



Research Summaries from the 1st Herons of the World Symposium, 2016

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Introduction

The first Herons of the World Symposium and Workshop was held as part of the 40th Anniversary Meeting of the Waterbird Society in New Bern, North Carolina, USA, during 21-23 September 2016. Three full days of heron sessions resulted in 47 oral and poster presentations on Ardeids and an all-day Heron Workshop. The Symposium was organized by the Waterbird Society and HeronConservation, the Heron Specialist Group of the International Union for the Conservation of Nature. Seventeen countries and all continents except Antarctica were represented (Fig. 1). Although the full proceedings of the heron symposium, workshop and poster and general sessions are not being published, all presenters were invited to submit their papers for consideration to *Waterbirds* or the *Journal of Heron Biology and Conservation*. Those presenters who did not wish to make full submissions were invited to submit a 400 word summary of their heron research program. Up to as many as five papers are being considered for a future Special Section of *Waterbirds* while up to 4-5 papers and 16 research summaries will appear in the *Journal of Heron Biology and Conservation*. We were not able to track papers from authors who choose to publish their presentations outside of these venues. The purpose of these varied publishing venues is to foster greater exposure, contact and familiarity among heron researchers and the IUCN's Heron Specialist Group. The experience of this Herons of the World Symposium and Workshop has demonstrated that the Waterbird Society and the various waterbird groups of the IUCN's Species Specialist Groups are a viable team for planning future World Waterbird Symposia and promoting Ardeid research and conservation worldwide.

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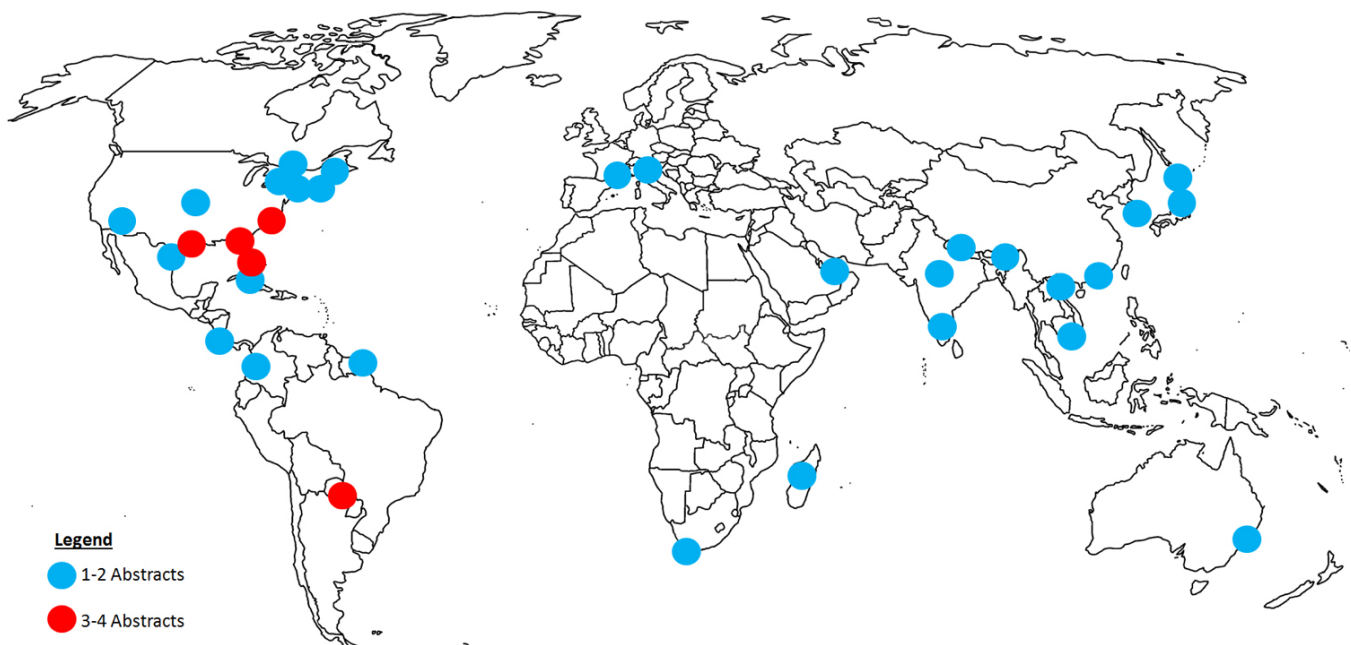


Figure 1. Study Areas (or author's home base) of Abstracts for Heron presentations (oral and poster, N = 47).

North America

Population monitoring of Great Blue Herons and other nongame waterbirds in Maine

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I am a wildlife biologist in the Wildlife Research and Assessment Section of Maine Department of Inland Fisheries and Wildlife. My main responsibility is to monitor statewide populations of nongame waterbirds. Focal species include Great Blue Herons (*Ardea herodias*), Black-crowned Night-Herons (*Nycticorax nycticorax*), and other long-legged wading birds, plus secretive marsh birds, Black Terns, and loons. I keep track of Special Concern, Threatened, or Endangered waterbird species in the state. This involves periodic monitoring of occupied sites, mapping habitats for these species to be used in environmental review for development projects, and collaborating with others involved in the research or monitoring of these species.

The Great Blue Heron is listed in Maine as a Species of Special Concern due to a decline in nesting pairs along the coast since the mid-1980s. For the past nine years, I have been working to determine if the decline is limited to the coast, occurring statewide, or due to movement from the coast to inland sites. In 2009, I began a volunteer adopt-a-colony program called the Heron Observation Network of Maine, which is a citizen science program whereby volunteers monitor colonies across the state. Currently there are nearly 100 volunteers monitoring 130 colonies statewide. I have also conducted aerial surveys to monitor known colonies and search for new ones. In 2015, working with Mark Otto, USFWS, we developed a stratified dual-frame sampling design for our aerial survey effort, and obtained our first statewide estimate of the Great Blue Heron breeding population. We hope to repeat this type of aerial survey every five years to determine trends.

I have also examined causes for colony disturbance and abandonment through the use of time-lapse cameras and sound recorders. Observations of disturbance and predation by bald eagles have increased in recent years, after a full recovery of Maine's bald eagle population. However, our pilot study using time-lapse cameras and sound recorders revealed some colony abandonments and failures were most likely due to raccoons at night.

My most recent work involved working with John Brzorad and 1,000 Herons, to equip adult great blue herons with GPS transmitters that communicate locations through cell towers to an open source website called Movebank. This project also involved partnering with many school groups who helped locate he-

rons for tagging and are now tracking them online. We hope to learn about their movements within Maine during breeding and post-breeding, as well as outside of Maine during migration and wintering.

Snowy Egret foraging behavior and ecology

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Our Avian Ecology and Behavior Lab investigated the foraging ecology and behavior of the Snowy Egret (*Egretta thula*) on the salt marshes of southern New Jersey. Of specific interest was their role in mixed-species aggregations using salt marsh pools for foraging during the breeding season. Observations led to two areas of focus: 1. understanding dynamics of aggregation formation and resulting species composition and 2. determining benefits derived from participation by Snowy Egrets as well as Great Egret (*Ardea alba*), Little Blue Heron (*Egretta caerulea*) and Tricolored Heron (*Egretta tricolor*). Understanding of this system led to field manipulation experiments on habitat selection to determine pool characteristics attractive to Snowy Egrets and how other egrets/herons perceived these characteristics. Quantification of prey density and use of egret models to manipulate behavior were among the techniques used.

Management of a Mixed-Species Wading Bird Colony on the Susquehanna River

Concern for continued existence of Pennsylvania's largest mixed-species heronry on Wade Island in the Susquehanna River following colonization by Double-crested Cormorants (*Phalacrocorax auritus*) led to a Pennsylvania Game Commission sponsored study of colony dynamics, habitat use and reproductive success. Nesting behavior, habitat use, foraging ecology and competition among Great Egrets, Black-crowned Night-Herons (*Nycticorax nycticorax*) and cormorants for nesting sites and food resources were investigated in order to formulate a colony management plan. Observational techniques including remote cameras, aerial surveys, banding and radio tracking were used during this study. Monitoring of nest and population numbers continues annually.

Continuing Interests

Comparison of conservation issues associated with riparian versus coastal wading bird colonies, repeating counts of aggregation participants in southern New Jersey for comparison with estimates from the 1980s and foraging ecology of selected neotropical herons are continuing research/monitoring interests.

Related Publications

Master, T. L. 1991. Use of tongue-flicking behavior by the Snowy Egret. *Journal of Field Ornithology*

62: 399-402.

Master, T. L. 1992. Composition, structure and dynamics of mixed-species foraging aggregations in a southern New Jersey salt marsh. *Colonial Waterbirds* 15: 66-74.

Master, T. L. 1993. Benefits of foraging in mixed-species wader aggregations in a southern New Jersey salt marsh. *Colonial Waterbirds* 16: 149-157.

Parsons, K. C. and T. L. Master. 2000. Snowy Egret (*Egretta thula*). in *The Birds of North America* (P. G. Rodewald, ed.). Ithaca: Cornell Lab of Ornithology. [online] doi.org/10.2173/bna.489.

Master, T. L., J. K. Leiser, K. A. Bennett, J. K. Bretsch and H. J. Wolf. 2005. Patch selection by Snowy Egrets. *Waterbirds* 28: 220-224.

The effects of colony structure and nest position on the nesting success of small herons

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This study was affiliated with a long-term wading bird monitoring project on Lake Okeechobee, Florida, that is directed by DEG and part of the Comprehensive Everglades Restoration Plan. Lake Okeechobee is a large, shallow, freshwater lake at the center of Florida's intensively managed water control system. Water regulation schedules on this highly regulated lake, like a growing number of controlled water bodies around the world, have generated high fluctuations of water levels that altered vegetation, including reducing the spatial extent of important nesting substrate for wading birds. Additionally, the construction of navigational canals has introduced novel habitat in the form of man-made islands, or spoil islands. The objective of our research was to determine the effects of colony structure and nest position on the nesting success of small herons. During the 2015 and 2016 breeding seasons (February-June), Tricolored Heron (*Egretta tricolor*) and Snowy Egret (*Egretta thula*) nests (N = 229) were monitored at Lake Okeechobee, Florida, USA. Data on nest fate, structure, position, and number of young fledged were recorded and analyzed using the logistic exposure method (Shaffer 2004) in an information-theoretic framework. Model selection showed the null model was the best model predicting daily survival rates (DSR). This suggested no clear relationship between DSR and habitat structure or nest position could be determined. However, in nests that succeeded, the number of fledglings produced increased when nests were placed farther from the canopy edge ($\beta_{\text{Canopy}} = 0.21$, 95% CI = 0.10-0.39). Increased distance from the canopy edge may provide nests with a sufficient buffer against adverse weather conditions. Furthermore, results indicated that spoil islands are capable of providing nesting habitat comparable to natural

islands in some years. One possible explanation for the lack of evidence supporting habitat structure and nest position effects on nesting success is that there was decreased food availability on-lake in 2016. That year was characterized by exceptionally high dry season water levels as a result of El Niño conditions. As a result, there was a limited recession of water levels that concentrate aquatic animals into shallow pools of vulnerable prey items, which drive wading bird nesting (Gawlik 2002). The availability of food resources within close proximity of nests is important for supporting the energetic demands of reproductive processes, and it can constrain breeding densities and affect nest survival (Bryan *et al.* 1995).

Literature Cited

Bryan, A. L., M. C. Coulter and C. J. Pennycuick. 1995. Foraging strategies and energetic costs of foraging flights by breeding wood storks. *Condor* 97: 133-140.

Gawlik, D. E. 2002. The effects of prey availability on the numerical response of wading birds. *Ecological Monographs* 72: 329–346.

Shaffer, T. L. 2004. A unified approach to analyzing nest success. *Auk* 121: 526–540.

A hop, skip and a jump: The use of long-term banding data to understand movement and survivorship of the Reddish Egret in Texas and Mexico

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Understanding a species' movement behaviors and apparent survivorship during different age classes is critical when developing a conservation strategy at local and global scales. Without knowledge of the species' life history in regards to such patterns, it can be difficult to create an appropriate management plan across and within its range, especially if the species in question travels great distances. The Reddish Egret (*Egretta rufescens*, REEG) is a medium-sized heron that displays plumage-dimorphism (dark and white). Its range is along the coast of the Gulf of Mexico, Pacific coast of Mexico, as well as portions of Central America and the Caribbean islands. The primary objective of our research was to estimate survivorship of juvenile REEG through long-term color banding, as well as analyze the movement ecology of individually marked birds across Texas and Mexico. During the breeding seasons between 2006 and 2016, we color banded REEGs in Texas/Tamaulipas (n = 627), Yucatan (n = 105), Chiapas (256) and Baja California Sur (n = 220). Using Cormick-Jolly-Saber models in Program MARK, we analyzed the

apparent survival and recapture probabilities between color morphs, age classes and the four target breeding regions mentioned above. We also used these data to look at movement patterns among and within the four regions. Even though only 62 resightings were made between 2006 and 2016, preliminary results show that there was variation in movement among individual birds and within different regions. Some REEGs tended to remain local (especially Chiapas), while others made great movements (Baja individual to El Salvador, Yucatan individual to Florida, etc.). There was no apparent difference in resighting dark vs. white morph REEG. Our results also suggest that hatch year REEGs have a lower apparent survival rate (0.25 in Texas/Tamaulipas, 0.51 in Baja) than older birds (0.86 in Texas/Tamaulipas, 0.91 in Baja), which leads us to believe that this life stage is possibly a limiting factor on the growth of the population across its range. Therefore our research targets the importance of long-term color banding, yielding considerable insight on survivorship and movement of a species. As more band-resighting data are gathered, our ongoing research of REEG will hopefully contribute to the conservation of one of North America's rarest herons.

Morphological relationships as indicators of integrated evolutionary dynamics in the Ardeidae

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I am a professor of environmental studies and my research focuses on 1. Field studies of herons in the Gulf of California, Sonora, Mexico, 2. Color-pattern evolution across Aves, including Ardeidae and 3. Museum skeletal measurements supported by field observations that examine the intersection between and among morphology, development and behavior in ardeids. Regarding the latter, in order to identify morphological trends, I measured skull dimensions and skeletal limb dimensions of the 12 North American species as well as 12 other taxa, including the morphologically divergent *Cochlearius*. My comparisons show that, in general, there is a negative association between proportionate head size and leg length. *Ardea* species, especially *A. alba*, exhibit the smallest relative head size while *Cochlearius*, *Nycticorax*, and *Nyctanassa* have the relatively largest heads. Similarly, *Butorides* and *Ixobrychus* have disproportionately large heads compared to leg length, but since their intracranial proportions are average for the family, the relatively large size of the head results from disproportionately short legs. I propose that the long legs of *Ardea* derive from hypermorphosis while the short legs of *Butorides* and *Ixobrychus* are paedomorphic features, which, in compensation, permit the feet to evolve a specialized prehensile function for grasping branches and reeds. Furthermore, a literature review revealed that those species that develop foot prehensility the earliest, such as by day 7 post-hatching in *Butorides*, retain that ability into adulthood and express enhanced prehensility in their foraging behavior by perching on branches, roots, etc. In contrast, those species that delay development of foot prehensility, such as 21 days for *Ardea*, experience extended limb elongation (hypermorphosis), and their feet, while still able to grasp for perching, are better adapted (than the feet of smaller species) to walking/running on flat substrate

while foraging. This upcoming field season (in Sonora, Mexico), I will collect data on age (days post-hatching) when nestlings are first able to grasp the edge of the nest or branches, the so-called “brancher” stage. I would be appreciative if colleagues working on nestling herons around the world would take note of this developmental stage and then share their observations with me.

Related Publications

Riegner, M. F. 2008. Parallel evolution of plumage pattern and coloration in birds: Implications for defining avian morphospace. *Condor* 110: 599-614.

Clark, E. W., A. B. Fleishman and M. F. Riegner. 2015. Diversity, abundance and nesting phenology of the wading birds of Bahia Kino, Sonora, Mexico. *Waterbirds* 38: 355-363.

Post-fledging and migration ecology of Black-crowned Night-Herons in Lake Erie, Ohio, USA

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I am currently a M.S. student working in Lake Erie, Ohio, with my field season extending from May to November. The objective of my research is to determine post-fledging survival and investigate the movement ecology of Black-crowned Night-Herons (*Nycticorax nycticorax*), a state-threatened species in Ohio. This project will track nanotag and satellite-marked juvenile and adult Black-crowned Night-Herons, respectively, throughout two field seasons (2016 and 2017).

This research is conducted on two breeding colonies of Black-crowned Night-Herons located within Lake Erie. The colonies are located on West Sister Island National Wildlife Refuge in Lucas County and Turning Point Island in Erie County. These sites were chosen because they provide critical nesting habitat for Black-crowned Night-Herons as well as other species of wading birds such as Great Egrets (*Ardea alba*), Great Blue Herons (*Ardea herodias*), Cattle Egrets (*Ardea ibis*), Snowy Egrets (*Egretta thula*), and Double-crested Cormorants (*Phalacrocorax auritus*).

Eleven radio telemetry towers have been erected on the western and southern shores of Lake Erie with sites in both Ohio and Michigan expanding the existing MOTUS array (Bird Studies Canada). Each tower is fixed with two 9-element Yagi antennas connected to an automated receiver (Lotek Wireless, Inc.). Detection range for towers is approximately 15 km. Tag identification number, date and time, antenna number and signal strength are recorded for each received signal. Upon the first visit to the colony, we affix motion sensitive cameras facing 20 nests on each colony. Cameras are used to record adult visi-

tation rates and predation events at each nest. Juveniles are hand captured and measured twice at the nest during the period before they fledge. One nestling is fitted with a nanotag (Tag mass: 2.6 g, NTQB-6-2, Lotek Wireless Inc.) attached to a figure-8 harness (Rappole and Tipton 1991). Individuals are located weekly using a combination of hand tracking, aerial telemetry and the MOTUS automated telemetry array to determine survivorship rates during the post-fledging period. Growth rates and provisioning intervals during the early nesting period are analyzed and compared between islands.

Adults are captured using a baited woosh net technique at both local marinas and Turning Point Island. Upon capture, adults are measured and fitted with a backpack-style satellite transmitter (Tag mass: 29 g, TAV-2630, Telonics, Inc.). Adult satellite tags will last 1 year providing locations during both autumn and spring migration.

Literature Cited

Rappole, J. H. and A. R. Tipton. 1991. New harness design for attachment of radio transmitters to small passerines. *Journal of Field Ornithology* 62: 335–337.

Natal fidelity and roosting habits of Great Egrets (*Ardea alba*) in southern Ontario, Canada

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We have been wing-tagging and/or color-banding Great Egret (*Ardea alba*) nestlings in Ontario since 2001, with 2,400 young marked to date. The objectives of the study are to determine the wintering areas, natal fidelity, and roosting habits and sites of Great Egrets from Ontario. Annual inventories of breeding marked egrets have been made at the main banding colony (Nottawasaga Island, Collingwood, Ontario) since 2004 and roosting habits, during the pre- and post-breeding season, have been monitored since 2008. First year survival of Great Egrets was 31%, 76% in the 2nd year and 78% as adults. Just over 10% of young egrets marked were re-sighted at their breeding colony; overall 34% of marked egrets were re-sighted/recovered at or away from the breeding colony. Natal philopatry was high: 96.4% of breeding adults observed at the colony were hatched at that site. When first observed at the breeding colony, 1.5% of the egrets were one year olds, 37% were 2 years old and 51% were 3-5 years old (N = 195).

Tagged adult and juvenile egrets began appearing at post-breeding nocturnal roost sites by mid-June and late-July/early August, respectively. Egret numbers at these sites usually peaked in late-August or early September. Numbers at roosts ranged from 1 to 816; most roosts contained 6-40 individuals. Egrets de-

part from their roosts at about 10 minutes before local sunrise and return during the last 90 minutes of daylight. Waterfowl hunting activities near egret roosts will usually cause the egrets to abandon their roost. Most egrets had left Ontario roost sites by late October/early November. Egret roosts (N = 70) were usually located in live trees along the shoreline of a wetland; less often on mudflats and shallow water. Egrets at over one-third of the tree roosts switched to roosting on mudflat or shallow water substrate, within the same wetland, as the season progressed and water levels receded. Egrets from Ontario winter from New Jersey to the Lesser Antilles but, on average, their center of their winter range is on the coasts of North and South Carolina.

Related Publications

Weseloh, D. V. C. 2011. Two small autumn roosts of Great Egrets at London and Metcalf, Ontario. *Ontario Birds* 29: 34-39.

Weseloh, D. V. C. and T. Hoar. 2012. Spring migration of Great Egrets into Ontario: an eBird analysis. *Ontario Birds* 30: 36-47.

Weseloh, D. V. C., D. Moore and T. Knezevic. 2014. Wintering locations of Ontario-banded Great Egrets: New Jersey to the Caribbean. *Ontario Birds* 32: 2-11.

Weseloh, D. V. C., R. Dubois, B. Di Labio and B. Scranton. 2013. Variable roosting habits of Great Egrets at Cornwall and Ottawa/Gatineau. *Ontario Birds* 31: 30-45.

Rush, S. A., C. Pekarik, D. V. C. Weseloh, F. Cuthbert, D. Moore and L. Wires. 2015. Changes in heron and egret populations on the Laurentian Great Lakes and connecting channels, 1977-2009. *Avian Conservation and Ecology* 10: 7. [online] [dx.doi.org/10.5751/ACE-00742-100107](https://doi.org/10.5751/ACE-00742-100107).

South America

Studies of the Agami Heron in French Guiana

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I am an ecologist working in habitat conservation and management and am currently project manager at GEPOG, an NGO studying and protecting birds in French Guiana. I am responsible for different projects, one of them being a study of Agami Herons (*Agami agami*). The Agami Heron is a Vulnerable

(IUCN Red List) neotropical species that is largely unknown. French Guiana holds a responsibility for its conservation as a large colony of about 2,000 pairs is located in one of the national reserves of the country, representing about 95% of the known population of the species. From 2011 to 2015, I was responsible for a project of satellite telemetry tracking of eight individuals equipped at the colony during the breeding season. The objectives were to identify space use during the breeding season and areas used after breeding in order to build up conservation actions. The site is inaccessible by foot or boat, hence a helicopter mission of three to five days is implemented at the end of April each year. The breeding season extends from April to July, with some shifts depending on the year. Birds were captured through mist netting and equipped with Argos satellite transmitters. Results show that this species can migrate up to 1,300 km along the coast after breeding, and uses about 100 to 200 km² around the colony. Based on these results, a species conservation plan for the Agami Heron has been written in French, English and Spanish in 2015 with partners from neighboring countries and the contributions of several heron specialists. An Agami Heron Working Group has been created under HeronConservation (IUCN Heron Specialist Group) to encourage research and conservation actions based on this conservation plan. I am currently coordinating this working group. Future activities will mainly concern the chairing of the working group, closer assistance in colony monitoring for the two natural protected areas in French Guiana that hold colonies and possible research programs or partnerships fitting the conservation plan guidelines if funds become available.

Webpage of the working group: [online] www.heronconservation.org/working-groups/agami-heron-working-group/

Links to the conservation plan:

In English: [online] lifecapdom.org/sitesmutu/lifecapdom.org/IMG/pdf/20150724_planconservation_ha_eng_web.pdf. In French: [online] lifecapdom.org/sitesmutu/lifecapdom.org/IMG/pdf/20150725_planconservation_ha_fr_web.pdf. In Spanish: [online] lifecapdom.org/sitesmutu/lifecapdom.org/IMG/pdf/20150726_planconservation_ha_esp_web.pdf.

Related Publications

Stier, A., A. Ricardou, S. Uriot, N. de Pracontal and J. Kushlan. 2017. Breeding season, home range, and migration of *Agamia agami*. *Waterbirds* 40: 289-296.

Heron conservation in Paraguay

Alberto Yanosky

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Guyra Paraguay is the leading biodiversity research and conservation organization in Paraguay. Knowledge on herons and their ecology and conservation is one of the areas benefited by the actions developed

by Guyra Paraguay. Paraguay's five major ecoregions hold a total of 14 heron species (Guyra Paraguay 2004). Currently, no species is considered threatened at a national or international level (Guyra Paraguay 2005); in fact most species are common to abundant (Guyra Paraguay 2004). Exceptions include the Boat-billed Heron and the three species of bittern (Pinnated (*Botaurus pinnatus*), Least (*Ixobrychus exilis*) and Stripe-backed (*I. involucris*)). Habitat conservation and mainstreaming conservation of herons in productive landscapes is one of the priority areas such as the case of populations of Pinnated Bittern and expansion of rice fields. While most herons remain common and widespread throughout the country, the increasing loss of wetland habitats and their degradation through runoff and sedimentation is of concern. Habitat loss is driven by flooding from hydroelectric dams, massive deforestation and conversion to industrial agriculture, with a particular concern being the loss of Estero Patiño and other wetlands within Pilcomayo watershed. Although the rapid and ongoing expansion of rice agriculture in Paraguay (Morales *et al.* 2006, 2010) provides important foraging habitat for at least eight heron species, their populations depend on the survival of natural wetland and woodland habitats in surrounding areas for roosting and breeding (De La Peña 2010). Water and wetlands are very linked to heron populations and severe extreme conditions such as drought and flooding may affect these populations in light of the different future scenarios related to shifts in temperature and rainfall. Paraguay has little evidence of climate change effects though a recent analysis has demonstrated the potential effects on biodiversity (CEPAL 2015).

Literature Cited

CEPAL. 2015. La economía del cambio climático en el Paraguay. CEPAL, Santiago de Chile, Chile.

De La Peña, M. R. 2010. Guía de nidos de aves del Paraguay. Guyra Paraguay/Río Tinto. Asunción. Paraguay.

Guyra Paraguay. 2004. Lista comentada de las aves de Paraguay. Annotated checklist of the birds of Paraguay. Asociación Guyra Paraguay. Asunción, Paraguay.

Guyra Paraguay. 2005. Atlas de las aves de Paraguay. Asociación Guyra Paraguay. Asunción, Paraguay.

Morales, C., R. Clay and H. del Castillo en Guyra Paraguay. 2006. Biodiversidad del Río Paraguay. Cap. 5. Guyra Paraguay-Transbarga Navegación, Asunción, Paraguay.

Morales, C., H. del Castillo, S. Centrón and F. Palacios. 2010. El contexto ambiental de los cultivos de arroz en Paraguay. Pp. 49-52 *in* Arroz un Negocio Creciente (A. Friedman and B. Wei, eds.). USAID – Programa Paraguay Vende. Asunción, Paraguay.

Research studies on herons in the Camargue (Southern France)

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The number of breeding herons increased significantly for the last decades in Western Europe. In the Camargue, a wetland complex of 180,000 ha situated in the Rhône Delta in southern France, the number of species of nesting herons increased from six to nine over the last 70 years: Grey Heron *Ardea cinerea*, Purple Heron *Ardea purpurea*, Great Egret *Ardea alba*, Cattle Egret *Bubulcus ibis*, Little Egret *Egretta garzetta*, Squacco Heron *Ardeola ralloides*, Black-crowned Night-Heron *Nycticorax nycticorax*, Eurasian Bittern *Botaurus stellaris* and Little Bittern *Ixobrychus minutus* (Hafner *et al.* 2004).

Scientific studies of Ardeids of the Camargue began in 1967 at Tour du Valat, a research institute for conservation of Mediterranean wetlands. For more than 50 years, studies concerned all species present in the Camargue on diverse topics like breeding behaviour, habitat selection, density dependence, diet, colonisation and migration.

Demographic studies were conducted through capture-recapture program implemented for 18 years (1982-2001) on Little Egrets, Cattle Egrets and Squacco Herons. In addition, from 1967, the number of breeding pairs of herons in the Camargue was estimated each year until 2002, and because of an increase in the number of colonies, every two years since then (Tourenq *et al.* 2000).

Recently, in parallel to this survey, focus is done on one colony in regional nature reserve of Scamandre which is hosting the largest mixed heron colony of France and one of the largest of Europe (Gauthier-Clerc *et al.* 2006). Every year since the establishment of the colony in 2004, five species of tree-nesting herons are breeding and since 2006, the Glossy Ibis *Plegadis falcinellus* joined to this 3 ha colony situated in a wood of French tamarisk *Tamarix gallica* in a flooded semi-temporary marsh. The number of breeding pairs nesting increased annually and was the highest in 2015 with 3,700 breeding pairs of Cattle Egrets, 3,255 Little Egrets, 1,028 Glossy Ibis, 669 Black-crowned Night-Herons, 371 Squacco Herons and 46 Grey Herons.

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tion and colony patterns of four species of tree-nesting herons in the Camargue, South France. *Waterbirds* 23: 236–245.

Dry rice paddies cause a decline of the breeding herons and egrets in Italy

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The monitoring of the 200 heronries in northwestern Italy, started in 1972 and now in its 45th year, is continued thanks to a group of 100+ volunteer collaborators. A strong increase in the breeding population of the seven species of herons and egrets occurred from 1980 to 2000, caused mainly by lower human-induced mortality, with some fluctuations affected by several climatic factors (Fasola *et al.* 2011). However, these populations entered a phase of decline after 2000. We hypothesize that the main cause of the present population decline was the expanding practice of rice cultivation on dry paddies, that during 2015 reached 80% of the rice surface in some areas. Rice paddies used to provide the bulk of the food for the herons and egrets during breeding, but the dry paddies are now flooded only for a few days, and become unsuitable for foraging, except for the Cattle Egret, the only one of the seven species that is adapted to forage on dry lands and that is still increasing in our study area. In the paddies that remain flooded, prey availability for herons has changed dramatically due to arrival of alien species and to the decreased water level compared to the traditional practices (Fasola and Cardarelli 2015). We are analyzing additional data collected in 2014-2015 on foraging success, reproductive output, surfaces of dry rice studied by satellite imagery, and consequences on population trends. In the other European areas of rice cultivation, in Spain, France and Greece, cultivation without submersion has not been adopted yet, but in Italy the new practices are undermining the value of rice cultivation for waterbirds.

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Status assessment and population trends of the Madagascar Pond-heron (*Ardeola idea*), Madagascar

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I have worked on waterbirds, mainly the Madagascar Pond Heron (*Ardeola idea*) and the Madagascar Heron (*Ardea humbloti*), since 1994. The objective of my present research is to evaluate the population level and trends of the pond-heron in Madagascar and nearby islands, including Europa Islands, Aldabra and Mayotte. This objective was achieved through strong collaboration with other ornithologists and bird observers in Madagascar. Changes in the population of this species were investigated over the last 23 years through literature reviews, field monitoring and surveys undertaken from 1993 to 2016. Data from 111 localities, including the 11 known breeding sites in Madagascar (6), Mayotte (4) and Europa Island (1), were collected and analyzed for this population assessment. The species occurred in all types of wetlands including lakes, ponds, marshes, rivers, mangroves, pasture wet meadow and also rice fields. During the non-breeding season, May-September, many pond-herons migrate to eastern and central Africa; however, some birds, represented by 911 records, remain in Madagascar and Mayotte during the austral winter. Data show that the current population is estimated at approximately 1,600 breeding birds (800 pairs) in the total breeding area including Madagascar and related islands (Europa island, Mayotte). The population has declined significantly, particularly at its main breeding sites. The main threats are habitat destruction, collection of eggs and fledgling birds, predation and disturbance at all breeding sites. Possible hybridization with the Squacco Heron (*A. ralloides*) is a potential threat which should be investigated. Urgent actions are needed at all breeding sites to limit this population decline.

I am also involved in the Madagascar waterbird census which is conducted twice a year as the opportunity exists (January-February and July-August). I am the national coordinator of this network in Madagascar with the participation of site managers and volunteers.

Related Publications

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Asia

Breeding biology and conservation of Grey Herons in Hokkaido, Japan

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I graduated from the graduate school of environmental earth science in Hokkaido University in 2001 and continue to do research without being affiliated with a professional organization. I also manage the Hokkaido Grey Heron Research Group, which is a small citizen group operating for heron conservation in the Hokkaido area.

My field work on Grey Herons extends all year long. One of my research objectives is to clarify the difference of strategy between wintering and migrating herons. We have both of them in Hokkaido. Field observations were conducted from March to August in a colony which I have visited for more than ten years. From September to February, I observe behavior of wintering herons mainly in their wintering roost. I obtained huge amounts of data, but the analysis is on hiatus as of now. I had conducted another project for about three years in a separate colony, where the objective was to clarify the significance of time-related information in the information center hypothesis. This project has been completed and I am preparing a paper now. From 1991 to the present, I have continued to collect information on heronries and do field research throughout Hokkaido, and accordingly illustrated the change of heronry distribution and population size. Recently, I noticed that some heronries were located in unusual sites, for example half-submerged willow bushes and an offshore islet. I think this could be heron's adaptable behavior to avoid terrestrial predators. I am also interested in conservation issues because wildlife management conducted by a government is very poor in Japan. I have been investigating the issues of elimination of Grey Herons. In addition, the research of the cultural relationship between people and Grey Herons is another of my passions.

Related Publications

Matsunaga, K. 2000. Effects of tidal cycle on the feeding activity and behavior of Grey Herons in tidal flat in Notsuke Bay, northern Japan. *Waterbirds* 23: 226-235.

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Changes in avian community composition at a restored floodplain grassland in the Mekong Delta

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Tràm Chim National Park (TCNP) is a restored floodplain recessional grassland located in the Plain of Reeds region of the Mekong Delta, Đồng Tháp Province, Vietnam. Founded to protect wintering Sarus Cranes (*Antigone antigone sharpii*), a variety of wading birds also use the reserve including twelve species of *Ardeidae*.

Following formal protection, TCNP officials adopted the goal of managing water levels to mimic the monsoonal hydro-period of the region by closing water gates at a time and water level sufficient to allow water recession to slowly dry most parts of the reserve by the end of the dry season. Drying wetlands were more susceptible to fire, and in 1996 TCNP officials began managing water to maximize protection of restored forests rather than balancing fire risk with broader ecological restoration objectives. Changes in water management coincided with two surveys of the birdlife of TCNP, one during a period of natural water management (1985-1996) and another following a period of year-round high water levels (1996-2005). We resurveyed study sites in January-March 2016, following the return of natural water management in 2005. With water management at TCNP most similar in the years preceding 1994 and 2016, we expected that the bird community composition encountered in 1994 and 2016 would be more similar than bird community composition in 2006.

A total of 55 bird species (5 species of *Ardeidae*) was recorded across all surveys. Pairwise PERMANOVA tests comparing similarity of avian community composition do not support our hypothesis. Community composition differed for all year combinations (Bonferroni adjusted $P = 0.003$, 999 permutations) with 2016 and 1994 the most dissimilar in composition. While broad comparisons of community composition did not support our hypothesis, analysis of site occupancy rates for avian foraging guilds found that species not characteristic of floodplain grasslands (species that utilize open water habitats) occupied a greater proportion of sites during the period of year-round high water (χ^2 ; $P < 0.001$). With further change coming to the region in the form of dam construction on the lower main stem of the Mekong River, continued research into water management at TCNP is critical to the survival of floodplain grassland bird communities.

Abundance and distribution patterns of two heron species in multiple agricultural landscapes of south Asia

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Multi-cropped agricultural landscapes in south Asia have recently been discovered to host surprisingly high bird diversity despite a very long history of cultivation and high human density. The region has strong seasonality, each season matched with a different crop, which collectively alters seasonal conditions. Nuanced understanding of how herons interact with the seasonal crops and wetlands is absent, and multi-scale assessments are also lacking.

As part of a long-term monitoring program to track large waterbird species in south Asian farmlands, we systematically collected information on seasonal abundance and distribution of two heron species, the Grey Heron *Ardea cinerea* and the Purple Heron *Ardea purpurea*, simultaneously in four agricultural landscapes in lowland Nepal (Rupandehi district) and north-central India (Anand district in Gujarat state, Rohtak in Haryana, and Etawah and Rae Bareilly in Uttar Pradesh) during 2014-2016. We also developed detailed wetland maps for each landscape using topographic sheets and satellite images to determine if abundance and distribution of the two heron species was influenced by wetland extent and position.

Abundance of both heron species varied greatly, and showed no clear or consistent relationship with rainfall in any of the landscapes. Most landscapes (except Etawah) had highest abundance of Purple Herons during the monsoon season (July-October), while most Grey Herons were counted during winter (November-February). Overall, Grey Herons were more common than Purple Herons with some exceptions.

Both heron species showed considerable variation in seasonal and annual distribution across all the landscapes. Number of wetlands and extent of wetlands (ha) per grid (5' x 5' size) influenced heron distribution. Herons avoided grids with the smallest number and extent of wetlands, and showed the highest preference for grids with intermediate levels (50-100 wetlands; 25-75 ha of wetlands) in all landscapes.

Observed abundances in this study suggest that hundreds of thousands of herons use south Asian agricultural landscapes. This suggests that current efforts to enumerate herons that focus solely on wetland sites are inadequate to properly assess population trends and ecological needs. Abundance of both heron species varied considerably across seasons suggesting that crops and potentially other local parameters drive heron use of agricultural landscapes. Consistent use of grids with a specified number and extent of wetlands across all of the focal landscapes suggests very strong scale-dependence. This finding underscores the need to retain multiple wetlands on agricultural landscapes to enable persistence of good populations of the two focal heron species.

Oceania

Bitterns in Rice Project, New South Wales, Australia

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The Bitterns in Rice Project began in 2012 with the broad aims to learn more about the globally endangered Australasian Bittern (*Botaurus poiciloptilus*) and its use of rice fields, and what rice farmers could do to aid in its conservation. It is a collaboration among the Ricegrowers' Association of Australia (RGA), Birdlife Australia (BLA) and a range of other organisations, with key support from Riverina Local Land Services through funding from the Australian Government's National Landcare Programme. My key support comes from Neil Bull (RGA), Andrew Silcocks (BLA) and Mark Robb (Coleambally Irrigation). The project is centred on the Riverina region of southern New South Wales, Australia, where approximately 95% of the nation's rice is produced. The rice season begins in October, with most harvesting completed by April. This region is situated within the Murray-Darling Basin, an important agricultural area where water politics are contentious; the recovery of environmental water from irrigators aims to address over-allocation issues and restore degraded, natural ecosystems. Key objectives involve monitoring the bittern population each rice season using randomly selected rice farms, as well as developing bittern-friendly rice growing incentives for farmers. Habitat occupancy modeling is being used to ascertain the size of the population in the rice fields each summer. Widespread breeding has been confirmed and initial modeling indicates that in most years the rice fields attract 500-1,000 bitterns, making it the largest known breeding population in the world. Determining the opportunity costs, identifying farmers' preferences for incentives and determining how the public values bittern-friendly rice growing are central to my PhD at Charles Darwin University with Kerstin Zander and Stephen Garnett. A crowd-funded satellite-tracking program is being used to identify the network of wetlands on which the population depends between rice seasons. This part of the project is a collaboration with Inka Veltheim (Federation University). Four of the first five tracked birds departed the Riverina at harvest time, with three of those heading south into Victoria, two of which used wetlands along the coast, 400-600 km from their rice fields. The Bitterns in Rice Project is a grassroots initiative about farming and nature conservation working together. It is about the integrated management of land and water that helps to depolarize the dominant "environment versus agriculture" paradigm.