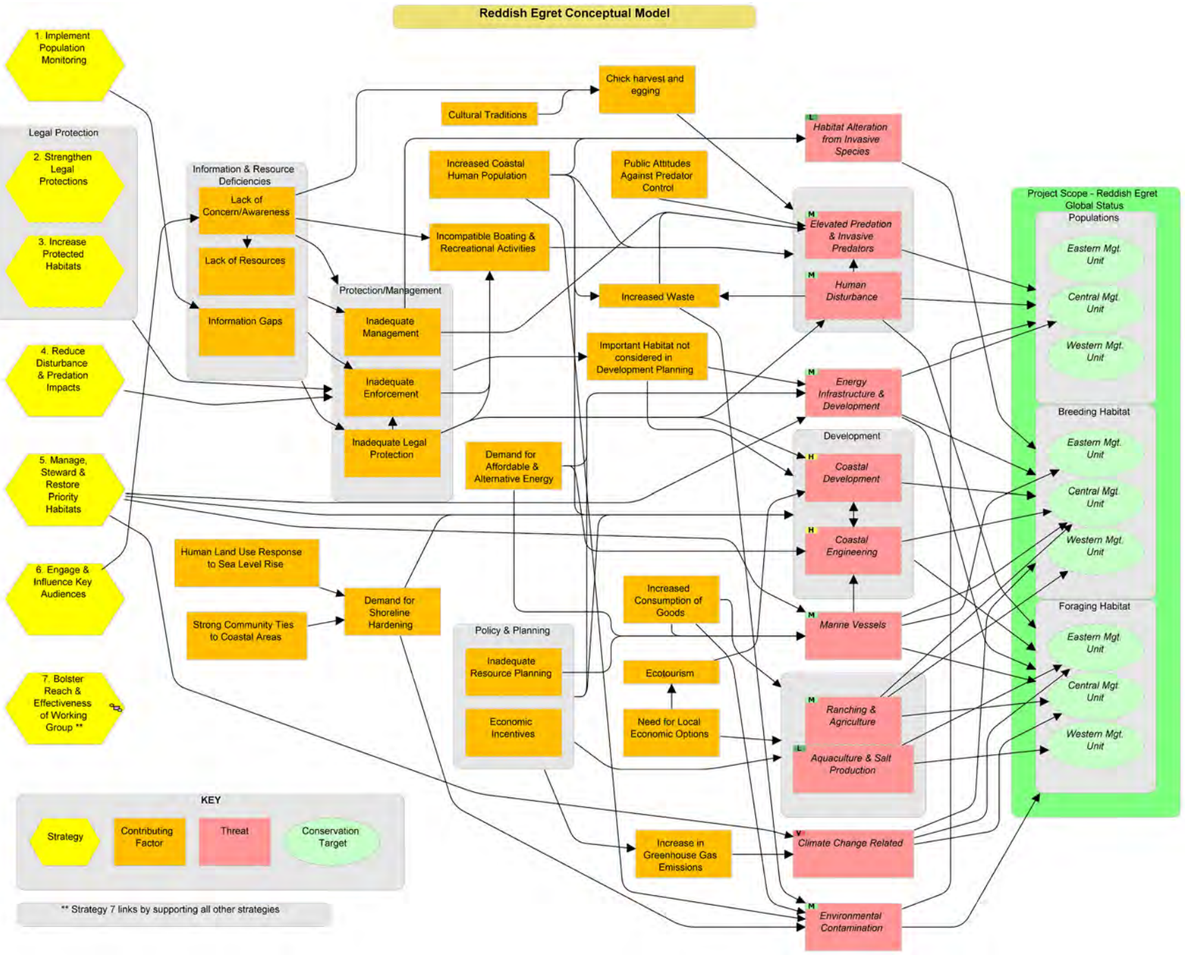


Figure 5. Conceptual model for Reddish Egret depicting relationships among threats, contributing factors, conservation strategies, and conservation targets (Miradi Software 2022).

CONSERVATION GOALS & STRATEGIES

GOALS

Goals are defined as the desired long-term status of conservation targets and should be impactful, measurable, time-bound and specific (CMP 2007). The Original Plan presented numeric goals for each management unit, but the overarching goal of the Update is to increase the global population of Reddish Egrets by 10% over 10 years (i.e., by 2032). While ostensibly a numeric "abundance" goal, this goal can still be evaluated by estimating trend, and offers flexibility given some inherent constraints in accurately estimating total abundance of such a wide-ranging species. Accordingly, one of the principal strategies of the Update is to achieve more reliable population data across the range for estimating total population and trend, and evaluating progress toward the goal (see Strategy 1). The Update does not prescribe population level goals for each of the management units. Rather, the 10% overarching goal should be realized more or less equitably across them to preserve the current balance in population distribution across the range.

The overarching goal of the Update is to increase the global population of Reddish Egrets by 10% by 2032

Prescribing bona fide goals for the other two primary conservation targets, breeding and foraging habitats, is complicated by inability to meaningfully characterize the relationship of these habitats in supporting Reddish Egret populations/population growth at specified levels. Not all threats influencing Reddish Egret abundance are habitat related, but in addressing those that are, conservation plans would typically attempt to qualify or quantify bird-habitat relationships – i.e., the amount, condition and configuration of habitats needed to support a given population – often based on empirical models. However, basic information that would aid in linking breeding and foraging habitats to their Reddish Egret "potential" (e.g., individuals, pairs, density) is lacking or confounded by underlying uncertainty.

For this reason, the Update identifies two chief information needs as prerequisites to establishing more specific goals regarding the amount and/or condition of breeding and foraging habitats within management units or rangewide:

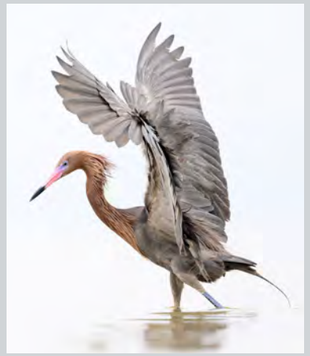
BREEDING HABITAT – identify "focal" breeding colony sites based on characteristics such as size, productivity, protected status, stability/longevity, and vulnerability, and develop plans for conserving and enhancing these priority sites in support of current rangewide abundance and distribution of Reddish Egrets and the 10% rangewide population goal;

FORAGING HABITAT – compile and map information describing known foraging areas, identify currently unknown or potential areas, and establish empirical or descriptive relationships regarding the availability and/or condition of these areas and Reddish Egret abundance throughout or within specific periods of the annual cycle (i.e., breeding, migration, wintering).

Good examples of management plans identifying key threats and conservation needs for focal breeding colonies are already in existence, such as for priority colonies in the Gulf Coast Joint Venture of the U.S. (Vermillion and Wilson 2009). These can serve as useful models in approaching the identification of focal breeding colonies and relevant management goals elsewhere. Similarly, existing regional conservation plans for habitats or ecosystems (e.g., for the Laguna Madre of Mexico, CONANP 2012) may provide platforms for tiering Reddish Egret foraging habitat goals based on generalized relationships regarding carrying capacity.

LIMITATIONS TO EXPRESSING BIRD-HABITAT MODELS FOR REDDISH EGRET

Articulating specific breeding and foraging habitat goals for Reddish Egret has been elusive. Information regarding all known Reddish Egret foraging areas has yet to be fully compiled and mapped, which precludes even basic models estimating foraging habitat requirements for supporting given populations regionally or rangewide. Characterizing relationships between breeding habitats and population size/abundance is similarly hampered by the variable density with which nesting Reddish Egrets occupy colony sites. Is breeding habitat saturated or limiting? Are lower nesting densities associated with some constraint in breeding habitat quality? Is proximity or sufficiency of foraging habitat limiting? These remain core uncertainties to resolve in proposing practical models linking population sustainability to availability or condition of Reddish Egret breeding and foraging habitats.



Foraging Reddish Egrets will frenetically chase and "shadow" small schooling fish. Ray Hennessy, rayhennessy.com

STRATEGIES

Seven broad strategies for Reddish Egret conservation are described in support of the overarching goal:

Strategy 1 – Implement Population Monitoring
Strategy 2 – Strengthen Legal Protections
Strategy 3 – Increase Protected Habitats
Strategy 4 – Reduce Disturbance & Predation Impacts
Strategy 5 – Manage, Steward & Restore Priority Habitats
Strategy 6 – Engage & Influence Key Audiences
Strategy 7 – Bolster Reach & Effectiveness of the Working Group

Strategies were developed via Open Standards methods and the use of webinars and multi-day workshops through which regional experts, partners and stakeholders defined the suite of possible interventions to address identified threats, the nature of intervention (e.g., research, information-sharing, advocacy for regulation and enforcement, increasing resources), and relevant sectors of society for involvement (e.g., industry, municipalities, agencies). Thematically, these strategies address several core sets of needs related to information and decision making, formal status and legal protections, threat mitigation and management, furthering public awareness and support, and capacity building.

Despite the Very High rating, no strategy explicitly addresses threats associated with global climate change (e.g., sea level rise, storm frequency and intensity, inundation, etc.). While incredibly important, effective climate responses will need to be rooted more fundamentally in broad societal commitments to the environment, sustainable standards of living, and similar causes. Such challenges lie largely beyond the collective reach and capacity of the Working Group to influence. Instead, the Update emphasizes more conventional conservation strategies intended to more "directly" improve resiliency and adaptive capacity of Reddish Egrets through population growth, securement and enhancement of quality breeding and foraging habitats, and preserving contemporary patterns of distribution and abundance.

Achieving Our Goal - Role of the Working Group

Achieving the overarching goal of ***increasing the global population of Reddish Egrets by 10% over 10 years*** will demand commitment and capacity organized around seven broad conservation strategies. Effective implementation of the strategies rangewide and within management units will benefit from oversight and coordination provided through the Working Group, thus the relevance of Strategy 7 overall in supporting activities outlined in the other six strategies.

Table 3. Seven key Update strategies and proposed Working Group oversight roles.

Conservation Strategy & Description	Working Group Oversight
Strategy 1 – Implement systematic long-term population monitoring to improve conservation decision making at all scales	Research & Monitoring Committee
Strategy 2 – Strengthen legal protections for the species where appropriate	
Strategy 3 – Increase the amount of priority habitats under long-term protection	Habitat Management Committee
Strategy 4 – Reduce disturbance and predation impacts related to human activity and modification of the environment	
Strategy 5 – Enhance and support management, stewardship and restoration of priority habitats	
Strategy 6 – Engage and influence key audiences to garner further conservation support and capacity	Communications Committee
Strategy 7 – Improve support and capacity for the Working Group to bolster reach and effectiveness	Planning / Steering Committee

Individual strategies are described in the sections that follow, accompanied by results chains depicting explicit relationships between the strategy and the envisioned *outcomes* that it is intended to promote. The results chains organize strategies, threats, intermediate results and objectives, and outcomes into logical influence diagrams. In some cases, outcomes relate to more effective implementation of other strategies rather than ecological outcomes per se. As such, some strategies (e.g., Strategy 1 and Strategy 7 concerning information and capacity needs, respectively) are foundational and imply a need to be addressed early on in implementation.

In the results chains, *intermediate results* illustrate specific short- or mid-term milestones in the path to achieving longer term outcomes. *Objectives* have been developed for a number of intermediate results to express specific, measurable, practical, and outcome-oriented accomplishments that more clearly define expectations for advancement (CMP 2007). Objectives are further described under their parent strategy. It is important to recognize that results chains present a relatively static, singular perspective regarding the influence of proposed conservation actions on key threats and outcomes. In the real world, the pathways are often far more complex, involving many more factors and potential intermediate waypoints. Hence, results chains should be interpreted as generalized illustrations by which advancement of Reddish Egret conservation could proceed.

Result chains are presented for Strategies 1-7. The expectations for Strategy 7 (Bolster Reach and Effectiveness of the Working Group) are difficult to consolidate within a simple influence diagram, however. The impacts of strengthened commitment and capacity through the Working Group are anticipated to be cross-cutting, and should broadly facilitate and enhance progress and efficacy of the other strategies through numerous indirect pathways that may be many steps removed from outcomes in the conservation targets. As such, the results chain for Strategy 7 is necessarily more elemental than the others.

Securing a promising future for Reddish Egrets starts with commitment to address needs outlined in the seven main strategies of the Update. Ray Hennessy, rayhennessy.com

STRATEGY 1: IMPLEMENT POPULATION MONITORING

Implement systematic, long-term monitoring of Reddish Egret populations to improve conservation and management decision making at all scales

Biologists with ProNatura Sur conducting wintering surveys in tidal wetlands, Oaxaca and Chiapas, Mexico. Edgar Amador

Activities under this strategy involve the generation of basic population information vital to evaluating status, planning conservation actions, and helping mitigate a variety of threats including coastal engineering and development, human disturbance, and predation/invasive species. Monitoring data will be used to assess response to conservation management and other interventions (or threats) and to determine whether populations in each management unit are tracking toward goals. There are a number of other information needs identified throughout the Update (and see Appendix C), but none are of such foundational importance to the entire enterprise of Reddish Egret conservation. Population monitoring is important for setting priorities across the range and for guiding other strategies based on a more rigorous understanding of status and trends, and any regional variation in these. Three primary objectives have been set under this strategy, and several related information needs are also identified including dispersal patterns, genetic differentiation among populations and compiling information on scope and status of breeding and foraging habitats (Figure 6, Table 4).

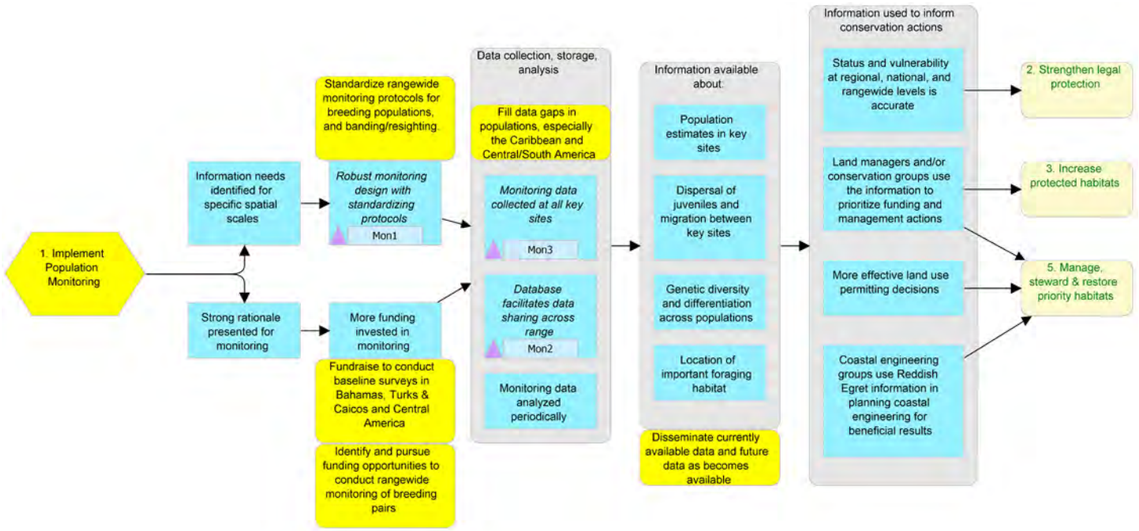


Figure 6. Results chain for Strategy 1 – Implement Population Monitoring (Miradi Software 2022). Outcomes from this strategy support effective implementation of Strategies 2, 3 and 5.

MONITORING OBJECTIVE 1 (MON1)

Develop and implement standardized, statistically rigorous monitoring protocols based on existing monitoring efforts (e.g., Cox et al. 2017) that will yield consistent estimates of breeding pairs over time. The established monitoring protocol should maximize the ability to inform (1) conservation actions at colony and population scales, (2) status updates for state and national species conservation designations, and 3) range-wide trend estimates. Several protocols may be necessary given the variety of breeding sites (e.g., mainland, island, marsh), habitats, and logistical constraints (e.g., personnel, colony accessibility) across the range, but should be designed for comparability and to provide a robust overall abundance estimate based on breeding pairs. Stakeholders from across the range should be involved in representing and reconciling local needs and challenges in surveying colonies within the three management units. Final protocols should be available for ready communication in Spanish and English.

MONITORING OBJECTIVE 2 (MON2)

The Working Group has compiled basic information on the location of all known breeding colonies throughout the range (see Appendix A). Historical as well as more recent survey data from each colony are compiled in a static Excel spreadsheet. However, ***a more accessible, dynamic, and queryable database is needed to facilitate use and exchange of information*** at a variety of scales among survey collaborators, independent researchers, and stakeholders involved or interested in Reddish Egret conservation. Initial plans have been laid for developing a suitable platform and housing/administering these and future data in conjunction with the Colonial Waterbird Database (https://www.pwrc.usgs.gov/cwb/index.html).

MONITORING OBJECTIVE 3 (MON3)

Over the past decade, relatively new survey efforts have provided baseline breeding data in Cuba (Gonzalez et al. 2018), northwestern Mexico (Palacios et al. 2018), and Great Inagua, Bahamas (Green et al. 2011). However, the status of populations in the remainder of the Bahamas and other Caribbean nations (e.g., Turks and Caicos, Haiti, Dominican Republic), Central America (e.g., Belize), Colombia, and Venezuela remains largely unknown. Using protocols developed under Mon1, ***periodic comprehensive surveys across the species' range are needed to establish baseline data for poorly known regions, and to more accurately evaluate status of rangewide populations and trends over time.*** Key constraints to broader, more cyclical survey coverage are funding (survey expenses) and institutional capacity (staff, expertise, commitment), which is itself largely a funding issue. New funding sources and novel mechanisms for implementing operational surveys must be explored, especially for presently unsurveyed regions and where more regular or complete surveys are inhibited by logistical or other constraints.

Table 4. Objectives for Strategy 1 – Implement Population Monitoring.

Objective	Objective Description	Indicator
Mon1	December 2023 – Develop and implement standardized protocols for colony /breeding pair surveys for use rangewide	Protocol endorsed and available to implement
Mon2	December 2024 – establish online Reddish Egret population monitoring data repository, develop protocols for administration and data entry, and upload existing data	% existing data entered
Mon3	Beginning 2025 – implement protocol for estimating breeding pairs throughout range on 5- year intervals	% of identified sites for which data have been collected and estimates generated

BENEFITS & INTENDED OUTCOMES - STRATEGY 1

Periodic population estimates rangewide, and ideally at the scale of management units, are fundamental to evaluation of status, trend, and whether populations are responding to conservation effort or to continuing perturbations. More complete identification and consistent monitoring of breeding colonies is important for prioritization of habitat restoration and protection activities, and for developing sound, compelling rationale for use by decision makers who fund such projects, who are involved in land use decisions at local or regional scales (e.g., municipal, county or state officials), or who direct projects that impact natural resources but seek or are required to minimize or offset these impacts (e.g., developers, engineers, heads of industry). Delineation of focal breeding colonies – i.e., colonies of particular significance, abundance or uniqueness – could prove especially important in leasing, siting and permitting decisions (e.g., petrochemical exploration, wind energy, tourism development) to avoid or mitigate impacts to nesting Reddish Egrets; whereas knowledge of even the smallest colony locations can aid in protecting these sites from recreational or other disturbance (e.g., establishment of buffer zones), and contamination during spill events.

Baseline surveys for the Caribbean, Colombia, Venezuela, and Central America – with a special emphasis on continuing the initial surveys begun in Belize – are a priority recommendation under this strategy. The present IUCN classification of Reddish Egret as “Near Threatened” cites 1000-2500 individuals in Belize, but this appears to be an over-estimate based in-part on information compiled from individual Important Bird Areas. More formal surveys completed recently within the northern Belize coastal complex estimate the population to be less than ~300 individuals (Santoya 2021; Table 1). More reliable information from Belize and elsewhere will ensure that IUCN designations reflect Reddish Egret vulnerability as accurately as possible, and promote awareness and attention commensurately (see Strategy 2). The Working Group should continue to prioritize coordination with partners in Central America, South America and the Caribbean to mobilize interest, secure commitments and funding, and strategize on the feasibility and logistics of implementing surveys in these regions.

Biologists with Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE) and ProNatura Sur boating out to breeding colonies for survey and color banding studies, Oaxaca and Chiapas, Mexico. Edgar Amador

STRATEGY 2: STRENGTHEN LEGAL PROTECTIONS

Strengthen legal protections for the species where appropriate

This strategy recognizes the formative role that protection under domestic and international law plays in species conservation, as well as the important potential for increased awareness and commitment when taxa are designated as conservation priorities by credible authorities. The primary activity and objective of this strategy (Figure 7, Table 5) are focused on elevating the conservation status of Reddish Egret internationally, under IUCN, as warranted based on more robust and comprehensive population information (Strategy 1). However, improving or clarifying the legal status of Reddish Egret in several range nations is needed as well (i.e., status as a protected species), for example where statutes protecting birds do not exist or where there is ambiguity regarding protection of Reddish Egrets or relevant habitats under more general environmental laws. Clarifying whether and to what degree protections exist throughout the range aids in more comprehensively portraying vulnerability, and identifying gaps in governmental commitment to the species or important habitats.

Other formal legal designations, such as recognition as “endangered” or “threatened” under national law, may provide further protections or limitations precluding exploitation or harm to individuals or populations. Recent efforts of Working Group members helped elevate the federal status of Reddish Egret in Mexico to Endangered (Anexo Normativo III NOM-059-SEMARNAT-2010, 14 November 2019). As highlighted earlier in the Update, this status specifically prohibits any form of harvesting or use without special governmental authorization. While such designations help further the cause of Reddish Egret conservation, the Working Group seeks opportunities to enhance legal protection or recognition as a vulnerable species *only where dictated* by objective review of credible scientific information regarding the status of Reddish Egrets. Expanding base protections under domestic or mutli-national bird or environmental laws or treaties should be sought *wherever feasible.*

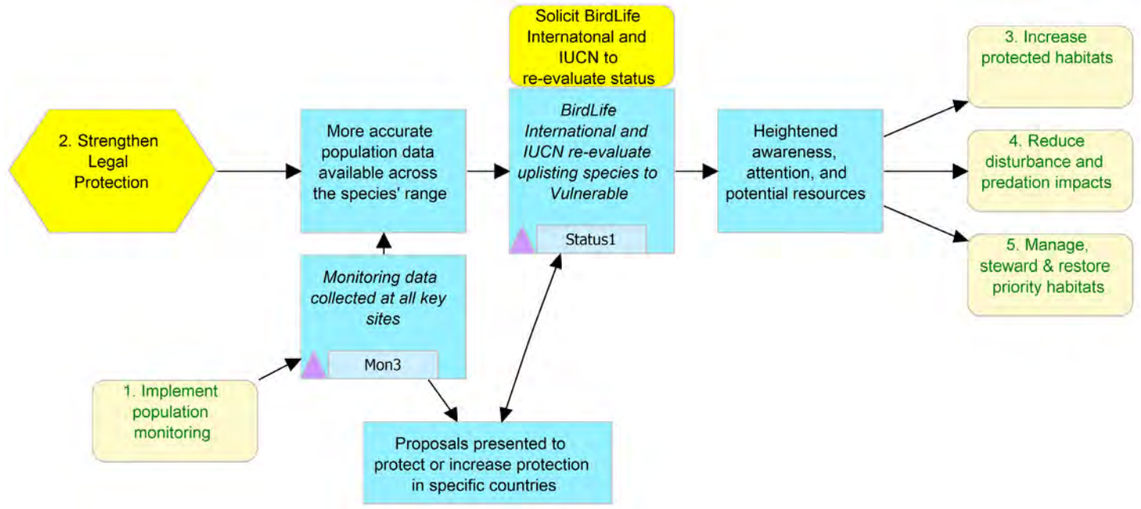


Figure 7. Results chain for Strategy 2 – Strengthen Legal Protections (Miradi Software 2022). Strategy 2 builds upon information needs addressed in Strategy 1, with the expectation of facilitating other strategies addressing habitats, predation and disturbance.

STATUS OBJECTIVE 1 (STATUS1)

In the absence of a comprehensive population estimate or trend information, IUCN currently lists Reddish Egret as "Near Threatened", with inconclusive or perhaps slightly declining populations overall (BirdLife International 2022). Through the successful completion of Monitoring Objectives 1-3 under Strategy 1, the Working Group will be better positioned to **provide robust population data to inform future IUCN assessments and demonstrate that an elevated classification may be warranted**.

Table 5. Objectives for Strategy 2 – Stregthen Legal Protections

Objective	Objective Description	Indicator
Status1	January 2025 – Working Group submits updated status justification seeking IUCN reevaluation with potential uplisting of Reddish Egret to "Vulnerable"	Update to IUCN Red List

BENEFITS & INTENDED OUTCOMES - STRATEGY 2

Building from Strategy 1, accurate population status data (i.e., abundance, trend) are critical to ensure the species receives elevated conservation attention where warranted through appropriate recognition or protection by scientific and government authorities. The IUCN rangewide designation as Near Threatened may or may not be warranted, but at the very least could be better informed by more comprehensive, rigorously obtained data. The Working Group supports reevaluation of the IUCN status if additional structured survey efforts in Belize and elsewhere demonstrate that the species is less secure than presently assessed. International recognition of Reddish Egret as Vulnerable rangewide would presumably encourage commitments and resources for conservation and management beyond current levels.

Small schooling fish predominate the diet of Reddish Egrets, but this adult in Florida strikes it big with a redfin needlefish (Strongylura notata). Jim Gray

STRATEGY 3: INCREASE PROTECTED HABITATS

Increase the amount of priority habitats under long-term protection

Activities under this strategy are focused on protecting breeding colony and foraging sites that presently lack adequate long-term safeguards and that are vulnerable to loss or degradation as a result. Approaches to implementing this strategy may include 1) creation of new natural protected areas, and developing and implementing corresponding management plans, 2) conservation easements, 3) legal designation of critical aquatic habitat, and importantly 4) recognition of opportunities to protect Reddish Egret habitats through complementary causes (e.g., carbon sequestration programs in mangroves; establishment or expansion of Marine Protected Areas; coastal restoration programs to address increased flooding risk). Evaluating vulnerability and ensuring protection of important sites over time must account for changes in physiography and attendant habitats as a function of a shifting climate.

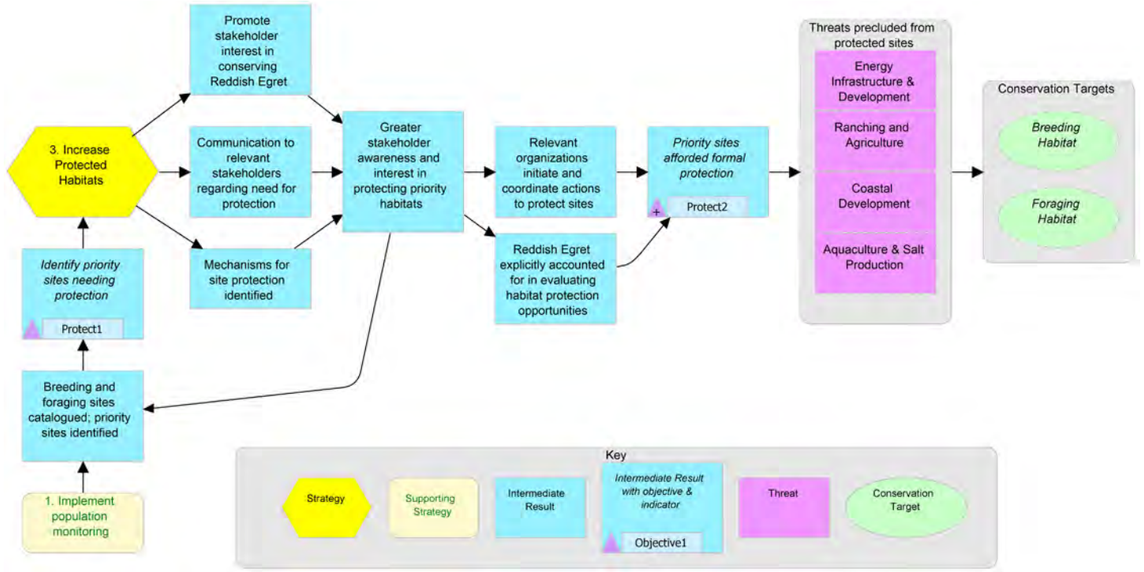


Figure 8. Results chain for Strategy 3 – Increase Protected Habitats (Miradi Software 2022). Activities here seek to secure priority Reddish Egret breeding and foraging sites with a formal protected status.

PROTECTION OBJECTIVE 1 (PROTECT1)

The Working Group estimates that approximately 95% of all breeding colonies throughout the Reddish Egret distribution have been identified (Appendix A). However, information regarding ownership and protected status of these sites has not been comprehensively and consistently compiled, and the extent and magnitude of breeding elsewhere remain assumed and unconfirmed. Likewise, while many important foraging sites have been identified in Mexico and the United States, this information has not been consolidated and large information gaps remain for Central America, South America and the Caribbean. Protect1 seeks to **complete the identification and cataloguing of breeding and foraging sites, assess the protected status/vulnerability of these, and prioritize additional sites in need of formal protection**.

PROTECTION OBJECTIVE 2 (PROTECT2)

Gaining protected status for natural areas can be a complex undertaking, shaped by many factors including landowner interest, public attitudes, land use trends, real estate markets, legal and liability considerations, staff expertise with land transactions and easement, and partner capacity for administering or managing sites. In many cases, it boils down to opportunity, and realistic milestones can be difficult to set. Nonetheless, a complete, rangewide compendium of foraging and nesting sites including pertinent ancillary data on ownership, importance, protected status, and vulnerability (per Protect1) should facilitate targeted efforts to secure protected status for key sites that lack it. Hence, when completed, activities under Protect1 will yield an essential baseline for more thoroughly evaluating and pursuing protection objectives for the long-term. In the interim, **Protect2 seeks to increase the present number of breeding and foraging sites known to be formally protected by 10%**.

Table 5. Objectives for Strategy 3 – Increase protected habitats

Objective	Objective Description	Indicator
Protect1	December 2025 – the protected status and ownership of priority breeding and foraging sites has been assessed and catalogued	% focal breeding & foraging sites assessed/catalogued
Protect2	Interim objectives until completion of Protect1 – increase the present number of formally protected breeding and foraging sites by 10%	% increase in breeding & foraging sites formally protected

Wings in full spread, canopy feeding attracts prey to the relative cover of the shadows, only to be surprised by a waiting beak! Ray Hennessy, rayhennessy.com

BENEFITS & INTENDED OUTCOMES - STRATEGY 3

Pursuing strategic site protection of Reddish Egret breeding and foraging habitats is contingent on attention to a number of activities. First, improved and more complete metadata for each presently known breeding and foraging site must be developed and uniformly compiled. Second, any new breeding colony and foraging sites that are not presently known or accounted for must be identified and similarly detailed with relevant metadata. Implicit in the above two activities are yet others related to monitoring and evaluation of populations as described under Strategy 1.

Delineating and evaluating foraging habitats (e.g., area, quality, vulnerability, relative importance or use) in a consistent manner is particularly challenging. For one, foraging habitats are not as “discrete” in extent or as amenable to identification as colony sites, and secondly, food resources and bird use may vary considerably across seasons and years, complicating any assessment. Third, in identifying priority breeding or foraging sites, compiled data must be objectively evaluated based on appropriate and consistently applicable criteria. Fourth, among the identified priorities, those in need of more formal protection and the feasibility of achieving those protections must be assessed. Finally, opportunities to promote new protections for identified sites can be purposefully pursued, which itself is a complex process involving numerous stakeholders whose priorities may not pertain to birds or conservation per se (e.g., landowners, recreational groups, municipal authorities).

Despite the effort involved, achieving greater protection of priority sites is critical in precluding or mitigating a number of threats, particularly coastal development, and industrial and other land uses with potential to catastrophically alter availability and suitability of these sites as important habitats. Easements, incorporation into existing protected lands networks, establishment of new independent preserves, and inclusion under broader coastal or marine protection or stabilization programs are all mechanisms by which long-term securement of Reddish Egret habitats can be incrementally expanded. Protected sites typically afford additional opportunities for on-site habitat enhancements and/or mitigation of other threats such as those stemming from disturbance, contamination, invasive species, and climate change.

Seasonal and annual variations in availability, suitability, food resources, and use complicate the identification and delineation of important Reddish Egret foraging sites. Clay Green

STRATEGY 4: REDUCE DISTURBANCE & PREDATION IMPACTS

Reduce disturbance and predation impacts related to human activity and modification of the environment

Interventions to address impacts stemming from human disturbance (to include unregulated take) and predation will be important elements of rangewide efforts to improve survival and productivity of Reddish Egrets, ultimately supporting population stability and growth. For disturbance, the principal pathways for mitigating impacts involve shaping human behavior proactively through education and policy, and reactively through enforcement. For predation, mitigating impacts linked to anthropogenic causes likewise involves education and policy, but may also involve active management at breeding colonies to curb unnaturally or unsustainably high predation.

Recreational boaters encroaching on Reddish Egret colony in Laguna Madre, Texas. Justin LeClaire

Targeted communication to groups (e.g. boaters, beachgoers, fishermen, home owners) whose activities contribute to increased disturbance and predation is intended to raise awareness regarding human impacts and mitigate these threats a priori by encouraging compatible practices and behaviors. In specific cases, such as prohibiting unrestrained pets or limiting accessibility to sensitive areas, enacting policies (e.g., community ordinances, regulations for protected areas) may be similarly helpful, and should be accompanied by communication to promote and explain the need. A sufficient enforcement presence to uphold protective laws and policies will always be an important component in modeling human behavior, and is essential for effectively addressing willfully negligent or egregious circumstances, or for patrolling particularly problematic areas. However, *positive reinforcement through awareness and education efforts – in concert with enforcement – is typically viewed as affording the most cost-effective and lasting benefits over the long term*. In areas of Mexico where unregulated, traditional collecting of eggs and chicks continues at nesting colonies and has strong cultural ties, special incentives or consideration for local subsistence needs may be required to encourage cooperation.

Activities under this strategy are divided into two sets of objectives, those addressing human disturbance and those addressing predation, each with a separate results chain.

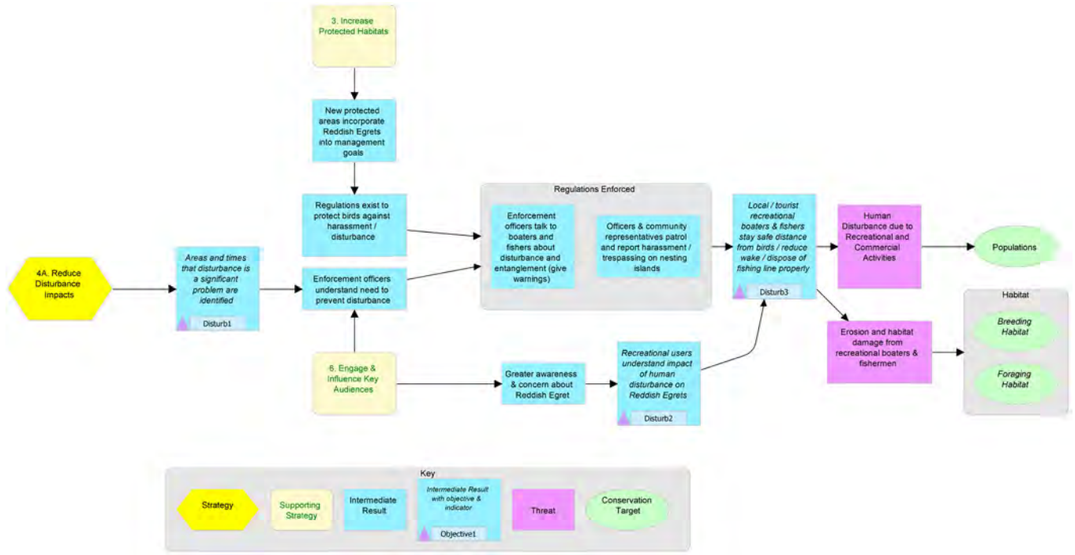


Figure 9. Results chain for Strategy 4A – Reduce Disturbance Impacts (Miradi Software 2022). Education and awareness activities linked to Strategy 6 (Engage & Influence Key Audiences) are a significant component in achieving desired outcomes.

DISTURBANCE OBJECTIVE 1 (DISTURB1)

While human disturbance is widespread across the distribution of Reddish Egrets, the prevalence, scope, and severity of impacts at specific sites and even within management units is largely unassessed. In some areas, the threat of human disturbance may be a year-round concern (e.g., consistent presence of recreational fishermen) whereas at other sites it may be seasonal and involve people who reside outside of locally affected areas for most of the year (e.g., vacationers). Disturbance may also manifest with acute impacts, such as at certain nesting colonies, or with more chronic impacts that affect survival and productivity less noticeably. To practically address human disturbance, ***it will be necessary to identify significant sources and patterns of disturbance, and to qualify or quantify impacts at local (e.g., priority sites) or regional (e.g., management unit) scales.*** Site level assessments will be more resource intensive, but will permit development of locally implementable strategies that more effectively utilize finite management and law enforcement resources. Education and outreach campaigns may also be informed by site level information, whether approached locally or as part of efforts to reach like audiences at broader scales.

DISTURBANCE OBJECTIVE 2 (DISTURB2)

Posting signs in and around priority breeding and foraging sites is important to alert recreational users to sensitivities associated with human presence or activity. Signage may reinforce messaging communicated through other means, such as through general outreach campaigns to key audiences intended to encourage compliance and compatible behavior (e.g., restrained pets, safe approach distances, exclusion/buffer zones). Additionally, use of signage supports and should accompany enforcement activities, such as those involving patrol of no-entry or disturbance-free areas. ***The potential for new or upgraded signage to moderate recreational disturbance at priority sites should be evaluated, with associated strategies developed for meeting identified needs and promoting compliance through secondary communication campaigns***.

DISTURBANCE OBJECTIVE 3 (DISTURB3)

Specific outreach should be conducted that is oriented towards educating boaters, anglers, and other users that recreate on or adjacent to Reddish Egret habitats about the effects of their activities on birds and practical safeguards to limit disturbance. This objective links to objectives Influence3 and Influence5 under Strategy 6 – Engage and Influence Key Audiences.

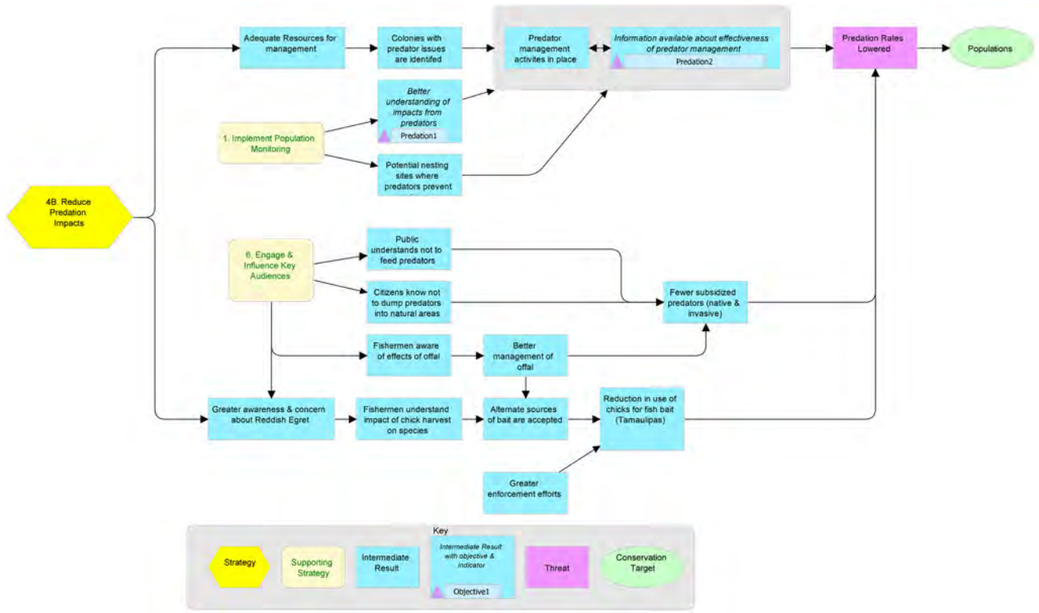


Figure 10. Results chain for Strategy 4B – Reduce Predation Impacts (Miradi Software 2022). Education and awareness activities linked to Strategy 6 (Engage & Influence Key Audiences) are closely tied to desired outcomes

PREDATION OBJECTIVE 1 (PREDATION1)

As with human disturbance, predation impacts remain poorly quantified at breeding colonies across the Reddish Egret range. It is not even well understood which predators may be having the most harmful influence on specific colonies, hindering identification of appropriate management strategies and the feasibility of implementing and evaluating them. This objective seeks to ***evaluate predation at priority breeding colonies and assess the effectiveness of predator management actions already taking place***. Proper assessment will require resources and commitment to document predation and its extent and effects. Effort should be prioritized based on known or suspected predation impacts as well as stakeholder/partner willingness to participate in site level assessments.

PREDATION OBJECTIVE 2 (PREDATION2)

Upon completion of Predation1, this objective will seek to ***implement predation management at a subset of breeding colonies***, ideally prioritized based on need, feasibility, and available resources. Any predation management that is initiated should include, at a minimum, periodic monitoring to evaluate effectiveness of control efforts and associated response of breeding colonies. This objective links to objectives Influence4 and Influence6 under Strategy 6 – Engage and Influence Key Audiences.

Table 7. Objectives for Strategy 4 – Reduce Disturbance & Predation Impacts.

Objective	Objective Description	Indicator
Disturb1	July 2027 – identify and evaluate sites where disturbance is a significant problem; prioritize sites for targeted attention to alleviate impacts	% of priority breeding and foraging sites evaluated; # of sites prioritized for action
Disturb2	July 2027 until – identify site level needs for improved signage to mitigate recreational disturbance; develop strategies to employ signage, communicate need, and promote compliance at 50% of identified sites	% of identified sites implementing signage improvements and corresponding outreach
Disturb3	July 2025 until – Conduct specific outreach oriented towards recreational boaters and anglers regarding practical safeguards to limit disturbance effects on birds	# of specific local or regional audiences reached by outreach campaigns; # of priority sites where disturbance alleviated
Predation1	July 2026 – predation risk / impacts assessed at 50% of priority breeding colonies; effectiveness of ongoing predation management activities evaluated	% priority breeding colonies assessed; information available regarding effectiveness of management actions
Predation2	July 2028 until – predation management strategies developed for 50% of breeding sites affected by predation (Predation1); implementation begun; monitoring in place	% of affected breeding sites with predation management strategies in place and being implemented

Raccoons (Procyon lotor) are natural predators of Reddish Egret nests, but can become problematic in areas where human activities provide them with additional food, shelter and access to nests. Creative Commons

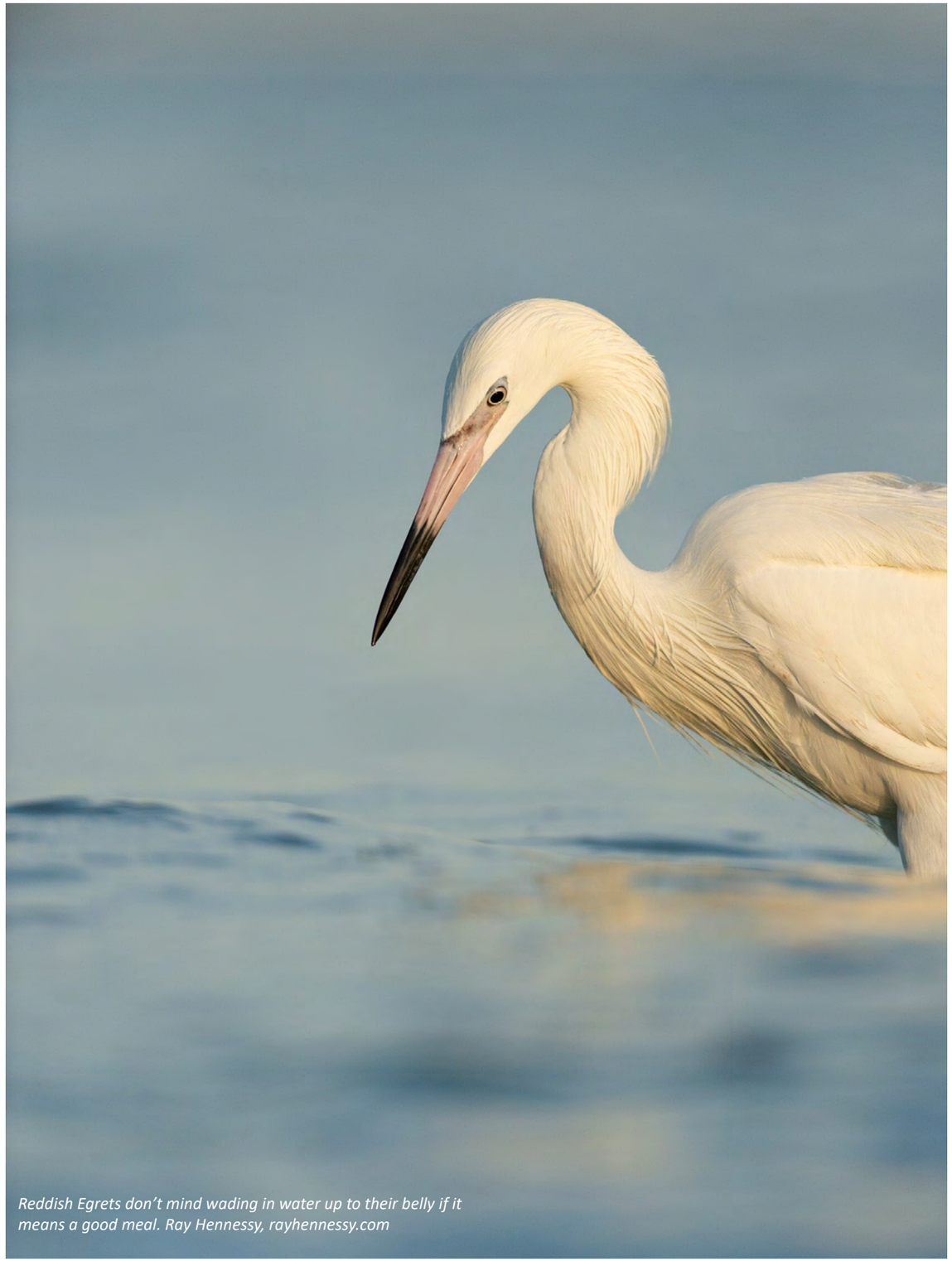
BENEFITS & INTENDED OUTCOMES - STRATEGY 4

Although threats to Reddish Egrets from human disturbance are not rated as highly as some other threats like coastal development and engineering, they are readily managed given sufficient resources and afford a high likelihood for immediate positive impacts when addressed. Signage, kiosks, no-entry and disturbance-free zones, administrative policies, and local ordinances are all viable means to address disturbance issues. However, effective reduction or prevention overall requires a significant commitment to targeted outreach and communication among key user groups whose activities disturb foraging and nesting birds, with a concomitant commitment to enforcing responsible behavior as necessary. Because Reddish Egrets nest colonially with other species throughout much of their distribution, efforts to manage and reduce disturbance at breeding sites offer benefits to an entire suite of waterbird species. Similarly, reduced disturbance in foraging areas should complement interests in managing disturbance for other waterbird and shorebird species that frequent these same habitats.

Predation on breeding Reddish Egrets is also evaluated as a moderate threat. Like disturbance, it is a manageable threat given sufficient resources and stakeholder support. Eggs and young may be especially vulnerable to depredation (or associated exhaustion or exposure) from a variety of sources near areas with high human activity, and at rates or by predators that populations are not adapted to withstand.

Presence and abundance of both native and non-native predators may be promoted by improper food waste and carcass disposal (e.g., raccoons, rodents), inadequate restraint (e.g., domestic pets), supplemental feeding (e.g., feral cats), habitat modification, and enhanced access to otherwise protected sites. All of these situations require public cooperation to effectively limit, and so outreach and communication must play a prominent role in managing and preventing undesirable predation impacts. Predation management may include the lethal control of predators which can be viewed unpopularly, presenting challenges with respect to stakeholder and public support. Ideally, human values, attitudes, and behaviors can be shaped in ways that promote compatible co-existence near colony sites, limiting the need to actively manage predators, which can be a time- and cost-intensive endeavor. The assessment of predation impacts at priority breeding sites and the use of pilot studies to document management effectiveness are essential elements in garnering partner and public support for active predation management strategies.

Ultimately, successful implementation of interventions to address impacts originating from human disturbance and anthropogenically linked predation will depend on increased scientific understanding, funding and public cooperation.



Reddish Egrets don't mind wading in water up to their belly if it means a good meal. Ray Hennessy, rayhennessy.com

STRATEGY 5: MANAGE, STEWARD, & RESTORE PRIORITY HABITAT

Enhance and support management, stewardship and restoration of priority habitats

Activities under this strategy seek to address several threats to priority breeding and foraging sites including those associated with coastal development (e.g., urbanization, tourism impacts, habitat degradation), energy infrastructure and development (e.g., habitat degradation, disturbance), marine vessels (e.g., erosion), climate change (e.g., sea level rise, storm surge, erosion), coastal engineering (e.g., altered hydrology), and habitat alteration from invasive species (e.g., degradation). They also seek to identify and prioritize opportunities to improve current status of breeding and foraging sites through management and restoration, such as re-vegetating degraded areas and capitalizing on beneficial uses of dredged material. Specific objectives and indicators focus on 1) evaluating the current or potential impacts of these threats at priority breeding and foraging sites, 2) coordinating with relevant actors to ameliorate ongoing or future threat impacts, and 3) evaluating practical opportunities to site level improvements through management and restoration.

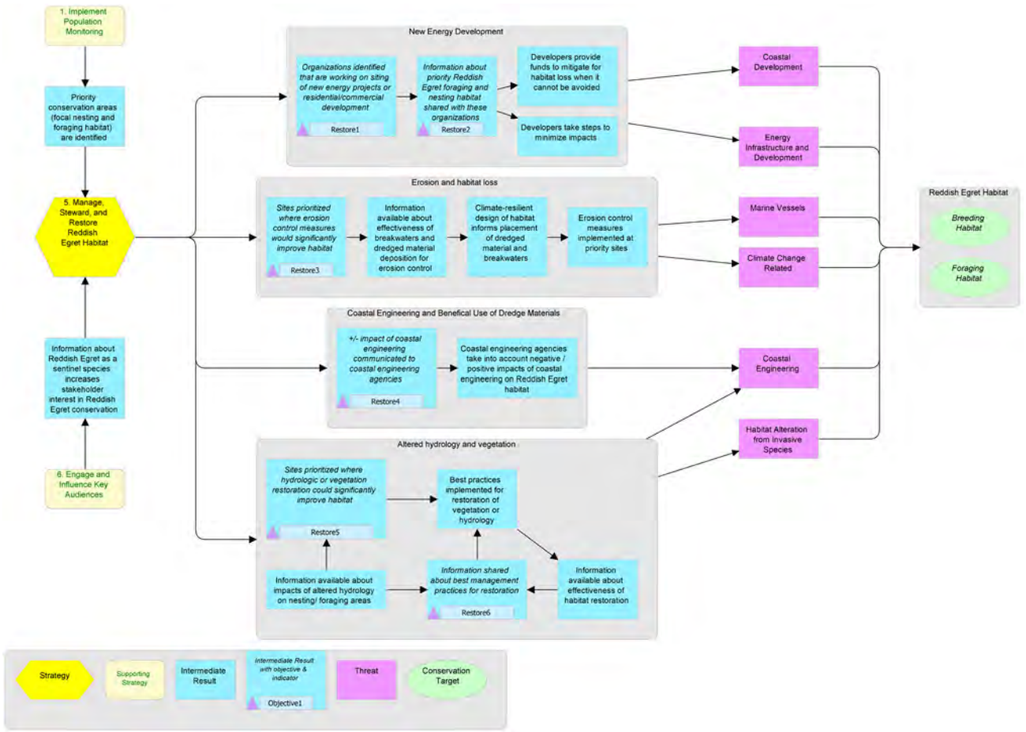


Figure 11. Results chain for Strategy 5 – Manage, Steward & Restore Priority Habitats (Miradi Software 2022).

MANAGE, STEWARD & RESTORE OBJECTIVES 1 & 2 (RESTORE1, RESTORE2)

Sea level rise exacerbates erosion in tidally influenced habitats, affecting the stability and longevity of important habitats. Chesapeake Bay Program

Coastal energy production and residential/commercial development pose ubiquitous threats to both breeding and foraging habitats, but the specific potential for such development and its impact to Reddish Egrets at the site level has not been assessed. **Identifying planned developments (and areas with high development potential) and evaluating the risk posed to key nesting and foraging sites** will support efforts to proactively engage project proponents and municipal or other authorities to identify and incorporate appropriate mitigative protections during pre-planning or other project phases. **Identifying appropriate entities and soliciting their interest and commitment in reconciling natural resource concerns germane to Reddish Egrets** presents unique challenges that will undoubtedly demand capacity and persistence of locally invested stakeholder groups. Coordination with conservation organizations who possess strong experience in effectively consulting on corporate development projects can greatly enhance potential for positive outcomes, as can piggy-backing interests in Reddish Egret and coastal waterbird protection within standard project-level environmental review and consultation processes.

MANAGE, STEWARD & RESTORE OBJECTIVE 3 (RESTORE3)

Reddish Egret breeding sites across the range will vary greatly in erosional processes that can affect the stability and longevity of nesting habitats and the physical sites themselves. For most colonies, the primary erosional concerns are related to changes in physical oceanography (e.g., current and wave dynamics) which in turn affect accretion, scouring, salt intrusion (as affects vegetation cover) and similar processes. **The aim of this objective is to assess the the scope, severity and feasibility of managing or mitigating erosional effects, and identifying factors that may be causing or contributing to them (e.g., recreational boating, commercial transportation, sea level rise, development, coastal engineering) on a site level basis.** Assessing erosion effects will support prioritization of on-site management actions to attenuate unsustainable loss or degradation of colony sites, as well as attempting to directly address particularly problematic sources of erosion through relevant consultation, education, community engagement, and policy development.

MANAGE, STEWARD & RESTORE OBJECTIVE 4 (RESTORE4)

Coastal engineering activities across the range of Reddish Egret take many forms, including channelization, levee construction and maintenance, beach refurbishment, dredging of harbors and shipping lanes, shoreline hardening, and installation of jetties and breakwalls. Ultimately, all of these actions affect patterns in the volume and flow of water, the timing and extent of areas subject to inundation and exposure (e.g., as affects site availability/suitability), and the gain or loss of key habitats through accretion and erosion. Many coastal engineering needs entail large, complex, multi-phased projects with lengthy planning horizons, and equally lengthy implementation schedules. These are not “simple” projects to positively influence on behalf of specific natural resource concerns, as there are often dozens of competing objectives, requirements and concerns to reconcile. Despite the inevitability of such projects, they do offer consideration to options for ameliorating broad coastal habitat impacts, as well as avoiding specific impacts to vulnerable species or sites. **Active participation during planning and permitting phases for these projects is essential in affording the highest likelihood for successful introduction of measures to offset negative implications to species and systems.** Compilation of data and development of maps, dynamic decision support tools, and generalized guidance pertinent to protection of priority Reddish Egret breeding and foraging sites/habitats will enhance collective potential to make practical and compelling arguments that result in more favorable post-construction outcomes.

MANAGE, STEWARD & RESTORE OBJECTIVE 5 (RESTORE5)

Given the diversity of threats affecting the condition of vegetative cover and its suitability as adequate nesting substrate at breeding sites, **there is a need to evaluate and prioritize vegetation management concerns and opportunities at the site level to promote continued sustainability of current sites to support successful breeding.** Management actions would largely involve mitigating vegetative loss or degradation, restoring beneficial substrates (e.g., mangrove planting), and addressing the detrimental impacts of invasive plants such as Guinea Grass (*Megathyrsus maximus*) and Brazilian Pepper (*Schinus terebinthifolius*) that diminish site suitability. Engagement by site owners/managers at local levels will be critical to ensure knowledgeable evaluation and encourage development of locally implementable management and restoration actions.

MANAGE, STEWARD & RESTORE OBJECTIVE 6 (RESTORE6)

Although Reddish Egret breeding habitats vary substantially across the range, and factors affecting condition and suitability of habitats in supporting nesting colonies also vary, there are still opportunities to **consolidate habitat restoration, protection and other recommendations at the site level into best management practices suitable for use and sharing at management unit or rangewide levels**. Fostering collaboration and sharing of broadly applicable management and restoration information through workshops, meetings and publications is a core premise behind creation of the Working Group. Development of broadly applicable management recommendations will rely heavily on incorporation of local knowledge and expertise (e.g., practices, techniques, costs, efficacy, evaluation, geographic peculiarities). While local information and priorities compiled under Restore5 will facilitate development, sharing, and implementation of generalized management and restoration recommendations under Restore6, doing so hinges on effective consolidation and synthesis.

Table 8. Objectives for Strategy 5 – Manage Steward & Restore Priority Habitats.

Objective	Objective Description	Indicator
Restore1	July 2026 – plans for (and possible impacts of) coastal energy production and residential/commercial development evaluated at 50% of priority breeding and foraging sites; key proponents and authorities identified	% of priority breeding and foraging sites evaluated; # of project contacts identified
Restore2	by July 2026 until – begin consultation with identified project contacts (Restore1) regarding avoiding and minimizing impacts to priority breeding and foraging sites	% of identified contacts with whom consultations are taking place
Restore3	July 2026 – prioritize breeding sites with respect to need for erosion control measures to improve habitat	% priority breeding sites evaluated
Restore4	by July 2026 until – begin consultation with coastal engineering proponents on mitigating/avoiding potential impacts	% known projects where consultations conducted
Restore5	July 2026 – prioritize breeding sites with respect to need for active vegetative restoration	% of priority breeding sites evaluated
Restore6	July 2026 until – needs for vegetative restoration at priority breeding sites shared and opportunities for addressing pursued	% sites with identified restoration needs that are actively pursuing means to address them

BENEFITS & INTENDED OUTCOMES - STRATEGY 5

The likelihood of influencing human activity and development in ways most beneficial to Reddish Egrets is apt to be improved if approached in the context of safeguarding habitats and natural resources holistically based on multiple interests. While information specific to Reddish Egret conservation is still fundamental, it is neither efficient nor practical to “go it alone” in attempting to steer engineering, development, or other coastal land use changes primarily on behalf of this single resource concern – unless extraordinarily compelling. Coastal resource interests ranging from fishing and recreation to coastline protection and wildlife preservation can all achieve mutually compatible ends through the safeguarding of natural systems and habitats. Reconciling rationale for protecting important Reddish Egret habitat with recommendations and concerns voiced to protect natural resources for a suite of constituents can prove more effective for egrets in the end due to “amplification” of compelling arguments, sharing of information and expertise, and efficiencies in communication and coordination. Ultimately, activities under Strategy 5 can be approached in conjunction with specific activities under Strategies 3 and 4 that similarly strive to evaluate the extent and magnitude of various threats, prioritize appropriate conservation interventions, and influence human activities and land uses accordingly.

White phase adult Reddish Egret in mangrove habitat, Belize. Leomir Santoya

STRATEGY 6: ENGAGE & INFLUENCE KEY AUDIENCES

Engage and influence key audiences to garner further conservation support and capacity

Effective education and communication efforts will be vital in leveraging interest and engagement among audiences that can lend or generate resources necessary to further support Reddish Egret conservation, or whose activities affect the birds or their habitats. Education, outreach and other forms of communications can be targeted to achieve specific, strategic purposes (e.g., reducing human disturbance impacts), but are also essential elements in achieving outcomes under the Update's other strategies, particularly those requiring stakeholder buy-in, financial support, and public involvement (e.g., supporting protection efforts, participation in citizen science). The objectives below outline areas that communications related activities will initially focus in promoting awareness and appreciation regarding the benefits and importance of conserving Reddish Egrets, as well as in modifying human attitudes and behaviors to mitigate disturbance and predation threats. In all applications, understanding and consideration of how values, beliefs, and attitudes shape human behaviors (Vaske and Donnelly 1999) will aid in developing appropriately tailored communication tactics and messaging.

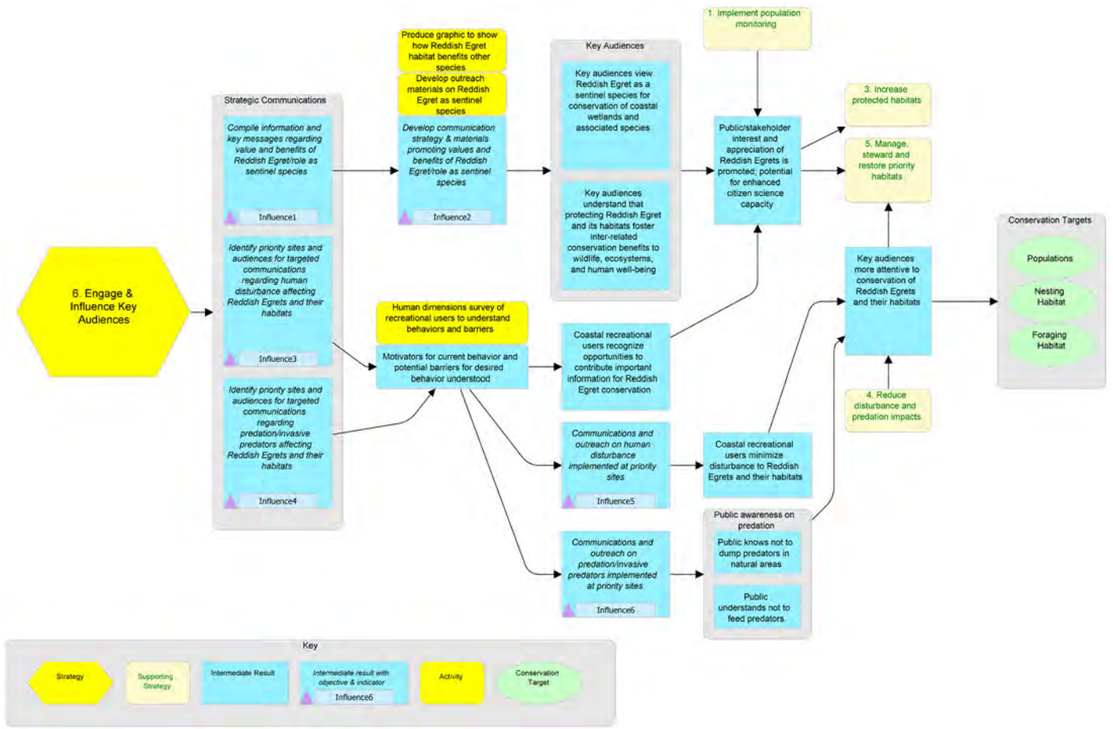


Figure 12. Results chain for Strategy 6 – Engage and Influence Key Audiences (Miradi Software 2022).

INFLUENCE OBJECTIVE 1 (INFLUENCE1)

Promoting public interest in the conservation of Reddish Egrets and their breeding and foraging habitats will be enhanced through communication efforts that convey the inter-related conservation benefits to other wildlife, ecosystems, and to human interests and well-being. Similarly, opportunities to promote community awareness and support for general conservation endeavors that simultaneously contribute to goals and objectives for Reddish Egret conservation can yield commensurate benefits, and may often be more practical. Conservation arguments can be made more compelling by incorporating messaging that communicates economic, social, and quality-of-life linkages and other benefits that resonate broadly with public interests. There are myriad potential audiences for communication materials containing messaging on these subjects, from fairly specific and local, to community-wide and more regional in scope. Identifying and assessing priority audiences must be a formative part of all communications efforts intended to further the goals and objectives of this plan. To effectively influence these audiences, it will be essential **to synthesize a broad array information on ecosystem and human benefits into a portfolio of key messages that compellingly convey salient rationale, generate compassion, and encourage appropriate support.**

Installation of an informative sign off the shore of an important bird nesting island in Nueces Bay, Texas to help reduce disturbance. Coastal Bend Bays and Estuaries Program

INFLUENCE OBJECTIVE 2 (INFLUENCE2)

In conjunction with Influence1, **develop a communication strategy and corresponding outreach materials to influence priority audiences regarding the role of Reddish Egret in ecosystems**, and how conservation efforts targeting Reddish Egrets help in sustaining species and ecosystems more broadly, in addition to promoting interests and values of importance to the public.

INFLUENCE OBJECTIVES 3 & 5 (INFLUENCE3, INFLUENCE5)

Activities under these objective are focused on developing and implementing specific communication strategies geared toward reducing human disturbance impacts at a proportion of priority breeding and foraging sites. Key activities will include: a) identifying and prioritizing breeding and foraging sites where disturbance is ongoing and where outreach and education offers practical potential to mitigate impacts; b) identifying audiences (e.g., boating enthusiasts, anglers, and other coastal recreational users) whose activities disturb Reddish Egrets or otherwise diminish the suitability of important breeding and foraging habitats at these sites; c) identifying means or opportunities (e.g., organizations, meetings, events, websites, social media) for effectively reaching relevant audiences; and d) undertaking communications activities and ultimately influencing people. Communication with these groups can simultaneously encourage engagement and compassion by promoting appropriate citizen science opportunities, such as reporting of marked/banded birds, and participation in counts or monitoring. Trusted opinion leaders should be sought in advocating for and modeling responsible behaviors among peers.

INFLUENCE OBJECTIVES 4 & 6 (INFLUENCE4, INFLUENCE6)

These objectives are analogous to Influence3 and Influence5 albeit with an emphasis on **developing and implementing specific communication strategies geared toward reducing predation impacts at a subset of breeding sites where predation stemming from adjacent human activities is problematic.**

Table 9. Objectives for Strategy 6 – Engage and Influence Key Audiences.

Objective	Objective Description	Indicator
Influence1	May 2024 – formally compile information linking benefits afforded by Reddish Egret conservation to other species and human welfare	Summary report and key messages finalized as foundation for public communications materials
Influence2	May 2024 – develop general communication strategy and associated material promoting Reddish Egret as sentinel species	Materials produced and available for use and distribution
Influence3	May 2025 – Identify priority breeding and foraging sites for targeted communications regarding human disturbance.	# priority sites identified; % of these with communications strategies under development
Influence4	May 2025 – Identify priority breeding sites for targeted communications regarding predation/invasive predators.	# priority sites identified; % of these with communications strategies under development
Influence5	May 2025 until – implement local/regional communications strategies for engaging relevant audiences at 10% of priority sites identified.	% of priority sites identified with communications strategies being implemented
Influence6	May 2025 until – implement local/regional communication strategies for engaging relevant audiences at 10% of priority sites identified.	% of priority sites identified with communications strategies being implemented

The shorebird community is making positive strides on addressing human disturbance to birds in coastal environments. Available tools and field tested approaches could jump start efforts to do likewise on behalf of Reddish Egrets. Top left to counterclockwise: NY Audubon, The Northern Agricultural Catchments Council, Birdlife Australia, and Friends of Sleeping Bear Dunes

BENEFITS & INTENDED OUTCOMES - STRATEGY 6

As with all communications oriented needs, Strategy 6 is a cross-cutting strategy with important potential to support and amplify outcomes sought through the other strategies in this plan. From securing resources and public support for habitat protection to generating awareness and commitment to address human disturbance, effective communication can prove critical in facilitating conservation interventions that may seem straightforward, but whose success inherently hinges on understanding, trust, and engagement from a variety of public, political and special interests.

To ultimately be successful, Reddish Egret conservation can't simply be about site protection, establishing buffers around nesting colonies, or identifying key factors driving populations. Conservation resources must increasingly be invested in promoting human values and attitudes that expect or demand these types of activities to be undertaken, and that fundamentally encourage lifestyles and behaviors that are more harmonious with the long-term sustainability of coastal ecosystems overall. Developing communication strategies and crafting messages and outreach products that encourage appropriate awareness and action among relevant audiences is, therefore, a core set of needs in its own right.

In generating awareness and support for Reddish Egret conservation, far more communication needs exist than there is capacity or potential to meaningfully address. In general, resources and professional expertise in human dimensions, communications, and development of effective outreach strategies (in conservation contexts) are extremely limited, or are not afforded the same attention as more conventional conservation activities like research, monitoring, and habitat protection. Moreover, resources to evaluate communication effectiveness and to modify subsequent efforts accordingly are even less available. Communication activities are frequently approached by well-meaning professionals with ecological or resource management expertise who may possess general awareness of the relevant sociological and marketing aspects but lack the savvy and understanding to approach communications strategically and adaptively. In acknowledging these limitations, two important caveats to achieving positive outcomes under this strategy are that 1) priorities must be established to direct finite communication resources where needs and potential for success are greatest, and 2) wherever possible, professional communications and/or human dimensions expertise must be enlisted in some capacity. Communication and outreach to promote awareness and influence outcomes on behalf of Reddish Egrets should complement or synergize with other conservation messaging to enhance mutual reach and effect.

STRATEGY 7: BOLSTER REACH & EFFECTIVENESS OF WORKING GROUP

Improve support and capacity for the Reddish Egret International Working Group to bolster reach and effectiveness

Activities and objectives under this strategy pertain to promoting reach, capacity, and effectiveness of the Working Group as a vital element in driving implementation of the Update and Reddish Egret conservation overall. Since its inception in 2005, the Reddish Egret International Working Group has functioned as a self directed, ad hoc group with no formally dedicated capacity beyond that afforded voluntarily by individual organizations seeking to support Reddish Egret conservation more cooperatively and collaboratively. From 2005-2018, the USFWS sponsored a representative to serve as Chair of the Working Group, committing attention as available in addition to fulfilling officially assigned duties. The Chair is vacant, however, as of this writing. Beyond the Chair, there has been no further organizational structure to develop, organize and share tasks and responsibilities. Membership has been informal, consisting of biologists, resource managers, researchers and other academics throughout the range with primary interest or responsibility for waterbirds, coastal wetland environments or Reddish Egret conservation specifically.

A more active and sustained Working group would figure prominently in positively directing implementation of the other Update strategies. Although this influence would often occur indirectly and many steps removed from "actual" conservation (e.g., capacity building, technical exchange, collaboration on grants and funding opportunities, systematic coordination of monitoring programs), it is no less essential in achieving the goals of this plan. Effective implementation of the Update will be directly tied to the capacity of the Working Group to coordinate sustained momentum. Objectives outlined below seek to improve structure and functioning of the Working Group, promote accountability in setting and achieving sustained and progressive accomplishments, and secure resources necessary for plan implementation.

Members of the Reddish Egret International Working Group visiting a colony site in Texas as part of a planning meeting in preparation of the Update. Kelli Stone

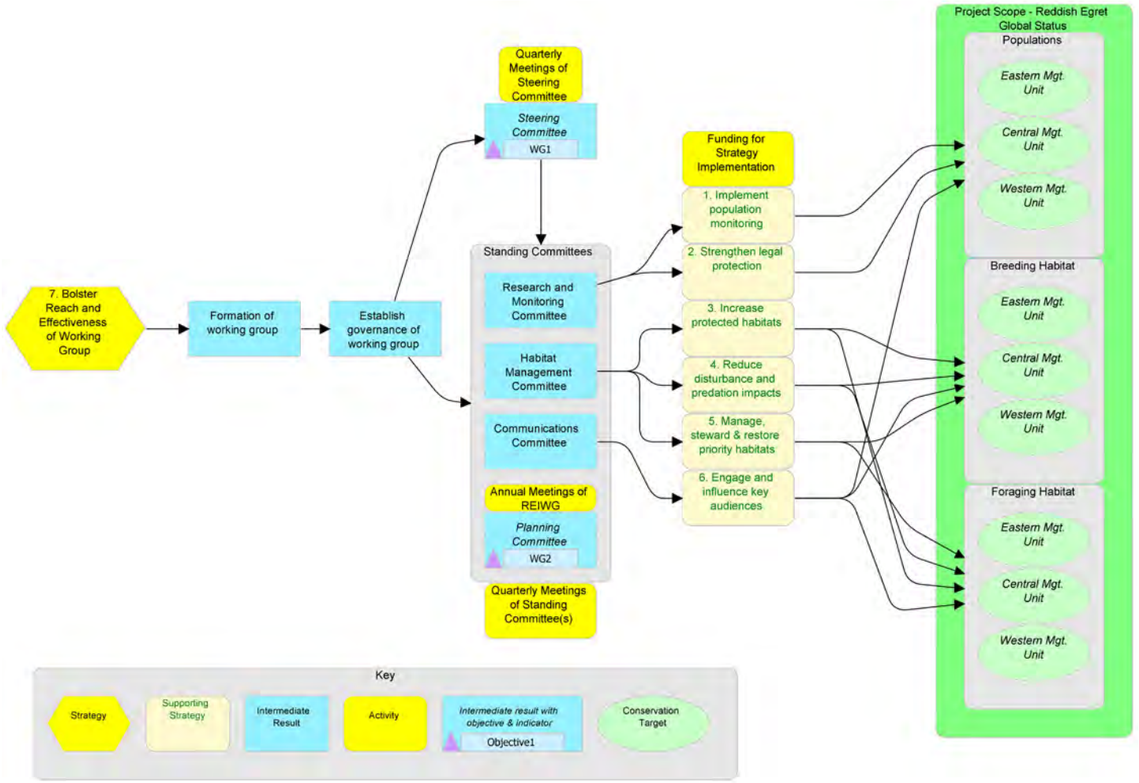


Figure 13. Results chain for Strategy 7 – Bolster Reach and Effectiveness of the Working Group. Depicting the theory of change associated with Working Group capacity is complicated by the many indirect pathways in which the group's efforts might ultimately support Reddish Egret conservation. The figure here greatly simplifies these pathways by linking Working Group committees to expectations for supporting specific Update strategies (Miradi Software 2022).

WORKING GROUP OBJECTIVE 1 (WG1)

Workshops supporting development of the Update highlighted steps that should be taken to enhance functioning and impact of the Working Group going forward. These included formalizing a Steering Committee and four standing committees (Planning, Communications, Habitat Management, and Research and Monitoring) with more explicit responsibilities and representation intended to promote continuity and follow through. Organizational commitment – the ability of stakeholders to consistently dedicate staff time, expertise, and other resources – will be the central ingredient to the future effectiveness of these committees and the Working Group. To be truly effective, organizational (rather than purely personal) support and participation in the Working Group and its committees must be strengthened.

Activities under WG1 **seek more formal organizational commitment in sponsoring a dedicated Working Group Chair and Co-Chair, who will also establish and chair a Steering Committee**. Additional commitments from Working Group organizations must also be secured to **staff and chair four standing committees (Communications, Planning, Habitat Management, and Research & Monitoring)**. Quarterly Steering Committee and regular standing committee meetings will be instituted to establish and direct priorities for plan implementation, evaluate annual progress, and address key limitations to effectiveness.

WORKING GROUP OBJECTIVE 2 (WG2)

Since the publication of the Original Plan (Wilson et al. 2014), meetings of the Working Group were not planned with any regular periodicity nor necessarily with prescribed agendas and goals related to plan implementation. In pursuing the goals of the Update, **it is imperative that the Working Group convene annual meetings specifically to review progress and coordinate more strategic implementation of key plan activities.** In-person international meetings are increasingly difficult, and so effective virtual options and piggy-backed opportunities with other conferences and workshops (e.g., Waterbird Society, BirdsCaribbean) should be sought to maximize regularity and engagement. Annual coordination among Working Group participants will help strengthen linkages among local level activities and rangewide goals, aid in attracting new members and broaden ownership and commitment in the partnership, and promote necessary refinement and re-prioritization of activities to best support plan implementation over time. As with establishing effective Working Group committees (WG1), institutional commitments will be essential in promoting full Working Group coordination on a regular basis, even in virtual settings. Core activities under WG2 will therefore center on securing dedications of staff, funding, and in-kind resources (e.g., meeting facilities, administrative support) from member organizations.

Table 10. Objectives for Strategy 7 – Bolster Reach and Effectiveness of the Working Group.

Objective	Objective Description	Indicator
WG1	August 2023 – secure commitments for chairing and staffing Steering Committee and standing committees. Initiate regular meetings. December 2023 – establish 2024 work plan and priorities for all committees	# Committees established and chaired; # active committees with work plans identified
WG2	December 2023 – host full Working Group virtual meeting to kick-off implementation of the Update; plan hosting full in-person meeting for late 2024 and annual meetings (virtual or in-person) thereafter.	2023 Full Working Group meeting hosted; 2024 Working Group meeting planned

Working Group partners enjoying time off the clock in downtown Merida, Mexico during a 2018 planning meeting for the Update. Regular, in-person gatherings are vital to the continued enthusiasm and energy of the Working Group.

BENEFITS & INTENDED OUTCOMES - STRATEGY 7

Under the Open Standards' five-step management cycle (CMP 2007), species conservation is a cyclical process of assessment, planning, implementation, analysis and adaptation, and sharing. The Working Group initially completed the assessment (Step 1) and planning (Step 2) phases during 2012-2014 in developing the Original Plan (Wilson et al. 2014). However, implementation of the plan (Step 3) was not effectively conducted due in part to lack of ownership (within the Working Group, and externally) in implementing its specific goals and recommendations.

With completion of the Update and initial work underway to address Strategy 7, the Working Group is committing to more formal accountability to plan implementation. As outlined above, establishment of an active Steering Committee and standing committees will permit responsibilities for specific Update strategies to be assigned to specific committees, recognizing that some strategies require attention from multiple committees for successful implementation. Some committees (e.g., Steering Committee, Communications Committee) will be accountable for responsibilities that cut across several if not all of the strategies. Further, the Steering Committee will oversee tracking of plan progress overall and must work closely with all standing committees throughout the management cycle. Regular, purpose-driven meetings for the committees and Working Group as a whole are necessary for sustained attention to the Update's objectives and recommendations as well as ensuring continual refinement as new challenges and opportunities arise. Finally, implementing the Update will require that its fairly broad strategies and objectives be "stepped down" to more local, actionable levels. Extensive involvement by Working Group members will be essential in this process and is expected to simultaneously foster mutual trust and buy-in.

The overarching goal of the Update is to increase Reddish Egret populations by at least 10% by 2032, and effective implementation of all strategies is necessary to achieve this. Though not strictly successive in nature, Strategies 1-5 follow a logical progression whereby the initiation and successful achievement of the latter strategies is contingent to a degree on diligent attention to the strategies that precede them. For example, Strategy 1 (Implement Population Monitoring) directly supports Strategy 2 (Strengthen Legal Protections) as the assimilation of information on the status of populations is foundational to any arguments for heightened protection. However, there are also many areas in the past decade where considerable knowledge has been gained and progress made, such as in understanding patterns of migratory connectivity and movement ecology, and in identifying and collating breeding colonies throughout the range. These advancements provide a basis for undertaking immediate actions pertinent to all strategies, including habitat protection and management, and disturbance abatement efforts at local levels. The Working Group and its committees will need to ensure effective coordination among strategy elements that are sequential or progressive in nature, as well as those that

can proceed concurrently or independently from the start.

Tracking progress, or shortfalls, in implementing the Update should include regular assessment of the appropriateness and effectiveness of the individual strategies. While the plan is a static document, the strategies and supporting objectives and activities should be evaluated for performance effectiveness and refined or revised as warranted. Within the Open Standards management cycle, the analysis and adaptation step represents a continual, dynamic process intended to track as well as challenge results and underlying assumptions, and adapt accordingly to changing circumstances that could otherwise impact the contributions of the Update in advancing Reddish Egret conservation.

Funding, as affects the availability of people and resources to conduct conservation work, is *the* chief constraint limiting enactment of all of the activities and recommendations outlined in this plan. While not outlined as an explicit objective here, the Working Group must proactively influence the availability of funding not only in furthering efforts in support of the Update's goals, but to enhance the Working Group's capacity to effectively guide and coordinate them. This may be accomplished through:

- communicating and promoting funding opportunities
- assisting with proposal development for competitive grant programs
- championing investment needs identified in the respective Business Plans for the Conservation of Reddish Egret in Mexico (Álvarez et al. 2018), and the United States (Tarbox et al. 2020)
- lobbying for organizational resources in support of the Update and Working Group, and
- leveraging scientific information into compelling arguments for Reddish Egret conservation and wetland conservation efforts.

Active Steering and sub-committees will help coordinate and drive implementation of the Update's ambitious recommendations Gary Levins, Creative Commons

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APPENDIX A

REDDISH EGRET BREEDING COLONIES IN THE BAHAMAS, BELIZE, CUBA, MEXICO, AND THE UNITED STATES

Appendix A compiles current information, as of preparation of this plan, regarding the site locations and corresponding management units of extant breeding colonies of Reddish Egrets as determined by individual surveys and monitoring throughout the range. Colony locations from elsewhere in the breeding range are either unknown, insufficiently monitored, or otherwise unavailable for inclusion in this plan.

Country	Province/Region/State	Colony (Site)	Mgt. Unit	Latitude	Longitude
Bahamas	Bimini	BI11	Eastern	25.7272	-79.2961
Bahamas	Grand Bahama	GB13	Eastern	26.8203	-77.9342
Bahamas	Grand Bahama	GB15	Eastern	26.7326	-78.0301
Bahamas	Grand Bahama	GB16	Eastern	26.7586	-77.9352
Bahamas	Grand Bahama	GB19	Eastern	26.5210	-77.8101
Bahamas	Great Inagua	Lake Rosa	Eastern	21.0800	-73.5000
Belize	Northern Belize	Cayo Pajaros	Central	18.0487	-87.9696
Belize	Northern Belize	Los Salones	Central	17.9581	-88.1046
Belize	Northern Belize	Wildtracks Lagoon	Central	18.3311	-88.1034
Cuba	Camaguey	Cayo Fogoncito	Eastern	22.0867	-77.7317
Cuba	Camaguey	Cayo Grillo	Eastern	22.0594	-77.6936
Cuba	Camaguey	Rio Maximo	Eastern	21.7050	-77.5117
Cuba	Ciego de Avila	Cayo Kiko	Eastern	22.2514	-77.9150
Cuba	Ciego de Avila	Cayo Romano	Eastern	22.1764	-77.9769
Cuba	Granma	Birama	Eastern	20.5436	-77.0392
Cuba	Granma	Laguna Caguaras	Eastern	20.7044	-77.2589
Cuba	Granma	Laguna de Jobabito	Eastern	20.6822	-77.2831
Cuba	Matanzas	Las Salinas	Eastern	22.1097	-81.2828
Cuba	Pinar del Rio	Cayos de San Felipe	Eastern	21.9833	-83.6333
Cuba	Sancti Spiritus	Cayo La Gloria	Eastern	22.4797	-78.6347
Cuba	Sancti Spiritus	Cayo Las Palmas	Eastern	22.1928	-78.9136
Cuba	Villa Clara	Cayo Fragoso	Eastern	22.7100	-79.4655
Mexico	Baja California	Isla Montague	Western	31.6897	-114.6895
Mexico	Baja California	Isla San Luis	Western	29.9559	-114.4120
Mexico	Baja California	Isla San Martín	Western	30.4900	-116.1160
Mexico	Baja California	Isla Todos Santos Sur	Western	31.8037	-116.7916
Mexico	Baja California	Islote Coronadito	Western	29.0971	-113.5295
Mexico	Baja California	Islote Guadalupe	Western	29.1670	-113.6075
Mexico	Baja California Sur	Barra Boca de La Soledad	Western	25.2560	-112.1230
Mexico	Baja California Sur	Canal Las Higuerillas	Western	27.9660	-114.0760
Mexico	Baja California Sur	Estero del CETMAR	Western	24.1430	-110.3478
Mexico	Baja California Sur	Estero El Cardon	Western	26.8019	-113.1470
Mexico	Baja California Sur	Estero El Conchalito	Western	24.1404	-110.3466
Mexico	Baja California Sur	Estero El Coyote	Western	26.8102	-113.4693
Mexico	Baja California Sur	Estero El Dátil	Western	26.4902	-112.8787
Mexico	Baja California Sur	Estero El Zacatal	Western	24.1169	-110.3499
Mexico	Baja California Sur	Estero La Bocana	Western	26.7740	-113.6585
Mexico	Baja California Sur	Estero Puerto Magdalena (I. Magdalena)	Western	24.6597	-112.1403
Mexico	Baja California Sur	Estero San Carlos (SFS)	Western	24.7808	-112.0929
Mexico	Baja California Sur	Estero San Lazaro (I. Magdalena)	Western	24.7995	-112.2688
Mexico	Baja California Sur	Isla Alambre	Western	27.7411	-114.2414
Mexico	Baja California Sur	Isla Ana I	Western	26.7126	-113.1699
Mexico	Baja California Sur	Isla Ana II	Western	26.7203	-113.1818
Mexico	Baja California Sur	Isla Concha	Western	27.8246	-114.2328
Mexico	Baja California Sur	Isla Pelícanos (sección norte)	Western	26.9280	-113.1609
Mexico	Baja California Sur	Isla Pelícanos (sección sur)	Western	26.9036	-113.1633
Mexico	Baja California Sur	Isla Piedra	Western	27.7013	-114.1538
Mexico	Baja California Sur	Isla Santa Margarita	Western	24.3799	-111.7069
Mexico	Baja California Sur	Islote cerca de Boca Las Animas	Western	25.5302	-112.0875
Mexico	Baja California Sur	Puerto San Carlos (API)	Western	24.7890	-112.1131
Mexico	Chiapas	La Polka	Central	15.9704	-93.6830
Mexico	Oaxaca	Isla Pajaros	Central	16.1272	-94.1177
Mexico	Quintana Roo, Isla Mujeres	Caleta Cocopatos	Central	21.5053	-86.8018
Mexico	Quintana Roo, Isla Mujeres	Isla Morena	Central	21.5178	-87.3207
Mexico	Quintana Roo, Isla Mujeres	Isla Pasión	Central	21.5015	-87.3888
Mexico	Quintana Roo, Isla Mujeres	Laguna de Las Garzas	Central	21.4651	-86.7987
Mexico	Quintana Roo, Isla Mujeres	Río Bomba	Central	21.4319	-87.2157
Mexico	Quintana Roo, Tulum	Islote San Miguel	Central	19.9667	-87.4818
Mexico	Quintana Roo, Tulum	Laguna Campechen	Central	20.1128	-87.4948
Mexico	Sinaloa	Isla El Mero	Western	25.0981	-108.2514
Mexico	Sinaloa	Isla Las Tunitas 1	Western	25.0863	-108.2359
Mexico	Sinaloa	Isla Las Tunitas 2	Western	25.0978	-108.1371
Mexico	Sinaloa	Isla Meléndrez	Western	24.8013	-108.0585
Mexico	Sinaloa	Isla Ohuira	Western	25.4920	-108.8125
Mexico	Sinaloa	Isla Pajaros	Western	25.3760	-108.7013
Mexico	Sinaloa	Isla Patos	Western	25.6222	-109.0113
Mexico	Sinaloa	Las Calabazas	Western	24.4659	-107.5501
Mexico	Sonora	Estero La Cruz (Islote)	Western	28.7936	-111.9150

Country	Province/Region/State	Colony (Site)	Mgt. Unit	Latitude	Longitude
Mexico	Sonora	Estero La Cruz (Manglar)	Western	28.7956	-111.9156
Mexico	Sonora	Estero La Luna	Western	27.8356	-110.5710
Mexico	Sonora	Isla Alcatraz	Western	28.8171	-111.9654
Mexico	Sonora	Isla Huivulai Norte	Western	27.0798	-110.0040
Mexico	Sonora	Isla Huivulai Sur	Western	27.0249	-109.9416
Mexico	Sonora	Isla Tiburón Punta Mala	Western	29.2197	-112.2848
Mexico	Tamaulipas	Isla la Vaca	Central	25.4255	-97.4936
Mexico	Tamaulipas	Unnamed	Central	24.5575	-97.6746
Mexico	Tamaulipas	Unnamed	Central	24.5596	-97.6749
Mexico	Tamaulipas	Unnamed	Central	24.6157	-97.6784
Mexico	Tamaulipas	Unnamed	Central	24.6169	-97.6856
Mexico	Tamaulipas	Unnamed	Central	24.6200	-97.6877
Mexico	Tamaulipas	Unnamed	Central	24.7068	-97.6485
Mexico	Tamaulipas	Unnamed	Central	24.7698	-97.6226
Mexico	Tamaulipas	Unnamed	Central	24.9928	-97.6873
Mexico	Tamaulipas	Unnamed	Central	24.9947	-97.6002
Mexico	Tamaulipas	Unnamed	Central	25.0501	-97.7091
Mexico	Tamaulipas	Unnamed	Central	25.2213	-97.4779
Mexico	Tamaulipas	Unnamed	Central	25.2487	-97.6750
Mexico	Tamaulipas	Unnamed	Central	25.2843	-97.6147
Mexico	Tamaulipas	Unnamed	Central	25.3180	-97.4497
Mexico	Tamaulipas	Unnamed	Central	25.3346	-97.4392
Mexico	Tamaulipas	Unnamed	Central	25.3983	-97.4253
Mexico	Yucatan, Progreso	La Carbonera	Central	21.2202	-89.8976
Mexico	Yucatan, Progreso	La Marca	Central	21.1982	-89.9465
Mexico	Yucatan, Progreso	Paso del Tigre	Central	21.1257	-84.1434
USA	Alabama	Cat Island	Central	30.3209	-88.2102
USA	Florida	Alligator Lake Bird Island	Eastern	27.9811	-82.6989
USA	Florida	Arsenicker Key	Eastern	25.3966	-80.2866
USA	Florida	Banana North #1	Eastern	28.5146	-80.6062
USA	Florida	Banana South #4	Eastern	28.4875	-80.6209
USA	Florida	Belleair Beach	Eastern	27.9132	-82.8422
USA	Florida	Big Island	Eastern	28.6089	-80.6601
USA	Florida	Boca Grande	Eastern	24.5368	-82.0052
USA	Florida	Bonita Bay North Island	Eastern	26.3431	-81.8239
USA	Florida	Brews Key	Eastern	25.0437	-80.7122
USA	Florida	Budd NW	Eastern	24.7211	-81.5122
USA	Florida	Central Bob Allen Key	Eastern	25.0319	-80.6784

Country	Province/Region/State	Colony (Site)	Mgt. Unit	Latitude	Longitude
USA	Florida	Central Jimmie	Eastern	25.0493	-80.6471
USA	Florida	Clearwater Harbor I-25 Bird Islad	Eastern	27.9660	-82.8147
USA	Florida	Coffeepot Bayou	Eastern	27.7915	-82.6241
USA	Florida	Cortez Key Bird Sanctuary	Eastern	27.4622	-82.6828
USA	Florida	Coupon Bite Mangrove	Eastern	24.6556	-81.3473
USA	Florida	Crane Key (Lower Keys)	Eastern	24.7546	-81.5132
USA	Florida	Cudjoe Key Mangrove	Eastern	24.6986	-81.4961
USA	Florida	Duck Key	Eastern	25.1801	-80.4894
USA	Florida	Eagle Key	Eastern	25.1680	-80.5963
USA	Florida	Galdin 3	Eastern	24.7005	-81.5955
USA	Florida	Green Heron Mangroves	Eastern	24.7317	-81.5073
USA	Florida	Happy Jack	Eastern	24.6857	-81.5686
USA	Florida	Happy Jack Kiss	Eastern	24.6854	-81.5758
USA	Florida	Howell Key Mangrove	Eastern	24.6699	-81.4296
USA	Florida	Lil 1st Mate	Eastern	25.0268	-80.6469
USA	Florida	Little Money Key	Eastern	24.6855	-81.2267
USA	Florida	Little Saddlebunch #5	Eastern	24.6045	-81.6210
USA	Florida	Lost River	Eastern	27.6916	-82.4977
USA	Florida	Lower Sugarloaf Sound	Eastern	24.6243	-81.5723
USA	Florida	Johnston Key Mangroves SE	Eastern	24.7097	-81.5785
USA	Florida	Manbirtee Key	Eastern	27.6359	-82.5740
USA	Florida	Mangrove Key	Eastern	25.3945	-80.3160
USA	Florida	Marco ABCs "A" west	Eastern	25.9580	-81.7059
USA	Florida	Marco ABCs "B" middle	Eastern	25.9566	-81.7040
USA	Florida	Marco ABCs "C" east	Eastern	25.9555	-81.7012
USA	Florida	Miguel Bay	Eastern	27.5710	-82.5993
USA	Florida	Mullethead Island	Eastern	28.7262	-80.7701
USA	Florida	Niles Channel Mangrove	Eastern	24.7114	-81.4472
USA	Florida	North Nest Key	Eastern	25.1501	-80.5092
USA	Florida	Palm Key	Eastern	25.1173	-80.8809
USA	Florida	Picnic Key Mangrove SE	Eastern	24.6336	-81.3931
USA	Florida	Pine Channel Mangrove SE	Eastern	24.7072	-81.3977
USA	Florida	Porjoe Key	Eastern	25.1378	-80.4730
USA	Florida	Richard T. Paul Alafia Bank	Eastern	27.8470	-82.4176
USA	Florida	Roberts Bay Bird Island	Eastern	27.2946	-82.5445
USA	Florida	Sandy Key	Eastern	25.0347	-81.0140
USA	Florida	Snake Key	Eastern	29.0964	-83.0309
USA	Florida	Stake Key	Eastern	25.0594	-80.5861

Country	Province/Region/State	Colony (Site)	Mgt. Unit	Latitude	Longitude
USA	Florida	St Joseph Sound Marker 26	Eastern	28.0755	-82.7999
USA	Florida	Tank Island	Eastern	28.7031	-80.7979
USA	Florida	Three Rooker Bar State Park	Eastern	28.1106	-82.8370
USA	Florida	Torch Key Mangrove N	Eastern	24.7413	-81.4702
USA	Florida	Torch Key Mangrove SW	Eastern	24.7332	-81.4730
USA	Florida	Upper Sugarloaf Sound	Eastern	24.6426	-81.5460
USA	Florida	Useppa Broken Island North	Eastern	26.6755	-82.1942
USA	Florida	Water Key Mangrove (cluster) 3	Eastern	24.7469	-81.3458
USA	Florida	White Pelican Island	Eastern	26.7905	-82.2463
USA	Louisiana	Belle Isle	Central	29.5744	-89.5733
USA	Louisiana	Brush Island	Central	30.0333	-89.1833
USA	Louisiana	Chandeleur Island	Central	29.7627	-88.8755
USA	Louisiana	Dry Bread Island	Central	29.8419	-89.3089
USA	Louisiana	East Bank Belle Pass	Central	29.1024	-90.2151
USA	Louisiana	East Grand Terre	Central	29.3042	-89.8844
USA	Louisiana	Eastern New Harbor Islands	Central	29.8500	-88.8667
USA	Louisiana	Elmer's	Central	29.1878	-90.0571
USA	Louisiana	Lake Du Diable	Central	29.2647	-90.4450
USA	Louisiana	Martin Island	Central	29.9667	-89.2000
USA	Louisiana	North Breton Island	Central	29.4986	-89.1725
USA	Louisiana	North Island	Central	29.8770	-88.8760
USA	Louisiana	North Point of North Islands	Central	29.8833	-88.8667
USA	Louisiana	Queen Bess	Central	29.3000	-89.9500
USA	Louisiana	Rabbit Island	Central	29.8484	-93.3834
USA	Louisiana	Raccoon	Central	29.0494	-90.9342
USA	Louisiana	Shallow Bayou	Central	29.1437	-90.3469
USA	Louisiana	Unnamed	Central	29.2214	-90.0439
USA	Louisiana	Unnamed	Central	29.3864	-91.3838
USA	Louisiana	Unnamed	Central	29.5042	-89.5306
USA	Louisiana	Unnamed	Central	29.5303	-89.5419
USA	Louisiana	Unnamed	Central	29.6833	-89.4667
USA	Louisiana	Unnamed	Central	29.8978	-89.3003
USA	Louisiana	Unnamed	Central	29.9208	-89.2625
USA	Louisiana	Unnamed	Central	29.9236	-89.3453
USA	Louisiana	Whiskey	Central	29.0556	-90.8036
USA	Texas	Aransas Channel Spoil	Central	27.8950	-97.1178
USA	Texas	Aransas Refuge Spoil	Central	28.1919	-96.8328
USA	Texas	Arroyo Colorado Spoil	Central	26.3328	-97.3150

Country	Province/Region/State	Colony (Site)	Mgt. Unit	Latitude	Longitude
USA	Texas	Ballou Island	Central	28.1239	-96.8789
USA	Texas	Big Bayou Spoil	Central	27.9339	-97.0858
USA	Texas	Big Bird Island	Central	28.2769	-96.7358
USA	Texas	Bird Island Marker 43 (North of)	Central	27.5300	-97.2908
USA	Texas	Bird Island North	Central	27.5200	-97.2908
USA	Texas	Bird Island South	Central	27.4919	-97.3058
USA	Texas	Bird Island South (South of)	Central	27.4889	-97.3128
USA	Texas	Causeway Islands	Central	27.6600	-97.2289
USA	Texas	Causeway Island Platforms	Central	27.9308	-97.0978
USA	Texas	Cedar Lakes	Central	28.8450	-95.4919
USA	Texas	Colorado River Delta	Central	28.6489	-95.9897
USA	Texas	Copano Rattlesnake Point	Central	28.0569	-97.1322
USA	Texas	Copano Shell Island	Central	28.0978	-97.0519
USA	Texas	Danger Island	Central	27.9078	-97.1258
USA	Texas	Dead Pecker Hill	Central	26.0439	-97.2058
USA	Texas	DM31-34 (NM65-74)	Central	27.5658	-97.2769
USA	Texas	Dog Reef Islands	Central	28.6300	-96.0000
USA	Texas	Dressing Point	Central	28.7308	-95.7600
USA	Texas	East Arroyo Spoil	Central	26.3528	-97.2808
USA	Texas	East Flats Spoil	Central	26.7219	-97.4269
USA	Texas	East Marker 265 Spoil	Central	26.6358	-97.3850
USA	Texas	East Shore Spoil	Central	27.8508	-97.1189
USA	Texas	Green Hill Spoil Island	Central	26.5139	-97.3969
USA	Texas	Green Island	Central	26.3919	-97.3250
USA	Texas	Green Island Spoils	Central	26.4100	-97.3169
USA	Texas	Hog Island Complex	Central	27.8978	-97.1050
USA	Texas	Kennedy Causeway Islands	Central	27.6328	-97.2669
USA	Texas	Laguna Vista Spoil	Central	26.1219	-97.2628
USA	Texas	Little Bay	Central	28.0328	-97.0369
USA	Texas	Long Reef - Deadman Islands	Central	28.0650	-96.9628
USA	Texas	Mansfield Int NE	Central	26.5639	-97.4000
USA	Texas	Mansfield Int SW	Central	26.5528	-97.4108
USA	Texas	Mansfield Odd Spoil	Central	26.6558	-97.3900
USA	Texas	Marker 37 - 38 Spoil NM 79	Central	27.5539	-97.2858
USA	Texas	Marker 63-65 Spoil (NM 127-131)	Central	27.4519	-97.3308
USA	Texas	Marker 69 Spoil (NM 141)	Central	27.4328	-97.3408
USA	Texas	Marker 77A Spoil Island (NM 155)	Central	27.4022	-97.3575
USA	Texas	Marker 81 Spoil Island (NM 163)	Central	27.3889	-97.3639

Country	Province/Region/State	Colony (Site)	Mgt. Unit	Latitude	Longitude
USA	Texas	Marker 85 A Spoil Island (NM 165)	Central	27.3797	-97.3689
USA	Texas	Marker 91 Spoil Island	Central	27.3489	-97.3819
USA	Texas	Marker 103-117 Spoil (NM 207-221)	Central	27.2989	-97.4028
USA	Texas	Marker 139-155 Spoil (19-35)	Central	27.2319	-97.4178
USA	Texas	Matagorda Bay Spoil 39-51	Central	28.5308	-96.4669
USA	Texas	Matagorda Island Heron Colony	Central	28.1300	-96.8000
USA	Texas	Naval Air Station Islands	Central	27.6739	-97.2428
USA	Texas	Nueces Bay East	Central	27.8569	-97.3608
USA	Texas	Nueces Bay West	Central	27.8578	-97.4900
USA	Texas	Padre Island Spoil	Central	27.1608	-97.4019
USA	Texas	Pelican Island Spoil	Central	27.8200	-97.1589
USA	Texas	Pita Island / Humble Channel	Central	27.6039	-97.2728
USA	Texas	Port Isabel Spoil	Central	26.1189	-97.2239
USA	Texas	Ransom Spoil	Central	27.8758	-97.1358
USA	Texas	Seadrift Island	Central	28.3978	-96.7400
USA	Texas	Second Chain of Islands	Central	28.1928	-96.8150
USA	Texas	Shamrock Island	Central	27.7600	-97.1689
USA	Texas	Skimmer Island	Central	27.8636	-97.4897
USA	Texas	South Baffin Bay Island	Central	27.2489	-97.4139
USA	Texas	South Land Cut	Central	26.7750	-97.4608
USA	Texas	Steamboat Island and Spoil	Central	28.3100	-96.6200
USA	Texas	Stedman Island	Central	27.8869	-97.1158
USA	Texas	Sundown Island	Central	28.4528	-96.3458
USA	Texas	The Hole	Central	27.1669	-97.4289
USA	Texas	Third Chain of Islands	Central	28.1489	-96.8728
USA	Texas	Three Island Spoil	Central	26.2458	-97.2789
USA	Texas	Three Islands South	Central	26.2728	-97.2750
USA	Texas	Turnstake / Turnstake Spoil	Central	28.3089	-96.6839
USA	Texas	West Harbor Island	Central	27.8369	-97.1269
USA	Texas	Yarborough Pass	Central	27.2208	-97.4100
USA	Texas	Yarborough Pass North (NM 37-39)	Central	27.2058	-97.4219
USA	Texas	Yarbourough Pass South (NM 41-47)	Central	27.1958	-97.4250

APPENDIX B

THREAT EFFECTS ON REDDISH EGRETS AND THEIR HABITAT

CLIMATE CHANGE RELATED – VERY HIGH

(SEA LEVEL RISE, STORMS AND COASTAL FLOODING)

Effects on Reddish Egrets: The direct effects on Reddish Egrets from increased frequency and intensity of storm events as a function of accelerating climatic shifts are difficult to anticipate, but expected to be isolated in time and space. The most severe impacts of large storm events such as hurricanes tend to be localized, and stronger storms tend to occur late in the breeding season or after its conclusion. Eggs, chicks, and young birds confined to the nest would have higher susceptibility to destruction from intense storms, whereas adults and flighted juveniles are presumably more capable of seeking shelter and escaping injury. Data from telemetered juveniles (Geary et al. 2015) and adults (K. Meyer, unpubl. data) indicate that flighted Reddish Egrets often survive even powerful hurricane events. Potential for injury or mortality would be tied closely to the regularity and severity of storm events overall, and the degree to which populations might be impacted in the long term is not easily evaluated. However, the impacts are not presumed to be appreciable by themselves, but could interact synergistically with other threats to exacerbate potential population impacts.

Effects on Breeding Habitat: Even with < 1m rise in sea level (IPCC 2014), most of the current breeding sites used by the species in the Eastern and Central Management Units (e.g., dredged material islands, keys), and many in the Western Management Unit, would be permanently inundated. Such impacts are essentially irreversible, although coastal engineering projects to control erosion and strategically place spoil material could slow the rate and scale of disappearance. In the Central Management Unit, subsidence (natural and anthropogenic) and reduced freshwater input into bays and estuaries are additional factors that magnify problems associated with sea level rise (Turner 1990, Rybczyk and Cahoon 2002, Jankowski et al. 2017). Along the Louisiana and upper Texas coasts, increasing subsidence rates are predicted to raise the relative sea level (Twilley et al. 2001), further reducing the amount of foraging habitat and inundating nesting islands. In the Western Management Unit, availability of mangrove islands in proximity to nesting colonies on the Pacific Coast could provide suitable refugia for Reddish Egrets forced to seek more elevated nesting substrates, thus potentially mitigating near-term severity and irreversibility of impacts to breeding colonies from rising sea levels. However, the largest colony within Ojo de Liebre wetlands is on a low elevation island with no mangrove islands or other suitable nesting sites in the adjacent wetlands.

Increased intensity and possibly, frequency, of storms related to global climate change (Emanuel 2005, Webster et al. 2005, Hoyos et al. 2006) will contribute to the destruction and degradation of breeding habitats. Almost all coastal areas are extremely vulnerable to damage and destruction from storm surge, and sites such as barrier islands and dredge material spits used by Reddish Egrets may be completely overwashed and eroded. Hurricanes can damage mangroves (see Green et al. 2011) and other nesting substractes that can take many years to recover. Combined with the risks of rising seas (and concomitantly, subsidence), the potential for increasingly regular and severe coastal storms to cause locally severe and possibly catastrophic damage to important breeding sites/habitats is very real.

Effects on Foraging Habitat: Sea level rise is expected to result in widespread loss of shallow foraging areas throughout the range of the Reddish Egret, especially in areas where shorelines cannot migrate inland owing to developed and dramatically altered near coastal environments (Enwright et al. 2016, Borchert et al. 2018). The effects of sea level rise are anticipated to be highly severe and irreversible, though there may be mitigating factors. For example, human created salt ponds (for evaporation and salt production) may afford locally available alternatives for foraging egrets despite lacking potential to substantively offset loss of natural habitats on the whole. Similarly, constructed artificial islands within production salt ponds could present viable alternative nesting sites for Reddish Egrets that may have lost traditional colonty sites to inundation.

Additionally, there will presumably be instances where rising sea levels could enhance foraging habitats, at least locally or periodically, e.g., as a function of altered elevation, hydrology, patterns of inundation, or even new management opportunities. However, whether and to what degree increases in mean sea level precipitate the formation of new natural or artificial foraging areas (or breeding sites) remains dubious relative to the irreversible deterioration in availability and quality of foraging habitats overall.

As with effects on breeding habitat and birds per se, storm events may also temporarily permanently affect the quality and availability of foraging habitat. For example, high winds generate turbidity, impeding conditions for visual, shallow water foragers such as Reddish Egrets. Nest failures of Reddish Egrets in the Florida Keys often occur after storms with heavy or sustained winds which result in more turbid water for several days (Tom Wilmers, pers. comm.). Absent more rigorous study, however, it is assumed that this threat, though widespread in scope, is low in severity and naturally reverses itself. More permanent alteration or destruction of foraging habitats from winds, wave action, surge, and overwash associated with more frequent and intense storms are expected to be more pervasive and severe.

COASTAL DEVELOPMENT – HIGH

Effects on Breeding Habitat: Widepsread human encroachment and development are long-standing threats to natural environments in coastal areas, directly eliminating or reducing available habitats for Reddish Egrets and indirectly altering quality and suitability of those that remain. In the U.S., much of the losses have already occurred, although development pressures along the Gulf of Mexico remain more persistent. Most breeding colonies along the U.S. Gulf Coast are in locations not well suited for development (small natural or dredged material islands) or are already under some form of protected status (e.g., nature reserve, wildlife refuge, private ranch). [Note that human disturbance, discussed later, may remain a threat even at protected sites]. Similarly, many of the major colonies on the Gulf of Mexico and Caribbean coasts of Mexico are in protected status, as is the colony on Great Inagua in Bahamas (National Park). Consequently, development for residential or commercial use is not deemed to be a direct threat to most breeding habitat in the Eastern and Central Management Units, although where it does occur it can have severe impacts. Exceptions include the Yucatan region, as well as all of the colonies in Oaxaca and Chiapas, none of which are protected, including the largest colony on Isla Pájaros in Oaxaca. And within Cuba, coastal development is an ongoing threat as increasing demands for energy and tourism are forecasted to continue. Any future slackening of U.S. restrictions on American trade with Cuba could further precipitate additional development pressures on coastal environments there. In the Western Management Unit breeding habitat is felt to be more broadly vulnerable to coastal development (e.g., residential and resort construction) due to the lesser degree of protections across western colony sites. The impacts of development, where it involves present or potential availability of future nesting sites, are highly severe and largely irreversible.

Effects on Foraging Habitat: Residential and commercial development can result in altered hydrology, such as the filling or channeling of shallow waters to increase surface area for building or to improve access into developable areas. This threat is presumed to remain somewhat localized throughout the Western and Eastern Management Units, but a bit more widespread in the Central Management Unit, especially in Mexico. Moreover, because of the importance of tidal mangrove creeks in areas where flats are less extensive (i.e., the Yucatan), loss of any mangroves signifies a corresponding loss of important foraging habitat. In all cases, loss or degradation of foraging habitat to development is considered highly irreversible. Note that development for some land uses, such as the creation of salt ponds associated with production facilities, can provide suitable foraging habitat (and breeding habitat, if creation of nesting islands is included) and should be exploited as opportunities to support Reddish Egret conservation.

COASTAL ENGINEERING – HIGH

Effects on Breeding Habitat: Coastal engineering projects occur throughout the range of Reddish Egrets, but are currently considered a significant threat only in the U.S. portions of the Central Management Unit. Typically, these activities do not convert or destroy breeding habitats outright, but may do so or otherwise impact them indirectly. For example, channel dredging to deepen waterways for shipping or industry may exacerbate rates of erosion at breeding sites through changes in downstream flow and deposition (Williams 1999). Inappropriate placement of dredge spoil can diminish suitability of breeding habitats by creating land bridges or facilitating changes in vegetation that attract or provide access to mammalian and other nest predators. Changes in predator presence or abundance can influence (e.g. moderate) survival, productivity, and propensity of adult wading birds to avoid or abandon affected sites. Severity is low because Reddish Egret populations do not seem to be significantly constrained by coastal engineering impacts at breeding sites overall. Irreversibility of impacts, however, is considered high, although moderated somewhat, especially on the Gulf of Mexico, by hurricanes and other storms that can redistribute sediments, breach land bridges, and damage engineering infrastructure. In addition, some of the potential negative implications associated with coastal engineering activities can be offset with intentional creation of breeding habitat (spoil islands) via beneficial deposition of dredge materials (Soots and Landin 1978, Erwin et al. 2003).

Effects on Foraging Habitat: Hydrologic changes from coastal engineering activities (e.g., increase in water depth, substrate damage to tidal flats) and secondary impacts such as decreased water quality (Caldwell 1985, Onuf 1994) may render foraging habitat suboptimal to unsuitable. The adverse effects of coastal engineering on Reddish Egret foraging habitat are expected to be widespread in all management units, but particularly so in Florida, which comprises the bulk of the Eastern Management Unit where the scope and intensity of coastal engineering is viewed as more severe. Reversing or ameliorating coastal engineering impacts to foraging habitats is expensive in all locations, but not impossible especially if natural processes favor formation of tidal flats.

HUMAN DISTURBANCE – MODERATE

Effects on Reddish Egrets and Habitats: The coastal areas used by Reddish Egrets, even those in protected areas, are often frequented by humans for recreational uses such as fishing, crabbing, boating, beach-going, dog walking, exercising, and bird-watching. While seemingly innocuous, disturbance from such activities – individually or in sum – can make breeding and foraging habitats less suitable or available, can increase susceptibility to exposure or mortality (e.g., eggs and young at nests), and undoubtedly can impact the physiology and condition of birds (e.g., flushing, vigilance, decreased foraging efficiency). Many protected sites lack sufficient enforcement of access restrictions and other safeguards intended to deter disturbance of breeding and foraging waterbirds, including Reddish Egrets. Deficiencies in enforcement presence may render these sites functionally unprotected from disturbance impacts. Recreational boating can be a particular problem given the access afforded to otherwise isolated or protected areas. Dredge material islands, for example, can be important habitats for Reddish Egrets yet are becoming increasingly popular among recreational boaters who may anchor for extended periods, explore on foot, bring unrestrained pets, etc.

By dispersing adult birds, human disturbance at breeding sites increases susceptibility of eggs and young to hypo- or hypothermia, and predation by gulls (*Leucophaeus atricilla, Larus* spp.), grackles (*Quiscalus* spp.), and crows (*Corvus* spp.; Tremblay and Ellison 1979, Carney and Sydeman 1999, Bouton et al. 2005). Disturbance can also cause abandonment of active nests (Bouton et al. 2005), increased stress or energy expenditure (Bouton et al. 2005), and reduced use or entire abandonment of colony sites (Tremblay and Ellison 1979, Muller and Glass 1988). The traditional collection of eggs and nestlings at breeding colonies, such as in Mexico (e.g., Chiapas, Oaxaca, Tamaulipas, Sinaloa), where they are used for human consumption or for bait in the blue crab (*Callinectes sapidus*) fishery is also considered disturbance for the purposes of this plan. In addition to mortality on removed individuals, collecting activities can be disruptive to other nests/nesting throughout the colony.

The scope of human disturbance was rated high, affecting the majority of the distribution, and the severity was considered sufficient to reduce affected populations by as much as 30%. While it follows that populations can absorb some level of disturbance impacts (e.g., relocating or renesting after failed nests or nest abandonment, habituation), it is difficult to quantify exactly how populations respond to disturbance impacts cumulatively,

over what time frames, and through what mechanisms. Functionally, disturbance effects are considered easily reversed or abated. For example, when disturbances are appropriately controlled, birds can readily return to normal behavior and/or access previously impacted habitats once disturbance ceases. Foraging birds may even habituate to modest levels of disturbance where otherwise undisturbed expanses would be favored. However, in practice, logistics, costs and public sentiment greatly limit feasibility in more effectively controlling disturbance, thus irreversibility is deemed high. This applies in areas highly popular for recreational use where any signage and education must be supplemented by regulation or law enforcement, and especially in areas where traditional, but unlawful consumptive uses occur.

Ranching and Agriculture – Moderate

Effects on Breeding Habitat: In the Laguna Madre of Tamaulipas, Mexico, Reddish Egret nesting habitat is under threat of alteration and degradation as some breeding islands are occasionally used for livestock production or other agricultural related industries (e.g., removal of woody vegetation for constructing shrimp harvesting tools). These activities are related to both local subsistence as well as more commercially oriented ventures, even though the islands are designated as federally protected. This threat was rated as low for the Central Management Unit, because its extent is limited to the southern Laguna Madre in Mexico, with high severity and moderate irreversibility. Management plans are in place for the affected islands, which are federal Natural Protected Areas, but implementation of these plans must be improved.

Marine Vessels – Moderate

Effects on Habitats: Wakes created by marine vessels can cause erosion of islands and shorelines (Nanson et al. 1994, Maynord 2005, Houser 2010, Zaggia et al. 2017). Large commercial ships in shipping channels produce stronger and more disruptive wakes, but recreational boats are more abundant and often operate in much closer proximity to vulnerable nesting and foraging habitats. In addition to wake impacts, boating traffic through shallow foraging habitats can lead to propeller scarring, turbidity, and other alterations, but these effects have not been well studied. The threat of wake erosion from marine vessels is widespread in the Eastern and Central Management Units where severity is moderate and high, respectively. Irreversibility is high because of the cost of abatement and erosion control projects.

Energy Infrastructure & Development – Moderate

Effects on Reddish Egrets: Energy infrastructure poses a threat to individual birds through collisions, as well as the ever present potential for contamination, fouling and poisoning discussed elsewhere in this Appendix (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016). Tracking studies of Reddish Egrets by Koczur et al (2018b) indicated that 3 of 21 tracked individuals died in areas of wind facilities, although specific cause of mortality was not determined (Bart Ballard, unpublished data). Considering the scarcity of evidence of direct mortality, this threat was rated as low in scope, moderate severity and high irreversibility (given the challenges in removing or mitigating the dangers of infrastructure). Collision risk is expected to increase as surges in renewable energy infrastructure, primarily wind, are planned throughout many coastal regions. Turbine rotors and transmission lines associated with wind developments both present collision potential.

Effects on Habitats: In parts of the Reddish Egret range, habitats are pockmarked from a legacy of oil and gas exploitation, including in-use and abandoned structures, canals and well pads. The potential for environmental contamination of habitats through release of pollutants is an ever-present risk (see later). There is an expanding effort to develop renewable energy sources including onshore and offshore wind power, which may not only pose direct risk to birds (see above) but may also detract from the real or perceived suitability of adjacent habitats, either structurally, or seconarily as a function of food resource availability and increased human traffic and presence (i.e., during both development and operation/maintenance). Development of wind energy is most notable in the Central Management Unit, which includes much of the Gulf of Mexico in the U.S. and Mexico, the Yucatan Peninsula, and the southern Pacific Coast of Mexico. For example, areas around the large breeding colonies in Oaxaca, Mexico are under intensive wind development pressure, including on the

long sandbar that separates the Lagunas Superior and Inferior on the Gulf of Tehauantepec. Additionally, first offers for offshore wind leases in U.S. federal waters along the Gulf of Mexico are expected in 2022-2023. Both breeding sites and foraging habitats may be impacted, including the potential to impact habitats that might otherwise have become suitable or available with rising sea levels.

Interest in wind energy development is influenced by wind potential, which is viewed by the industry as lower in eastern portions of the Reddish Egret range, and moderate in the central and western portions. These are relative terms, of course, and once built out, wind developments can pose similar impacts to birds or habitats regardless of the underlying wind potential. Nonetheless, in seeking to the broadly evaluate both the present and future scope of this potential threat, wind potential was used as a relative indicator. Severity ranks high (e.g., damage to shallow water hydrology, structural impediments to availability and use of habitats) and the effects are considered highly irreversible.

Environmental Contamination – Moderate

Effects on Reddish Egrets: The deleterious effects of large scale contamination events, such as oil spills, can be severe and cause significant mortality and lingering nonlethal impacts for coastal birds generally (e.g., Deepwater Horizon Natural Resource Damage Assessment Trustees. 2016). Reddish Egrets would certainly be among those species that are susceptible. However, contamination not associated with a major event can also pose chronic threats to wading bird populations. For example, plastics and other debris are readily ingested by wading birds (Francis et al. 2020) and can also entangle birds with both nonlethal and lethal consequences (reviewed by Ryan 2018). In addition, contaminants known to produce sublethal effects (e.g., embryonic deformities, delayed growth rates) have been found in wading birds within the Reddish Egret's range (Mora 1996a, 1996b, Spahn and Sherry 1999), but the sources and population-level effects of such contaminants are not well understood. There are few data specific to Reddish Egrets in the literature, but we expect that the risks associated with contaminants are similar among coastally dwelling wading bird species.

Effects on Foraging Habitat: There are few data to the effects of contaminants on Reddish Egret habitats specifically. Foraging areas would figure to have greater exposure to potential contamination than breeding sites due to a wider variety and greater extent of foraging habitats. It is widely understood that waterbirds readily bioaccumulate contaminants found in their prey, to the point that they are often identified as appropriate targets for monitoring environmental pollution (e.g., Burger and Gochfeld 2004, Ogden et al. 2014). As such, contamination of foraging habitat readily translates into discrete risks to the physiology, condition, productivity and/or survival of individual birds. Pollutants may also impact quality of waterbird foraging habitat by killing prey (e.g., Pain et al. 1998), or by reducing reproductive potential in prey species (Karels et al. 2003), thereby affecting abundance and availability.

Elevated Predation & Invasive Predators – Moderate

Effects on Reddish Egrets: Although adult egrets may be taken by many predators (crocodiles [*Crocodylus* spp.], Alligators [*Alligator mississipiensis*], and large raptors such as Bald Eagles (*Haliaeetus leucocephalus*)], the threats are much greater for eggs and flightless young. Mammals, birds, reptiles, and land crabs (*Ocypode* spp.) may eat unattended eggs and young. When nests are over water, Alligators, crocodiles, and scavenging fish take young when they fall from the nest. Unrestrained dogs and cats are problems, especially near areas of human settlement or where supplemental food is made available. Snakes, Raccoons (*Procyon lotor*), opossums (*Didelphis* spp.) and rats (*Rattus* spp.) are efficient climbers and common predators at all wading bird colonies, including those in mangroves or other trees.

Predation by itself may not be cause for concern, but the abundance of some predators (e.g., Raccoons, rats, crows) may increase in human dominated habitats because of increased availability of food, changes in land cover, and from the lack of apex predators (Crooks and Soulé 1999). In addition, an array of non-native predatory species continue to expand and establish. It is the elevated threat from new and unnaturally high (i.e., human-assisted) sources of predation that is of concern. The threat was rated as being widespread

throughout the range of Reddish Egret. Its severity was considered moderate, as the decreased productivity of affected colonies will constrain populations over time (i.e., 11 to 30%). Irreversibility is high. Predator control at scale is not cost-effective, and in many areas is neither practical nor effective. At some sites in Texas, adequate commitment of resources has reduced predation rates (e.g., Audubon Wardens patrolling at Green and Chester Islands).

Introduced Red Imported Fire Ants (*Solenopsis invicta*) have become a significant concern at Reddish Egret breeding sites along the Gulf of Mexico, and the Tawny Crazy Ant (*Nylanderia fulva*) is becoming established as a looming threat. Once a chick begins pipping, blood and fluid attract ants, which kill young birds before they are able to escape the egg. Evidence also exists that Red Imported Fire Ants are able to breach apparently intact eggshells (Seymour 2007). In Florida new threats include exotic reptiles such as Burmese Pythons (*Python bivittatus*), monitors (*Varanus* spp.), and Green Iguanas (*Iguana iguana*), all of which may prey on adults, eggs, and chicks. Also in Florida, introduced predatory fish may have negative impacts on communities of smaller fish that Reddish Egrets are known to prey upon (Harrison et al. 2013). In Cuba, rats have been documented in breeding colonies (A. Gonzalez, pers. obs.).

Threats to populations of Reddish Egret from invasive predators are of concern in scattered locations in the Eastern Management Unit, and more so in the Central Management Unit. However, the threat is assumed to be of low severity and reversible with relatively low cost. There are no data on invasive species threats for the Western Management Unit.

Habitat Alteration From Invasive Species – Low

Effects on Breeding Habitat: In addition to predation impacts discussed above, invasive exotic species can also affect habitat, making it less suitable or amendable to breeding in particular. At some sites in Texas, exotic grasses such as guineagrass (*Urochloa maxima*) and buffelgrass (*Pennisetum ciliare*) have encroached in areas of woody vegetation that previously provided substrate for Reddish Egret nesting. The invasive Cactus Moth (*Cactoblastis cactorum*), which entered Florida in 1989 and is moving quickly along both the U.S. Gulf of Mexico and Atlantic Coasts, threatens populations of *Opuntia* cacti that appear to be selected preferentially by some Reddish Egrets as a guard against predation. Loss of this nesting substrate might adversely affect Reddish Egret productivity, especially in Texas if it occurs in large colonies near the mainland where predation rates are relatively higher to begin with. Loss of cactus could increase exposure of nests and young. The threat of invasive grasses and potential impacts of Cactus Moths are considered of moderate scope and severity in the Central Management Unit, and low in the Eastern. It is reversible to some extent with modest investment (i.e., alternative nesting substrate).

AQUACULTURE AND SALT PRODUCTION – LOW

Effects on Habitats: Industrial shrimp production occurs mostly in Mexico. The construction of ponds, diversion of water and associated infrastructure (roads, utilities) can result in damage to mangroves (nesting habitat in Central Management Unit) and shallow waters (intertidal flats used for foraging in Central and Western Management Units.) Shrimp aquaculture already exists near the largest colony in the Yucatan, and in the coastal mudflats of Sinaloa, Sonora and Nayarit, Mexico. The threat rating varies by location from low to high in scope and low to moderate in severity. In all management units, irreversibility is rated as moderate, because flooding regimes set up for aquaculture can be manipulated to improve habitat conditions. It is possible that the channelization created for flooding shrimp ponds might result in benefits to Reddish Egret habitat if it forms shallowly flooded areas that serve as foraging habitat (Koczur et al. 2020).

Reddish Egrets have been documented using human-made salt pans (e.g. Guerrero Negro Solar Saltworks, Baja Mexico, and at Great Inagua, Bahamas) although the frequency of use and the potential threats at these sites are not well understood (Green et al. 2011, Palacios et al. 2018). Furthermore, it is unclear if human-made salt pans are a net threat (i.e., conversion of natural tidal flats to salt pans) or potentially a net benefit through their use by Reddish Egrets as foraging habitat.

APPENDIX C

INFORMATION NEEDS FOR REDDISH EGRETS AND THEIR HABITAT

Population Surveys & Monitoring Needs

Information on abundance, distribution and trends are lacking for some portions of the range (e.g,, parts of Caribbean, Central and South America), and elsewhere may be dated or incomplete. This information is typically gathered through surveys at breeding colonies, which afford the most practical opportunities for standardizing survey coverage and effort across sites and over time. As identified under Strategy 1, comprehensive rangewide surveys are needed to provide baseline status and trend data for the population within management units and across the range entirely. For instance, periodical surveys conducted at standard intervals (e.g., once every five years) are needed in establishing rigorous baselines from which to more quantitatively evaluate population status/trend over time.

Eastern Management Unit: Populations in this unit are probably higher than present estimates from monitoring efforts suggest (see Table 1). In Florida, detectability and protracted breeding season can complicate population estimation from colony surveys (Cox et al. 2019b) and may introduce the same challenges elsewhere in the Eastern Management Unit. Survey coverage is also less than complete. In the Bahamas, while Great Inagua was surveyed approximately 10 years ago (Green et al. 2011), other potentially important islands (e.g. Andros, Exuma, Grand Bahama) within the archipelago have not been systematically surveyed. Additionally, Reddish Egret populations within the Bahamas are likely connected with Turks and Caicos which have not been surveyed. A baseline survey for Cuba was completed recently (Gonzalez et al. 2016) but periodic surveys are needed there to establish trends. Since 2016, some new breeding colonies have been documented in Cuba but quantitative breeding estimates have not been completed. The status and population size of Reddish Egrets in the remainder of the Caribbean is unknown and while likely small, the information would be valuable for Caribbean wide conservation planning for the species. The Caribbean is likely one of the most threatened regions for Reddish Egret due to global climate change, associated sea level rise, and increasing pressures on important habitats from coastal development, all in a relatively concentrated terrestrial footprint. Outside of some areas in Florida where Reddish Egret movements and habitat use have been tracked using telemetry, very little is known about important foraging areas and the associated spatial and temporal patterns of use and availability of these areas – especially throughout the Caribbean.

Central Management Unit: Within the U.S. and Mexican portions of this unit, recent estimates for all states exist and periodic surveys are likely to continue. In Belize, recent surveys by Sarteneja Alliance for Conservation and Development (Santoya 2021) have provided baseline surveys for this country. Elsewhere, population estimates are either dated or do not exist (e.g. Meso-America, northern South America). Comprehensive surveys within Meso-Central America should be undertaken to obtain reliable population estimates and better understand species distribution throughout the region. Because of the shared geography with Mexican states on the Yucatan peninsula, surveys in Belize should ideally coincide with surveys in Mexico to better capture the Yucatan peninsula's population. Although there are recent estimates from Colombia, surveys across coastal Colombia, Venezuela and Dutch Antilles would be beneficial to better estimate population size and understand extent of South American distribution for Reddish Egrets. Similar to the Eastern Management Unit, very little is known about important foraging areas in many regions of the Central Management Unit, and even within better known areas (e.g., Texas and Tamaulipas) the delineation of important foraging areas is incomplete.

Western Management Unit: This is the smallest unit in terms of geographic area, comprising primarily breeding and wintering populations in northwestern Mexico (e.g. Baja peninsula, Sonora, Sinaloa and Nayarit). While the last published survey was 2018 (Palacios et al. 2018), some data from that survey are already over a decade old. Like many other regions within the species' range, more recent surveys are needed to establish population trends and potential changes in breeding distribution. Additionally, priority foraging areas within the Western Management Unit are not well known nor delineated.

RESEARCH INFORMATION NEEDS

Poplulation Structure, Gene Flow, and Movement: Over the past 15 years, considerable research has been conducted on gene flow and movement in Reddish Egrets. Initial studies of gene flow documented a panmictic population in Texas and Tamaulipas (Bates et al. 2009, Hill et al. 2012) and significant genetic differentiation between Texas-Tamaulipas, Bahamas and Baja California which supported establishment of the Eastern, Central and Western Management Units in the Original Plan. The Eastern and Western Management Units remain well supported by later genetic sampling from Baja California, Tamaulipas, Chiapas-Oaxaca, Yucatan, Texas, Louisiana, Florida and Bahamas) by Shahrokhi et al. (2020), but birds from Chiapas-Oaxaca exhibited a high degree of genetic isolation from other regions, including other areas within the Central Management Unit where Chiapas and Oaxaca are presently included. Absent from these studies are samples from Cuba, Turks and Caicos, and South America. Future genetic studies are warranted to examine gene flow within the Caribbean, Meso-America and South America and their relationship to other regions within the Central and Eastern Management Units.

Recent telemetry studies (e.g. Geary et al. 2015; Koczur et al. 2017, 2018a, 2018b) have revealed considerable insight into movement ecology of Reddish Egrets, however most have focused on juveniles and breeding adults originating from Texas, and limited sampling from Florida. These studies, in addition to unpublished data from birds in Louisiana and Chiapas, have revealed migratory patterns in adults from Texas and Louisiana, whereas breeding adults in Florida and Chiapas appear to be resident. In the remainder of the range, little is known about movement ecology (e.g., migratory behavior, juvenile dispersal) and patterns of movement, and further study is needed. For example, limited banding resight data suggests hatch-year birds in northwestern Mexico disperse southwards towards Central America with some limited dispersal northwards into California and Arizona in the U.S., but nothing is known about movement among breeding-aged adult birds. Within the Caribbean, very little is known about movement including any connectivity between Yucatan, Cuba, Bahamas and elsewhere in the region. Cuba may serve as bridge for connectivity between birds in Eastern and Central Management Units. Future studies combining telemetered birds and genetic sampling (e.g. Shahrokhi et al. 2020) would yield improved understanding regarding movement and gene flow across the range and aid in conservation of populations within and across the management units.

Poplulation-Habitat Relationships: Basic ecological information for the species is still limiting, especially outside of the U.S. where most of the published research has been conducted (see review in Koczur et al. 2020). Questions persist related to recruitment of young into breeding populations including understanding factors that influence growth, survival, and competition while in the nest as well as after fledging and during the ~2-3 years before young birds reach sexual maturity. Research is also needed to elucidate foraging habitat requirements and spatio-temporal relationships with nesting sites, especially in light of sea level rise and potential shifting dynamics among foraging and breeding habitats – or outright loss of some of these habitats altogether. For migratory components of the population (e.g., Texas, Louisiana), factors influencing habitat quality and use of stopover and wintering sites are not well understood. Understanding seasonal habitat use and requirements has obvious implications to conserving population segments that may move broadly across the annual cycle.

Quantifying Impacts of Threats: While some research has been conducted evaluating specific threats and their impact Reddish Egrets and other coastal waterbirds, our understanding of how threats influence populations, breeding habitats, and foraging habitats is much more qualitative than quantitatively based. Important threats recognized as affecting Reddish Egret populations include human disturbance, environmental contamination and predation. However, despite documented examples of nest abandonment from human disturbance or predation as well as nesting mortality from predation or exposure, there are no published studies quantifying abandonment and/or mortality rates from these sources. Understanding how nest survival and success are influenced under different rates of predation and disturbance can aid mitigating these influences to levels that are better tolerated by local breeding populations, and to avoid abandonment of otherwise suitable colony sites. Few studies (e.g., Holderby et al. 2012) exist that even estimate nest success. In addition to more rigorously evaluating rates of disturbance and predation among breeding birds, better understanding the impacts of human disturbance on foraging birds – where even less is understood – will be important as many habitats used for foraging are under increasing human pressure for recreation and other activities. Human disturbance has been documented as negatively affecting foraging among other Ardeid species in Florida (Rodgers and Schwikert 2002, 2003).

Little data exist on the effects of environmental contaminants on Reddish Egrets (as well as other coastal waterbirds within the species' range) and existing data are decades old. While some studies have examined contaminants that produce sublethal effects (e.g., Mora 1996a, 1996b), no studies have been published that examine effects of marine debris either through ingestion (e.g. microplastics) or entanglement (e.g., monofilament, derelict netting).

Climate change was evaluated as the highest threat to Reddish Egrets and their habitats. Mitigating climate change impacts, especially as they relate to alternation and/or loss of breeding and foraging habitats, must increasingly become an integrated aspect of conservation interventions. Significant habitat restoration and management activities are ongoing (e.g. along the U.S. Gulf of Mexico under the RESTORE Act) yet we do not have a level of understanding that permits management and restoration actions to be designed and delivered to achieve desired responses in Reddish Egrets and other coastal waterbird populations in the context of climate induced perturbations. For example, which coastal islands or colonies should be priorities for restoration based on factors such as relative contributions to Reddish Egret populations, projected colony longevity under scenarios for sea level rise, proximity to or suitability as future foraging habitats, etc.; or where should beneficial spoil islands be created to best aid in optimizing breeding or foraging potential for the species?

APPENDIX D

PARTICIPANTS AT WORKSHOPS HELD TO SUPPORT PLAN DEVELOPMENT

Merida, Yucatan, Mexico Workshop – 28-29 November 2018

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