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Message from President of the Waterbird Society

Welcome to New Bern, North Carolina. As you will hear throughout the meeting, we meet in the state of North Carolina on this 40th anniversary of the Waterbird Society, as the idea of the development of a society to study wading birds (and in the subsequent years modified to include other groups of birds associated with water), was first conceived at a meeting of the North American Wading Bird Conference, just to the south, in Charleston, South Carolina, in 1976. There will be many activities to highlight the history of our society here over the next few days. Many of the founders and the past presidents will be here so you will be among exalted company!

In addition to the social events celebrating the accomplishments and growth of the Waterbird Society and its place as an important avenue for research on waterbird biology and conservation, we of course will have our scientific program. Aply assembled by Dr. Clay Green, the contributed presentations, symposia and plenaries are the components of the program that will help all of us to appreciate the sophistication and state of waterbird biology 40 years after the society's inception.

This year, in particular, we are thankful for your attendance, participation and support of the Waterbird Society. Holding the meeting in a state where actions of the State Government did not sit well ethically with many of our members, and where state funding for participation was explicitly banned for some employees of other states (including states where some of our most active members live and work), caused consternation for your Waterbird Council as well as for the local organizers. One positive benefit from the strife that came from the N.C. state legislation known as HB2, is that the Waterbird Society now has a Diversity Committee, which indeed will have some activities at the meeting. Your council has openly advocated for a more diverse society. We hope that you will all attend the inaugural events of this committee. In addition, this committee has designed a colorful sticker to brighten up your name tags.

New Bern is a welcoming city (see note from Local Committee Chair) and the activities planned by the local committee will be exceptionally enjoyable. I want to especially thank Dr. Sara Schweitzer for her tremendous work in putting together the meeting activities, talking with state and local (and hotel) officials to ensure that we will have a welcoming and open meeting, and generally in providing excellent leadership to the local committee.

Again, thanks to all of you for being here and I hope that your Waterbird Society meeting is both productive in making new connections, re-establishing old and in having fun.

I look forward to meeting each and every one of you. Special greetings too, to the students and young professionals in attendance. Please come and introduce yourself!

With regards,

Erica Nol
President, Waterbird Society

Welcome from the Chair of the Scientific Program

The Waterbird Society is pleased and honored to convene its 40th Annual Meeting in beautiful New Bern, North Carolina from 20 - 23 September, 2016. The 2016 Scientific Program is comprised of 102 oral presentations, 69 poster presentations and 4 plenaries. Three symposia, one workshop and a meeting of the Atlantic Marine Bird Cooperative are featured as part of the overall program. Symposia planned are as follows: 1) Herons of the World (full day), 2) Black Skimmer (half day) and 3) Eastern Black Rail symposia (half day). The Herons of the World symposia will be followed by Herons Workshop (full day). In addition, the program features plenary addresses from 5 distinguished waterbird biologists who have made significant contributions to our knowledge of waterbird biology and the conservation of waterbirds.

I would like to extend a warm welcome to our student participants in the scientific program, many of whom may be presenting for the first time at an international meeting. Since its inception, the Waterbird Society has always made students an integral part of our society and our society and our journal *Waterbirds* are both better because of the significant contributions that students provide. Additionally, while our society has always strived to be international in our membership and meeting participants, it is quite exciting that for our 40th Annual Meeting we have presenters traveling to New Bern from the Caribbean, Central and South America, Asia, Africa and Europe.

If this is your first Waterbird Society meeting, I hope you find it a rewarding and engaging experience and will consider future participation at our meetings and joining the society.

I want to give a hearty thanks to Chip Weseloh, Cathy King, John Brzorad, Caleb Spiegel, Whitney Wiest and Troy Wilson for helping me organize the scientific program and chairing the various symposia and workshops. In closing, I want to personally thank Sara Schweitzer for chairing the local organizing committee. She has done a truly amazing job and I am confident we will have one of the most successful meetings of our 40-year history.

Clay Green

Chair, Scientific Program

Welcome from the Local Planning Committee

I am pleased to welcome all participants and guests to the 40th Anniversary Meeting of the Waterbird Society in New Bern, North Carolina. It has been 22 years since the Waterbird Society held a meeting in North Carolina, and 20 years since it has been in South Carolina. It is fitting to have the 40th Anniversary meeting in the Carolinas, as the inception of the Society was in 1976 in Charleston, South Carolina.

This meeting will host the International Union for the Conservation of Nature, Heron Specialist Group's Herons of the World Symposium and Workshop, and the Atlantic Marine Bird Cooperative Workshop, both of which are bringing scientists to New Bern from many distant locales. A newly formed Diversity Committee will hold a Facilitated Discussion during Thursday's lunch, so please contribute to this important development for the Society. We are fortunate to have a very welcoming small town from which host families have stepped forward to welcome several meeting participants into their homes.

The Local Planning Committee includes members from North and South Carolina, thus it is a Carolina Committee welcoming you to this region of the United States. New Bern has a very diverse history. Located at the confluence of the Neuse and Trent Rivers, it was the site of Chattoka, the village of Tuscarora Indians. In 1710, the area was settled by Swiss and German immigrants, and their leader, Christoph von Graffenreid, named the town New Bern. New Bern is the second oldest colonial town in North Carolina. It was the capital of the North Carolina colonial government and later briefly the state capital. Tryon Palace was the British colonial government house, then state capital after the Revolutionary War. There is much Civil War history in New Bern as well. New Bern was a refuge for freed slaves who established a vibrant community in James City, across the Trent River from New Bern. Enjoy the history with several walks around town, the details of which are at the Visitors Center in the Convention Center entranceway.

Each of the meeting's hotels is within easy walking distance to the convention center, as are restaurants, shops, and museums. Be sure to thank the businesses that contributed items to our Silent Auction!

Our registration desk will be open each day with your welcome bag, merchandise, and sign-up sheets for early morning local birding field trips.

We thank the exceptional cadre of scientists presenting their work during the meeting. Three receptions, activities during each lunch period, and the awards banquet will provide ample opportunities for networking and camaraderie.

Each indefatigable member of the Local Planning Committee and Chair of the Scientific Program Committee have made this meeting possible; please thank them (with host ribbons on their name badges) when you see them. We thank the President of the Waterbird Society, the Treasurer, Councilors, and Anniversary Committees for their unwavering support in the development of this anniversary meeting.

We welcome you to the Carolinas and wish you a fabulous time in New Bern!

With kind regards,



Sara H. Schweitzer
Chair, Local Planning Committee



THE
WATERBIRD
SOCIETY

The **Waterbird Society** is an international scientific, not-for-profit organization dedicated to the study and conservation of waterbirds. This society was created to establish better communication and coordination between the growing number of people studying and monitoring aquatic birds, and to contribute to the protection and management of stressed population or habitats of this species.

The Society was established in 1976 following the North American Wading Bird Conference held in Charleston, South Carolina, USA, and named the Colonial Waterbird Group. The organization changed its name to the Colonial Waterbird Society in 1986. In 1999, the organization became The Waterbird Society to reflect an expanded interest in all aquatic birds.

Officers

President	Erica Nol
Vice President	Clay Green
Secretary	Patricia Szczys
Treasurer	Christine Custer
Editor of <i>Waterbirds</i>	Stephanie Jones

Elected Board Members

2014-2016	P. Becker, J. Brzorad, B. Palestis
2015-2017	E. Craig, R. Zambrano, P. Baird
2016-2018	J. Fraser, S. Bouwhuis, J. Lamb

Past Presidents

Susan Elbin, Katharine Parsons, D. V. Chip Weseloh

40th Anniversary Celebration Committee

Co-Chairs: Joanna Burger, Susan Elbin, Mike Erwin

Members: Christine Custer, Iola Price, Sara Schweitzer, Jeff Spendelow, Chip Weseloh

Sub-committee for Memorabilia

Jeff Spendelow and Christine Custer

Sub-Committee for Anniversary Signature Drink

Chair: David Mizrahi

Members: Elizabeth Craig, Susan Elbin, Debra Kriensky, Nellie Tsipoura

40th Anniversary Quilt designed and donated by Stephanie Jones

Silent Auction Committee

Susan Elbin and Elizabeth Craig

Recognition Awards Committee

Chair: Mike Erwin

Members: John Anderson, Sarah Karpanty, Gopi Sandar

General Information

Meeting Venues

Our primary venue is the **New Bern Riverfront Convention Center**, 203 South Front Street, New Bern. Its two levels include rooms for meetings, symposia, workshops, technical sessions, displays of Silent Auction materials and 40th Anniversary memorabilia, as well as the Welcome and Centennial receptions.

The Poster Session and Reception will be held in **Mattocks Hall of the History Center of Tryon Palace**, 529 South Front Street, a short walk from the Convention Center and hotels, along the Trent River.

The Convention Center and History Center of Tryon Palace are within easy walking distance to the meeting's hotels, parks, restaurants, shops, and museums. The New Bern Visitors Center is within the Convention Center so you can easily get assistance about the area's attractions and activities.

Registration Desk

The registration desk for the meeting is at the entrance to the Convention Center, within Heritage Hall, at the base of the stairs to the second floor. Hours of operation will be:

Tuesday, September 20th, 15:00-18:30

Wednesday, September 21st, 7:30 - 12:00, 13:30 - 17:00

Thursday, September 22nd, 7:00 - 12:00, 13:30 - 17:00

Friday, September 23rd, 7:00 - 13:00

Parking

Parking lots are available at the Convention Center, History Center of Tryon Palace, and at each hotel. In downtown New Bern, you may parallel park along the streets for free.

Getting Around

Meeting venues and hotels are within easy walking distance to one another, as are restaurants, pubs, shops, and museums. There is no public transportation system serving this small town.

The DoubleTree by Hilton has a free shuttle to and from the Coastal Carolina Regional Airport (New Bern). If you are staying at the Courtyard Marriott or BridgePointe Hotel & Marina and need transportation to or from the airport, the Planning Committee will have vans available for you. Please contact Ted Simons (tsimons@ncsu.edu) to coordinate pick-up with one of the meeting's vans.

Internet

There is free Wi-Fi throughout the Convention Center for meeting participants.

Help

For any questions or problems you might have, please contact the **registration desk** at the entrance to the Convention Center. Each member of the Local Planning Committee will have a Host ribbon on their name badge, and will be happy to help you with your questions. Additionally, Volunteers for the meeting will have a Volunteer ribbon on their name tag and they also will be happy to help you with your questions.

Information for Presenters

Oral presentations

15-minute presentation + 5-minute discussion time

Software Requirements: All presenters must have PowerPoint presentations created in Office 2010, 2013 or 2016.

Hardware: The North Carolina Wildlife Resources Commission will provide a projector and laptop computer (Windows 7) for the Berne Room, Tryon Room A, and Tryon Room B, all on the second floor of the Convention Center. The plenary presentations in Ballroom A will use the in-house projector and laptop to accommodate the size of the room and audience. A laptop computer and projector in the second floor Craven Boardroom will be available during the meeting for viewing and rehearsing presentations. Rooms will be closed and locked when the meeting is not in session.

Presentation Requirements:

1. All PowerPoint presentations must be created in Office 2010, 2013 or 2016;
2. Morning presentations must be submitted to the Craven Boardroom by 18:00 the day before the presentation;
3. Afternoon presentations must be submitted to the Craven Boardroom by 11:00 the morning of the presentation;
4. All presentations not submitted by the aforementioned times are subjected to not being reviewed for functionality and the presenter must install it on the laptop prior to his/her presentation.

Questions and Concerns:

If presenters have a question or concern about audio-visual needs, contact Thomas Nixon (919-218-5547; thomas.nixon@ncwildlife.org) or Christy Hand (843-870-9381; handc@dnr.sc.gov).

Poster presentations

Posters must be 40 inches width by 30 inches height (102 cm width by 76 cm height).

For the International Heron Symposium, posters may be taped to the meeting walls (Berne Room) with tape provided by the Hosts at the Reception Desk or in the Craven Boardroom.

For the **Poster Session and Reception on Thursday, September 22nd**, posters must be pinned to poster display panels in Mattox Hall of the Tryon Palace History Center. Authors may begin setting up posters at 16:00. Each display panel will be marked with authors' names. Posters for the Atlantic Marine Bird Cooperative will be grouped together and marked accordingly. At least one author must be present at their poster during the session.

Best Student Presentation and Poster Award

Awards will be given to students participating in the Waterbird Society meeting to recognize excellence in oral and poster presentations. These awards are presented at the Banquet on Friday evening. Student contributions are marked throughout the program with a skimmer chick symbol.



Student Activities

Wednesday, September 21st, 13:00 - 14:15: Student-Mentor Luncheon, Ballroom A

Thursday, September 22nd, 7:00- 8:00: Discussion about publishing with the editor of *Waterbirds*, Stephanie Jones, Ballroom B

Thursday, September 22nd, 12:30 - 14:00: Diversity Committee Facilitated Discussion, Ballroom B

Friday, September 23rd, 16:30 - 17:30: Business Meeting of the Waterbird Society, Ballroom B

Social Program

Tuesday, September 20th, 19:00 - 22:00, **Welcome Reception**, Heritage Hall and Riverfront Veranda

Wednesday - Friday, September 21st - 23rd, 8:00 - 16:00, **Silent Auction bidding**, Ballroom C

Wednesday, September 21st, 17:30 - 19:00 p.m., U.S. Fish and Wildlife Service sponsored **Migratory Bird Treaty Act Centennial Celebration Reception**, Ballroom B

Wednesday, September 21st, 18:30 - 20:30, **Wine and Design Fundraiser**, Second Floor Promenade

Thursday, September 22nd, 17:30 - 19:30, U.S.G.S., Wetland & Aquatic Research Center, and Atlantic Marine Bird Cooperative sponsored **Poster Session Reception**, Mattox Hall, History Center at Tryon Palace

Friday, September 23rd, 16:00 - 16:30, **end of Silent Auction bidding**, Ballroom C

Friday, September 23rd, 16:30 - 17:30, **Waterbird Society Business Meeting**, Ballroom B

Friday, September 23rd, 18:00 - 20:30, **Anniversary and Awards Banquet**, Ballroom A

Field Trips

Transportation provided; no fee; sign-up at Registration Table, Heritage Hall

- Wednesday, September 21st, 6:30 - 8:00, New Bern Quarry birding
- Wednesday, September 21st, 17:00 - 19:00, Trent River kayaking, meet at Union Point Park
- Thursday, September 22nd, 6:30 - 8:00, Simmons Street Project or Northern Croatan National Forest birding
- Friday, September 23rd, 6:30 - 8:00, Latham-Whitehurst Nature Park birding

Transportation provided; fee; sign-up on meeting website through August 15th

- Saturday, September 24th, 7:00 - 17:30, Cape Lookout National Seashore and Core Sound Museum, \$25.00; check at registration desk for openings.
- Saturday & Sunday, September 24th - 25th, 7:00 leave time; Hatteras Pelagic birding trip; \$175 + lodging + food; check registration desk for openings.

Scientific Program

Program at-a-Glance

Tuesday, September 20, 2016		
9:00 - 17:00	Council Meeting	Craven Boardroom
10:00 - 15:00	NC Sea Grant Meeting by invitation	Tryon Room B
15:00 - 18:30	Registration	Heritage Hall
19:00 - 22:00	Welcome Reception	Heritage Hall & Riverfront Veranda
Wednesday, September 21, 2016		
6:30 - 8:30	Local birding field trip	Leave from Convention Center
7:00 - 17:30	Registration Silent Auction bidding Presentation uploads	Heritage Hall Ballroom C Craven Boardroom
7:00 - 8:00	Continental Breakfast & Coffee	Heritage Hall
8:00 - 9:30	Opening Plenary Session President, Waterbird Society Co-Chairs, 2016 Meeting Planning Sanders & Golder: <i>Welcome to the Carolinas</i> Kushlan: <i>Heron Conservation – A History</i>	Ballroom A
9:30 - 10:00	Coffee and Refreshment Break	Heritage Hall
10:00 – 13:00	Tern Ecology & Conservation Atlantic Marine Bird Cooperative Herons of the World Symposium	Tryon Room A Tryon Room B Berne Room
13:00 - 14:15	Lunch / Student-Mentor Luncheon	Ballroom A
14:00 - 17:30.	Atlantic Marine Bird Cooperative	Tryon Room B
14:15 - 17:30	Waterbird Habitat Conservation Herons of the World Symposium	Tryon Room A Berne Room
15:30 - 17:00	Coffee available Snack concessions available	Promenade, 2nd Floor Concession stand, Heritage Hall
17:30 - 19:00	Reception: Centennial Celebration for the Migratory Bird Treaty Act	Ballroom B
18:30 - 20:30	Event: Wine & Design Fundraiser	Promenade, 2nd Floor

Program at-a-Glance

Thursday, September 22, 2016		
6:30 - 8:30	Local birding field trip	Leave from Convention Center
7:00 - 17:30	Registration Silent Auction bidding Presentation uploads	Heritage Hall Ballroom C Craven Boardroom
7:00 - 8:00	Continental Breakfast & Coffee Publication discussion w/ Editor	Heritage Hall Ballroom B
8:30 - 9:30	Plenary Presentation Dr. Bryan Watts	Ballroom A
9:30 - 9:50	Coffee available Snack concessions available	Heritage Hall Concession stand, Heritage Hall
9:50 - 12:30	Piping Plover Ecology & Conservation Hérons of the World Workshop	Tryon Room A Berne Room
9:50 - 13:00	Atlantic Marine Bird Cooperative	Tryon Room B
12:30 - 14:00	Lunch Diversity Comm. Facilitated Discussion	Ballroom A Ballroom B
14:00 - 17:30	Shorebird Ecology; Waterbird Diseases Eastern Black Rail Symposium Hérons of the World Workshop	Tryon Room A Tryon Room B Berne Room
15:30 - 17:00	Coffee available Snack concessions available	Promenade, 2nd Floor Concession stand, Heritage Hall
17:30 - 19:30	Reception: Poster Session for Waterbird Society & Atlantic Marine Bird Cooperative	Mattox Hall, History Center of Tryon Palace
Friday, September 23, 2016		
6:30 - 8:30	Local birding field trip	Leave from Convention Center
7:00 - 17:30	Registration Silent Auction bidding Presentation uploads	Heritage Hall Ballroom C Craven Boardroom
7:00 - 8:00	Continental Breakfast & Coffee	Heritage Hall
8:30 - 9:30	Plenary Presentation Dr. McCracken	Ballroom A
9:30 - 9:50	Coffee available Snack concessions available	Heritage Hall Concession stand, Heritage Hall
9:50 - 12:30	Waterbird Ecology & Hydrology Black Skimmer Symposium Heron Ecology & Conservation	Tryon Room A Tryon Room B Berne Room
12:30 - 14:00	Lunch: Past Presidents' Luncheon	Ballroom A
14:00 - 16:00	Marsh Bird Ecology & Conservation Seabird Ecology Heron Ecology & Conservation	Tryon Room A Tryon Room B Berne Room
16:00 - 16:30	Silent Auction - end of bidding	Ballroom C
16:30 - 17:30	Business Meeting - Waterbird Society	Ballroom B
18:00 - 20:30	Banquet & Awards	Ballroom A

Plenary Presenters

Welcome to the Carolinas: Habitats and Waterbirds

Felicia Sanders and Walker Golder

The coast of the Carolinas stretches 785 km from Back Bay to the Savannah River and includes the states of North and South Carolina. The climate is humid subtropical, with long, hot summers and short, mild winters. The gently sloping Outer Coastal Plain consists of tannin-stained rivers that flow to tidal estuaries and eventually to the Atlantic Ocean, cypress and hardwood swamps, moss-hung oaks, pocosins, Carolina Bays, and pine forests. The outermost region includes sandy barrier islands separated from each other by inlets, and separated from the mainland by marshes and sounds. Waterbirds are abundant, including large colonies of brown pelicans, terns and wading birds, as well as pelagic seabirds in offshore waters. Shorebirds, such as American oystercatchers nest on beaches and islands, and migrants refuel in coastal wetlands or spend the winter; marshes are home to secretive marsh birds like rails and bitterns, along with waterfowl and other birds. Key areas of the Carolina coast are protected by state and federal agencies, and non-governmental conservation organizations, working together to ensure safe havens for waterbirds of the region.



Felicia Sanders has a BS in Zoology from Duke University and MS in Biology from Clemson University. She joined South Carolina Department of Natural Resources in 2001 after working 10 years on avian conservation for employers such as US Forest Service and US Fish and Wildlife Service. She currently leads South Carolina Department of Natural Resource's shorebird and seabird projects. Projects include protection of large seabird colonies and American oystercatcher and red knot monitoring.



Walker Golder is Director of the National Audubon Society's Atlantic Flyway Coast Initiative. Walker joined the National Audubon Society's staff fresh out of graduate school at The University of North Carolina at Wilmington where he received a MS in Marine Biology under the guidance of Dr. James F. Parnell, a long-time member of the Waterbird Society. For more than two decades, Walker has worked to advance the conservation of shorebirds and waterbirds in North Carolina and along the Atlantic coast.

Heron conservation – a history

James A. Kushlan

Heron conservation inserted itself into the world of institutionalized conservation 34 years ago, in 1982, when an organization co-founded by Heinz Hafner, Patrick Dugan and me was accepted as a research group by the International Waterfowl Research Bureau and as a specialist group by the International Council for Bird Protection, followed soon by its acceptance as a specialist group of IUCN Species Survival Commission. Since then, serving primarily a convening and communication function, numbering over the years between 100 and 200 members, it has held conferences, conducted population-level conservation status assessments, produced biological and conservation monographs of the family, three editions of a global action plan, built a web presence, and encouraged going-on three generations of heron specialists. Interest in herons far preceded any bureaucratic organizing, stretching back to their illustration in 1400 BC in Egypt and in the first century in Pompey. Specific heronries were protected in Japan and Hindu India for hundreds of years, and much appreciated by Falcon-hunting European nobility. Frederick II wrote of their biology in the 1200s, as did Konrad Lorenz in the 1930s, a study anticipating his founding of Ethology. Herons have endured habitat loss - mainly through wetland and river basin hydrological modification and coastal development - and killing - especially during the plume trade of the late 1800s-early 1900s but continuing today at aquaculture facilities worldwide and locally for food and medicine – to remain among the most iconic birds of wetlands, and by extension remnants of wild places. Some populations have been of long-term concern because they are restricted to small numbers or limited range and a few others remain in grave danger of extirpation or even extinction. But conservation planning and action are underway for some species, herons in general are more and more included in large-scale habitat planning, and research is probing new questions using new tools. The past is merely a prologue to an exciting future for heron research and conservation, much of which will be revealed at the following World Heron Symposium and Workshop.



James Kushlan is an ornithologist, educator, writer, and conservationist. His professional positions have included those of research associate Smithsonian Institution, director USGS Patuxent Wildlife Research Center, professor and biology chair The University of Mississippi, professor Texas A&M-Commerce, and wildlife biologist National Park Service. He is past-president of the American Ornithologists' Union and Waterbird Society and past-editor of the journal *Waterbirds*. He received the Waterbird Society's Kai-Curry Lindahl award for his work in heron conservation. He was chair of the North American Bird Conservation Initiative and senior author of the North American Waterbird Conservation Plan. He co-founded and co-chairs HeronConservation -the IUCN Heron Specialist Group and has served on the boards of the American Bird Conservancy, Bahamas Environment Fund (chair), Hawk Mountain Sanctuary, North American Bird Conservation Initiative—US, Tropical Audubon Society, Biscayne Nature Center (chair), and

HistoryMiami and chaired the Bird Conservation Alliance. He currently serves on the boards of the American Ornithologists' Union, Waterbird Conservation for the Americas, Fairchild Tropical Botanic Garden, Zoo Miami Foundation (chair), and Everglades Foundation and on the BirdLife International Global Advisory Group, and University of Miami College of Arts and Sciences Visiting Committee. He earned a PhD from the University of Miami and has been awarded two honorary doctorates. He has provided the impetus for the bird conservation program at Fairchild Tropical Botanic Garden, University of Miami's Chair of Waterbird Biology and Conservation, and research grants programs at Hawk Mountain Sanctuary, Waterbird Society, and University of Miami. He has written and co-written over 200 technical papers and 8 books; the most recent (with Kirsten Hines) being *Attracting Birds to South Florida Gardens, Birds of Fairchild, and Key Biscayne*.

Return of the fish eaters: Unexpected pathways to a new normal for Chesapeake Bay waterbirds

Bryan D. Watts

Over the past 40 years, recovery of the great fish eaters of the Chesapeake Bay has arrived like a freight train. Breeding populations of the bald eagle, osprey and great blue heron have exceeded 2,000, 10,000 and 15,000 pairs, respectively, and are up ten to fifty fold from their nadir in the early 1970s. The collective demand of these metabolic engines is now estimated to exceed 15,000 metric tons of prey per year. In retrospect, silent spring was a demographic perturbation of relatively short duration. However, the long-term study of these populations as they have expanded back into the void created by DDT has revealed an exceptional capacity for continual adjustment to new circumstances. The most interesting chapters in these stories of recovery have been the most recent as the populations have begun to confront their numerical limits within a Bay that is ever changing. All species have moved beyond our preconceived notions of their ecological envelopes. Eagles are adjusting to human land consumption, herons are responding to predation pressure and osprey have extended their reach down the salinity gradient. These unexpected pathways could not have been anticipated during the heady days of the DDT crisis. An evolving but more complete portrait of these species is the return from investments made in long-term monitoring.



Bryan Watts is the Mitchell A. Byrd Professor of Conservation Biology and Director of the Center for Conservation Biology, a research unit shared by the College of William and Mary and Virginia Commonwealth University. He received a BS from Virginia Tech, a MS from the College of William and Mary, and a PhD from the University of Georgia under the direction of H. Ronald Pulliam. Watts co-founded and has directed the Center for 25 years and overseen more than 500 research projects. The overarching mission of the Center is to ensure the viability of bird populations throughout the Western Hemisphere. The recipient of 400 grant awards, author of more than 250 publications and mentor to dozens of undergraduate and graduate students, Dr. Watts has an insatiable interest in all aspects of avian ecology and a passion for solving conservation problems. Current

interests include winter sparrow community structure, bald eagle breeding ecology and population regulation, restoration of imperiled species, ecological economics, ecology of disturbance-prone species, threats to marsh-bird communities, passerine migration ecology, mitigation of hazards within urban landscapes, and the conservation of declining shorebirds.

Genetic Adaptation and Phenotypic Plasticity in High-Altitude Ducks

Kevin G. McCracken

A fundamental question in evolutionary genetics concerns the extent to which adaptive phenotypic convergence is attributable to convergent or parallel changes at the molecular sequence level. Here we report a comparative analysis of hemoglobin (Hb) function in eight phylogenetically replicated pairs of high- and low-altitude waterfowl taxa to test for convergence in the oxygenation properties of Hb, and to assess the extent to which convergence in biochemical phenotype is attributable to repeated amino acid replacements. Functional experiments on native Hb variants and protein engineering experiments based on site-directed mutagenesis revealed the phenotypic effects of specific amino acid replacements that were responsible for convergent increases in Hb-O₂ affinity in multiple high-altitude taxa. In six of the eight taxon pairs, high-altitude taxa evolved derived increases in Hb-O₂ affinity that were caused by a combination of unique replacements, parallel replacements (involving identical-by-state variants with independent mutational origins in different lineages), and collateral replacements (involving shared, identical-by-descent variants derived via introgressive hybridization). In genome scans of nucleotide differentiation involving high- and low-altitude populations of three separate species, function-altering amino acid polymorphisms in the globin genes emerged as highly significant outliers, providing independent evidence for adaptive divergence in Hb function. The experimental results demonstrate that convergent changes in protein function can occur through multiple historical paths, and can involve multiple possible mutations. Most cases of convergence in Hb function did not involve parallel substitutions and most parallel substitutions did not affect Hb-O₂ affinity, indicating that the repeatability of phenotypic evolution does not require parallelism at the molecular level.



Kevin McCracken received his PhD from Louisiana State University in 1999. He served on the faculty of the University of Alaska Fairbanks from 2001 to 2014, after which he assumed the inaugural Kushlan Chair in Waterbird Biology and Conservation at the University of Miami in Coral Gables, Florida. His research has primarily focused on the genetics and physiology of waterfowl, including species that inhabit high-altitude environments in the Andes in particular. He has published more than 80 peer-reviewed scientific articles and served as lead Principal Investigator on numerous grants from the National Science Foundation. He has conducted extensive fieldwork in the Arctic, Australia, and throughout southern South America.

Program Details

Wednesday, September 21			
10:00	Tern Ecology and Conservation Session Chair: Patty Szczys Loring* – Movement of adult Common and Roseate Terns during the chick provisioning period	Workshop: Atlantic Marine Bird Cooperative Chair: Caleb Spiegel 10:00 - 10:30 Introductions, Meeting Objectives & Ground Rules	Symposium: Herons of the World Chairs: Chip Weseloh and Clay Green Harebottle – HeronryMAP: mapping the distribution and status of ardeid breeding colonies in Africa
10:20	Davis* – Family matters: begging behavior as an honest signaling mechanism for parent-offspring association in Roseate Terns	10:30 - 13:00 <u>LEARNING FROM OUR PAST (History and accomplishments):</u>	Rabarisoa – The new status of the two endangered heron species, the Madagascar Heron and the Madagascar Pond Heron
10:40	Arnold – Multiscale metapopulation dynamics among North American common terns: implications for conservation of declining inland subpopulations	10:30 Brief History of AMBC 10:45 Broad Review of Accomplishments	Lee – Current status, ecological characteristics and conservation of Family Ardeidae in natural and disturbed forests of urban area, Korea
11:00	Parsons – Spatio-temporal patterns of habitat use by pre-migratory hatch year Roseate Terns on Cape Cod, Massachusetts, USA	11:15 Group Structure	Senner* – Response of avian communities to water management in the floodplain grassland of Mekong Delta
11:20	Nepshinsky* – Determining sex of two monomorphic seabirds at the Isle Dernieres Barrier Island Refuge in Louisiana		Sundar – Abundance and distribution patterns of two heron species in multiple agricultural landscapes of south Asia
11:40	Shealer – Outlook not so good: the plight of the Black Tern in North America		Mondal – Foraging strategy and prey-handling time in White-bellied heron in Namdapha Tiger Reserve, Arunachal Pradesh, India
12:00	Dayton* – Population structure of the Eurasian Whiskered Tern, a species exhibiting demographic	12:15 What Has Worked and What Hasn't	Toquenaga – Collective colony formation algorithm

	expansion		
12:20	Windhoffer* – Evidence of predation and disturbance in nesting waterbird colonies on a Louisiana barrier island system using video monitoring		Riegner – Morphological trade-offs and recursive plumage patterns as indicators of integrated evolutionary dynamics in the Ardeidae
12:40	Szczys – Range-wide patterns of population differentiation of Eurasian Black Terns related to use of discrete post-nuptial staging sites		Durham* – Distribution and temporal trends of Western Reef Heron populations along the Arabian Gulf Coast, UAE
13:00	LUNCH		
14:30	Waterbird Habitat Conservation Chair: Woody Woodrow Woodrow – Texas Rookery Island Project – A Deepwater Horizon Early Restoration Project	Workshop: Atlantic Marine Bird Cooperative Chair: Caleb Spiegel 14:00 - 17:30 <u>FUTURE DIRECTIONS Part I</u> <u>(Reevaluating our focus):</u> 14:00 Review Questionnaire Results 14:30 Audience 15:00 Scope 15:30 Priorities	Symposium: Herons of the World Chairs: Chip Weseloh and Clay Green Yanosky – Conservation status of herons in Paraguay: future scenario in face of accelerated habitat degradation.
14:50	Hardegree – Preliminary planning for colonial waterbird rookery habitat needs, San Antonio Bay, Texas		Ruiz-Guerra – Herons in Colombia: status, knowledge gaps and conservation
15:10	Hackney – Already gone: GIS analysis and modeling of American Oystercatcher nest site erosion risk in the upper Texas coast		Stier – From ARGOS to conservation: reporting 4 years of action for Agami Heron
15:30	Moran* – Ecosystem impacts from Double-crested Cormorants in a southeastern lentic, reservoir system		Herring* – Rice fields support the largest known breeding population of the endangered Australasian Bittern
15:50	Golet – When is additional shorebird habitat most needed in California’s Sacramento Valley		Fasola – Dry rice paddies cause a decline of the breeding herons and egrets in Italy

16:10	Movement Ecology of Waterbirds Chair: Tommy King King – Home ranges and habitat use of brown pelicans in the northern Gulf of Mexico	16:30 Vision and Goals Statements	Green – A decade of Reddish Egret research: looking back and moving forward
16:30	Rojas – Migration of American White Pelicans in central coast of Veracruz		Gonzalez* - Characterization of Ardeid assemblages on the southern coast of Cuba
16:50	Shelpr* – GPS tag attachment is likely to affect hatching but not chick rearing in Herring Gulls		Gawlik – Representing hydrologic variability in heron models: key processes for wetland ecosystem management
17:10	Meyer – Annual movements, breeding and winter affinities, and seasonal activity ranges of Magnificent Frigatebirds tracked by satellite		Brzorad – Patterns of annual habitat utilization, spatial distribution and migration by Great Egrets
17:30 End day			

Thursday, September 22

9:50	Piping Plover Ecology and Conservation Chair: Dan Gibson Gibson – Winter habitat conditions influence survival across the full life cycle for an imperiled migratory shorebird	Workshop: Atlantic Marine Bird Cooperative Chair: Caleb Spiegel 9:50 - 12:30 <u>FUTURE DIRECTIONS Part II</u> <u>Determining how we work together:</u>	Hérons Workshop Chairs: John Brzorad and Cathy King Introduction <i>Kushlan</i> 5 min
10:10	Bimbi – The role of the Piping Plover towards shorebird conservation on developed beaches in the southeastern USA	9:50 Group Structure	Part I: Communication & structure HSG Brief explanation of Heron Specialist Group (HSG) and Strategic review <i>Green</i> 15 min
10:30	Hunt* – Piping Plover prey abundance and body condition after large-scale habitat creation on the Missouri River, USA		HSG questionnaire : who's a heronophile now? <i>Brzorad</i> 10 min
10:50	Weithman* – Carryover effects of reproductive performance and density dependence influence breeding propensity in		

	a short-lived species		
11:10	Friedrich* – Piping Plover habitat suitability on the Niobrara River, Nebraska	11:15 Meetings	Heron-related working groups: structure, objectives, successes and challenges <i>7 group representatives</i> 60 min
11:30	Robinson* – Variable space use between nesting and brood rearing periods by Piping Plovers on Fire Island, NY	11:45 Member Time Commitment	Part II: Heron Action plans, research and conservation
11:50	Eunbi – Using the Dail-Madsen model to estimate abundance of migratory shorebirds at a stopover site	12:00 Support Structures 12:30 Next steps 13:00 Adjourn	Review status of species: trends, threats and gaps <i>King</i> 15 min Action plan priorities and implementation issues <i>6 species representatives</i> 55 min
12:30	LUNCH		
14:00	Shorebird Ecology Chair: Lisa Ferguson Felton* – Behavioral and physiological responses of nesting American Oystercatchers to off-road vehicles on North Carolina’s national seashores	Eastern Black Rail Symposium Chair: Whitney Wiest Tolliver* – Influences on detection and occupancy of black rails in Texas	Hérons Workshop Chairs: John Brzorad and Cathy King Allocation of heron research and conservation efforts, now & future plans
14:20	Claassen – Multi-scale habitat selection by sandbar-nesting River Birds in Cambodia	Moore* – Mud, sweat and skeeters: determining the status of the Eastern Black Rail in Texas	<i>Brzorad</i> 15 min Heron Global Action Plan – priority actions and species
14:40	Ferguson, L – Enhancing beach elevation to improve reproductive outcomes for beach-nesting birds	Hand – Assessing the distribution of the Eastern Black Rail in South Carolina	I. Review of current action plan <i>Kushlan</i> 25 min
15:00	Heller* – Red Knot and prey abundance and distribution along the Virginia barrier islands, USA	Brinker – Where have all the Black Rails gone?	II. Breakout discussion groups: identifying important gaps and priorities 75 min
15:20	Black* – Diet of Great Black-backed and Herring Gulls, Tuckernuck and Muskeget Islands, Massachusetts, USA	Tsipoura – Assessing the status of Eastern Black Rail in New Jersey	

15:40	Waterbird Disease, Parasites and Contaminants Chair: Kate Sheehan Haram* – Waterbird distribution and avian vacuolar myelinopathy species susceptibility on a Georgia reservoir infested with the aquatic plant hydrilla	Watts – Status and distribution of the Eastern Black Rail	<p>HSG in Future discussion groups <i>55 min</i></p> <ol style="list-style-type: none"> 1. Standardization of methodologies 2. Communications 3. HSG objectives 4. Future focus topics 5. Role in fund-raising <p>Wrap up <i>Green 10 min</i></p>
16:00	Ferguson, T* – Natural West Nile Virus infection in captive raised American White Pelicans	Eastern Black Rail Discussion	
16:20	Goodenough* – Making lemonade out of lemons: what we have learned about Gull-billed Tern colony recovery after the 2013 epizootic		
16:40	Sheehan – How the metabolic theory of ecology helps us predict avian ectoparasite infracommunity carrying capacity		
17:00	Kurimo-Beechuk* – Factors affecting the abundance of breeding secretive marsh birds and investigating the effects of metal contaminants on clapper rail health		
Friday, September 23			
9:50	Waterbird ecology and hydrology Chair: Peter Frederick Clem – Trends in hydrology, habitat loss, and Wood Stork nesting at Corkscrew Swamp Sanctuary	Black Skimmer Symposium Chair: Troy Wilson Smith – Black Skimmer management in New York State	Heron Ecology and Conservation Chair: Alan Maccarone Ruiz-Guerra – Prey consumed by wading birds in mangrove swamps of Colombia Caribbean Coast
10:10	Evans* – Dietary flexibility of Wood Storks in response to human-induced rapid environmental change in South Florida	Brinker – Status and population change of Black Skimmers in Maryland 1985-2016	Maccarone – Intraspecific and intersexual variation in three species of wading birds

10:30	Tiway* – The role of environmental factors in influencing nest survival in Painted Stork populations of north India	Ray – Black Skimmer protection, monitoring, and stewardship at St. Pete Beach, Florida	D’Auria – Estimating the breeding populations of Great Blue Herons in Maine: what’s not on our colony list?
10:50	Frederick – Breeding site longevity and site characteristics have intrinsic value for predicting persistence of colonies of an endangered bird	Forys – Movements of first-year Black Skimmers in Florida	Yanosky – Potential impacts in heron populations due to scenarios of climate change in South America: focus in Paraguay and bordering countries
11:10	Peterson* – Contrasting resource selection of Great Egrets and Wood Storks in a dynamic ecosystem	Hackney – A bird’s eye view of nest sites: mapping habitat for Black Skimmers in the Upper and Mid Texas Coast	Matsunaga – Recent trends of the nesting location of Grey Herons in Hokkaido, northern Japan
11:30	Poli* – Impact of water management on nesting ecology of Snail Kites in South Florida	Heath – Industry provides a safe haven for nesting Black Skimmers	Essian* – Hydrologic fluctuations influence daily survival rates of small herons and Great Egrets in a subtropical littoral wetlands
11:50	Tiegs* – Analysis of wintering whooping crane behavior along the Texas Gulf Coast	Discussion	Rylander* – A hop, skip and a jump: the use of long-term banding data to understand movement and survivorship of Reddish Egret in Texas and Mexico
12:10	Gawlik – Strategies to cope with food-limitation: differing implications of prey and foraging habitat availability for wading birds		Gonzalez* – Clinal variations in dark morph proportion of Reddish Egrets in Cuba
12:30	LUNCH		
14:00	Marsh Bird Ecology and Conservation Chair: Chris Elphick McRae – Royal flush: ecology and conservation of the king rail on the mid-Atlantic coast	Seabird Ecology Chair: Pat Baird Goyert – Density- dependence and changes in carrying capacity in Alaskan seabird populations	Heron Ecology and Conservation Chair: Clay Green Cook – Range-wide survey of inland wading bird nesting colonies in North Carolina
14:20	Byerly* – Effectiveness of remote data collection methods for monitoring secretive marshbirds	Baird – Least Terns nesting in Hawaii – Darwin’s Finches or Great Auks? Difficulties in establishing a foothold within a highly altered and hostile	Maccarone – Foraging microhabitat selection by long-legged wading birds at an artificial weir

		environment	
14:40	Pierce – Coordinated conservation and monitoring of secretive marsh birds in the Midwest	Lamb – Long-term physiological responses of nestling seabirds to variation in prey availability and nest site characteristics	Yanosky – Impacts of a road construction on waterbird populations and first regional rehabilitation actions at Asuncion Bay Ecological Reserve
15:00	Rush – Temporal changes of oligohaline emergent marsh and associated marsh bird abundance in lower Mobile-Tensaw River Delta	Veit – Detecting hotspots of seabird abundance off southeastern Massachusetts	May* – The effects of colony structure and nest position on the reproductive success of small herons
15:20	Elphick – Tidal marsh bird conservation in the northeastern U.S.	White – Evaluating seabird persistence in the Northwest Atlantic	Schwarzer – Development of a survey protocol for monitoring Reddish Egrets in Florida
15:40	Znidarsic* – Camera traps as an effective monitoring tool for low detectability species – a rail tale	Welch – Using seabirds to track ecosystem change in the Gulf of Maine	Sundar – Making a case for long-term monitoring of large waterbirds in agricultural landscapes: preliminary findings from south Asia
16:00		Reynolds – Tohoku tsunami inundation: variation in impacts to Pacific island bird communities	Mohanraj – Diversity of waterbirds in Periyakulam lake Tiruchirappalli District, TamilNadu, Southern India

* indicates student presenter

Poster Presentations

1. Gilbert, Andrew T.

A Mobile Avian Survey Data Collection Software Application (SeaScribe) (Atlantic Marine Bird Cooperative)

2. Abemayor, Michael A.

Using nest cameras and automated telemetry to monitor chick provisioning by Common and Roseate Terns (Atlantic Marine Bird Cooperative)

3. Wells-Berlin, Alicia M.

Satellite Tracking Highlights Use of Ocean Habitat by Diving Bird Species in Federal Waters of the US Mid-Atlantic (Atlantic Marine Bird Cooperative)

4. Fiely, Jonathan L.

New technologies reveal fine-scale spatial patterns in migrating northern gannets: Preliminary data from 2016 spring migration using GPS/GSM transmitters (Atlantic Marine Bird Cooperative)

5. Welch, Linda J.

Movements and Foraging Areas of Great Shearwaters *Puffinus gravis* in the Gulf of Maine (Atlantic Marine Bird Cooperative)

6. White, Timothy. P.

At-sea sightings and model predictions of Black-capped Petrels (*Pterodroma hasitata*) north of Cape Hatteras, North Carolina (Atlantic Marine Bird Cooperative)

7. Spendelow, Jeffrey A.

Evaluating current limiting factors and future threats to recovery of endangered Roseate Terns (Atlantic Marine Bird Cooperative)

8. Etherington, Amy R.

Factors affecting the inter-annual growth rates of Royal Tern (*Thalasseus maximus*) chicks in coastal North Carolina

9. Anderson, John G.T.

Use of GPS Tags in Evaluating the Impact of Oyster Farms on Gull Foraging Patterns

10. Brown, Caroline*

Using Pellet Collection and Chick Regurgitation to Determine the Diet of Herring Gulls (*Larus smithsonianus*) on Great Duck Island

11. Allen, Michael

Coastal impoundments of the Northeast and Mid-Atlantic: A regional approach to mapping and assessing value to birds and vulnerability to climate change

12. Chowdhury, Sayam U.*

Ecology of the Endangered Masked Finfoot in Sundarbans, Bangladesh

13. Macklin, William

Incubation and diving depths of Audubon's Shearwaters and Red-billed Tropicbirds at Little Tobago Island, Trinidad and Tobago.

14. Atwood, Jonathan L.

Colony formation, site fidelity and movements among nesting Least Terns on Plymouth Beach, Massachusetts

15. Cornish, Michael. R.*

Using A Commercially-Available UAS to Count Nesting Gulls on Great Duck Island, Maine

16. Craig, Elizabeth

A Continental Divide in Migratory Behavior: Conservation Implications for the Common Tern

17. Bellman, Henrietta A.

When is dense vegetation too dense for Piping Plovers on Fire Island, NY?

18. Custer, C.M.

Concentrations and spatial patterns of organic contaminants in tree swallows at United States and Binational Great Lakes Areas of Concern (AOCs), 2010-2015.

19. Palestis, Brian G.

Interactions Between Common Terns and Ground-Nesting Ospreys

20. Ferguson, Lisa

Seabird Colony Registry and Atlas: South Carolina, Georgia, northern Florida

21. Orzechowski, Sophia C^{1*}

Quantifying the impacts of Burmese pythons on wading bird reproduction

22. Finch, Molly M.*

Predation by Great Black-backed Gulls (*Larus marinus*) on Great Duck Island, Maine, USA

23. Anholt, Allison R.

Waterbird productivity on a salt marsh island following a trial beneficial reuse of dredged material project

24. Barr, Jarred R.*

Evaluating the use of unmanned aerial systems (UAS) to survey mixed-species waterbird colonies

25. Hand, Christine. E.

Investigating vocalization patterns of the Eastern Black Rail in South Carolina

26. Schroeder, Katie M.*

Detection probability using the standardized marsh bird monitoring protocol in a coastal breeding king rail population

27. Marbán, Paul

Initial testing of a minimally invasive surveillance system used to monitor a Maryland state endangered species, the common tern (*Sterna hirundo*).

28. Bracey, Annie

Conservation and Management of Common Terns (*Sterna hirundo*) in the Western Great Lakes Region

29. Williams, D.S.

Cow Trap Lake Shoreline Protection: A Wetland, Reef and Colonial Waterbird Nesting Island Restoration Project, San Bernard National Wildlife Refuge, Texas

30. Snook, C. F.

Color-banding adult Wilson's Plover: A pilot study focused on small breeding sites.

31. Hansen, James

Population monitoring, ecology, and habitat relationships of sora and Virginia rails in northwestern Ohio

32. Kerstetter, David W.

Assessment of Trophic Positions for the Seabirds of South Florida using C and N Stable Isotopes

33. Venuti, Gemma*

Habitat Selection in the Leach's Storm Petrel on Great Duck Island

34. Kriensky, Debra

Herring Gull Colonies on New York City Rooftops

35. Laurich, Bruce

An investigation of Herring Gull population declines on Lake Superior

36. Mazza, Anthony G.*

Comparing simple digital photography and digital calipers as methods for measuring egg dimensions

37. Dolgova, Lana*

Amino acid-specific $\delta^{15}\text{N}$ analysis improves our ability to interpret spatial patterns in waterbird contaminant levels

38. McTague, Audra Novine

Glucocorticoid comparisons of Herring (*Larus smithsonianus*) and Great Black Backed Gull (*L. marinus*) faecal samples in coastal Maine

39. Hopkins, Heather C.

The Potential Effects of Underwater Sound on Double-Crested Cormorants in Dodge Pond, Niantic, CT

40. Moran, Leah L.K.*

Where to Next: Modeling Potential Double-crested Cormorant Breeding Locations in the southeastern U.S.

41. Kerstetter, David W.

Relationships of Endoparasite Diversity and Feeding Ecology in the Seabird Complex of South Florida

42. Nefas, Stephanie M.

Least Tern (*Sternula antillarum*) Nest Success and Chick Survival on the Missouri River Following an Historic Flood Event

43. Post, Laura R.*

Distinguishing between specialism and opportunism in the diet of herring gulls

44. Moore, David J.

Migration patterns and overwintering distribution of Black Terns using geolocators.

45. Ringler, Katie B.*

Investigating the evidence for ecological succession of colonial waterbirds

46. Spear, Kathryn A.

Assessment of Storm Impacts on Coastal Bird Populations, Behavior, and Nesting along the Outer Banks Barrier Islands, North Carolina

47. Wires, Linda R.

Integrated Waterbird Management and Monitoring and the Avian Knowledge Network: a Partnership to Enhance Conservation of Nonbreeding Waterbirds.

48. Takahashi, Fumika*

Shorebird utilization of horseshoe crab eggs at Cape Romain National Wildlife Refuge, South Carolina

49. Szczys, Patricia

Common Tern and Arctic Tern hybridization produces fertile offspring

50. Goodenough, Katharine*

Black Skimmer post-breeding dispersal and migration strategy in the Peruvian Amazon

51. Rutter, Jordan E.*

Plover lovers? Knowledge and public support for piping plover conservation by visitors to Michigan beaches

52. Satgé, Yvan

An automated alert system to help with the recovery of archival loggers deployed on seabirds

53. Underwood, Jared G.

Improving Bullfrog Capture Methods to Benefit Hawaii's Endangered Endemic Waterbirds

54. Walker, Katie M.*

Piping Plover nesting habitat selection on Fire Island, NY following Hurricane Sandy

55. Durham, Sarah*

Population Viability of the Reddish Egret (*Egretta rufescens*) in Texas: An Analysis of Management Actions and Implications

56. Master, Terry L.

Distribution and abundance of egret and night-heron species in Pennsylvania, past and present

57. McCracken, K.

Mitochondrial and Nuclear Phylogenies of the Herons

58. Andersson, Annika G.

Great Egret roosting dynamics along the North Carolina coast

59. Wong, I C. Captain

Long Term monitoring of egrets and herons in Hong Kong (1989 – present)

60. Mashiko, Miyuki

Changes in populations of colonial herons and egrets in Japan

61. Stein, Kristie*

Survival and movements of Black-crowned Night-Herons in Lake Erie, Ohio

62. Daigneault, Beau J.*

The correlation between prey item distribution and Reddish Egret (*Egretta rufescens*) foraging behavior

63. Weseloh, D.V. Chip

Habitat characteristics and seasonal numbers of Great Egrets at 70 roost sites in the area of Southern Ontario, Canada

64. Scarlett, Todd L.

Effects of hydroelectric generation on foraging in Great Blue Herons (*Ardea herodias*)

65. Hung, Le Manh

Status and Conservation of White-eared Night Heron in Vietnam

66. Stier, Anna

ARGOS tracking to understand the ecology and behavior of Agami Herons

67. Alvarado, Ghisselle M.

Importance of Costa Rican Conservation Areas and IBAS for Ardeidae conservation and management

68. Walker, Isabelle*

Seasonal variation of Reddish Egret movement along the Gulf of Mexico

ALPHABETICAL LIST OF ABSTRACTS FOR ORAL AND POSTER PRESENTATIONS



A skimmer chick next to the name indicates that the presenter is a student. Bolded names are the presenters

Abemayor, Michael A.¹, Loring, Pamela H.^{1,2}, Paton, Peter W.C.³, Sievert, Paul R.¹, Griffin, Curtice R.¹, Reid-Shaw, Indiana¹, and Thorne, Kalaina¹

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Using nest cameras and automated telemetry to monitor chick provisioning by Common and Roseate Terns (Poster – Atlantic Marine Bird Cooperative)

Monitoring chick provisioning by nesting seabirds provides useful information on the prey base, which is one of the key drivers of fledging success for birds nesting on offshore islands. During 2016, we attached uniquely coded VHF transmitters to adult Common Terns (*Sterna hirundo*; $n=30$) and Roseate Terns (*Sterna dougallii*; $n=30$) on Great Gull Island in Long Island Sound, NY. Transmitters emitted signals every 6 seconds for over 150 d, thus we were able to quantify nest attendance patterns throughout the chick-rearing period with an automated telemetry station on the island. We also conducted nest observations from blinds during the pre-fledging period for a subset of tagged birds ($n=11$ Common Tern nests, and $n=20$ Roseate Tern nests). Our observations from blinds were designed to quantify: 1) the prey species, its approximate size, and delivery rate to chicks; 2) interspecific and gender differences in prey selection and provisioning flight duration; and 3) variation in nest attendance by members of a pair. We used high resolution nest cameras concurrently with observational stints to improve identification of prey species. We demonstrate the utility of these technologies for collecting data on prey delivered during chick provisioning, as well as nest attendance patterns. In addition, we summarize our current efforts to link prey-delivery data with spatially-explicit information on the routes and destinations of provisioning flights tracked by an array of 24 automated radio telemetry stations established throughout the Southern New England-New York region.

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Patterns of annual habitat utilization, spatial distribution, and migration by Great Egrets (*Ardea alba*) (Oral – Heron Symposium)

State-of-the-art satellite GPS transmitters (48-g Bird Solar; e-obs) are providing unprecedented details regarding movements and habitat utilization for birds heavier than 1 kg. We present current information on habitat utilization and the spatial distributions of 13 Great Egrets (*Ardea alba*) captured in various locations from 2013 to 2015. Nearly 560,000 GPS points were used to quantify the size of areas used by birds during 3694 observation-days by using LoCoH program in the R platform. The habitat size required for breeding (n = 10 birds), particularly when young require most food, is larger than that used for the post-breeding period (n = 7) and during winter (n = 5). All major migrations occurred at night, and we present details for post-breeding (n = 9) and Spring (n = 5) migration segments. Two young-of-the-year, non-breeding birds displayed both conservative and exploratory use of habitat.



Allen, Michael*¹; Tsipoura, Nellie¹; Schrass, Karl²; Schotland, Taj²; Kane, Austin³; Miller, John⁴; Emerson, Clay⁴; Frost, Chuck⁵; Galbraith, Hector⁶; Mizrahi, David¹

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Coastal impoundments of the Northeast and Mid-Atlantic: A regional approach to mapping and assessing value to birds and vulnerability to climate change (Poster)

Coastal impounded wetlands with water levels managed for wildlife proliferated along the Atlantic Flyway in the mid 20th century with the growth of the National Wildlife Refuge system and efforts to reverse waterfowl population declines. Today many of these sites have high ecological value for a variety of waterbirds. However, they are increasingly vulnerable as infrastructure ages, sea levels rise, and frequent storms necessitate costly repairs. In response to damage caused by Superstorm Sandy in 2012, we attempted to map all federal, state, and locally-owned coastal impoundments from Maine to Virginia and collect information on their history, management, bird usage, and vulnerability to climate change. Information was obtained through manager interviews, workshops, literature review, GIS analysis, and site visits. We found 161 impoundments totaling >9400 ha at 40 sites. 151 (94%) occurred in four states: New Jersey, Delaware, Maryland, and Virginia. Twenty (12%) are abandoned with no plans to restore. We ranked potential vulnerability to storms based on Lidar-derived berm characteristics, and made engineering assessment visits to a subset to assess other factors influencing vulnerability. We located waterbird data for 124 of 161 impoundments from a variety of sources (e.g., International Shorebird Survey, Integrated Waterbird Management and Monitoring, eBird). We present preliminary comparisons of waterbird abundance at impoundments using eBird data (the most readily available dataset), and discuss benefits of a regional, multi-agency approach to impoundment prioritization and monitoring.

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Importance of Costa Rican Conservation Areas and IBAS for Ardeidae conservation and management (Poster)

Costa Rica has 350 documented wetlands (350,000 ha) in the National Wetland Inventory; all them administrated by Conservation Areas (Environmental Ministry). However the diversity of more of them is poorly known (except Ramsar Sites). Ardeidae species live and move along the country. I used 55,000 electronic records from the National Museum and Global biodiversity information facility (GBIF) to create Conservation Areas and IBAS ardeidae species lists and prioritize them by species diversity, vulnerability and future needs. I applied ecological niche modelling for Costa Rica threatened or sensible species: Agami Heron, Least Bittern, Pinnated Bittern and Rufescent Tiger-Heron.

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Use of GPS Tags in Evaluating the Impact of Oyster Farms on Gull Foraging Patterns (Poster)

The rapid decline of traditional fin-fisheries in the Gulf of Maine and elsewhere has led to an increasing emphasis on concentrated aquaculture operations, especially in inshore environments. This in turn has raised concerns about the possible attraction of gulls to production sites in the vicinity of airports or other sensitive humanized landscapes. Prior to the installation of submerged oyster growth cages in a bay in eastern Maine, we conducted a series of shore-based observations of waterfowl at the proposed aquaculture site, and color-banded Herring and Great Black-backed Gulls (*Larus argentatus* and *L. marinus*) at a major gull colony approximately 33 km to the southeast. Observations at the proposed aquaculture site revealed that at least some birds banded at the colony were already using the area for foraging. Oyster cages were then introduced to the site in early May of 2016. Post-installation bird counts show there has been no significant increase in gull activity in the area. We attached solar-powered GPS loggers to 6 Herring Gulls on the primary colony and on two gulls at a secondary colony located a further 18 kilometers offshore. Loggers were set to record position and altitude every 10 minutes, and can last for several years. We present the resulting flight-tracks of tagged birds in relation to the aquaculture site and other sources of anthropogenic food.

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Great Egret roosting dynamics along the North Carolina coast (Poster)

To understand more about the habits, habitat preferences, species composition, abundance trends and overall importance of Great Egret (*Ardea alba*) roosting sites, we monitored eight roosts along the North Carolina Coast from 2015 – 2016. These roost locations, in Carteret County and at Lake Mattamuskeet National Wildlife Refuge, were obtained through reported observations of tagged egrets from concerned citizens and from a separate radio-telemetry project. Only two of the eight roosting sites have been used consistently by Great Egrets throughout the year; these roosts are on suburban,

privately-owned land and are at risk of development or other manipulation. Three roosts are used on a short-term basis (≤ 3 consecutive months), two sites have been deemed inactive, and we lost access to another. Roost size ranged from 0 – 259 Great Egrets. High counts of other colonial waterbirds at these roosts include 6 Snowy Egrets (*Egretta thula*), 46 Cattle Egrets (*Bubulcus ibis*), 20 Black-crowned Night Herons (*Nycticorax nycticorax*), 15 Little Blue Herons (*Egretta caerulea*), 7 Green Herons (*Butorides virescens*), 7 Great Blue Herons (*Ardea herodias*), 1 Tri-colored Heron (*Egretta tricolor*), 383 White Ibis (*Eudocimus albus*), 18 Glossy Ibis (*Plegadis falcinellus*) and 1097 Double-crested Cormorants (*Phalacrocorax auritus*). Our data collection is ongoing and will supplement other roost monitoring projects in North America.

Anholt, Allison R.¹; Ferguson, Lisa¹; Jahn, Jackie²; Yepsen, Metthea³; Golden, David⁴

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Waterbird productivity on a salt marsh island following a trial beneficial reuse of dredged material project (Poster)

In response to degraded conditions, a multi-partner restoration project was initiated in August 2014 to restore a coastal salt marsh in southern New Jersey with locally dredged material. Two thin-layer placement (TLP) plots, 0.2 hectares each, were raised 12-22 cm. A higher elevation nesting habitat plot (1.6 m x .77 ha) was also created. Following material placement we employed two monitoring approaches in order to better understand use of the marsh system by nesting and migratory birds. Point count surveys captured avian use in three seasons at points encompassing areas proximate and distal to TLP plots. Intensive breeding monitoring was also conducted at the TLP, nesting habitat plot, and control plots. Breeding activity was monitored for eleven species of birds and other taxa, including at-risk species American Oystercatcher (*Haematopus palliatus*), Least Tern (*Sternula antillarum*), Common Tern (*Sterna hirundo*), diamondback terrapins (*Malaclemys terrapin*), and horseshoe crabs (*Limulus polyphemus*). The elevated habitat especially proved beneficial for nesting species in 2015, with 100% productivity for all nesting pairs. The 2016 breeding season has so far also seen high rates of productivity, including the expansion of a state-endangered Least Tern colony. Activity of all wildlife species, including potential predators of nesting birds, was monitored at least twice weekly via direct and remote observations, and through wildlife cameras. Continued post-construction monitoring will allow us to assess how metrics of bird use change over time at this significant salt marsh island and, more broadly, in response to salt marsh restoration projects. As more restoration projects are initiated for coastal wetlands in response to rising sea levels, it is critical that avian use be incorporated into planning, construction, and post-construction stages.

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Multiscale metapopulation dynamics among North American common terns (*Sterna hirundo*): implications for conservation of declining inland subpopulations (Oral)

Understanding metapopulation dynamics is often critical for successful conservation of declining regional populations. Dynamics such as dispersal, local extinction and colonization occur across multiple scales. Epidemiological and metacommunity studies often incorporate multiscale dynamics, but scale-dependent processes remain largely unexplored for single species. Seabirds are good model organisms for this investigation as their life histories favor metapopulation dynamics and factors influencing extinction and colonization of breeding sites often act at different spatial scales. Accordingly, we used regional population genetics from 12 sites to examine subregional (<400 km) and regional (>1,000 km) dispersal among breeding common terns across declining Great Lakes and more stable Atlantic coast subpopulations.

At subregional scales, population differentiation was low-to-moderate, suggestive of metapopulation structure. Additionally, Bayesian inference of migration rates indicated asymmetrical dispersal over the last several decades from Great Lakes strongholds to subpopulations in heavily-managed areas of the inland St. Lawrence River. Metapopulation structure was also evident at the regional scale and asymmetrical dispersal from inland to coast regions increased ten-fold over the same time period (with no change in the opposite direction).

Our finding of dispersal on multiple scales indicates that common terns are leaving the Great Lakes region (a stronghold of this species since the last ice age), presumably as a result of declining suitability for breeding over the past 50 years. Our results implicate established seasonal migration routes for inland/coastal subpopulations as the mechanism behind asymmetrical dispersal to coastal regions. As migration routes appear fixed over large timescales, recolonization of historical inland breeding strongholds is unlikely to occur. Our study therefore strongly supports urgent conservation efforts for declining populations of this species in inland North America.

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Colony formation, site fidelity and movements among nesting Least Terns on Plymouth Beach, Massachusetts (Poster)

Least Terns (*Sternula antillarum*) in the northeastern U.S. are often considered to be quite flexible in their fidelity to nesting sites, a characteristic which can complicate protection and management efforts. Based on an 8-year study of mapped nest locations distributed among 6 distinct sites along a 3-mile-long barrier beach in Massachusetts, this paper examines year-to-year movements of color-banded adults and the relationship of these movements to age, sex, nest initiation date, nesting success during the previous year, and pair bond stability. Total numbers of nests annually recorded varied from 67 - 228 (mean = 161, SD = 54.8). Also discussed will be the role of social stimulation in site selection, including how “hot spots” of courtship and nesting activity result in the growth and development of colonies.

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Least Terns nesting in Hawaii - Darwin's Finches or Great Auks? Difficulties in establishing a foothold within a highly altered and hostile environment (Oral)

Three nesting pairs of small *sternula* terns were first discovered nesting on the Big Island of Hawaii in 2012. This was the first time that this genus had been discovered nesting in the southeast Hawaii islands. Least terns have been found in the Hawaiian archipelago from March through November since the 1970s, yet where they spend the nonbreeding season is unknown- even for mainland subspecies. In 2014, our team recovered DNA from a nonviable egg from one nest and found that the terns were least, not little, terns (Szczyz et al. 2014, Annual Meeting The Waterbird Society, La Paz). We collected breeding data on the three pairs from 2012-2015, and then trapped two adults from the two nests we could find in 2016, and placed geolocators on them. These two nests had helpers at the nest in this El Nino year, which is common for least terns in poor food years. Each clutch had 3 eggs, but only one hatched per clutch. Both chicks were killed within two weeks of hatching- one run over by a golf cart, and the other we suspect was killed by mynahs. Afterwards, both tagged adults were seen foraging near the nesting areas but they never re-nested again. Is this breeding experiment on Hawaii a failed one, or might these birds eventually succeed, even with such a confined gene pool?

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Evaluating the use of unmanned aerial systems (UAS) to survey mixed-species waterbird colonies (Poster)

Breeding surveys of colonial waterbirds are of critical importance to make informed management decisions. The accuracy and precision of classic survey methodology (i.e. ground counts and aerial surveys) has been tested in previous research, and it has been shown that there are caveats to each method (e.g. aerial surveys produce biased counts, ground counts can cause excess disturbance to nesting birds). Unmanned aerial systems (UAS) could provide a useful alternative for survey methodology, and we hope to investigate the utility of using UAS. We are assessing the probability of detecting four different waterbird species in two distinct nesting strata (coastal spoil islands and forested wetland) and we are also measuring possible disturbance caused by UAS. Our focal species are all priority species for the Gulf Coast Joint Venture: reddish egret (*Egretta rufescens*), little blue heron (*Egretta caerulea*), black skimmer (*Rynchops niger*), and gull-billed tern (*Gelochelidon nilotica*). We have conducted initial surveys in 2016 using a fixed-wing UAS and rotary-wing UAS at spoil island and forested wetland colonies. During Fall 2016, we will be using waterbird decoys at existing (inactive) colonies to assess probability of detection from UAS using a known number of nesting birds (decoys). We will conduct a second season of UAS surveys on active waterbird colonies in 2017.

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When is dense vegetation too dense for Piping Plovers on Fire Island, NY? (Poster)

Fire Island, New York, supports a breeding population of the federally endangered Piping Plover. Since 2013 the Virginia Tech Shorebird Program has been monitoring the population response to habitat changes following Hurricane Sandy. Previous studies indicated that Piping Plover populations increase following habitat creating events such as storms, most likely due to the removal of vegetation and creation of overwash, crucial habitat for nesting and brood rearing. It is widely accepted that Piping Plovers avoid areas of particularly dense vegetation. However, previous definitions of dense vegetation have been inconsistent. To address this question of vegetation density, adult (N=1854) and nest (N=42) locations were collected using a GPS unit throughout April to August 2016. To quantify density values for each location, we overlaid the adult and nest locations on vegetation density maps, created within ArcGIS 10.3 using aerial imagery collected in March 2016 (15cm by 15cm resolution). We conducted ground truthing during April 2016 to verify ground cover and habitat type. To quantify changes to Piping Plover habitat, we used annual aerial imagery and Normalized Difference Vegetation Index as a measure of live vegetation pre and post Hurricane Sandy. Data collection and analyses are ongoing, but our results will provide a better understanding of available habitat, and offer guidance for habitat restoration and management in Piping Plover conservation areas.

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The role of the Piping Plover towards shorebird conservation on developed beaches in the southeastern United States (Oral)

Many species of shorebirds require healthy beach habitats with low disturbance to support all or part of their life cycle. Most of these species are in decline and some, such as the nonbreeding piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*) are listed as threatened under the Endangered Species Act. Shorebirds require certain physical and biological features associated with beach habitats that need to be taken into consideration throughout the entire year encompassing migratory and winter seasons in addition to the breeding season. These considerations need to be reflected in beach management and in planning shoreline stabilization and restoration projects. Monitoring the physical and biological features of habitats that support these species before and after project construction is an integral part of planning and designing shoreline stabilization and restoration projects, which are typically constructed to protect developed shorelines and facilitate recreational use. Conducting shorebird surveys to determine abundance and distribution is also an integral part of project monitoring, but surveys alone may not be adequate to assess potential impacts. Preliminary results from our banding study on piping plovers and band resightings from surveys in Georgia and South Carolina suggests high use beaches may be functioning as ecological traps based on return rates, which would otherwise not be evident from surveys alone despite high winter site fidelity. These preliminary results may warrant a closer look at the effectiveness of existing beach management on developed beaches. Since the majority of the beaches along the Southeastern U.S. are developed, changes in

beach management during the piping plover nonbreeding season could have a positive impact on piping plover recovery and conservation of other shorebird species.



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Diet of Great Black-backed and Herring Gulls, Tuckernuck and Muskeget Islands, Massachusetts. (Oral)

Great Black-backed and Herring Gulls both colonized Massachusetts during the early 20th century, as their North American population dramatically increased and expanded southwards. Herring Gulls have declined by at least 50% after a peak before 1980, and Great Black-backed Gulls have decreased proportionately less since a peak in the 1990s. Part of the precipitous decline of gulls, perhaps most of it, reflects changes in garbage dumping procedures and decline of New England fisheries. With virtually no data on gull diets collected in Massachusetts, it is unknown how they are impacted by changes of fish stocks, nor how they impact fish. We studied Great Black-backed and Herring Gull diet on Tuckernuck and Muskeget Islands during the breeding season of 2015. We collected voluntary chick regurgitations as well as basic demographic data including clutch initiation date and size, hatching dates, and chick weights. We found a high frequency and proportion of squid (*Loligo pealei*) in both Great Black-backed and Herring diet. Great Black-backed diet was composed predominately of squid and fishes, while Herring diet had other sources, most notably blueberries. Great Black-backed gulls had high fledgling success, while Herrings were less successful, especially on Muskeget Island. With our findings we hope to further elucidate the underlying causes of the continued decline of these breeding species in Massachusetts.

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Conservation and Management of Common Terns (*Sterna hirundo*) in the Western Great Lakes Region (Poster)

The Common Tern (*Sterna hirundo*) is declining globally, and in the North American Great Lakes declines have been significant. Loss and modification of habitat and predation are significant issues during the breeding season. However, lack of information on seasonal movement patterns and non-breeding habitat requirements limits the ability of managers to determine why populations are declining. Using

geospatial tracking devices will help identify local movement within the breeding grounds and large-scale movement during the non-breeding season, which will help determine the degree of migratory connectivity and the extent of segregation of regional populations. We used light-level geolocation to track individuals breeding in lakes Superior, Huron, and Winnipeg. In 2013-2015, 96 geolocators were deployed on birds nesting on Interstate Island ($n=25$) in the Duluth-Superior Harbor, Chequamegon Bay ($n=11$), Ashland, WI, Elm Island ($n=30$) in the North Channel of Lake Huron, and McLeod and Egg Islands ($n=30$) in Lake Winnipeg, Manitoba. In 2016, we deployed 20 global positioning system tags on birds breeding in Lake Superior, five of which were used for year-round monitoring. Results from geolocators ($n=23$) reveal birds wintered in Central America and along the west coast of South America, with >50% of individuals wintering in coastal Peru, suggesting low recruitment between regional populations. On Interstate Island, individuals traveled up to 35km from the breeding colony, primarily along coastal Lake Superior and in Chequamegon Bay, movement up to 15km from the breeding colony was observed, primarily within the bay. I will present preliminary results from these tracking technologies, provide information on local movement by Common Terns in Lake Superior, and describe migratory routes and overwintering locations for individuals breeding in the Western Great Lakes region.

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Where have all the Black Rails gone? (Oral – Eastern Black Rail Symposium)

The extensive tidal marshes of Dorchester and Somerset Counties in Maryland have long been recognized throughout North America as one of the best locations for avid bird watchers to detect Black Rails (*Laterallus jamaicensis*). Community level surveys targeting difficult to detect obligate marshland breeding birds in 1990-91 found Black Rails to be the third most abundant secretive marshbird species breeding in Maryland. These baseline setting surveys detected Black Rails at 31 percent of 233 sample points. Surveys using the National Marshbird Monitoring Protocol conducted during 2005-06 did not detect Black Rails at a single point. In response to this alarming result, Black Rail specific surveys that were also conducted in 1990-91 were replicated during 2007. All locations where Black Rails were detected during the 1990s era surveys were resampled, along with additional sample points. Black Rails were detected at 12 locations during 2007. During 2014 Black Rail specific surveys were repeated as part of larger coordinated mid-Atlantic Black Rail surveys. In the past 25 years Maryland has experience a decline of approximately 90 percent in the breeding population of Black Rails. During this time period no clearly obvious change has occurred in habitat distribution and condition of the wetlands that were Maryland's core Black Rail breeding habitat. One possible causative factor in the decline of Maryland's Black Rail population that should be given serious conservation attention may be sea level rise induced changes to essential breeding habitat.

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Status and population change of Black Skimmer in Maryland 1985-2016. (Oral – Black Skimmer Symposium)

Maryland began routine census of colonial nesting waterbird species in 1985 and has continued these census efforts annually through 2016. Between 1985 and 1995, the breeding population of Black Skimmers (*Rynchops niger*) in Maryland ranged from 150-290 pairs, exceeding 200 pairs in six breeding seasons. During the period from 1998 through 2004, the breeding population varied between 71 and 143, only exceeding 125 pairs in one year. During the past six years the breeding population was less than 15 pairs in all years except 2015 and 2016, when it was 20-25 breeding pairs. Maryland breeding skimmers have used a variety of habitats, including temporarily available sites created by construction activity. Potential factors responsible for the decline include habitat loss, gull and owl depredation, and more pervasive regional declines in Black Skimmer populations.

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Using Pellet Collection and Chick Regurgitation to Determine the Diet of Herring Gulls (*Larus smithsonianus*) on Great Duck Island (Poster)

The Gulf of Maine in the western North Atlantic is home to a broad range of habitats and includes a number of nesting seabird islands. Among these is Great Duck Island, (Lat. 44.14 N, Long 68.24 W.) The island is home to several species of nesting seabirds including Herring Gulls. Gulls can access intertidal zones, farm fields, and fishing vessels, and are exposed to a variety of food sources. During the summer of 2016 I collected prey samples from both adult and juvenile gulls in the form of regurgitate and pellets within and near nests. I sampled chick regurgitate during daily visits into the colony throughout the pre-fledging period to assess what adults fed their offspring. Pellet contents suggest that Herring gull adults feed primarily on crustaceans, focusing their efforts on Rock (*Cancer irroratus*) and Jonah Crab (*C. borealis*). In addition there were several instances of female Green Crab (*Carcinus maenas*) remains, however I hypothesize that this species was targeted due to their red coloring which the gulls could mistake for *C. irroratus* or *C. borealis*. Male Green Crabs lack the reddish coloration. The next most abundant food found was fish, including bait fish and local sources. Gull chicks were fed a similar diet to that indicated by adult pellets, with somewhat greater variety including species of North Atlantic shrimp. My results differ from previous studies of near-shore colonies in that they included a lower proportion of anthropogenic food

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Effectiveness of Remote Data Collection Methods for Monitoring Secretive Marshbirds (Oral)

Use of traditional point-count methodology can be challenging for monitoring marshbird populations on Louisiana barrier islands. Louisiana salt marshes are often remote and difficult to access, and regular, standardized visitation may not be possible. Remote methods of data collection, such as camera traps and autonomous recording units, could prove an effective alternative method of determining marshbird occupancy. We deployed 43 Autonomous Recording Units (ARUs) and 14 camera traps on two barrier

islands in order to monitor the use of restored marshlands by breeding and migratory marsh and shorebirds in the Gulf of Mexico. ARUs were placed 150-300m apart and 75m from habitat edges, and set to record 30 minutes a day during primary vocalization periods of target species. Cameras were placed at habitat edges to detect non-vocal target species. Targeted species included Clapper Rails, Least Bitterns, Green Herons, and Reddish Egrets. ARUs were left from mid-March—late July, and were visited monthly to monitor equipment and collect data. Occupancy was estimated using combined data from ARUs and camera traps. ARU data was analyzed using Song Scope analysis software and unique vocalization recognizers developed for over 10 species. Our camera traps were ruined during a storm surge, highlighting the threat of sea level rise to barrier islands, and we recommend caution in deploying cameras in saltmarsh due to this reason. We found the ARUs to have high utility in for detecting many, but not all, of the marsh and shore birds we observed on the islands, and recommend them as an effective substitute for point counts when collecting data in remote areas.

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Conservation status of herons in Paraguay: future scenarios in face of accelerated habitat degradation (Oral – Heron Symposium)

Paraguay's five major ecoregions hold a total of 14 heron species. Currently, no species is considered threatened at a national or international level; in fact on the contrary, most species are common to abundant. Exceptions include the Boat-billed Heron, which is scarce and locally distributed, but probably overlooked due to its nocturnal habits; and the three species of bittern (Pinnated, Least and Stripe-backed). Knowledge of the vocalizations of the two *Ixobrychus* bitterns has revealed them to be more widespread and abundant than previously thought, though they are still infrequently recorded and primarily found in wetlands within the Paraguay River valley. A recent increase in Pinnated Bittern records is likely related to the expansion of rice fields, and the relative ease of observing the species in such habitat. Capped Heron is the one species with a restricted distribution, limited to the Pantanal and associated wetlands in the north of the country. Little Blue Heron is a scarce vagrant to the country, though records appear to be increasing. Cattle Egret was already widespread in Paraguay by 1977, when first recorded by ornithologists. There is increasing evidence for seasonal movements by both that species and Striated Heron. While most herons remain common and widespread throughout the country, the increasing loss of wetland habitats, and their degradation through runoff and sedimentation (driven by massive deforestation and conversion to industrial agriculture) is of concern. Although the rapid and ongoing expansion of rice agriculture in Paraguay provides important foraging habitat for at least 8 heron species, their populations depend on the survival of natural wetland and woodland habitats in surrounding areas for roosting and breeding.

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Ecology of the Endangered Masked Finfoot in Sundarbans, Bangladesh (Poster)

148 km of waterways were surveyed for the Endangered Masked Finfoot *Heliopais personatus* and its nests between 14 June 2011 and 1 September 2011 in the Sundarbans of Bangladesh, additional 100 km were covered in 2014 and 2015. A total of 25 nests were found, nests were detected on 'Gewa' *Excoecaria agallocha* (56% of nests), 'Sundri' *Heritiera fomes* (39%) and 'Dundul' *Xylocarpus granatum* (8%) trees. The nests were built in the first line of vegetation along the narrow creeks of 12.66 ± 3.54 m and located 1.78 ± 0.53 m above water level at high tide. 75% of all waterways surveyed in 2011 fall within the width between 5 and 25 m ($\chi^2 = 4.65$, $df = 1$, $p = 0.03$, total $n = 107$ waterways). We applied Factor Analysis on all variables where the data was complete or nearly complete, to summarize the patterns of covariation present in these variables: nest height from water level, nest depth, nest diameter, angle, tree diameter, nest stream diameter and khal width. The combined data with all 44 nest-sites indicated that nest site characteristics were distinct in 2004 compared to all subsequent years. One breeding pair was thoroughly observed, both sexes shared incubation and exchanged bouts at the initial stage but the male left the nesting site nine days before the chicks hatched. On average the female and male incubated 19.39 ± 2.53 and 3.30 ± 3.37 hrs/day ($N=19$) and the nest was left unattended on average 1.06 ± 1.30 hrs/day with 33.56 ± 23.37 ($N=30$) minutes mean inter-bout interval. The pair was observed foraging ($N=21$) on crabs (80.95%) and small shrimps (19.04%). Home range during incubation was estimated c.800m².

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Multi-scale Habitat Selection by Sandbar-nesting River Birds in Cambodia (Oral)

Riverine ecosystems in Southeast Asia are some of the most biodiverse, yet highly threatened in the world. The Mekong River and major tributaries in Northeastern Cambodia support several regionally threatened and declining bird species that nest on riverine sand and gravel bars. To improve conservation efforts, there is a need to identify habitat characteristics of areas that support these species. We investigated breeding habitat selection by four riverine bird species along the Mekong River in Cambodia at three spatial scales: nest site, nest patch, and breeding territory. Compared to unused control sites, River Terns (*Sterna aurantia*) selected areas with less vegetation, were located further from the river channel, and had territories with a higher proportion of bare ground. River Lapwings (*Vanellus duvaucelli*) selected nest sites with less overhead concealment, nest patches with a higher proportion of dry mud and lower proportion of water, and territories with a higher proportion of bare ground. Small Pratincoles (*Glareola lactea*) selected nest sites with more overhead concealment and higher proportions of gravel, mimosa (*Mimosa pigra*; an invasive woody plant species), and small debris, nest patches with higher proportions of gravel and crop cover (watermelon and beans), lower proportion of water, larger patch size, and were nearer to edge vegetation. Additionally, pratincole territories had a higher proportion of bare ground. Little Ringed Plovers (*Charadrius dubius*) selected nest sites with more overhead concealment, nest patches with more gravel and mimosa, and had territories with less woody vegetation and more bareground. Further results will elucidate effects of habitat characteristics on nesting success. This information will aid habitat management and conservation efforts for these species.

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Trends in hydrology, habitat loss, and Wood Stork nesting at Corkscrew Swamp Sanctuary (Naples, FL) (Oral)

Corkscrew Swamp Sanctuary was home to the largest historical colony of Wood Storks (*Mycteria americana*) in North America. With as many as 6,000 nesting pairs annually in the 1960s, the Corkscrew colony has experienced steady decline since the 1970s and has only seen two successful nesting seasons in the past decade. The decline in the Corkscrew colony was concurrent with population growth throughout Southwest Florida, including increases in residential development, agriculture and rock mining, and improved flood control. While the Sanctuary preserves the bald cypress colony site, most of the inland freshwater wetlands within the core foraging area (CFA) of the colony are non-conservation lands. Examination of the hydrology of this rainfall-driven system in the 60 years since the Sanctuary was established revealed no decadal variation in rainfall patterns (annual or monthly totals), or in the average date or magnitude of peak wet-season water levels. Since the 1960s and 1970s, however, we observed hydroperiod in freshwater marsh/pond cypress, bald cypress, and ponds was reduced by 47%, 34%, and 25%, respectively. No hydroperiod change was seen in higher elevation wetlands (wet prairie/scrub/dwarf cypress, pine forest, and hammock forest). Additionally, examination of land cover within the CFA (pre-development vs. 2004) suggests 70% of wetlands have been lost, including 82% of historic wet prairies and 77% of historic hydric flatwoods. Loss of critical early-nesting season foraging habitat coupled with increased water level recession rates later in the nesting season has created a daunting situation for this critical historic colony and many wading birds in this region. We discuss strategies for wetland conservation and restoration to benefit Wood Storks and other wetland-dependent wildlife.

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Range-wide Survey of Inland Wading Bird Nest Colonies in North Carolina (Oral)

Although fairly common in North Carolina, accurate estimates of Great Blue Heron (*Ardea herodias*) and Great Egret (*A. alba*) abundance are poor. Since the 1970s, wading bird colony surveys have been conducted only for certain regions. From April to mid-May, 2008-2012, we completed a stratified aerial survey of all major waterways within the state breeding range. Goals were to design a repeatable survey accounting for detection probability using a double-observer method. We also wished to evaluate landscape characteristics associated with persistent and abandoned heronries to improve conservation recommendations. A total of 490 active heronries were detected ([192] Piedmont, [298] Coastal Plain), 80% of which had not been recorded previously. Heronry size was not correlated with detection probability and detection probability did not differ between observers (0.9, 95% credible interval [CI] [0.8-1.0]). Along our flight route, the Bayes estimate of total heronry abundance incorporating detection probability was 548 heronries (95% CI [535 – 561]). We estimated 533 heronries that included GBHE (95% CI: [520 – 546]) and 38 heronries with GREG (95% CI: [37 – 39]). Nest abundance estimates were

8,306 GBHE nests (95% CI [7963 – 8660]) and 4,963 GREG nests (95% CI [4963 – 5406]). Other species had low counts and or detectability and so are not reported.

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Using A Commercially-Available UAS to Count Nesting Gulls on Great Duck Island, Maine (Poster)

UAS (unmanned aerial systems), or “drones”, are aerial vehicles of many uses. While the technology is new, UAS are becoming increasingly common as a tool for aerial imagery. Prior annual or decadal counts in Maine, USA, have used a variety of methods to count Herring (*Larus smithsonianus*) and Great black-back gulls (*L. marinus*) including ground counts and aerial photography from small aircraft. Both these techniques are costly and/or labor intensive. In addition, ground counts may be a major source of disturbance to nesting birds. A small UAS was deployed on Great Duck Island, ME (Lat. 44.14 N, Long 68.24 W.) that generated imagery of the gull colony on the island’s southern coast. From these images the nests were counted and compared to an intensive ground count. The UAS photographed the colony in sections, flying a grid pattern autonomously using an IOS autopilot program. Photographs are automatically geo-referenced and can be stitched into a single ortho-photo. To measure disturbance during flights, birds off-nest or in the air were counted and showed no difference from pre-flight conditions. While using full-scale aircraft has shown to be effective for estimating colony size, high costs and the availability of suitable aircraft limit the frequency of this activity. Ground counts are time-intensive and landing on some islands may be nearly impossible except under ideal sea states. With reduced disturbance, time, cost, and resource requirements, the use of UAS to count gull colonies appears to be an attractive alternative to traditional census methods.

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Development of a survey protocol for monitoring Reddish Egrets in Florida (Oral)

The Reddish Egret (*Egretta rufescens*) is North America’s rarest heron and roughly 10% of its global population resides in Florida. The rarity of the species, its localized breeding distribution and a potential negative population trend have prompted the need to monitor this species. However, standard aerial surveys performed from fixed-wing aircraft often implemented for colonial nesting wading birds are ineffectual for this dark-plumaged and sub-canopy nesting species, leading some researchers to use either direct counts or flight-line surveys. During the 2015 breeding season we compared the efficacy of flight-line surveys and direct counts using data collected by multiple observers during repeated visits to colonies located in three of Florida’s core breeding areas (Tampa Bay, Florida Bay, and the lower Florida Keys). Our objectives were to 1) determine the appropriate duration of flight-line surveys, 2) estimate variation between multiple flight-line surveys performed at the same sites, and 3) estimate the correlation between flight-line surveys and direct counts. Average variation between counts was high for a 1-hr flight line survey (60%), but more acceptable for 2-hr (20%) or 3-hr (16%) surveys. Flight-line

surveys often produced abundance estimates that were biased high when compared to direct counts, likely because nest exchanges occurred >1 time per survey, violating a primary assumption of the method, or because breeding sites contained interior ponds used for foraging by adult birds breeding elsewhere. Nevertheless, some breeding sites were not amenable to direct counts and others are in areas where such access is prohibited. Ultimately, variation in habitat, site access, and breeding synchrony will necessitate the use of multiple approaches when conducting a statewide survey.

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A Continental Divide in Migratory Behavior: Conservation Implications for the Common Tern (Poster)

The Common Tern (*Sterna hirundo*) is a threatened species in New York. The Cornell Biological Field Station, in partnership with the NY State Department of Environmental Conservation, has protected and studied a small colony of terns on Oneida Lake, NY since the 1970's. Traditionally, conservation efforts have focused on improving breeding conditions for these birds. However, terns are long-distance migrants that spend only a third of the year on the breeding grounds, and little is known about the migratory and wintering behavior of this population. Addressing this information gap is an important first step in understanding and confronting conservation challenges during these critical periods of the year. In 2014, we deployed geolocators on 10 terns to observe their movements during the following year. Seven of the 10 geolocators were retrieved in 2015. All seven birds exhibited similar migratory and wintering habitat use, although there was variation in the timing of some events. Birds breeding on Oneida migrated down the Atlantic coast, stopped in Cuba, and then migrated down the west coast of South America to winter in Peru. During northward migration, some birds spent a shorter stopover period along the Atlantic coast before returning to the breeding grounds. This migratory and wintering behavior is markedly different than what has been observed in Common Terns breeding at coastal colonies, as these birds winter in Eastern South America. Our data highlight a continental divide in migratory and wintering behavior among breeding populations of Common Terns, providing novel and critical information for the conservation of this species in the Americas.

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Concentrations and spatial patterns of organic contaminants in tree swallows at United States and Binational Great Lakes Areas of Concern (AOCs), 2010-2015. (Poster)

Tree swallows (*Tachycineta bicolor*) were sampled across the Great Lakes basin in 2010-2015 to provide a system-wide assessment of current exposure to organic contaminants as part of the Great Lakes Restoration Initiative (GLRI). Eggs were collected from 69 sites across all five Great Lakes, including 27 Areas of Concern (AOCs), some with multiple sites, and ten sites not listed as an AOC. Concentrations of organic contaminants in eggs were quantified and compared to background and reproductive effect thresholds. At approximately 30% of AOCs, tree swallow eggs had geometric mean total polychlorinated

biphenyls (PCBs) concentrations at or below average background concentrations (0.34 µg/g wet wt.). Mean concentrations at 78% of AOCs were below the mean at the most contaminated non-AOC location (1.30 µg/g wet wt.). The AOC with the highest level of PCBs in eggs was Waukegan Harbor, IL (geometric mean = 7.30 µg/g wet wt.). Exposure to polybrominated diphenyl ethers (PBDEs) was minimal, and only 3 of 27 AOCs and one non-AOC had geometric mean concentrations that exceeded background for tree swallows (96 ng/g wet wt.). In contrast, geometric mean concentrations of dioxin and furan (PCDD-F) toxic equivalents (TEQs) at Saginaw River and Bay AOC (242 pg/g wet wt.) and Midland, MI (475 pg/g wet wt.), a non-AOC site upstream, exceeded the lower limit for hatching effects (181 pg/g wet wt. PCDD-F TEQs). All other sites had geometric mean concentrations of PCDD-F TEQs below background levels (87 pg/g wet wt. PCDD-F TEQs). Other organic contaminants, including p,p'-dichlorodiphenyldichloroethylene (DDE), mirex, heptachlor, and chlordane, were at or below background concentrations, or did not differ between AOCs and non-AOCs.

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The correlation between prey item distribution and Reddish Egret (*Egretta rufescens*) foraging behavior (Poster)

The Reddish Egret is a coastal wading bird with an IUCN conservation status of near threatened, and is listed as threatened in Texas where much of its breeding population occurs. We utilized a Texas Parks and Wildlife Department coastal fisheries database to examine spatial and temporal factors driving prey community structure in the Laguna Madre of Texas. We divided the Laguna Madre into three regional zones: Upper Laguna, Landcut, and Lower Laguna. The fisheries data was collected from 1976-2014 and consisted of multiple seine hauls each month. Environmental data including salinity, turbidity, and temperature were also collected corresponding to each seine haul collection event. We limited the fisheries data to only include those species either known to be prey of Reddish Egrets or were members of the same genus as known prey species. The dataset was also broken into breeding, post-breeding, and migration-wintering seasons based on Reddish Egret life history. We used multivariate analysis to determine what biotic and abiotic factors influenced prey species distribution. This multivariate analyses showed prey varied by both season and region within the Texas Laguna Madre. Future analysis will examine the relationship of prey distribution to known Reddish Egret colony site location and nest initiation date.

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Estimating the breeding population of Great Blue Herons in Maine: what's not on our colony list? (Oral)

The Great Blue Heron (*Ardea herodias*) is listed in Maine as a Species of Special Concern due to a decline in nesting pairs and colonies along the coast since the mid-1980s. In order to determine whether the decline is limited to the coast, occurring statewide, or due to movement from the coast to inland sites, an aerial survey was conducted in 2015 to obtain an estimate for the statewide breeding population. Aerial surveys had been conducted previously, but this time a stratified dual-frame design accounting for imperfect detection of colonies was used. The strata were based on habitat and known colony densities. The area frame consisted of 10 km x 10 km plots; a sample of which was searched independently by front and rear observers for both new and known colonies. The list frame consisted of plots that contained known colonies and was only searched for known colonies. Detection of active nests within colonies and colonies themselves were accounted for in the estimation. The estimates of total nests and active nests were obtained from the number of colonies multiplied by the average colony size. The estimate of total colonies for the state is 336 (range = 261-455 colonies) and the estimate of active nests is 1800 (range = 1631-2159 nests). Observer detection ranged from 31 to 95 percent. The list coverage, or the percentage of colonies included in the list frame, was 67 percent but varied widely among strata. By repeating these methods at future intervals (e.g., every 5 years), we plan to obtain population trends for each strata as well as the entire state of Maine.

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Black Skimmer post-breeding dispersal and migration strategy in the Peruvian Amazon (Poster)

The pulsed Amazon flooding regime in South America presents a considerable challenge to river beach nesting waterbirds such as the Black Skimmer *Rynchops niger*. As the main channel of the Amazon integrates various water sources, there is considerable variation between locations in the timing and amplitude of peak water, depending on proximity to headwaters, number of sources providing input at any site, and location along the east-west axis of the main channel of the Amazon. This variation in hydrologic regime creates a variety of differing micro-habitats that should influence the development of a labile migration strategy for waterbirds exposed to this type of regime. In 2014, we began a tracking study to document Black Skimmer movements within the Peruvian Amazon to document migration strategy and post-breeding dispersal. Eight platform transmitting terminals (PTTs) were deployed on Black Skimmers in Manu National Park, Peru. Individuals were tracked via the ARGOS system from 20-376 days. Results of the tracking study indicate local movements within the Amazon Basin were wide ranging associated with river tributaries with several individuals making trips greater than 700km roundtrip. Three skimmers visited the Llanos de Moxos, Bolivia. One individual travelled twice north to the Río Laco in Brazil. A second skimmer was tracked moving southeast to Paraguay. Most interestingly, two individuals crossed the Andean cordillera at altitudes of 5000 m (16,404 feet) above sea level to non-breeding locations along the Pacific coast. These results suggest that the migration strategy of the Black Skimmer is labile to allow for responses to variation in hydrology of the Amazon Basin that, for the skimmer, translates into continent-wide dispersal in South America.

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Family Matters: Begging behavior as an honest signaling mechanism for parent-offspring association in Roseate Terns (*Sterna dougallii*) (Oral)

In many bird species that exhibit specialized foraging techniques, parental care is prolonged during the post-fledging period, despite the higher costs of caring for fledged chicks. Reliable signaling mechanisms for parent-offspring communication are needed to avoid misdirected care of unrelated fledglings. Begging, the behavior by which offspring solicit food and parental care, may be an honest signaling mechanism for association of parents to offspring. Roseate Terns (*Sterna dougallii*; ROST) exhibit prolonged parental care during the post-breeding staging period at Cape Cod, MA. During this staging period, Hatch Year (HY) ROSTs are dependent on parents for food, as they do not possess the specialized foraging skills needed to successfully fish for themselves. We present data from two pre-migratory staging seasons (2014–2015) at Cape Cod National Seashore, MA to determine whether begging behavior in ROST HYs is directed at parents, as would be expected if begging was an honest signal for parent-HY association, and which environmental factors, including human activities, natural disturbance events, time, and day, affect these interactions. We found that HY ROSTs begged at their parents more often than would be expected if begging were directed to random adults ($\beta_{\text{Beg}} = 1.8 \pm 0.7$). Human activities ($\beta_{\text{Human}} = 0.06 \pm 0.04$) and natural disturbance events ($\beta_{\text{Natural}} = -0.09 \pm 0.06$) did not affect HY ROST begging behavior; however, begging increased with time of day ($\beta_{\text{Time}} = 0.31 \pm 0.06$) and decreased with day of season ($\beta_{\text{Day}} = -0.21 \pm 0.06$), presumably indicating greater HY ROST independence later in the season. Our results demonstrate that ROST begging behavior is an honest indicator of parentage, and HY ROSTs beg less frequently as they gain independence.

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Population structure of the Eurasian Whiskered Tern (*Chlidonias hybrida*), a species exhibiting demographic expansion. (Oral)

The Whiskered Tern (*Chlidonias hybrida*) is a lacustrine-nesting migratory bird with an extensive distribution across Eurasia, Australia, and Africa. Over the last three decades, Whiskered Tern populations exhibited substantial growth and colonization from Eastern Europe into central and northwestern Europe, contrasting the general trend of population decline among waterbirds (including the congeneric Black Tern, *Chlidonias niger*, in Eurasia). The Whiskered Tern population in Poland increased from 40 pairs in 1990 to >1600 in 2007 and exhibits high reproductive success largely due to the establishment of high quality habitat in reservoirs and carp ponds. To counteract low pre-breeding

survival and emigration from colonies and to explain the growth observed in the region since 1990, immigration rates must be substantial and western Ukraine may be the source. To explore this proposed connectivity, we sampled 78 individuals from colonies in France, Poland and Ukraine and genotyped them for six microsatellite loci and one mitochondrial region. Genetic diversity was generally high, F_{ST} values indicated strong differentiation between France and the Eastern European sites, and Bayesian analysis indicated two distinct genetic clusters without subdivision between Poland and Ukraine. The results showed lower genetic differentiation between the three eastern sites indicative of gene flow and supported the hypothesis of high immigration rates from Ukraine to Poland. *Cyt-b* provided a perspective of thousands of years and sequences sampled among all sites showed no significant differentiation. Our study highlights avenues for future work. Assessment of the genetic connectivity of this species across the range will allow accurate estimates of dispersal rates among regions based on genetics alone, and will facilitate comparison to related species suffering from habitat loss, population decline, and range constriction.

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Amino acid-specific $\delta^{15}N$ analysis improves our ability to interpret spatial patterns in waterbird contaminant levels (Poster)

Top predator bird species serve as useful indicators of environmental conditions. Colonial waterbirds, such as gulls and terns, have been used in this capacity for decades across a variety of Canadian ecosystems. An important aspect of this work has been to monitor levels of biomagnifying contaminants in the environment to better understand contaminant sources. This is done by evaluating spatial patterns in contaminant levels in eggs collected from different locations. Higher levels at some sites may indicate the presence of local contaminant sources. However, when interpreting waterbird egg contaminant levels in a spatial context, possible differences in the diets of birds need to be considered since levels of biomagnifying contaminants in eggs will increase with trophic position. Trophic position can be evaluated by measuring stable nitrogen isotopes ($^{15}N/^{14}N$, expressed as $\delta^{15}N$ values) in eggs. However, comparing $\delta^{15}N$ values across sites is not appropriate without considering possible inter-site differences in baseline $\delta^{15}N$ values. Stable nitrogen isotope analysis of bulk tissue does not address this issue. To resolve this, we use a new approach: amino acid compound-specific nitrogen isotope analysis (AA-CSIA) to generate both baseline $\delta^{15}N$ and trophic $\delta^{15}N$ values from the same sample. The resulting isotope data are corrected for baseline differences providing the means to compare nitrogen isotope values across sites. These baseline-corrected isotope data are used to remove the influence of trophic position on egg contaminant levels so that the other factors that may be regulating spatial differences in egg contaminant levels, such as proximity to sources, can be better understood.

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Population Viability of the Reddish Egret (*Egretta rufescens*) in Texas: An Analysis of Management Actions and Implications (Poster)

Reddish egrets are a threatened waterbird species that inhabit the Gulf Coast of the U.S. and Mexico, as well as, the Bahamas, Cuba, the Mexican Pacific Coast, and the Yucatan peninsula. The plume trade of the late 1800s drastically reduced global population numbers of reddish egrets. By the 20th century, the species was decimated and possibly extirpated in many parts of its range. While much of the historical range has been recolonized, the reddish egret remains North America's least abundant heron species. An estimated one-third to one-half of the global reddish egret population occurs in the United States, with Texas having approximately 75% of the breeding pairs. While egret population numbers may be increasing throughout portions of the range, many factors continue to threaten the persistence of the species. Population viability analyses (PVAs) are a common method of predicting a species' persistence into some future time. The purpose of developing a population viability analysis for *E. rufescens* is to identify possible factors impeding the growth of Texas populations. By assessing the relative threat of each contributing factor and identifying vulnerable life stages, a robust PVA can estimate how different management actions will affect population demographics. The outcome of this analysis will help guide the management of Texas populations of *E. rufescens*. Using population and demographic data from the Texas population of *E. rufescens*, our model will serve as the backbone for the creation of a range-wide PVA.

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Tidal marsh bird conservation in the northeastern United States (Oral)

Since 2010 the Saltmarsh Habitat and Avian Research Program (SHARP) has studied the status of tidal marsh birds from Maine to Virginia, USA, through a combination of extensive surveys of all species that use tidal marshes and intensive demographic studies of specialist species. Our design-based survey of 1780 point locations has produced the first comprehensive population estimates for this region for clapper rails (151,000), willets (117,000), and saltmarsh (53,000), Nelson's (5,000), and seaside (230,000) sparrows, as well as another 18 other species recognized as being of greatest conservation need. Comparing our surveys to historical data suggests that tidal marsh birds have undergone serious declines since 1998, with per annum losses of 4.6% for clapper rail, 9.0% for saltmarsh sparrow, and 4.2% for Nelson's sparrow. No regional population changes were detected for willets or seaside sparrows. Demographic data from 23 sites in seven states from Maine to New Jersey, show that saltmarsh sparrow populations have consistently negative growth rates throughout their range. Data from the northern range limit of clapper rail and seaside sparrow also point to falling nest densities, suggesting the possible beginnings of range collapse in these species. Tidal restrictions appear to have played an important role in causing saltmarsh sparrow declines, and population models suggest that sea-level rise will exacerbate future declines. Demographic projections indicate a high chance that

saltmarsh sparrows will go extinct within ~50 years and that Nelson's and seaside sparrows will experience range contractions over that timeframe. Surveys pre- and post-Hurricane Sandy suggest that the storm had little effect on either specialist birds or marsh vegetation. Ongoing work will evaluate management actions designed to improve coastal resilience.

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Hydrologic fluctuations influence daily survival rates of small herons and Great Egrets in a subtropical littoral wetland (Oral)

Subtropical freshwater wetlands in South Florida USA, support large populations of wading birds that are thought to be food-limited. The production of many wading bird prey species is controlled by hydrological variation, which is increasingly regulated by human activities through water management regimes. Thus, we expected that water management regimes on Lake Okeechobee, Florida USA would also influence wading bird reproduction. We use a model selection approach to investigate the influence of hydrological parameters on the daily nest survival rates (DSR) of wading birds. We pooled Tricolored Heron (*Egretta tricolor*) and Snowy Egret (*Egretta thula*) nests since they are indistinguishable during the incubation period. Because lake stage and water level recession rates, in particular, can be adjusted by water managers, we focused on the influence of those parameters on the DSR of Great Egrets (*Ardea alba*; n=298) and small herons (n=1524). Nest survival for all species was highest when lake stage was below 4.0 m and above 3.6 m. Lake stage was the only important parameter that influenced DSR of Great Egrets, but this model was only marginally better than the null model. Water level recession rate, lake stage, and their interaction were important parameters for predicting DSR of small herons, regardless of nesting stage. These species were more sensitive to lake stage and water level recession rate than were Great Egrets. Our results suggest that water management strategies could be designed to benefit species sensitive to hydrologic constraints such as small herons without hindering the reproductive success of less sensitive species.

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Factors affecting the inter-annual growth rates of Royal Tern (*Thalasseus maximus*) chicks in coastal North Carolina (Poster)

Previous studies of Royal Terns (*Thalasseus maximus*) have indicated that the breeding population in the Cape Fear River estuary, North Carolina, has fluctuated inter-annually, likely due to changing environmental conditions. To further investigate environmental factors and their influence on Royal Tern chick growth rates, an age prediction model was developed. This model was based on chick wing chord length and weight taken on a single visit to the colony and was used to calculate an estimated chick age regressed on weight for multiple nesting seasons. This model was replicated from one first derived in 2002 and is useful in validating this method. The single regression analysis indicated that chick

growth rates varied significantly from 2001-2015. Analyses were conducted to determine if these variations in growth rates correlated with diet as indicated by stable isotopes analyses ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$), total mercury (THg) exposure, or annual precipitation as a proxy for estuarine productivity. A strong negative correlation was found between $\delta^{13}\text{C}$ signatures and growth rates, suggesting that adults feeding their chicks more pelagic prey yielded higher chick growth rates. Though not statistically significant, a positive trend was observed between $\delta^{15}\text{N}$ signatures and growth rate, indicating that chicks feeding at higher trophic levels, likely from prey items with higher nutritional value, are growing at a faster rate. The mercury analyses showed a positive correlation between THg in chick feathers with growth rates, evincing that current levels of mercury exposure are not impacting chick development. This work has introduced a new technique to assess chick growth, and has provided baseline data of Royal Tern chick growth that can be used to assess impacts from future environmental and anthropogenic disturbances.

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Current Status, ecological characteristics and conservation of Family Ardeidae in natural and disturbed forests of urban area, Korea (Oral – Heron Symposium)

Of 72 egret species recorded in the world, 18 species were observed in Korea. According to the nationwide census conducted by the National Institute of Environmental Research between 2011 and 2012, 35,512 breeding pairs at the 148 sites were recorded in Korea. We found 142 breeding pairs of 5 species at 3 sites in Daejeon in 2016. 10 individuals (5 gray herons, 4 great egret and 1 intermediate egret) were tagged with GPS-Mobile based Telemetry (WT 300; 35 x 63 x 14mm, > 27g, Korea) and released. Some of them (5 gray herons, 2 great egret) were successfully tracked by now. Their home-range sizes were about 20-25km² (100% Minimum Convex Polygon Method, 95% Kernel Density Estimation) in breeding season. They moved down to the southern part of China and Vietnam on October 2015. As a result of analyzing potential habitats using 12 variables selected by Maxent model, 106.68km² (19.7%) were extracted in Daejeon, Korea. Among them, we selected Wolpyung Park as compensatory habitat, and placed 20 decoys with nests and a recorder stored breeding song on the top of trees to induce egret breeding on January 2016, but failed. More effective long-term plan should be needed to solve the conflict between residents and breeding egrets.

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Using the Dail-Madsen model to estimate abundance of migratory shorebirds at a stopover site (Oral)

Estimating abundance is an important part of understanding population dynamics. However, failure to observe birds that are moving in and out of a survey site can result in estimation errors. For open populations, a generalized state-space model can be used to account for this error. The extended Dail-Madsen model uses spatial and temporal replicates of count data and estimates abundance as a function of probability an animal survives and remains in that site, local contribution of population growth, and immigration of new animals into the survey site. We applied the extended Dail-Madsen model to counts of migratory shorebirds at a stopover site on Fire Island and Westhampton Island, Long Island, New York. Seasonal abundance of ten shorebird species were monitored during spring and fall migration of 1997-2000 and 2014-2015. While assuming the rate of survival and remaining at the site is constant within each migration window, we tested the effects of study plot and survey week on the daily recruitment rate of shorebirds and tested the effects of survey time, tide height, precipitation, and wind direction and speed on detection probability. For the most abundant species on site, the sanderling, the recruitment rate varied among study plots. The detection probability was higher when surveys were later in the day and when the water was low. The seasonal pattern of predicted counts of sanderlings was similar to the seasonal pattern in the observed counts, however, the predicted maximum number of birds was 14% higher than the maximum observed count. We are estimating daily abundance for all ten species and will determine if the timing of shorebird migration has shifted across two decades.

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Dietary flexibility of Wood Storks in response to human-induced rapid environmental change in South Florida (Oral)

Wood Storks (*Mycteria americana*) serve as indicator species for wetland restoration due to their reliance on hydrologic processes that produce high quality foraging habitat and prey. As a result of human-induced rapid environmental change (HIREC), Wood Stork populations declined in South Florida during the mid to late 20th century. Human manipulation of the Everglades landscape resulted in a disruption of natural hydrologic conditions and the creation of novel anthropogenic water bodies. Despite the well-documented sensitivity of Wood Storks to changes in hydrologic conditions and human disturbance, storks are often seen foraging in anthropogenic water bodies along roadways, suggesting these novel habitats may provide adequate foraging habitat and prey. We sampled natural wetlands and anthropogenic water bodies (e.g., canals, wet and dry stormwater ponds, swales) to determine the aquatic fauna available for foraging storks. To determine Wood Stork prey selection, we collected stomach regurgitations (boluses) from nestling storks in five nesting colonies within both the natural marsh and urban landscapes. Historical studies show that exotic fish were absent in Wood Stork diets prior to the establishment of anthropogenic water bodies; however, we found exotic fish frequently in both anthropogenic water bodies and bolus samples. Furthermore, we found that Wood Storks selected prey that were more similar to larger-bodied fishes in anthropogenic water bodies than to the smaller fishes in the natural wetlands. We also found that Wood Storks nesting in urban and natural marsh landscapes selected different species of larger-bodied prey. These dietary patterns suggest that Wood Storks may have some form of behavioral plasticity in foraging habitat and prey selection to adapt to some degree of HIREC.

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Dry rice paddies cause a decline of the breeding herons and egrets in Italy (Oral – Heron Symposium)

After a period of strong increase since 1980, and a peak around 2000, the breeding herons and egrets in Northwestern Italy entered a phase of decline. The population fluctuations were affected by several climatic factors, but the main cause for the increase was reduced human-induced mortality. The recent decline, however, occurred following the expanding practice of rice cultivation on dry paddies that during 2015 reached 80% of the rice surface in some areas. The dry paddies are not flooded for more than a few days, and become unsuitable for the herons and egrets, 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. 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. The monitoring of the 200 heronries in our study area, now in its 45th year, is continued thanks to a group of 100+ volunteer collaborators.

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Behavioral and Physiological Responses of Nesting American Oystercatchers to Off-Road Vehicles on North Carolina's National Seashores (Oral)

Shorebird populations face increasing challenges as rising sea levels and growing human populations constrain their breeding habitats. We designed a field experiment to study the responses of nesting American Oystercatchers to off-road passenger vehicles (ORVs) at Cape Hatteras and Cape Lookout National Seashores. We used continuous video and heart rate recordings to assess changes in the incubation behavior and physiology of incubating oystercatchers. We conducted driving experiments on seven nesting pairs in 2014 and 19 nesting pairs in 2015, between April and July each year. Experimental treatments were repeated throughout the incubation period for each nest. Though responses were highly variable within and among pairs, general linear mixed models indicated that, overall, oystercatcher pairs left their nests more frequently and attended their nests for a significantly lower proportion of time during driving treatments. Pairs also spent a greater proportion of time in alert postures and experienced slower heart rates during driving treatments. There was some evidence that these responses degraded as nests approached hatching. These findings provide quantitative estimates of the response of incubating American Oystercatchers to vehicle disturbance in a controlled experimental setting. The long term demographic consequences of this disturbance remain to be determined.

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Seabird Colony Registry and Atlas: South Carolina, Georgia, northern Florida (Poster)

We created a Seabird Colony Registry and Atlas for the southeastern US, including South Carolina, Georgia, and northern Florida, to aid in the conservation of seabird populations that utilize the coast in this region. Focal species include nesting seabirds common to the region, including Brown Pelicans, Laughing Gulls, Royal Terns, Sandwich Terns, Least Terns, Gull-billed Terns, and Black Skimmers, as well as species less common to the region, including Common Terns, Forster's Terns, and Sooty Terns. Data for the register were compiled from records kept by state natural resource managers. Specifically, we requested survey data for all seabird colonies in the focal region from 2003-2012 which, with the guidance of state partners, was conformed to standardized data fields. We believe this product will be a valuable tool for local, state, and federal resource managers for the development of regional plans, production of robust population estimates, and evaluation of important bird use areas. In the event of natural and anthropogenic disaster, such as chemical spill or disease outbreak, this product will serve as a reference for response teams. This product will help address conflicts related to coastal zone management, including recreational use of and access to beaches, marine spatial planning for wind turbines, scheduling and sighting sand-dredging and beach nourishment operations, and land/marine conservation planning. Researchers will find it useful for study site selection, monitoring population trends, tracking bird movements, for example. The register and atlas will be available for download and could serve as the foundation for future development of a dynamic database for the larger region.

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Enhancing beach elevation to improve reproductive outcomes for beach-nesting birds (Oral)

Following Hurricane Sandy, we implemented a beach restoration and enhancement project at Stone Harbor Point, New Jersey to improve conditions for beach-nesting birds. Elevated habitats were created to provide nesting habitat with reduced risk of flooding from spring tides and other storm events. We harvested sand from accretional areas of the site and constructed elevated nesting habitats (0.3 -1.8 ha; 4.5-6 NAVD88) prior to the 2015 and 2016 nesting seasons. American Oystercatcher (*Haematopus palliatus*) pairs nested on the constructed habitats in both years of the study (47.6% of pairs in 2015, 34.6% in 2016). Oystercatcher pairs nesting exclusively on constructed habitats in 2015 had greater success hatching chicks (100%) but lower fledging rates (0.83 fledged/pair) compared to pairs on unaltered habitat (73% and 1.18 fledged/pair, respectively). A strong response by Piping Plover

(*Charadrius melodus*) was not detected. Only one re-nest attempt from six pairs was documented on the habitats in 2015, and no nest attempts occurred on constructed habitats in 2016. In 2015, mean elevation of successful nests for both species combined (1.4 ± 0.2 m) was greater than that of failed nest attempts (1.1 ± 0.2 m; $p < 0.01$). Constructed habitats were also used by Black Skimmer (*Rynchops niger*), Common Tern (*Sterna hirundo*), Least Tern (*Sternula antillarum*), and Royal Tern (*Thalasseus maximus*). No nest failure due to flooding occurred on constructed habitats in 2015, though nests were lost to flooding on constructed habitats in 2016 and on unaltered habitat in both years.

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Natural West Nile Virus infection in captive raised American White Pelicans (*Pelecanus erythrorhynchos*) (Oral)

The effects of West Nile virus in captive American White Pelicans (*Pelecanus erythrorhynchos*) are previously unreported and clinical aspects of infection are poorly understood. Twenty-one of 24 naïve hand-reared American White Pelicans being used in a captive study became naturally infected with West Nile virus during June-July 2012. Progression of disease in WNV infected pelicans could be classified into 2 categories with some pelicans experiencing a chronic infection usually resulting in great loss of body weight, or as more acute where pelicans were more affected by neurological symptoms. Clinical symptoms ranged from lethargy and/or wing droop to total paralysis. Necropsies were performed on 24 pelicans. This presentation describes clinical signs, physiological parameters, and pathology of disease observed in those 21 captive American White Pelicans infected by West Nile virus. The progression of the disease is emphasized in two well-defined case studies.

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New technologies reveal fine-scale spatial patterns in migrating northern gannets: Preliminary data from 2016 spring migration using GPS/GSM transmitters (Poster – Atlantic Marine Bird Cooperative)

Offshore wind development could impact marine birds through direct mortality and by altering flight paths and behavior. Northern gannets (*Morus bossanus*) are one such species of concern; as far-ranging and long-lived birds, gannets may regularly come in conflict with offshore facilities throughout their lives. To investigate offshore use by gannets and evaluate potential impact with wind facilities, we deployed recently developed 32-g solar-powered transmitters which logged hourly GPS locations (accurate to 3 m) and transmitted them to cellular towers. Additionally, we tested new attachment techniques using custom-molded silicone harnesses and 3D printed transmitter adapters with the goal of eliminating the need for implanted transmitters, improving hydrodynamic flow around tags, and reducing overall handling time. In April 2016, we deployed 10 of these transmitters on gannets in

Chesapeake Bay, Virginia and Delaware Bay, Delaware. Preliminary results support that gannets use offshore areas regularly during late winter and spring migration flying at altitudes that may bring them in direct conflict with operating turbines (38% of time spent offshore (>5.5 km) flying at an average 13.3 m (± 18 m) altitude). Sixty percent of individuals traveled directly through Wind Energy Areas (WEAs) over the course of their migration north and several loafed for several days within 5 km of WEAs, particularly off the Rhode Island / Massachusetts coast. Preliminary investigations into the influence of weather covariates on offshore movements by gannets and predictive modeling of these events are ongoing. These data will be instrumental in modeling of habitat use, mortality risk, and the impact of weather on flight behavior for these species in the face of multiple proposed offshore wind-power facilities along the US Atlantic coast.

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Predation by Great Black-backed Gulls (*Larus marinus*) on Great Duck Island, Maine, USA (Poster)

In 2016, predation of hatching-year Common Eiders (*Somateria mollissima*) by Great Black-backed Gulls (*Larus marinus*) within Great Duck Island's (Lat. 44.14 N, Long 68.24 W) southern breeding colony significantly exceeded similar predation events recorded at the location over the previous five summer field seasons combined. In 2015, close observations of both species revealed no evidence of predatory interaction. To investigate this development, predation attempts by Great Black-backed Gulls were monitored in 2016 through behavioral observation and diet analysis. Prey remains were collected multiple times from all identified Great Black-backed Gull nests in addition to a comparable sample of Herring Gull (*Larus smithsonianus*) nests within the colony. Remains were classified by taxa, identified to species wherever possible, and quantified by size and minimum number of whole individuals consumed. Distribution trends of prey types, sizes, and consumption frequency were analyzed for the colony as a whole. In addition to Common Eider chicks, Great Black-backed Gulls were found to consume Herring Gull chicks as well as crustaceans, fish, terrestrial birds and mammals, insects, aquatic and terrestrial mollusks, and human garbage. Analysis of remains from individual nest sites revealed a broad spectrum of generalist to specialist diets. A sub-sample of five Great Black-backed Gull nests were closely observed from the lighthouse tower to determine chick feeding frequency, and predatory behavior was regularly monitored throughout the colony. Trends in feeding and predation events are analyzed in relation to time within the breeding season, time of day, and weather phenomena.

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Black Skimmer protection, monitoring, and stewardship at St Pete Beach, Florida (Oral – Black Skimmer Symposium)

Pinellas County is the most densely populated in Florida and more than 600,000 people from all over the country and the world visit this area in July alone. The county hosts over >55km of sandy public beaches

suitable for beach-nesting birds such as the Black Skimmer (*Rynchops niger*). Human disturbance and habitat loss are leading causes of declines in coastal nesting bird species. For the past three years, we have protected (e.g. signs and temporary fencing) and monitored a skimmer colony on busy St Pete Beach. Part of our protection efforts include nest site stewardship, where trained field technicians and volunteers educate beach-goers about these nesting birds and intervene when people breach posted areas. In 2014, 110 pairs produced 100 fledges (1.1 fledges/pair); in 2015, 150 pairs produced 90 fledges (0.60 fledges/pair); and in 2016 midway through the season, we observed 380 adults (80 more than 2015) and 20 first year birds, equating to 180 breeding pairs. Over three years, nearly 80 volunteers have spent over 1,280 hours directly educating 3,842 people through nest site stewardship. Birds encounter human disturbance in many forms, including people intentionally or unintentionally walking through the colony, balls and Frisbees that land inside the posted area, fireworks (both commercial and private use), and large beach parties. By implementing multiple management approaches, we can increase public awareness and influence behavioral changes to reduce human disturbance at critical nesting locations located on highly urbanized beaches. Stewards play an important role in contributing to increased reproductive output for this Black Skimmer colony.

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Movements of first year Black Skimmers in Florida (Oral – Black Skimmer Symposium)

Florida's Black Skimmers (*Rynchops niger*) are declining in both number of breeding pairs and colony size. While some productivity and chick survival data exists, almost nothing is known about survival and movements of skimmers after fledging. During the 2015 breeding season we banded 48 near-fledgling skimmer chicks from two colonies in the Tampa Bay, FL region using plastic color bands with field readable alpha-numeric codes. We solicited band resightings through social media, websites, and presentations. To date, we have >600 resightings and all birds have been resighted once. All but one skimmer stayed near its natal colony until the end of August; one mortality was recorded. After August most (68%) of the birds were seen and the majority of these went ~150km south on the Gulf Coast to beaches in the vicinity of Marco Island where they were seen with banded birds from New York and North Carolina. One skimmer was resighted on the east coast of Florida and several were resighted inland on the shore of Lake Okeechobee. Only 17% of the birds were seen in the Tampa Bay area out of the breeding season. To date, during the 2016 breeding season, only 7 banded skimmers have been seen. One was at its natal colony, 3 were seen at other colonies within the region and 3 were seen loafing on beaches far from colonies. One of the 7 was seen offering a fish to a female in an apparent attempt to initiate mating, but was unsuccessful. The first year of our data has shown that skimmers disperse widely and most do not return to their natal colonies during their first year.

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Piping Plover habitat suitability on the Niobrara River, Nebraska, USA (Oral)

Habitat degradation and loss is the greatest threat to bird species, which makes defining, locating, and modeling future presence of high-quality habitat critical to management efforts. Habitat quality can be estimated through site-specific demographic parameters such as reproduction and survival. For threatened Piping Plovers that breed on river sandbars, some factors that have been associated with nest success, and therefore may indicate high-quality habitat, are amount of dry sand for nesting, amount of moist sand for foraging, amounts of surrounding vegetation, and distance and separation from the bank. Despite being largely unaltered by humans and one of the least modified habitats supporting Piping Plovers in the Great Plains, USA, the Niobrara River in northeastern Nebraska has experienced population declines in recent years. We created a model that assesses Piping Plover nest habitat suitability and found that suitability increases with the proportion of dry sand and distance from the bank line.

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Representing hydrologic variability in heron models: key processes for wetland ecosystem management (Oral – Heron Symposium)

The response of herons and other wading birds to hydrologic variability has been studied for over 50 years in the Florida Everglades (USA) and globally. Collectively, these studies illustrate a variety of mechanisms through which hydrologic variability affects nesting and foraging, and how this variability can be represented in ecological models that have application to wetland restoration and management. In wetlands with a pronounced seasonal water cycle, herons and other wading birds often initiate nesting when water levels are dropping and aquatic animals are concentrated into shallow water. The success of nesting is dependent on the rate of receding water being at an optimal level, with rates above and below the optimum causing lower nest survival. When water levels stop receding and rise suddenly due to rain or inflows, birds will abandon their nests. This pattern contrasts with that of floodplain wetlands where wading birds often initiate nesting when water levels are rising and prey are dispersing rather than being concentrated. Juvenile aquatic animals disperse out of river channels to the floodplain where they experience a rapid growth rate leading to an increase in prey biomass for birds. The parameters hydroperiod and minimum water level affect the production of prey populations, establishing the upper limit to subsequent foraging conditions, with the actual value being lowered by the degree to which deep water levels restrict access to prey by birds. The range in water level fluctuations defines the spatial extent of habitat that becomes suitable for foraging. In floodplain systems this variable is often the primary determinant of numbers of nests.

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Winter habitat conditions influence survival across the full life cycle for an imperiled migratory shorebird (Oral)

Assessment of demographic processes for migratory species often is complicated because migrants use different sites during different seasons. Additionally, as mortality for these species often is estimated indirectly, it is difficult to establish the relative importance of seasonal habitats on population regulation. For the piping plover (*Charadrius melodus*) recovery efforts primarily aim to increase productivity. However, low juvenile or adult survival during the winter could offset productivity. We developed a full life-cycle population model that simultaneously estimates multiple seasonal and annual demographic processes based on individuals from all major breeding populations wintering in coastal South Carolina and Georgia. We found that demographic processes varied among overwintering sites, as well as between breeding sites. The Great Lakes breeding population differed from the remainder of the range. Areas with fewer anthropogenic disturbances had higher survival, recruitment, and population growth rates than areas with greater disturbance. Although all wintering sites fluctuated in population size across time, the average population growth rates for three of our sites were > 1.0. However, the population associated with Hilton Head, SC, the most disturbed site, declined throughout the study, possibly due to both lower survival of adults and lower recruitment of new individuals relative to the other winter sites. Annual survival was strongly associated with the average body condition for individuals at each site, which was also substantially lower for individuals at Hilton Head than at the other sites. Individuals from the endangered Great Lakes breeding population that overwintered at Hilton Head had, on average, annual survivals of 0.35, approximately 50% less than the annual survival rate (0.68) for Great Lake's individuals that overwintered at our other sites.

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A Mobile Avian Survey Data Collection Software Application (SeaScribe) (Poster – Atlantic Marine Bird Cooperative)

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Offshore seabird, marine mammal, and sea turtle surveys are necessary to collect baseline and project-specific data for offshore development. Previously, there were only a couple of computer applications designed to collect such data in the field. These programs are antiquated and sometimes difficult to use with little or no ability to be run using current handheld computing infrastructure, such as tablet computers and smart phones. However, tablet computers and smart phones are now ubiquitous, usually have onboard GPS, Wi-Fi, or cellular connectivity, are relatively low cost, and are easy to weather-proof. We created a freely available, modern survey data collection program (SeaScribe) with enhanced data standardization and improved performance for deployment to those performing marine animal surveys. We designed this program to have built in on-the-fly data checking, improved data standardization across surveys, improved data entry, and readily available quality-controlled data. The application was designed to collect core data but also to give users the flexibility to add data fields as necessary to satisfy research needs. In order to achieve a modern application for this environment, we built SeaScribe from the ground up to best use the most current hardware and software. We also used a cross-development platform to allow for development in one language to be deployed across both Android and Apple iOS operating systems, dramatically reducing the time to release to both platforms and future updates.

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When is additional shorebird habitat most needed in California's Sacramento Valley? (Oral)

In the Sacramento Valley, much of the historic wetland area is now planted in rice (*Orza sativa*). When winter flooded this crop serves as critical surrogate habitat—some years providing 85% of the total wetland area. Rice fields provide suitable shallow habitat conditions for shorebirds during initial floodup and when being drawn down; however, the timing of these events may not coincide with the needs of shorebirds, and optimal habitat conditions may be short-lived. To improve the situation, we launched BirdReturns, a program that incentivizes farmers to create shallow-water habitat before and after the traditional winter flooding season. To test the value of this habitat, we monitored enrolled and unenrolled fields. Results indicate that enrolled fields were highly successful in attracting shorebirds. The greatest added value of the created habitat came in late August and September when shorebird densities in enrolled fields were the highest of the entire year, despite fewer shorebirds being in the region relative to some other times. Our data suggest a large amount of shallow water habitat is available in February, but habitat limitations may present themselves in March and April. Although we did not find significant differences in shorebird density, richness or diversity between enrolled and unenrolled fields in January, densities in the subset of flooded fields that were shallow were among the highest recorded. This suggests that although there is a great deal of flooded habitat in the Sacramento valley during mid-winter, there may be a shortage of habitat at appropriate depths for shorebirds.

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Characterization of Ardeid assemblages on the southern coast of Cuba. (Oral – Heron Symposium)

Cuba has 12 species of herons distributed throughout the national territory, with exception of American Bittern, all breeding in Cuba and has migrant populations from North America. The group is well

represented in natural and anthropic wetlands, however little has been published about their status and distribution. In this work we evaluated the ardeidos assembly in nine Cuban natural wetlands distributed along the southern coast of Cuba from May 2011 to March 2013, and one ricefield between 1992 and 1995. Of the 12 species represented in the archipelago, nine were present in 100% of observations in nine of the wetlands studied. Here were included all representatives of genus *Egretta* in Cuba. The highest values of abundance were recorded in Los Palacios (1188 individuals); Delta del Cauto (958 individuals) and Canales Hanábana (924 individuals). In more than 50% of the sites Snowy Egret, Little Blue Heron, Tricolored Heron and Great Egret were identified as the most abundant species. In Punta Caribe and Tunas de Zaza, the highest values of abundance were recorded in the period of Permanent Residence (May-June), while in Los Palacios y Monte Cabaniguán was during the fall migration (October-November). In the remaining sites these higher abundance values were reported during the spring migration (February-March). Meanwhile, in the ricefield 12 species of herons were identified. Of these, the most abundant were Cattle Egret, Snowy Egret, Little Blue Heron and Great Egret. In general, the results support the importance of natural and anthropic wetlands in Cuba for ardeidos.

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Clinal variations in dark morph proportion of Reddish Egret (*Egretta rufescens*) in Cuba (Oral)

The Reddish Egret presents a polymorphic plumage that is independent of age and sex. According to information from the ratio of dark morph in some areas of its range, the species appears to exhibit a cline variation, with dark individuals predominating in the most western populations (e.g., Baja California, ~100% dark morph), while the eastern populations contain a small proportion of these (e.g., Great Inagua, ~12% dark morph). An analysis of the proportion of dark individuals over 20 Cuban wetlands revealed a consistent pattern of geographic variation with apparent cline described in the global distribution of the species. In turn, the proportion of dark individuals was higher in the N coast than in the S, but in both cases the probability of observing a dark individual decreased with distance from the western end of Cuba (cline west-east, coast N: 92-50%, S coast: 80-9%). A case study in three wetlands of the south coast distributed throughout Cuba confirm the results found for this coast. The study included systematically sampled in these wetlands for two years.

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Making lemonade out of lemons: What we have learned about Gull-billed Tern colony recovery after the 2013 epizootic (Oral)

Over the last five years we have initiated various research projects on the San Diego, California Gull-billed Tern (*Gelochelidon nilotica*) breeding population that includes diet research using pellet regurgitation and stable isotopes, mark-recapture efforts to understand colony structure and juvenile

dispersal, and the influences of reproductive demands on movement ecology. In May 2013, the San Diego colony was hit with an acanthocephalan-related mortality that killed between 85-91% of the breeding population (estimated 130-150 individuals). Of the 91 terns recovered, 68 individuals were banded (75%) with San Diego being the natal site (92%). Capture data combined with the mortality data suggests that the Gull-billed Tern population in San Diego has a high degree of natal philopatry and breeding location tenacity. In the three seasons since the mortality event, the colony has rebuilt to 33 breeding pairs due in large part to the return of young from 2011-2012 that returned to breed in 2014 (75%). Diet data from 2010-2016 highlights the importance of the mole crab *Emerita analoga* as a food resource and vector for parasite infection for the Gull-billed Tern. Concurrent with the tern mortality, mole crab populations underwent a population boom and then decline in beaches within tern foraging ranges. Based on current invertebrate surveys, *Emerita* populations have not yet recovered to 2013 population estimates. The diet base for the tern chicks appears to be changing from crustacean to a more mixed prey base.

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Density-dependence and changes in carrying capacity in Alaskan seabird populations (Oral)

The Alaska Maritime National Wildlife Refuge comprises an expansive network of islands and coastal sites that support breeding colonies of 19 monitored seabird species. We provide the first comprehensive Alaska-wide assessment of kittiwake (*Rissa* spp.), murre (*Uria* spp.), and puffin (*Fratercula* spp.) population trends, over the past four decades. We reconstructed historic population size estimates by calculating annual rates of change from sampled counts at 33 colonies. We scaled these estimates to total population size by integrating probability-proportional-to-size estimators, from recent counts, with population data from the Beringian Seabird Colony Catalog. Using the resulting time-series, we evaluated a set of models that allowed for either density-independence or density-dependence, with or without a time trend in carrying capacity. The most competitive models indicated that these seabird populations are negatively density-dependent, and additionally that the carrying capacity of Black-legged Kittiwakes (*R. tridactyla*) has decreased in the last four decades. Colonies in the Gulf of Alaska appear to be the source of these declines. Negative density dependence can help to sustain a declining population's probability of persistence on the long term. Therefore, it is important to include demographic factors in determining the ecosystem-wide drivers of seabird population trends in Alaska.

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A decade of Reddish Egret research: looking back and moving forward (Oral – Heron Symposium)

In 2006, the US Fish and Wildlife Service published a species status report for the Reddish Egret (*Egretta rufescens*), the first status review of the species in 15 years. From that report, it was evident that knowledge gaps on the ecology and limiting factors of the species remained. Since 2006, we have conducted research in Texas and various parts of the species' range on 1) movement ecology, 2) nesting and foraging ecology, 3) juvenile and adult survival and 4) genetic differentiation and gene flow. Juvenile Reddish Egrets exhibit nomadic behavior during post-fledging dispersal before showing little movement during first winter and subsequent breeding season, whereas roughly 60% of adult Reddish Egrets nesting in Texas exhibit migratory behavior overwintering in Mexico and as far south as El Salvador. While annual survival of adult birds is high, survival of juvenile Reddish Egrets is low (~25%) and potentially as low as 10% during first 3-6 months post hatch. Low juvenile survival is in contrast to high nesting survival (~80-90%) from incubation through 4-5 weeks post hatch. Within Texas, we found little genetic differentiation (mtDNA and microsatellites) geographically or between color morphs. Across the range, we found significant differentiation along a longitudinal gradient with genetically isolated population centers in Baja California, Chiapas and Bahamas. Populations in Louisiana, Texas, eastern Mexico and Florida appear to be transitional between the extremes of Baja and Bahamas. Our research fills many information gaps for this little studied species, provides important implications for future research, and informs resource managers for more directed and impactful conservation for the Reddish Egret.

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Already gone: GIS analysis and modeling of American Oystercatcher nest site erosion risk in the upper Texas coast (Oral)

Western Gulf of Mexico American Oystercatchers depend heavily on dredge spoil islands for nesting, many of which have not been replenished with material for years. Our analysis sought to examine erosion rates of 76 nesting islands observed by the Gulf Coast Bird Observatory from 2011-2016 in Galveston, East Matagorda and Matagorda Bays. GIS shapefiles were created from Texas Orthoimagery Program images (2009, 2015) to estimate total island area, vegetated and open ground habitat and shorelines for each image. We used the USGS Digital Shoreline Analysis System (DSAS) to compute rate-of-change statistics from the multiple created shorelines. The DSAS Least Median of Squares value was selected to estimate shoreline change (in meters) per site. This value was then extrapolated into the future to estimate island areas in 3,5,10, and 25 years. Island ID units were classified as: Completely Gone (loss of 100%), Extremely High (loss of >75%), High (loss of 50-75%), Medium (loss of 25-50%), or Low (loss of 5-25%) risk for loss based on the change in percentage of area. We expect this analysis to bring attention to lesser known islands experiencing loss and to guide future American Oystercatcher funding in the Western Gulf of Mexico.

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A bird's eye view of nest sites: mapping habitat for Black Skimmers in the Upper and Mid Texas Coast. (Oral – Black Skimmer Symposium)

Black Skimmer breeding populations have declined drastically in Texas, from over 10,800 pairs in 1973 to roughly 4,389 pairs in 2015. GIS data was assembled on rookery islands with Black Skimmer colonies from 2010-2015 located in Galveston, East Matagorda or Matagorda Bay (N= 26). GIS land cover maps were generated from Texas Orthoimagery Program images (2009, 2015), to examine open ground nesting habitat loss for skimmers 2010-2015. As a consequence of population data gaps, known year breeding pair counts were matched with land cover acreage calculations (N = 21) to determine relationships between colonies and physical island properties: island percent bare ground habitat, pairs per acre of bare ground habitat and pairs per acre of total island area. We used the USGS Digital Shoreline Analysis System (DSAS) to compute rate-of-change statistics from the multiple created shorelines. The DSAS Least Median of Squares value was selected to estimate shoreline change (in meters) per site. This value was then extrapolated into the future to estimate island areas in 5, 10, 25 and 50 years. Island units were classified as: Completely Gone (loss of 100%), Extremely High (loss of >75%), High (loss of 50-75%), Medium (loss of 25-50%), or Low (loss of 5-25%) risk for loss based on the change in percentage of area. By examining existing habitat and past bird use, this analysis can pinpoint ideal areas for restoration activities for Black Skimmer and preferred island composition.

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Assessing the distribution of the Eastern Black Rail in South Carolina (Oral – Eastern Black Rail Symposium)

The eastern subspecies of the black rail (*Laterallus jamaicensis jamaicensis*) is a candidate for federal listing as endangered or threatened under the Endangered Species Act; however, the distribution and abundance of the subspecies is poorly understood. Due to their rarity and secretive habits, assessing and monitoring their status is difficult. The species is very seldom seen, and auditory surveys are the primary method of determining occupancy. During 2015 and 2016, the South Carolina Department of Natural Resources coordinated auditory call-response surveys throughout coastal South Carolina to assess the distribution of black rails. As declines are documented in the areas historically occupied by the species in the Northeastern USA, two areas of coastal South Carolina are emerging as important sites for the subspecies.

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Investigating vocalization patterns of the Eastern Black Rail in South Carolina (Poster)

Populations of the eastern subspecies of the black rail (*Laterallus jamaicensis jamaicensis*) appear to be declining rapidly; however, due to their rarity and secretive habits, assessing and monitoring their status is difficult. The species is very seldom seen, and auditory surveys are currently the primary method of determining occupancy. Conducting auditory call-response surveys for this species using trained observers in the field is very costly and logistically challenging, but achieving accurate results is critical. Therefore, concentrating survey efforts during the optimal time of day is essential. However, the optimal time of day to conduct auditory surveys of black rails may vary regionally and among habitat types, so it may be necessary to establish a survey protocol specific to the Southeastern USA. During the 2015 and 2016 breeding season, we deployed autonomous recording units (ARUs) in wetlands where black rails have been detected during recent years to investigate the temporal vocalization patterns of black rails. ARUs are emerging as a useful tool for studying the distribution and ecology of marsh birds, and their use has been proposed for other black rail studies. The techniques and preliminary results presented in this poster will be valuable to other researchers surveying black rails and/or incorporating ARUs in their research.

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Population monitoring, ecology, and habitat relationships of sora and Virginia rails in northwestern Ohio (Poster)

Effective management of any wildlife species is aided by the ability of wildlife managers to estimate abundance and track changes in abundance over time. Interest in secretive marsh birds including rails, bitterns, coots, and gallinules has increased in recent years, culminating in the implementation of the spring secretive marsh bird survey. Rails (sora and Virginia rails in particular) are of special interest in Ohio and many other states because of their status as harvestable game birds. Rail bag limits are relatively liberal in Ohio but harvest is assumed to have little impact on rail populations because hunting pressure is light. Due to their secretive nature, no current estimates of rail abundance exist for the state of Ohio, nor do measures of population parameters that might indicate the health of Ohio's rail populations such as nest success or survival rates. We plan to equip both sora ($n=50$) and Virginia rails ($n=50$) with radio transmitters after spring migration in 2016, 2017, and 2018 to estimate breeding season vital demographic rates, breeding habitat use, and migratory timing. We also intend to model factors affecting callback rates and other components of the standardized Marshbird Monitoring Protocol. Lastly, we intend to use a trail-camera trap array to develop estimates of occupancy and untimely abundance by habitat type.

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Waterbird distribution and avian vacuolar myelinopathy species susceptibility on a Georgia reservoir infested with the aquatic plant hydrilla (*Hydrilla verticillata*) (Oral)

Man-made reservoirs, often deficient in native aquatic vegetation, can be rapidly inundated with exotic, invasive, submerged aquatic vegetation such as hydrilla (*Hydrilla verticillata*) once the plants are introduced. Investigations into exotic aquatic vegetation and waterbird feeding ecology suggest hydrilla

is an important food resource for avian species that migrate through and over-winter on southeastern lakes and reservoirs in the United States. Hydrilla and a novel epiphytic cyanobacterium (*Aetokthonos hydrillicola*) have been linked to the neurologic disease avian vacuolar myelinopathy (AVM). Studies suggest AVM is caused by ingestion of a cyanobacterial neurotoxin either directly from hydrilla – *A. hydrillicola* complex, or secondarily through consumption of diseased prey. AVM has been documented primarily in American Coots (*Fulica americana*) and Bald Eagles (*Haliaeetus leucocephalus*), however, a number of waterfowl species, as well as one Killdeer (*Charadrius vociferous*) have been reported since AVM was first diagnosed in 1994. We conducted ground and aerial surveys on a Georgia reservoir with a history of AVM, from Fall through early Winter, to document waterbird use of hydrilla. We found that American Coots, waterfowl, grebes, Common Loons, shorebirds, and raptors congregate at hydrilla infested areas of the reservoir, and that undiagnosed species of waterbirds may be at risk of acquiring AVM either through hydrilla herbivory, or through prey that utilize hydrilla.

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Preliminary Planning for Colonial Waterbird Rookery Habitat Needs, San Antonio Bay, Texas (Oral)

In Texas, many colonial nesting waterbirds are declining based on annual pair count data collected by the Texas Colonial Waterbird Society. Recent status and trends reports for colonial waterbirds in San Antonio Bay, Texas, indicated a lack of nesting waterbirds, despite being one of the major bay systems on the Texas coast. One factor contributing to the low numbers of nesting waterbirds is the lack of available island nesting habitat. This presentation will document the need for additional nesting habitat within the bay, as well as, the work of project partners including five non-profit conservation organizations, two state resource agencies, and the U.S. Fish and Wildlife Service to identify a suitable location to restore or build a rookery site in San Antonio Bay.

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HeronryMAP-----:Africa -- mapping the distribution and status of ardeid (and other waterbird) breeding colonies in Africa (Oral – Heron Symposium)

Colonial breeding waterbirds are spread across seven bird families — Laridae, Phalacrocoracidae, Ardeidae, Phoenicopteridae, Threskiornithidae, Pelecanidae and Ciconidae. Due to their conspicuous behavior and often socio-economic and ecological impacts, most taxa have been well studied. In Africa, information on the status and distribution of breeding colonies in the Ardeidae is severely lacking which provides a gap in the knowledge of how important these sites are in terms of location and productivity. HeronryMAP: Africa is a citizen science initiative that aims to address this gap through the systematic collection of long-term data on inter alia where ardeid breeding sites occur, their species composition, nest abundance and site tenureship. Preliminary results are presented from 2013, and challenges identified and discussed regarding data mobilization and sustainability. Future objectives such as the

assessment of priority sites, and identification of conservation action for colonies under threat are discussed and the impact of climate and landscape changes are briefly highlighted.

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Industry provides a safe haven for nesting Black Skimmers (Oral – Black Skimmer Symposium)

In 1961, a few Black Skimmers attempted to nest on an oyster shell parking lot at Dow Texas Operations' Plant A in Freeport, Texas. Some concerned employees cordoned off the area with red cones to protect the bird's nests. From that meager effort, the Dow Skimmer Lot has grown into a three-acre area with a crushed shell and limestone substrate that is enclosed by a 42 inch high chain link fence with a livestock electric fence wire to exclude predators. Within the fence, two water flumes provide fresh water for grooming, wetting brood patches, and water for chicks. In the midst of heavy manufacturing the site is a virtual island and is one of the most productive Black Skimmer colonies on the Texas coast. The Gulf Coast Bird Observatory began weekly monitoring of this colony in April 2014. The colony hosts approximately 500 breeding pairs of Black Skimmers and smaller numbers of Gull-billed and Least Terns pairs each year. Dow Texas Operations holds an annual Skimmer Day in late June of each year in which visitors can go into the plant and see the colony. This event attracts hundreds of guests each year and provides an excellent opportunity for outreach and education about beach nesting bird ecology.

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Red knot (*Calidris canutus rufa*) and prey abundance and distribution along the Virginia barrier islands, USA (Oral)

Every year during spring migration, thousands of migratory red knots use Virginia's barrier islands as stopover habitat to regain the fat required to continue flights to breeding grounds. We investigated the variation in red knot island use and potential effects of prey on this variation from 2007-2015 by counting red knots and collecting core samples containing prey (blue mussel - *Mytilus edulis*; coquina clam - *Donax variabilis*; other prey – i.e. crustaceans and polychaetes). During peak migration (May 14-28), we estimated that 3600-11900 red knots used the islands. Prey distribution was not continuous, but where present, 850-12500 coquina clams and 150- 56700 blue mussels were available/m² shoreline. Red knot numbers and prey abundances varied by island. Hog Island and Parramore Island supported the highest numbers of red knots/km. A Poisson regression model including island, coquina clam abundance, and other prey abundance best explained the variation in red knots (AIC wt = 0.64), followed by a model with island and other prey abundance (AIC wt = 0.36, Δ AIC = 1.14). Fisherman Island and Wreck Island had the highest abundances of coquina clams, and Myrtle Island had the highest abundances of other prey, but these islands had relatively small numbers of red knots. This suggests that other factors, such as tide or roost site locations, may affect red knot use. Since the red knot is

federally threatened and uses Virginia's barrier islands during spring stopover, understanding factors influencing prey abundance is imperative to successful management practices in Virginia and the larger mid-Atlantic stopover

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Rice fields support the largest known breeding population of the endangered Australasian Bittern (Oral – Heron Symposium)

The Australasian Bittern (*Botaurus poiciloptilus*) is a poorly known, globally endangered species with a total population of just 1000-2499 mature individuals. The Riverina region of New South Wales is recognised as a stronghold. It supports around 95% of Australia's rice production, which constitutes approximately 100 000 hectares in years of 100% water allocation. Despite this, little was known about the Australasian Bittern population found in these rice fields. From 2012-2016, standardised surveys of rice crops on randomly selected farms in two of the three main rice-growing areas were used to estimate the population size and determine the extent of breeding. Occupancy at the 23-30 hectare sites ranged 0.23-0.29, depending on the year and region. Most observations were of one or two birds, but up to four were recorded during a single survey. Habitat occupancy modelling, accounting for the unsurveyed third region and substantial detectability issues, suggests that in most years these rice fields attract approximately 500-1000 mature individuals. This represents around 43% of the estimated global population. Nests found at the randomly selected farms indicate widespread breeding and observations of fledged young confirm that some nests succeed before harvest. The results highlight the overlooked conservation role of agricultural wetlands in Australia and the potential for dual-purpose water use. Bitterns showed a strong preference for more traditional rice growing methods of aerial sowing with early inundation, as opposed to direct-drill sowing with delayed inundation. However, driven by water savings, an increasing number of rice growers are altering their sowing methods and water management. Development of bittern friendly rice growing incentives will be discussed.

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The Potential Effects of Underwater Sound on Double-Crested Cormorants in Dodge Pond, Niantic, Connecticut, USA (Poster)

The behavior of a population of double-crested cormorants (*Phalacrocorax auritus*) that regularly visit Dodge Pond in Niantic, CT was observed in the May through October of 2015 and 2016. At the center of the study site on a test platform is the Dodge Pond Acoustic Measurement facility. Various types of Navy sound systems such as transducers, arrays, and airguns are deployed from this platform and tested underwater. The behavior of double-crested cormorants was observed during sound testing and in the absence of sound testing to determine if their behavior is significantly altered in the presence of underwater sound. In order to record cormorant behavior, individual cormorants were observed for five

minute intervals by one scientist using binoculars while another scientist records the behavior on a personal laptop computer.

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Status and Conservation of White-eared Night Heron in Vietnam (Poster)

For the last ten years, several works have been done for the little known and endangered White-eared Night Heron *Gorsachius magnificus* in Northern Vietnam. From direct field surveys and interview the local hunters, we confirmed the records of this species at three different sites in two provinces in Northern Vietnam including (Cho Don and Ba Be districts of Bac Kan province), Trung Khanh district of Cao Bang province. We have also confirmed the occurrence of 8 breeding pairs and estimated the population size in Northern Vietnam is under 100 individuals. The main threats to the species have been identified including habitat loss and hunting. Several conservation works have been done such as setting up the nest protecting group at Xuan Lac and Ba Be sites and the species action plan have been made. Particularly, this species was included in the 160 Degree of Vietnam Government in 2013 which is used as the main reference for Vietnam penal code and Biodiversity Law.

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Piping Plover prey abundance and body condition after large-scale habitat creation on the Missouri River, USA (Oral)

Habitat may have a profound effect on the condition and fitness of individuals and on population demography for many bird species. We investigated the effects of habitat quality and quantity on the condition of Piping Plovers (*Charadrius melodus*) on the Missouri River from 2005–2014. The amount of breeding habitat increased substantially following flooding in 2011, which resulted in improved demographic rates (e.g., nest success, chick survival) compared to the pre-flood period. We hypothesized that condition would be related to habitat quality (invertebrate prey abundance) and quantity (foraging habitat availability) and that increased demographic rates throughout the post-flood period would, at least in part, be reflected in increased condition. We measured the amount of foraging habitat available annually using remote sensing. We collected 3,347 invertebrate prey samples, and mass measurements of 405 clutches, 633 adults, and 1,996 pre-fledged chicks. We found that foraging habitat availability was proportionally lower following the flood relative to nesting habitat. Invertebrate prey abundance, egg mass, and pre-fledge chick growth rates decreased each year post-flood. Adult mass, however, remained unchanged. Although egg mass and pre-fledged chick growth rates followed a similar pattern to habitat quality, contrary to our hypothesis, the condition of individuals did not appear

to contribute directly to the increased demographic rates following the flood. Instead, our results suggest that a decline in density-dependent predation following the flood may explain the discrepancy. Although the demographic effects of the flood were positive for plovers, it is important to understand the effects of habitat on the condition of individuals, and the short- and long-term demographic consequences of these effects.

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Assessment of Trophic Positions for the Seabirds of South Florida using C and N Stable Isotopes (Poster)

Seabirds outside the NE Pacific and NE Atlantic regions are poorly understood from a trophic perspective. To elucidate trophic level relationships, we examined the concentration of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ in the blood, breast muscle, and feathers of nine species of adult marine-associated birds common in South Florida: osprey *Pandion haliaetus*, black skimmer *Rynchops niger*, brown pelican *Pelecanus occidentalis*, northern gannet *Morus bassanus*, double-crested cormorant *Phalacrocorax auritus*, royal tern *Thalasseus maximus*, herring gull *Larus argentatus*, laughing gull *Leucophaeus atricilla*, and ring-billed gull *Larus delawarensis*. We collected specimens from four wildlife rehabilitation centers after death; three centers were in mainland-coastal areas, while one was coastal-island. Calculated mean trophic levels (TLs) ranged from 5.15 (osprey and northern gannet) to 3.64 (ring-billed gull), findings consistent with existing diet information, and all species exhibited expected $\delta^{13}\text{C}:\delta^{15}\text{N}$ ratios. Herring and laughing gulls (TL 4.59 and 3.90, respectively) appear to have a straight trophic enrichment based on coastal POM. Northern gannets (TL 5.15) are likely consuming a limited diet in offshore areas consistent with POM-based enrichment patterns and feeding strategies. Brown pelicans, osprey, and royal terns (TLs 4.78, 5.15, and 4.11, respectively) overlap diets when in South Florida, likely reflecting feeding areas; consistent with field observations, when onshore winds are strong, these species feed inshore on carbon-enriched prey, but when winds are weak, they feed near/offshore on carbon-depleted prey, such as lipid-rich fishes. However, double-crested cormorants (TLs 3.40 to 5.59) appear to have an unusually bifurcated $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ signal between specimens, apparently representing the two habitats inhabited by individual birds in South Florida: one along the coastal/nearshore ecotone and one along the inland/coastal ecotone.

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Home Ranges and Habitat Use of Brown Pelicans (*Pelecanus occidentalis*) in the Northern Gulf of Mexico (Oral)

Little is known about movements and habitat use of Brown Pelicans (*Pelecanus occidentalis*) in the northern Gulf of Mexico. We attached satellite transmitters to 18 adult Brown Pelicans (nine males, nine females) that were captured on Grand Isle along the Louisiana coast during 31 August-2 September 2010. Their movements and habitat use were tracked between September 2010 and March 2012. Nine of the Brown Pelicans remained proximate to the Louisiana coast; four ranged along the coasts of Alabama, Mississippi, and Louisiana; three moved from Louisiana to Texas; and two migrated across the Gulf of Mexico to the Yucatan Peninsula. Annual 99% home range estimates varied widely ($= 10,611 \text{ km}^2$, $\text{SE} = 2,370$), and males had larger ranges ($= 15,088 \text{ km}^2$, $\text{SE} = 2,219$) than females ($= 6,133 \text{ km}^2$, $\text{SE} = 1,764$). Habitats used by Brown Pelicans were primarily open water, estuarine emergent wetland, grassland, unconsolidated shore, and deep water habitat types.

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Strategies to cope with food-limitation: differing implications of prey and foraging habitat availability for wading birds (Oral)

Food-limitation is a common restriction for several wading bird populations. Effective management strategies for these populations must take into consideration the degree to which food abundance or foraging habitat affects sympatric species. We determined prey selection for four wading bird species, and investigated the effects of prey and foraging habitat availability on the number of nests initiated by six wading bird species in the Florida Everglades. To determine prey selection, we compared food items recovered from Tricolored Heron (*Egretta tricolor*), Snowy Egret (*Egretta thula*), Little Blue Heron (*Egretta caerulea*), and Wood Stork (*Mycteria americana*) nestlings to a 10-year dataset of aquatic prey availability across the Everglades landscape. We found that Tricolored Heron and Snowy Egret prey composition was statistically similar across years, with the majority of prey biomass coming from relatively large marsh fish. Little Blue Herons also consumed marsh fish, but they differed from the other two herons in that they consumed higher proportions of grass shrimp and exotic fish species. Wood Stork prey composition differed from all small heron diets, composed of sunfish and exotic fish species. Numbers of small heron nests were driven more by local marsh fish densities, whereas numbers of Wood Stork nests were more influenced by the amount of foraging habitat that became available over the nesting season. Whereas small heron foraging may seem restricted by their specialization on marsh fishes, their short nesting cycles allows for the phenological flexibility to delay nesting until foraging conditions are optimal. Conversely, Wood Storks with longer nesting cycles are more temporally constrained, but appear to have greater flexibility in prey items, foraging range, and foraging habitat.

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Herring Gull Colonies on New York City Rooftops (Poster)

Herring Gull (*Larus argentatus*) colonies in NYC have fluctuated from a high count of 21,000 pairs in the 1980s to 5,000 pairs in the 2000s. NYC Audubon (NYCA) has documented gull nesting activity on NYC islands for the past 30 years during its annual wading bird nest survey. A major shift occurred in the East River over the past 5 years when gulls abandoned South Brother Island and moved to rooftops on nearby Rikers Island. Port Authority data indicate consistent nesting on Rikers for the past 6 years. Are roofs providing important nesting habitat for gulls in NYC? In 2014 NYCA began monitoring two rooftop colonies in NYC. Colony size increased on both roofs: James A. Farley Post Office Building (37% in 2 years); and Jacob K. Javits Center green roof (37.5% in 3 years). A third roof was monitored in 2016 (NYPD Tow Pound, n=43 nests). Rooftop substrate is an important factor in determining nest establishment by gulls. Two roof complexes are gravel (Farley Post Office and NYPD Tow Pound); Javits Center roof is sedum; and Rikers consists of various substrates (gravel, white or black membrane, concrete). On Rikers, gulls prefer gravel to membrane roofs, and white to black roofs. To evaluate nest site fidelity, roof substrate preference, and quality of different types of rooftops as nesting habitat, NYCA has started a banding program, with 103 Herring Gulls banded to date (37 adults, 66 chicks). NYCA will expand rooftop monitoring as more colonies are reported. Resighting data will aid in assessing rooftop fidelity, quality, and dynamic use by gulls and help us analyze the role of rooftops as habitat in an urban landscape.

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Factors affecting the abundance of breeding secretive marsh birds and investigating the effects of metal contaminants on clapper rail (*Rallus longirostris*) health in the Timucuan Ecological and Historic Preserve, Jacksonville, Florida, USA (Oral)

The main threats to secretive marsh birds include loss of emergent wetlands and degradation of remaining wetlands. Secretive marsh birds will likely increase reliance on refuges and preserves because of habitat loss outside of protected areas. Expanses of intact marsh, such as the Timucuan Ecological and Historic Preserve, provide invaluable resources to several species. However, the landscape adjacent to the Preserve is densely populated and rapidly developing. The St. Johns watershed within the Preserve is listed as an urban estuary, with known heavy metal and organic contaminants. Given the surrounding land use of the Preserve, our aim is to identify appropriate scales and factors affecting abundance of secretive marsh birds. Analyses are ongoing, but the objective is to establish a link between abundance and contaminant levels of clapper rails (*Rallus longirostris*). Clapper rails were chosen as a proxy for marsh bird health because they exhibit strong territory fidelity and their diet

consists primarily of benthic invertebrates, which have increased exposure to contaminated sediments. Point counts for eleven species were conducted during two breeding seasons (2015, 2016) following the Standardized North American Marsh Bird Monitoring Protocol. Seven species were detected during survey efforts. Species with sufficient detections will be modelled in a single-season, hierarchical framework to estimate detection, occupancy or abundance, and the influence of environmental covariates. Preliminary results indicate edge density of marsh at the landscape scale is an important predictor of bird abundance. Clapper rails were captured (n=15) and blood samples were collected for complete blood counts, chemistry panels, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc levels. Several birds exhibited metal levels and health screens which may be of concern.

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Long-term physiological responses of nestling seabirds to variation in prey availability and nest site characteristics (Oral)

While the number of young produced per nesting pair (i.e., fledging success) is often used as a proxy for recruitment in seabird populations, post-fledging survival is likely to be much lower than this estimate suggests. Mortality is difficult to measure accurately once juveniles disperse from the breeding site; however, accounting for differences in fledgling physical condition can expose variation in survival probability not captured by fledging success alone. To assess inter- and intra-colony variation in nestling condition, we collected measures of short-term (body condition index: i.e., relationship of mass to skeletal size) and long-term (corticosterone levels in contour feathers) physical condition of 3-6 week-old chicks from pelican colonies across the northern Gulf of Mexico over a three-year period. We compared these metrics to traditional measures of nest productivity and post-fledging success, including nest observations, band resighting and live recapture-dead recovery survival models. We found an overall negative relationship of corticosterone to body condition, with both metrics strongly correlated to fledging success at the individual and colony-wide levels. However, feather corticosterone was more likely than body condition to reflect variation in nestling survival across nest-specific variables, particularly nest location. Additionally, feather corticosterone was correlated with post-fledging survival at the colony level, while body condition index was not. Since elevated stress levels during development are known to affect lifetime survival and reproductive fitness, we suggest nestling feather corticosterone as a useful index of developmental conditions and post-fledging survival probability that may capture additional information not reflected in short-term measures of physical condition.

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An investigation of Herring Gull population declines on Lake Superior (Poster)

Top-level predators, such as colonial waterbirds, have been used for decades on the Laurentian Great Lakes to assess the state and health of ecosystems. In Pukaskwa National Park on Lake Superior, Herring Gull (*Larus argentatus*) population size is used as an indicator of ecological integrity. However, gull populations in the park have declined by approximately 80% since the 1970s. One factor that may be particularly important in regulating these declines is food availability. Lake-wide declines in surface-schooling prey fish, e.g. rainbow smelt (*Osmerus mordax*), may be limiting natural food sources for Pukaskwa Herring Gulls. The southern part of the park occupies the most isolated shoreline in the Great Lakes with birds having little or no access to human sources of food. In the northern section of the park, impacts of natural food declines may be buffered as birds can obtain anthropogenic food from sources associated with two nearby small communities. To quantify possible regional differences in gull diets, Herring Gull eggs were collected from northern and southern parts of Pukaskwa National Park. Markers of diet composition, i.e. stable isotopes of nitrogen and carbon; fatty acids, were measured in these eggs. Results of these analyses support the hypothesis that gulls breeding in the southern part of the park rely to a greater extent on natural food sources. The lack of alternative foods in the south may be contributing to more extreme population declines in that region. Understanding the degree to which anthropogenic food subsidies may be maintaining Herring Gull populations on Lake Superior is critical when utilizing gull population size as an indicator of ecological integrity in Pukaskwa National Park.

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Impacts of a road construction on water bird populations and first regional rehabilitation actions at Asunción Bay Ecological Reserve (Paraguay) (Oral).

The Asunción Bay, is a relatively small bay (c.600 ha in total) located along the northern outskirts of Asunción, the capital of Paraguay. Although a relatively small area, more than 290 species of birds have been recorded in the bay, including 89 waterbird. Families represented by most species include Scolopacidae (18 species), Anatidae (15 species), Rallidae (13 species) and Ardeidae (11 species). 34 of the recorded waterbirds are migratory species, including 21 Nearctic migrants and 13 Austral migrants. Due to its importance for migrants in particular, the bay has been designated as an IBA and WHSRN site, and in 2005 was declared as an Ecological Reserve. The recent development of a coastal road has presented important opportunities for the urban population of Asunción to reconnect with its natural heritage, but unfortunately dredging to create the embankment for this road in 2010 destroyed about 70% of the habitat in the bay. The disappearance of muddy beaches on the bay caused drastic reductions of the total number of Nearctic shorebirds that regularly visited the Bay, but also caused changes in abundance and diversity of resident waterbird populations. The Municipality of Asunción and the Ministry of Public Works have been working together with Guyra Paraguay on the implementation of a series of habitat recuperation and management measure to improve remnants habitats for both waterbirds in general and shorebirds in particular.

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Movements of adult Common and Roseate Terns during the chick provisioning period (Oral)

Common Terns (*Sterna hirundo*) and federally-endangered Roseate Terns (*Sterna dougallii*) nest sympatrically on a few offshore islands in the western North Atlantic Ocean. Both species use similar chick provisioning strategies whereby both parents plunge dive in nearshore and offshore waters to obtain fish to feed chicks during the pre-fledging period. Information on the timing, routes, and destinations of chick provisioning flights is useful for elucidating interspecific differences in habitat selection and determining high-use foraging areas. During the 2015 and 2016 breeding seasons, we used 1.5 g digital VHF transmitters and an array of 24 automated radio telemetry stations to track the local and regional movements of Common Terns ($n=60$) and Roseate Terns ($n=60$) from a large nesting colony (Great Gull Island) in Long Island Sound, NY (USA). During the chick provisioning period, individuals of each species regularly traveled from the nesting colony to sites 30 to 50 km away, much farther than past research has documented. We developed spatially-explicit models to assess the timing, routes, and destinations of these movements for males and females of each species. In addition, we assessed prey (e.g., species, size) that adults were feeding their chicks. By linking movement data with information on prey items, our objective is to identify high priority areas utilized by terns that could be used to inform management efforts, such as developing regulations to manage forage fish and recommendations for the siting of offshore wind energy facilities.

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Intraspecific and Intersexual Variation in Three Species of Wading Birds (Oral)

Intraspecific and intersexual morphological variation is common in many groups of birds, but few data regarding such differences exist for Ardeids. Since 2008, we have trapped long-legged wading birds in Kansas and along the East Coast for telemetry studies. Captured individuals are weighed and several measurements taken before they are released. Beginning in 2013, a blood sample was collected from each bird, which was used to determine its sex. Measurements of 103 birds of three species were used to examine relationships among mass, culmen length, and tarsus length, and to determine whether males of each species differ from females in these values. Great Blue Herons (1702-2859 g), Great Egrets (1769-1300 g), and Snowy Egrets (349-539 g) all showed high variation both in body weights and morphometric measurements. For all three species, weight was correlated significantly both with culmen and tarsus lengths, which were themselves strongly associated. For Great Egrets and Snowy Egrets, males were significantly heavier than females and also had longer culmen and tarsus lengths (all $P < 0.003$). Sample size for Great Blue Herons was not large enough to compare male and female birds. We discuss the possible implications of intraspecific variation and sexual differences in Ardeids.

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Foraging Microhabitat Selection by Long-legged Wading Birds at an Artificial Weir (Oral)

To better understand how wading birds select among different foraging microhabitats that show spatial heterogeneity, we divided a 100-m-long concrete weir located at the terminus of the Little Arkansas River in Wichita into 10 patches based on water depth. We observed four species of wading birds during 60 1-h periods from 12 June-28 July 2015 to document microhabitat use and feeding behavior. The independent variables collected before each session were time of day, date, water level, water clarity, and flow velocity. We documented capture efficiency, prey length (relative to bill length), and aggressive interactions for Black-crowned Night-Herons (n = 396), Great Egrets (n = 54), Snowy Egrets (n = 36), and Great Blue Herons (n = 30). Time of day and water level were the only significant predictors of weir attendance. A total 348 fish were captured, of which 108 were 3/4 bill length or greater. Wading bird species differed in capture efficiency, mean prey lengths, and the primary patch use. Great Blue Herons and Black-crowned Night-Herons captured mainly large fish (gizzard shad, catfish, and freshwater drum); Great Egrets captured both large and small fish, and Snowy Egrets captured mainly small fish (minnows). Overall aggression rate was correlated with the number of large fish captured but not with total fish, whereas the per capita aggression rate was correlated with the number of birds at the weir. Electro-fishing showed a non-uniform distribution of fish among the 10 patches. The pattern of fish spatial distribution was reflected in prey-capture patterns, where mean fish length differed significantly by patch and ranged from 2.8 cm to 11.9 cm.

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Incubation and diving depths of Audubon's Shearwaters and Red-billed Tropicbirds at Little Tobago Island, Trinidad and Tobago. (Poster)

For many pelagic seabirds, the methods of feeding and incubation behavior are poorly known. Both Audubon's Shearwaters and Red-billed Tropicbirds dive below the surface for food, but little information is available about the frequency and depth to which they dive or their incubation behavior. In 2013, geolocators with maximum pressure and daily average temperature sensors were attached to 9 Audubon's Shearwaters and 11 Red-billed Tropicbirds at Little Tobago, Trinidad and Tobago. Pressures were converted to estimated depths using the Unesco formula for seawater. Shearwaters were in the pre-laying stage while three of the tropicbirds had begun incubation and one had a young chick. In 2014, four devices were retrieved with usable data from each species. We used pressure and temperature readings to search for periods of incubation, compare diving among individuals and species, and look for trends in sea surface temperature. Three of the shearwaters exhibited incubation stints of about 6 consecutive days of no diving and 6 days with diving; each bird exhibited 3 such incubation stints and were recaptured in the same nest in 2014. One shearwater exhibited no incubation behavior and moved nest sites in 2014. Shearwaters consistently dove on all foraging trips, sometimes to depths greater than 20 m. Tropicbirds dove to 1 m or less on most days but occasionally had days with maximum dives

between 2 and 5.5 m. These sensors can inform our understanding of incubation and feeding behavior with low impact on the subjects' behavior.

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Initial testing of a minimally invasive surveillance system used to monitor a Maryland state endangered species, the common tern (*Sterna hirundo*). (Poster)

Common terns (*Sterna hirundo*) are a Maryland state endangered waterbird whose population has steadily declined over the past several decades. In order to determine the reason(s) for this decline, a surveillance system composed of iButton temperature sensors, video cameras, and a DVR powered by both marine batteries and solar panels was developed. Video cameras will be used to detect predation and monitor nesting behavior in the colonies while iButtons will be used to measure nest attentiveness. A pilot project was run in May 2016 to test the effectiveness of the system, determine footage analysis techniques and accuracy of the iButton sensors. Two small systems (one using wireless and one using wired cameras) composed of two cameras each were utilized for the initial tests. Effective range of the wireless cameras and power consumption of both camera types were tested. The iButton sensors were tested in lab using known temperature hand warmers to determine lag time of detection and accuracy of measurements. Various temperature-sampling intervals were also tested. The main issue encountered during these initial tests was correctly programming the iButton sensors to accurately record temperature readings of the hand warmer. The solar panels proved to be a highly effective tool that will prove especially useful in the field. Further testing of the camera models will allow for finalizing the camera type (wired or wireless) for use in the field. Preliminary results from the field season will be included as well.

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Changes in populations of colonial herons and egrets in Japan (Poster)

Rice is the most important crop in Japan, and large areas of rice paddies support large populations of colonial herons and egrets. Japanese people have traditionally worshiped herons and egrets as gods protecting crops from pest bugs and locusts. But population sizes of herons and egrets are thought to be declining after World War II due to the decline of areas of rice fields. Here we report colony dynamics around Ibaraki Prefecture, eastern Japan. First, 10-year population dynamics from 2002 to 2011 were addressed by censuses based on a combination of aerial photography and ground surveys. Population changes differed among the six constituent species: Great Egret (*Ardea alba*) and Black-crowned Night Heron (*Nycticorax nycticorax*) remained relatively constant, while Grey Heron (*A. cinerea*) and Intermediate Egret (*Egretta intermedia*) increased, but Little Egret (*E. garzetta*) and Cattle Egret (*Bubulcus ibis*) decreased. The marked increase of the Grey Herons contributed to the increasing

temporal variation in colony size and in species composition ratio. Second, whether the addition of Grey Herons has affected colony persistence was examined. After the increase of Grey Herons in 2005, colonies with Grey Herons had a greater propensity to persist. Grey Herons began to take the initiative in establishing colonies, and other species began to follow them in colony site selection. The expansion of Grey Herons into mixed-species colonies has promoted the persistence of colonies, and local populations of colonial herons and egrets seemed to gain the benefit of colony sustainability.

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Distribution and abundance of egret and night-heron species in Pennsylvania, past and present (Poster)

Of the egret and night-heron species inhabiting Pennsylvania before the turn of the 20th century, only the Black-crowned Night-Heron was reported reasonably often as a breeding species. Yellow-crowned Night-Herons and Great Egrets were recognized only as stragglers and post breeding wanderers. At the turn of the 20th century, a few nests were reported in southeastern Pennsylvania, also the focus of Black-crowned Night-Heron nesting at the time. Nests of all three species increased in number through the mid 20th century, likely a response to recovery from plume hunting and subsequent range expansion. At this time major colony location switched to the lower Susquehanna Valley and environs from the southeast, perhaps due to increasing development in this most populated corner of Pennsylvania. In the mid 20th century, the three species were joined by relatively short-lived colonies of Snowy and Cattle Egrets, also nesting in the lower Susquehanna Valley. Beginning in the early 1970s, colony locations and numbers were documented routinely and, with the advent of two state-wide atlas efforts spanning 25 years and eBird, a continuous and accurate record of population status has been available since then. Interestingly, throughout this entire period, few individuals and almost no nesting have occurred in the western half of the state. The number of colonies and current population levels of all three species warrant endangered status within the state.

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Recent trends of the nesting location of Grey Herons in Hokkaido, northern Japan. (Oral)

The nesting location of Grey Herons (*Ardea cinerea*) in Hokkaido (83,450 km²), northern Japan was documented from 1960 to 2016. During the study period, 152 colonies were confirmed to exist, though some of them have been already abandoned. All herons were observed to nest at trees in the inland area until the early 1990s. After the mid-1990s, however, 10 colonies were confirmed in unusual locations: an islet, flooded trees and buoys in reservoirs, and offshore rocks. These type of locations could be considered to be selected to defend their eggs and chicks against terrestrial predators by being surrounded with water area. In fact, in Hokkaido, Brown Bears (*Ursus arctos*) and Common Raccoons

(*Procyon lotor*) were observed to eat chicks in conventional colonies in 1994 and 2012, respectively. Moreover, some colonies were recently established in isolated groves in towns and others adjacent to houses despite the presence of vast woodlands around. It would be another strategy to prevent bears and raccoons from approaching the colony. The number of colonies had increased, at least until 1999, and raccoons, which are alien species, have rapidly expanded their range until now. These situations would increase the encounters between herons and predators, and therefore, herons may be forced to nest in unusual locations.

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The effects of colony structure and nest position on the reproductive success of small herons (Oral)

When food is not limiting, competition for high quality nesting sites can limit the density of breeding birds. Quality nesting sites must provide structural support for nests as well as to offer effective protection against predators and unfavorable weather. Anthropogenic influences can alter the structure and composition of vegetation available for nest sites, thereby providing birds with novel habitat. During the 2015 breeding season, we examined the effects of colony structure and nest position on the reproductive success of Tricolored Herons (*Egretta tricolor*) and Snowy Egrets (*Egretta thula*) nesting at Lake Okeechobee, Florida USA, to determine if colonies in anthropogenic habitat (spoil islands) had lower reproductive rates than colonies in natural habitat (willow, *Salix sp.*; islands). Daily survival rate (DSR) of nests did not differ significantly between the two colony types. The best model predicting DSR included nest height, distance to canopy, and type of substrate species (invasive or noninvasive). Apparent survival was higher for nests placed farther from the canopy edge, higher from the ground, and in noninvasive substrate. Results indicate that spoil islands are capable of providing nesting habitat comparable to natural islands in some years. However, factors that led to a lower DSR, (e.g., invasive plants and short vegetation), also tended to be more prevalent on spoil islands, so over a longer time we would expect to see differences in DSR emerge.

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Comparing simple digital photography and digital calipers as methods for measuring egg dimensions (Poster)

Egg volume is often a key variable used in studies of waterbird life history and is conventionally estimated from length and breadth measurements made using calipers. We examined the potential for simple measurements made using digital photography to rival this conventional method. In 2015, we took photographs of 29 common tern (*Sterna hirundo*) eggs from different clutches at the Gull Island colony, Presqu'île Provincial Park, Ontario, Canada, each scaled by a ruler in the images. Image analysis software "imageJ" was used to measure length and breadth in each photograph. Additionally, length and breadth of the same eggs were measured with digital calipers independently by two investigators.

Egg volumes for each method were then calculated from these dimensions using a published, standard equation. In 2016, we constructed a device to standardize the distance between eggs and the camera and also the light conditions in photographs. We tested this method using a repeated measures experimental design under controlled conditions, estimating volume of 24 commercial chicken (*Gallus gallus domesticus*) eggs separately from caliper measurements, digital photography as in 2015 and using the new device. In all cases (field and laboratory), conventional measurement using digital calipers exhibited less variation than estimates from digital photography and were also consistent between different investigators. Although our approach does not yet rival the conventional method in accuracy, our study elucidates challenges to overcome to access the benefits of digital photography (permanent storage of archived images, reduced measurement time in the field) for simple egg measurement in the field.

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Mitochondrial and Nuclear Phylogenies of the Herons (Poster)

Systematic relationships of the herons (Aves: Ardeidae) are of strong interest to ornithologists. Here we present phylogenies derived from both mitochondrial (cytochrome b) DNA and next-generation sequencing of nuclear DNA, encompassing most of the world's heron species. Phylogenies from both genomic regions were largely concordant with similar structures confirming the monophyly of five main heron groups: (1) *Cochlearius* (*Tigriornis*, *Tigrisoma*); (2) *Agamia*; (3) *Zebrilus* (*Ixobrychus*, *Botaurus*); (4) *Syrigma*, *Pilherodias*, (*Egretta*), (5) (*Butorides*, *Ardeola*) (*Ardea*, *Casmerodius*, *Mesophoyx*, *Bubulcus*). The night-herons *Nycticorax*, *Nyctanassa*, and *Gorsachius* appear to be polyphyletic.

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Royal flush: ecology and conservation of the king rail on the mid-Atlantic coast (Oral)

Under pressure from loss of wetland habitat, the King Rail (*Rallus elegans*) is increasingly becoming restricted to the coastal margins of its historical eastern U.S. range. Yet, coastal areas are prone to variable water regimes and extreme weather adding to the imperilment of populations. In an effort to understand King Rail population dynamics and assist their conservation, we have studied a population breeding in managed wetlands at MacKay Island NWR in coastal North Carolina for six years. We find and monitor nests to characterize nest site preferences within the management framework, and to determine annual variation in reproductive effort and success in support of population models. Using a variety of methods for capture, we mark and sample king rails, and have developed microsatellite genetic markers to begin to understand population structure and dispersal on a regional scale. We have used radio-telemetry to characterize home range size, habitat preferences, and seasonal variation in habitat use by resident birds. Preferred nesting habitat is emergent marsh interspersed with tracts of open water. However, parents with broods shift their microhabitat preference to areas with shallower

water and more edge than preferred nesting habitat. King rails showed seasonal variation and sex differences in habitat use. In addition to year-round use of emergent marsh, king rails used impoundments and wooded marsh seasonally. Monitoring this population enables us to contribute to the development of more accurate and less invasive methodology for estimating breeder density of rail populations throughout their range.

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Glucocorticoid comparisons of Herring (*Larus smithsonianus*) and Great Black Backed Gull (*L. marinus*) faecal samples in coastal Maine (Poster)

Despite current declines in populations in the western Atlantic, the numbers of Herring and Great Black Backed Gulls have been increasing on Great Duck Island (GDI) and Mount Desert Rock (MDR) in eastern Maine, USA. While the total number of gulls has increased on both islands, since the GDI research station was established in 1998 the GDI population distribution has concentrated in the south of the island in the vicinity of the field station. We believe that stress caused by eagle predation may be responsible for changes in populations regionally and distributions locally. Of the three gull nesting areas in this study (the north and south GDI sub-colonies and the MDR colony), the north sub-colony on GDI is closest to an eagle nest and the farthest from regular human activity. The south sub-colony is 1.5 kilometers from the nearest eagle nest but is exposed to human disturbance from the operations of the research station. Mount Desert Rock is over 18 kilometers from the nearest eagle nest, but birds must live in close proximity to people. We collected fecal samples from approximately 100 individual gulls during the summer of 2016. A portion of these samples from each of the three sub-colonies was analyzed for fecal glucocorticoid concentrations (per g dried fecal mass) to provide insight into different stress levels in relation to eagle proximity, inter-species interactions, and human disturbance. We relate the results to possible causes of population shifts.

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Annual movements, breeding and wintering affinities, and seasonal activity ranges of Magnificent Frigatebirds tracked by satellite (Oral)

Magnificent Frigatebirds (*Fregata magnificens*) nest colonially on islands of the Gulf of Mexico, Caribbean basin, Bahamas, and southern Florida. Their small, scattered sub-populations are difficult to monitor, adding to concerns about colony extirpations, estimated at 20 to 50%, and declines. The only U. S. colony, in Key West NWR, had 250 pairs before it was abandoned in 1990, likely due to human disturbance. A new colony of ~150 pairs, which formed 90 km west in the Dry Tortugas, now contains just 100-120 pairs. Over 5,000 wintering individuals occupy the Florida Keys and Gulf coast, forming large night roosts and foraging within 40-50 km of shore. Tracking 5 such birds by satellite (30,395 GPS fixes), we learned they represent breeding populations from the western Caribbean, including colonies off southern Cuba and the eastern coasts of the Yucatan Peninsula and Central America. Activity ranges

averaged 4,700 km² during the winter and 15,180 km² while nesting, with distinct residence areas per bird. In contrast, a male and female tracked from the Dry Tortugas (U. S.) colony (4,363 GPS fixes) remained over Florida's coastal waters year-round, with nest-season ranges of 650 (female) and 820 (male) km², and winter ranges of 2,530 and 8,200 km². The Tortugas female occupied a single 40 x 15 km wintering area around the colony; the male's residence areas included the Tortugas, Florida Keys, and Florida's Gulf and Atlantic coasts, overlapping only partially with wintering Caribbean breeders. Florida's coastal resources support a single, precarious breeding colony and wintering MAFR that nest across much of the species' distribution. MAFR habitats in Florida suffer from frequent, intensive human disturbance.

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Diversity of waterbirds in Periyakulam Lake, Tiruchirappalli District, Tamil Nadu, Southern India (Oral)

The bird community of Periyakulam wetlands in Tiruchirappalli District, Tamil Nadu, Southern India was studied during January 2011 to December 2012. The methodology followed was mainly observations using binoculars, and the site was done by direct count. A total of 35 species belonging to 7 orders and 18 families, including 14 resident species, 16 resident-migrant species, and 5 migrant species. Thirty species of Least Concern and 5 Near Threatened species were recorded in the area during the period. Little egret, Little Cormorant, Purple Moorhen, Purple Heron, Little Grebe, Spot billed duck, Black crowned Night Heron, Indian Pond Heron, Common coot, River tern, White breasted Kingfisher, and Whiskered Tern were the most abundant resident and migrant species found in the Periyakulam wetlands.

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Foraging strategy and prey-handling time in White-bellied heron *Ardea insignis* in Namdapha Tiger Reserve, Arunachal Pradesh, India (Oral – Heron Symposium)

The White-bellied heron (*Ardea insignis*) is Critically Endangered and no detailed studies have been carried out prior to ours across the species' range. Studies on the foraging behavior and prey handling time of the heron were undertaken from November 2013 to March 2016 in Namdapha. Focal animal sampling was used to record the foraging behaviour of herons. The major fish species of the reserve were used for length (cm) and wet weight (g) estimates. The White-bellied heron is a visual forager and adapts to forage amidst fast-flowing freshwater rivers in India, especially within Namdapha. Number of foraging attempts and number of fish caught while 'facing water current' (FWC) and 'against water current' (AWC) was studied during different months in three seasons. Though the mean number of foraging attempts during FWC (Mean±SD; 0.80±1.04) and AWC (0.85±1.05) did not vary significantly (t=0.63; d.f. 558; n.s.) during three seasons, the number of fish caught did (FWC: 0.34±0.60) (AWC: 0.26±0.51; t=-2.13; d.f. 558; p<0.03). The fish eaten ranged in length from 3-60 cm (mean±SD) (12.9±6.8;

n=335) in Namdapha. Fishes of 7 cm were more (11.1%) in the diet of WBH followed by 25 (9%) and 26 cm (9%). As the size of the fish increased in the diet of WBH corresponding prey-handling time also increased.

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Mud, sweat, and skeeters: determining the status of the Eastern Black Rail in Texas (Oral – Eastern Black Rail Symposium)

Secretive water birds like Black Rails (*Laterallus jamaicensis*) are poorly understood in terms of habitat requirements, distribution and population abundance throughout North America. Although they are listed as a species of highest conservation concern on Audubon's Watchlist and their IUCN conservation status is Near Threatened, the species has no special protection in Texas and very little is known about the population status and distribution of the Black Rail in the state. Our studies will provide the needed information to assess resilience and redundancy of Black Rails in Texas, information that is needed for a Species Status Assessment (SSA). Resiliency and redundancy are hierarchical and measure the ability of a species to withstand stochastic events. Our efforts will include determination of peak calling period(s) through acoustic monitoring (ARUs), the use of call play-back survey data and accompanying vegetation analyses to create species distribution models, radio telemetry studies to determine home range/movement, and determination of over-winter/survival of Black Rails by banding across seasons. The outcome of our research will result in quantitative estimates of Black Rail resilience and redundancy, allowing for an informed decision of Black Rail status within the state and to guide future management of the species in Texas.

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Migration patterns and overwintering distribution of Black Terns using geolocators. (Poster)

Limited information exists on the migration and wintering biology of Black Terns (*Chlidonias niger*) breeding in North America. In 2016, we deployed leg-mounted geolocators (light-level data loggers) on 40 adults breeding on the Laurentian Great Lakes near Midland, ON, to collect information on the timing of migration, routes taken, location of and residency at staging areas and stop-over sites, and non-breeding distribution. Tagged birds will be recaptured in 2017, when movement and habitat (aquatic vs. marine) data will be retrieved. We will also identify potential staging and stop-over locations (and timing of use) in North America using the eBird database. This project will: (i) fill gaps in our basic understanding of the ecology of this species, (ii) identify critical habitat and timing of its use within and outside of North America, (iii) be used to identify and assess potential causes of long-term population declines and (iv) inform conservation planning.

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Ecosystem Impacts from Double-crested Cormorants in a southeastern Lentic, Reservoir System (Oral)

Ornithogenic material delivered by Double-crested Cormorants (*Phalacrocorax auritus*) to their nest colonies can affect soil properties, community composition, growth, health and survival of vegetation, and water quality within and proximate to colonies. In this study we will address changes to insular habitats within a reservoir system of the southeastern United States (Lake Guntersville, AL) colonized by cormorants. Islands within Lake Guntersville, have been colonized since 2003 with some subject to natural succession (colonization and abandonment) and others cormorant management and habitat restoration efforts. Using measurements of vegetation, soil, and water quality we will compare and evaluate changes to edaphic and plant community characteristics on islands that have been naturally colonized and abandoned, are currently colonized and subject to cormorant removal and prescribed burning, and control (unoccupied) islands. We will also use telemetry to evaluate site fidelity of cormorants subject to removal and islands subject to habitat restoration efforts. Quantifying the cormorant's impact to these insular ecosystems and their response to natural succession and cormorant management and habitat restoration efforts will help inform and address what, if any, management actions are needed towards restoration and mitigation of Lake Guntersville and similar insular habitats in lentic ecosystems of the southeastern United States.

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Where to Next: Modeling Potential Double-crested Cormorant Breeding Locations in the southeastern U.S. (Poster)

Ornithogenic nutrient additions delivered by colonial-nesting Double-crested Cormorants (*Phalacrocorax auritus*) have been associated with changes in soil chemistry, floristic growth, vitality and community composition. Managers often seek to conserve and restore ecosystems affected by these inputs. The prescription of management actions depends on understanding historic processes within altered ecosystems. Cormorants have nested on islands within Lake Guntersville, Alabama for the last decade. Applying information derived from cormorant colonies throughout its breeding range, complimented with data collected from cormorant colonies within Lake Guntersville, we will construct models to predict potential locations of future cormorant colonies along river, lake and reservoir systems of the southeastern United States. Our models will enable managers to identify breeding habitat suitable for cormorants, helping them to proactively identify and protect ecosystems most likely to receive ornithogenic additions.

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Common Tern and Arctic Tern hybridization produces fertile offspring (Poster)

This study provides the first conclusive (molecular) evidence for hybridization of Arctic Tern *Sterna paradisaea* and Common Tern *Sterna hirundo*. We studied a mixed pair (P1; male Arctic Tern and female Common Tern) and its offspring on Penikese Island, Massachusetts, USA in 2007 – 2015. The pair maintained a long-term pair bond (8 yr); its reproductive performance was comparable to that of Common Terns and higher than that of Arctic Terns at the site. Molecular analyses confirmed that all young raised by the pair (at least 5 males and 4 females) were biological offspring. Although F1 hybrid young were intermediate between the parent species in certain characteristics, dark feathers extending below the eye gave them a distinctly arctic tern-like appearance. We detected one male F1 hybrid that returned to breed; it retained some features intermediate between the parent species, but we qualitatively judged it to be more common tern-like. It mated with a Common Tern and produced three back-cross hybrid young (biological offspring) that closely resembled Common Terns. We speculate that rarity of Arctic Terns, especially females, at and near the study site and age/inexperience of the Common Tern parent were proximate mechanisms for the formation of the P1 pair. Further, we suggest that Arctic/Common Tern hybridization may occur more commonly than realized in the western North Atlantic Ocean.

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Relationships of Endoparasite Diversity and Feeding Ecology in the Seabird Complex of South Florida (Poster)

Parasite communities within specific host taxa can often provide insight on ecosystem processes, namely through variation associated with the feeding ecology, distribution, environmental effects, and phylogeny of hosts. Despite the variable and important roles in marine ecosystems played by seabirds, surprisingly few studies have examined parasite community questions in these species, and little is known about how parasite community structure varies among trophic guilds and migratory habits. For example, parasite communities should differ in species that feed in estuaries and mangroves versus other marine habitats. We examined parasite communities in eight South Florida seabird species: brown pelican *Pelecanus occidentalis* (n=34), northern gannet *Morus bassanus* (n=29), double-crested cormorant *Phalacrocorax auritus* (n=33), laughing gull *Leucophaeus atricilla* (n=42), herring gull *Larus argentatus* (n=12), royal tern *Thalasseus maximus* (n=29), least tern *Sternula antillarum* (n=1), and osprey *Pandion haliaetus* (n=14). Since 2012, seabird carcasses obtained from local wildlife rescue agencies have been necropsied, with endoparasites recovered, enumerated, and identified from several

specific tissue types. Preliminary analyses have found high endoparasite abundances within stomachs and intestines, but not muscle or other organs. Endoparasite taxa include nematodes (e.g., *Contracaecum* sp.), cestodes, monogeneans, and digeneans. Species that forage further offshore (pelicans and gannets) harbor greater abundance and diversity of endoparasites than species that forage inshore (gulls, terns, cormorants, and osprey). Preliminary results also indicate structural differences among communities. For example, seabird species differed in the relative dominance of intestinal trematodes and nematodes. Finally, insight on the endoparasite faunal community within these targeted seabird species may indicate preferred prey items and trophic levels, as well as variation in foraging habits.

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Least Tern (*Sternula antillarum*) Nest Success and Chick Survival on the Missouri River Following an Historic Flood Event (Poster)

The federally endangered U.S. Interior Least Tern (*Sternula antillarum*) historically nested on river sandbars created by sediments deposited during high flows. However, rivers such as the Missouri River have been dammed and regulated to prevent flooding, resulting in erosion that decreased sandbar extent. However, in 2011, high water levels that escaped the dams, created extensive sandbar habitat on the Gavins Point Reach of the Missouri River. From 2012–2014 we monitored 382 Least Tern nests, uniquely marked 672 chicks, and attempted to recapture chicks every 3–4 days until fledging (ca. 18 days). We estimated daily nest survival at 0.9941, resulting in a mean nest success of 0.88 ± 0.002 . Nest success was highest in 2012 (0.92 ± 0.003 SE) and declined slightly each year (2013: 0.87 ± 0.003 SE, 2014 0.85 ± 0.003 SE). We estimated daily chick survival at 0.96 ± 0.010 resulting in a mean survival to fledge of 0.44 ± 0.08 . Chick survival did not appear to vary by year, but decreased with later hatch dates. Nest success may have decreased as sandbar habitat aged following the flood due to erosion, vegetation encroachment, and increased predation, but chick survival remained stationary. Our results indicate that sandbars created by flooding are highly productive for terns. Least Terns may have historically taken advantage of newly created sandbars with similarly high reproductive output to boost and maintain population levels. Further research on what factors contribute to high survival rates can help guide future management and maintenance of nesting habitat.

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Determining Sex of Two Monomorphic Seabirds at the Isles Dernieres Barrier Island Refuge in Louisiana (Oral)

Most seabirds are sexually monomorphic and do not display conspicuous differences in plumage or size. Two sexually monomorphic seabird species, Royal Tern (*Thalasseus maximus*) and Sandwich Tern

(*Thalasseus sandvicensis*), have been intensely studied on the Isles Dernieres Barrier Island Refuge (IDBIR) in Louisiana. However, sex-bias of parameters, such as natal recruits, survivorship, foraging movements, parental care, and site fidelity, have not been addressed due to the difficulty of sexing individuals. The goal of this study was to determine if morphometric measurements are a reliable method of sex determination for Royal and Sandwich Terns. During the 2014 and 2015 breeding seasons, we captured adult Royal and Sandwich Terns, measured morphometric attributes (mass, wing chord, bill length, head+bill length, and tarsus) and collected blood samples to determine sex using molecular techniques. Analysis of blood samples identified the sex of 82 Royal Terns (57 males and 25 females) and 84 Sandwich Terns (40 males and 44 females). Discriminant function analysis (DFA) was used to determine if morphometric measurements were effective in determining sex of each species. DFA resulted in a correct classification rate of 75.6% for Royal Terns based on wing chord and head+bill length and 79.8% for Sandwich Tern based on mass and head+bill length. The ability to determine sex of monomorphic seabirds using morphometric measurements will allow for rapid sexing and enhance ecological investigation of these species.

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Quantifying the impacts of Burmese pythons on wading bird reproduction (Poster)

Burmese pythons (*Python molurus bivittatus*) may pose a predation threat to nesting long-legged wading birds in the Everglades but detection and ensuing conservation and management efforts are hampered by the extreme crypticity of this exotic predator. Small mammals have hitherto constituted 75% of python diets but now that mammals have declined by 95% due to pythons, we predict a shift in diet towards birds. Wading bird nesting colonies, which range from dozens to thousands of breeding pairs, represent an energetically dense, attractive food source. Pythons may impact colonies by preying upon adults, juveniles, and nests, as well as potentially causing abandonment of breeding pairs or colony failure. In 2013-2016 we monitored nests in selected wading bird colonies in Everglades National Park and the Water Conservation Areas using camera traps. We monitored nests continuously from incubation to fledging. No python predation attempts were documented between 2013 and 2015, though snakes have been found in empty nests. In 2016, we initiated an occupancy study using environmental DNA to detect pythons and determine if they are attracted to active colonies on tree islands compared to bird-free tree islands. This work fulfills a need for a clear assessment of the potential impact of this invasive snake on wading bird reproduction.

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Interactions Between Common Terns and Ground-Nesting Ospreys (Poster)

Ospreys (*Pandion haliaetus*) typically nest above ground on structures, but occasional ground-nesting may occur on islands free of mammalian predators. In 2013 and 2014 a pair of Ospreys nested on the

ground in the middle of the Common Tern (*Sterna hirundo*) colony on Pettit Island, in Barnegat Bay, New Jersey USA. This island is very small (0.3 ha) with limited nesting substrate. The Osprey nest occupied an area near the center of the island that is usually safe from flooding. This area is typically densely packed with tern nests, but no terns nested in the vicinity of the Osprey nest until it was abandoned. The presence of the Ospreys caused prolonged upflights, as an Osprey would be chased away then quickly return and be mobbed again repeatedly. The number of tern nests decreased in both years that the Ospreys were present, reaching 80 breeding pairs in 2014, the smallest number recorded at this site since 1981. Despite causing frequent disturbance, presence of the Ospreys did not appear to affect the productivity of those terns that did nest. No eggs in the Osprey nest hatched in either year without any obvious cause, and may be the result of frequent mobbing preventing the Ospreys from incubating effectively. The Ospreys did not return in 2015 and the number of tern breeding pairs increased to 205, a typical number for this site. This increase occurred despite continuing declines in the Barnegat Bay Common Tern population. Although the changes in the number of nesting terns on Pettit Island cannot be conclusively linked to the presence of the Ospreys, the pattern of change is suggestive.

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Spatio-temporal patterns of habitat use by pre-migratory hatch year Roseate Terns on Cape Cod, Massachusetts, USA (Oral)

The Northwest Atlantic population of the Roseate Tern (*Sterna dougallii*) was listed as endangered in 1987 under the US Endangered Species Act. Despite intensive efforts to protect nesting colonies, and initial population gains, the number of breeding pairs remains 25% below the recovery goal. We studied the spatial and temporal distribution of banded Roseate Tern hatch years (HYs) at staging sites in Cape Cod National Seashore (CCNS) during Jul-Sep 2014-2015. We surveyed tern flocks at 12 CCNS staging sites and documented presence of individual terns via observations of field-readable bands used on pre-fledglings at eight colony-sites in Long Island Sound (LIS), northern New England (NNE), and Nova Scotia (NVS). Approximately 75% of banded fledgling terns (n=2,325) from breeding range sub-regions were resighted at CCNS staging sites during 2014 and 2015. Nearly a third of HYs from LIS were resighted only once, whereas less than 10% of NVS HYs were resighted once. Terns arrived at staging locations in Jul and were still present by mid-Sep. Resightings peaked during the last week of August in both years. Mean (\pm SD) number of days HYs from breeding range sub-regions remained at staging sites were: LIS 13.8 \pm 13.8 da; NVS 18.3 \pm 12.0 da; NNE 22.5 \pm 14.9 da. HYs from LIS were the latest to arrive at CCNS staging sites and earliest to leave. Sites at the northern end of Cape Cod were consistently used in both years, however during weeks of maximal resights, additional sites in CCNS yielded the highest resighting rates of HYs. This study is part of a cooperative research program of USGS, Virginia Tech, State University of New York, the National Park Service and Mass Audubon to inform management of terns on staging grounds.

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Contrasting resource selection of Great Egrets and Wood Storks in a dynamic ecosystem (Oral)

The management and conservation of anthropogenically altered ecosystems requires an understanding of the linkage between indicator species and environmental variables that represent high quality habitat. Wading bird species are sensitive to land use changes, chemical contamination, and fluctuating habitat conditions, and thus serve as important indicator species for wetland health. To understand resource selection by Great Egrets (*Ardea alba*) and Wood Storks (*Mycteria americana*), we created Resource Selection Functions (RSFs) for these species in the Florida Everglades, USA, a wetland with seasonally fluctuating water levels. We obtained Great Egret and Wood Stork presence/absence data in this ecosystem from a Systematic Reconnaissance Flight Survey from 1991 through 2009. Surveys were conducted monthly January to June over approximately 1,300 2km x 2km grid for which we also obtained hydrologic data. Using a hierarchical multinomial logit model we found that birds selected foraging sites based on hydrologic parameters, but they varied by species. Water depth, water level recession rate, and days since drydown significantly affected the likelihood of habitat selection by Wood Storks. This species was most likely to select cells with 15cm of water that had slower recession rates and shorter time since drydown. Great Egrets were more likely to select cells with 20cm of water where water levels had not increased by more than 3cm in the previous two weeks. These differences in resource selections correspond to morphological and behavioral differences between the two species, whereby Wood Storks are more constrained hydrologically and would be more affected by water manipulation.

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Coordinated Conservation and Monitoring of Secretive Marsh Birds in the Midwest (Oral)

Conservation planning and habitat management for secretive marsh birds has often been overlooked by wildlife agencies due to lack of information regarding abundance, distribution, population trends, habitat relationships, and management needs for species in this guild. While Midwest wildlife organizations have begun addressing some of the data gaps, much of this information can only be obtained through a systematic and coordinated monitoring approach which has long been recognized as a high priority in national and regional conservation plans. In 2012, Midwest bird conservation partners organized a workshop to begin discussing the potential of implementing an operational marsh bird monitoring program focused on regional population-level management and conservation needs. Results of the workshop included establishment of a clear goal and objectives for marsh bird monitoring in the Midwest, regional adoption of the National Marsh Bird Monitoring Protocol, and the formalization of the Midwest Marsh Bird Monitoring Working Group. The working group facilitates information sharing among partners and also provides a forum to collaboratively determine regional monitoring strategies and primary research questions to inform management. We provide an update of partner progress towards regional marsh bird monitoring and research objectives, overcoming implementation and

coordination challenges, and steps for continuing to move forward with regional marsh bird conservation in the Midwest.

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The impact of water management on the nesting ecology of Snail Kites in South Florida (Oral)

Management of wetland habitat for multiple uses including fishing and boating may affect wildlife and influence the timing and location of nesting activity in birds. Water regulation schedules in particular can impact nesting activity by altering the distribution and abundance of prey, availability of nesting substrate, and accessibility of nests to predators. The Snail Kite is an endangered, wetland-dependent raptor that occupies areas used by a range of stakeholders that are managed for multiple purposes, however gaps exist in the understanding of the link between habitat management and nesting ecology. We therefore examined Snail Kite nesting activity in relation to water management from 1996-2016 in key wetlands used for breeding. We monitored 2499 active nests across 23 sites that were exposed to varying water stages, recession rates, and ascension rates. Water recession overlapped with nesting activity from March-May whereas water ascension typically occurred from April-August. The probability of nest initiation differed within and between sites and water regulation schedules. Additionally, the relationship between daily nest survival and water recession was negative, and rapid water recession corresponded closely to nest failure but not nest success. This study will enhance our understanding of factors that influence nesting behavior of Snail Kites and provide valuable information for future habitat management.

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Distinguishing between specialism and opportunism in the diet of herring gulls (Poster)

For large gulls, predation of other waterbirds is generally considered a specialist strategy and may have potential benefits to reproductive success. During three years of study, however, all herring gulls (*Larus argentatus*) breeding around the edges of a large ring-billed gull (*L. delawarensis*) colony on Gull Island, Ontario, were found to eat chicks of this smaller species to some extent. We collected diet, behavioral and productivity data to determine whether predatory behavior was a specialist strategy or merely opportunistic, and test the hypothesis that feeding on waterbirds confers a reproductive advantage. Predation of ring-billed gull chicks by herring gulls peaked when these chicks were most available: when they first hatched and at fledging when they formed crèches on beaches. Behavioral watches and >500 hours of remote video footage (both day and night) showed that all attacks were initiated within the herring gulls' territories. Herring gulls with territories close to ring-billed gulls exploited ring-billed gull prey more often but showed no benefits in terms of reproductive output. In fact, linear growth rate of chicks from these territories was significantly lower than that for chicks raised away from ring-billed gulls. This likely results from bird prey being less nutritionally suitable for chick growth than fish (the

main alternative) and further points to predation of ring-billed gulls as opportunistic, incurring a low-cost rather than a high benefit. We conclude that, at our site, waterbird predation by herring gulls is opportunistic and, although it constitutes an easy meal, feeding on ring-billed gull chicks does not ultimately confer any reproductive benefit. Our results differ from those previously reported potentially due to differences in food availability, interspecific associations and physical habitat.

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Movements and Foraging Areas of Great Shearwaters *Puffinus gravis* in the Gulf of Maine (Poster – Atlantic Marine Bird Cooperative)

In the western North Atlantic, great shearwaters *Puffinus gravis* consume vast amounts of marine prey and are among the most abundant seabirds during summer months, yet little is known about their movement ecology and habitat requirements in this ecosystem. We used platform terminal transmitters (PTTs) and a Bayesian switching state-space model (SSSM) to describe shearwater movements, foraging areas, migration timing, and how such habitat use might be related to age in the Gulf of Maine. From July to November great shearwaters traveled an average 515 km per week (individual weekly average bird range 365-765 km) and spent the majority of their time foraging (Area Restricted Search behavior) around the rim of the gulf primarily using shallower waters (<100 m) where bathymetry was more steeply sloped. Movements associated with their southern migration began in August and continued through much of September with birds leaving the study area via a pathway south of Nova Scotia, Canada. The age composition of the Gulf of Maine great shearwaters as determined by nape plumage was predominately young; 89% of birds examined were < 3 years old. Core foraging areas were identified in three locations: lower Bay of Fundy, northeast Georges Bank and Stellwagen Bank/Cape Cod Slope. Foraging areas were not characterized by consistent environmental variables across sites indicating a flexible foraging strategy based on high mobility. Given the apparent adaptability assumed from their use of different habitat patches within the Gulf of Maine, great shearwaters may have the capacity to adapt to climate change and environmental variability during the non-breeding season.

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Status assessment and population trends of the Madagascar Pond Heron, *Ardeola idea* (Hartlaub, 1860) (Oral – Heron Symposium)

The Madagascar Pond Heron, *Ardeola idea*, is a migratory species breeds exclusively in Madagascar and related islands such as Europa, Aldabra, Mayotte and Comoros. Changes in the population of this species were investigated over the last 20 years through literature reviews, field monitoring and surveys

undertaken from 1993 to 2016. Data from 108 localities including the seven known breeding sites were collected and analyzed for the species population assessment. The species occurs to all types of wetlands including lakes, ponds, marshes, rivers, mangroves and also rice field. During the non-breeding season, May - October, birds migrate to eastern and central Africa but some population, with 911 records, remain in Madagascar spent austral winter. Data shows that the current population is evaluated at 2200 breeding birds remaining into its entire breeding areas. The populations are rapidly declining particularly at its main breeding sites. The main threats are the habitat destruction, collect of eggs and fledgling birds, predation and disturbance at its breeding sites.

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Current status of the Madagascar Heron, *Ardea humbloti* (Milne-Edwards and Grandidier, 1885) in Madagascar (Oral – Heron Symposium)

The Madagascar Heron, *Ardea humbloti*, is endemic to Madagascar and Comoros. The species breeds in Madagascar, with recent records in Mayotte. Distribution and status of the species was investigated over the last 23 years through literature reviews and surveys undertaken from 1993 to 2016 in Madagascar. During this period, 374 records from 108 localities were collected and analyzed. Bird occurs to all type of wetlands habitat with higher concentration recorded to site along the coastal area in western Madagascar; Mangoky Ihotry wetland complex (+100 individuals), Tsiribihina River & delta (+20 individual), Manambolomaty Lakes complex (+300 individual), Baly Bay wetlands (+100 individual), and Mahavavy Kinkony wetland complex (+40 individual). The current population was evaluated at 1,470 individual breeding birds remaining into its entire distribution areas. The population is in declining. The main threats are habitat destruction, disturbance and persecution at its breeding site. Action plan for conservation are needed to preserve this species.

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Tohoku tsunami inundation: variation in impacts to Pacific islands bird communities (Oral)

Earthquake-generated tsunamis threaten coastal areas and low-lying islands. Although human hazards and infrastructure damage have been well documented for tsunamis in recent decades, the effects of sudden flooding on waterbird communities are rarely quantified. On 11 March 2011 a moment magnitude (Mw) 9.0 earthquake occurred off the Tohoku coast of Japan, generating a tsunami. This study describes the earthquake-generated wave event on Pacific Islands more than 3,800 km from the epicenter, and uses a spatially explicit approach to estimate habitat inundation and predict short-term impacts to breeding waterbirds across four islands. We used GPS, satellite imagery, distribution and abundance data to quantify inundation extent and probable effects to 21 bird species in the Hawaiian Archipelago. The extent of sudden flooding at Midway Atoll and Laysan Island ranged from 21–100% of island area. We estimated that Procellariiformes (albatrosses and petrels) chick and egg losses from the

tsunami. The tsunami waves flooded nests of thirteen species and caused the direct mortality of adult breeders and the chicks of seven species. The non-migratory endangered Laysan Teal (*Anas laysanensis*) populations experienced breeding failure, and declined approximately 40% on both atolls post-tsunami. Laysan Teal experienced an avian botulism (*Clostridium botulinum* type C) outbreak concurrent with the large number of seabird carcasses at Midway Atoll. The anthropogenically limited ranges and high concentrations of the insular bird communities on Hawaii's atolls are especially vulnerable to catastrophic population declines from Pacific tsunamis.

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Morphological trade-offs and recursive plumage patterns as indicators of integrated evolutionary dynamics in the Ardeidae (Oral – Heron Symposium)

The ultimate form an organism attains is based, in large part, on the rate and timing of developmental trajectories and on compensatory relationships between anatomical structures. For example, there is often an inverse correlation between the size of an organism's head and the length of its legs. To determine whether a compensatory relationship exists between relative head size and leg length in Ardeidae, I measured skull dimensions (length, width, and height of cranium, and total length including bill) and skeletal limb dimensions (femur, tibiotarsus, and tarsometatarsus) of the 12 North American species as well as 10 other taxa, including the morphologically divergent *Cochlearius*. In addition, plumage pattern was tabulated across Ardeidae to assess whether an association exists between various patterns and specific morphological traits. My comparisons show that, in general, there is a negative association between proportionate head size and leg length. *Ardea* species 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. Regarding plumage pattern, there are identifiable trends; for example, smaller species and those that forage in enclosed habitats tend toward cryptic patterns. Additionally, specific plumage patterns are not restricted to closely related taxa but recur in diverse genera across Ardeidae.

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Investigating the evidence for ecological succession of colonial waterbirds (Poster)

Ecological succession, the replacement of one ecological community by another, is widely studied for plants, but less well documented for vertebrates across broad regional scales. The large lakes of North America support important breeding colonies of gulls, terns, pelicans and double-crested cormorants.

Each species has well-established habitat preferences and evidence exists that breeding waterbirds can modify their habitats, changing the suitability for nesting in future years. Here, we explore evidence for ecological succession among communities of these waterbird species within the large lakes of Manitoba. We classified six species into three communities (“cormorant/ pelican”, “gull/large tern”, “small tern”) based on body size and nesting habitat preferences. From known impacts of each species on vegetative cover and diversity we predicted that the succession of waterbirds in these areas follows a cyclical pattern: cormorant/pelican to gull/large tern to small tern and back to cormorant/pelican. To explore this, we analyzed census data collected between 1945 and 2012 across 347 different breeding sites. We examined evidence for negative correlations between the population trajectories of the three communities across 48 breeding colonies that supported at least two of these communities during two time periods (1945-1999, 2000-2012). Fourteen sites (29%) showed negative correlations that supported our hypothesis of ecological succession. Sites for which community abundance trends matched our prediction were in areas where human population density surrounding the lakes was lowest. We suggest that factors associated with human land-use changes (elevated predator populations, disturbance, and reduced prey availability) that might mask the predicted succession trend were least likely in these areas. We also report our preliminary examination of vegetation change as the mechanism underlying waterbird succession.

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Variable space use between nesting and brood rearing periods by Piping Plovers on Fire Island, New York, USA. (Oral)

The Piping Plover (*Charadrius melodus*), a threatened species that breeds on the Atlantic coast, occupies habitat that has experienced extensive modifications after Hurricane Sandy made land in the fall of 2012. The barrier islands of New York overwashed and breached in multiple locations. With the potential habitat creation after Hurricane Sandy, we were interested in how habitat changes and space use of Piping Plovers interact. To begin answering these questions, we mapped nesting and brood rearing territories of individually marked Piping Plover pairs on Fire Island and West Hampton Island, NY from April to August of 2016. We obtained locations of Piping Plovers using a GPS unit and a laser rangefinder. Using all known locations of banded Piping Plover pairs (N = 13 pairs), we estimated space use by each pair during the total season, as well as nesting and brood rearing periods, using minimum convex polygons. We identified defended nesting territories during one to three-hour territory mapping sessions, in which locations and behavior were recorded every ten minutes, whereas total space used was defined as all points of a pair during the season. Defended territories averaged 1.43 ha (95% CI = 0.45 – 2.41), while total space use averaged 18.78 ha (95% CI = 8.61 – 28.95). Brood rearing territories were similar in size to nesting territories, however, they contained more intertidal habitat and vegetation than nesting territories. With similar sized territories, but differential habitat requirements across a Piping Plover’s life cycle, it is crucial that a mosaic of habitat types remain available for nesting Piping Plovers.

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Migration of American White Pelicans in Central Coast of Veracruz (Oral)

The Central Coast of Veracruz witness one of the largest raptor migration in the world, as well as an important aquatic bird migration of American White Pelicans, Wood Storks, and Anhingas. Since 1994 the Veracruz River of Raptors watch site monitors the largest worlds known concentration of migratory raptors. Every year, the Pronatura team reports an average of 4.5 million migratory raptors, plus an average of 600,000 aquatic birds. The monitoring protocol, adapted from the Hawk Association of North America, includes two count sites, one located in the Chicicaxtle Municipality of Puente Nacional and the other one located at Cardel, La Antigua Municipality in Veracruz, México. In this work, we report data of migratory counts for the two stations in central Veracruz collected from 1999 to 2015. This dataset representing 17 years of data constitutes a total effort of 1,530 days of monitoring for each station (3,060 days for both stations, 90 days every year (Pronatura Veracruz –River of Raptors Database). Every year, we estimated an average of 59, 952 American White Pelican individuals migrating through the coast of Veracruz, but population numbers change noticeably over the years, with a maximum of 139,885 individuals in 1998 and the lowest 22,141 in 2010. We also present the timing of migration and their relationship with time of the day, wind direction and wind velocity, as well as the variation of size of the flock during the migration period and during the time of the day.

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Prey Consumed by Wading Birds in Mangrove Swamps of Colombia Caribbean Coast (Oral)

Understanding the diet of wading birds can act as an instrument to study relations of key ecosystems, such as mangroves. Although the diet of various species has been studied due to their tendency to regurgitate upon capture, for many species their food requirements are still unknown. In 2015, from May until December, we studied the diet composition of wading birds in the best-conserved area of mangrove swamps of Northwestern Caribbean coast of Colombia, This study encompass both non-breeding season for Little Blue Heron, Tricolored Heron and Snowy Egret and breeding season for Agami Heron, Cocoli Heron, Boat Billed Heron and Bare Throated Tiger Heron. For all species, except Little Blue Heron, fish was the most common prey, with guppies as the most common item followed by gambusia; even with in reduced samples for some egret species. Samples from Agami Heron and Bare-Throated Tiger Heron were too difficult to obtaining for both adults and nestlings, proving them still the most poorly known diet of wading birds in the area and in general in the Neotropic. Based on this information, we are assembled a trophic network to better understand the role of wading birds in mangrove areas, and how this can be affected or not due to human intervention. We found out two families of fish, Engraulidae and Poecilidae are the most vulnerable resource of the trophic network, which are used as bait by artisanal fishermen and are also preys eaten by wading birds.

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Hérons in Colombia; status, knowledge gaps and conservation. (Oral – Heron Symposium)

Colombia is host of 24 species of herons including both migrant and breeding populations. This significant diversity is due to the geographical position that includes a large number of biomes and wetlands complex in the country, such as Orinoco floodplains, Amazon forests, and Pacific and Caribbean coasts. However, few studies have focused on herons in this country and information about genera *Syrigma*, *Tigrisoma*, *Agamia*, *Cochlearius*, *Ixobrychus*, *Botaurus* and *Zebriulus* is scarce. The vast majority of this species inhabits on mangrove forest, swampy forest and natural grasslands that are being profoundly transformed by legal and illegal mining, urbanization, agriculture development, and infrastructure. We made an analysis of risks for herons in Colombia, crossing species distribution and national scale threats. As a result of this analysis we propose two heron species to be included in the Colombian Red List: Zig-zag heron and Agami heron.

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Plover lovers? Knowledge and public support for piping plover conservation by visitors to Michigan beaches (Poster)

Although the Great Lakes Piping Plover population has been listed as endangered for 30 years, no formal research has examined beach-goer knowledge of piping plovers or level of public support for associated conservation and management efforts. Human opinion surveys (400) were conducted at a dozen current and recent piping plover nesting sites in Michigan during the 2016-breeding season (May-August). Each survey included 12 questions designed to measure knowledge of plovers, attitude towards protecting beach wildlife and level of support for regulations that safeguard beach wildlife. Because the presence of dogs is known to increase disturbance to plovers, and is a frequent problem in the Great Lakes area, we asked additional questions related to dog ownership and interest of owners in using designated dog beaches. Results based on preliminary data indicate that approximately half of Michigan beach-goers are familiar with piping plovers to at least some extent. The level of support for protecting beach wildlife was strong (86.75%) but willingness to accept restrictions was only 64.24% percent. Despite overall positive support for plover conservation, increased outreach and education is required to achieve recovery goals. Initiatives to increase beach-goer awareness of piping plovers and human impact on plovers and coastal biodiversity are needed in the Great Lakes region. Additionally, dog beaches should be designated at public recreation locations to provide areas where dogs and their owners do not come in conflict with plovers and other wildlife. As with any recovery effort, public support is critical for successful conservation.

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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 (Oral)

Understanding a species' dispersal and movement behavior is critical when developing a conservation strategy at local and global scales. Without knowledge of the species' life history in regards to movement 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 American and the Caribbean islands. The primary objective of this 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 - 2016, we color banded REEGs in Texas/Tamaulipas (n=628), Yucatan (n=105), Chiapas (256), and Baja California Sur (n=220). Using multi-state models, we analyzed the movement between color morphs (dark and white), sexes (when known), and the four target breeding regions mentioned above. Variation in movement measurements and juvenile dispersal behaviors was seen among individual birds and within different regions. Our results also suggest that juvenile REEG suffer from high mortality rates, 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 to considerable insight on survivorship and movement of a species. As more band-resight data is gathered, our ongoing research of REEG will hopefully contribute to the conservation of one of North America's rarest herons.

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An automated alert system to help with the recovery of archival loggers deployed on seabirds (Poster)

Pelagic seabirds, which travel through expansive and distant marine regions for foraging, are one of the most threatened groups of birds globally and present unique conservation challenges. Informing assessments of threats requires defining spatial and temporal use areas at sea through the deployment of geo-locating loggers. Thanks to advances in miniaturization, such devices are now able to archive daily locations of smaller species of seabirds over several years. Use of this technology, however, is restricted by the fact that archival loggers must be recovered to allow access to location data. Current methods used to recover loggers are time-consuming or require expensive infrastructure, and are inefficient for monitoring seabirds in extremely remote locations. We developed a system that enables automated nest monitoring and automatically sends alerts when birds carrying loggers return from migration. Our design combines low-power, low-cost components (RFID readers, microcontrollers, and

radios) to record when birds use their nesting sites and transmit the information over the Internet, via satellite. This project is a collaborative effort between seabird ecologists and computer scientists. Custom hardware, software, and network protocols will be made openly available. Our system may also have broader applications for monitoring nest attendance patterns among multiple bird species.

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Effects of hydroelectric generation on foraging in Great Blue Herons (*Ardea herodias*) (Poster)

Tailwater streams below hydroelectric dams are subject to drastic changes in water depth and velocity over short periods of time. The effects of altered flow regimes on macroinvertebrates and fish have received significant study, but the effects on other wildlife have received virtually no attention at all. I examined the effects of altered flow regimes on foraging success and bird abundance of great blue herons (*Ardea herodias*) at the Lake Wylie Dam near Rockhill, South Carolina, USA. Heron foraging was observed from the dam structure to a distance of 850m downstream of the dam. During periods of no generation foraging rates were highest at shallow areas 500-850m below the dam and lowest near the dam. During generation foraging rates were highest immediately downstream of the dam near the outflow of the generators and foraging in the shallows downstream was very low. Censuses conducted every thirty minutes during foraging observations show that significantly more herons were present near the dam during generation than in periods of no generation. Conversely, in the shallow areas 500-850m below the dam, more herons were present during periods of no generation than during generation, though the differences at this location were not significant. Great blue herons generally forage solitarily but hydroelectric dams concentrate foraging great blue herons into much greater densities than they are found elsewhere. This may impact breeding colony size and the distance travelled between foraging and nesting sites, particularly during the breeding season when adults are feeding young.

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Detection probability using the standardized marsh bird monitoring protocol in a coastal breeding king rail population (Poster)

Previous studies have found effects of weather, time of day, and time of season on detection probability of marsh birds. King rails (*Rallus elegans*) are listed as a USFWS priority species for management, yet few studies have successfully assessed king rails due to low detection rates using standardized monitoring protocols. Focusing on a breeding population of king rails studied over the last six years at Mackay Island NWR in coastal North Carolina, we modeled detection probabilities using a standard protocol as a function of breeder density estimates, incorporating effects of temperature, wind, sky conditions, time of day, and time of season. Intensive nest searches and opportunistic auditory or visual detection of king rails were used to calculate breeder density around each survey location. Call broadcast surveys were then conducted based on the standardized marsh bird monitoring protocol, and the number of

detections during passive listening periods and callback periods were used to determine factors affecting detection probability. We found a higher rate of detection during evening surveys versus morning surveys (significance pending). The peak in number of detections occurred during the last week in May. Wind and cloud cover had a slightly negative effect on detection probability, with temperature having little effect. These preliminary results contribute to an effort to improve survey methodology, and ameliorate detection of king rails across their range.

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Response of Avian Communities to Water Management in the Floodplain Grasslands of the Mekong Delta (Oral – Heron Symposium)

Critically important to waterbirds, wetlands in the world's deltas are disappearing at an alarming rate. In locations such as the Vietnamese Mekong Delta, the loss of natural wetlands is almost complete, necessitating research into the restoration and conservation of the remaining remnants. At Tram Chim National Park (TCNP), a restored floodplain grassland in the Mekong Delta, managers use water control structures to conduct season long draw-downs, mimicking the flood pattern of the Mekong River. Few publications have studied avian communities in Southeast Asian floodplain grasslands or evaluated the success of season long draw-downs in maintaining these communities. At TCNP, changes in water management coincided with two surveys of bird and plant communities, one during a period of dry-season water draw-downs (1986-1995) and another following a period where high water levels were maintained year-round (1996-2005). In the spring of 2016, we repeated these surveys to assess the status of TCNP's floodplain grassland communities following the resumption of draw-downs in 2006. Using results from the previous surveys as a reference, we assessed species turnover and used taxonomic and functional diversity indices to compare the avian and vegetative communities present during different water management regimes. In 2016, we recorded 33 plant species and 2,241 individuals of 46 bird species. We found that grassland plant communities remained stable across all three surveys. In contrast, avian species diversity was lowest when high water levels were maintained year-round. Grassland specialists (e.g., *Megalurus* sp. and *Anthus* sp.) were most abundant in draw-down years, while *Ardea* sp. and *Phalacrocorax* sp. were more abundant with high water. As currently implemented, dry-season draw-downs are an effective management technique to maintain floodplain grassland communities at TCNP.

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Distribution and Temporal Trends of Western Reef Heron (*Egretta gularis*) Populations along the Arabian Gulf Coast, United Arab Emirates (Oral – Heron Symposium)

The Arabian Gulf of the United Arab Emirates contains highly productive mangrove and seagrass habitats that are essential breeding and non-breeding areas for vast numbers of waterbirds. Unfortunately, both mangroves and seagrasses are declining in this area due to anthropogenic disturbances such as pollution, development, and commercial and recreational activities. Due to their dependence on these coastal habitats, waterbirds such as the western reef heron (*Egretta gularis*) can act as important bioindicators of ecosystem health. The estimated global population size of *E. gularis* is roughly 10,000 to 100,000 individuals. While populations are considered stable, many important breeding and overwintering areas of the western reef heron remain unprotected. We performed line transect counts at fifteen sites along the Arabian Gulf Coast of the U.A.E. monthly from 2006-2015. Using a mixed effects model, we found that counts varied by both month and year independently, suggesting no interaction between the two fixed factors. Our model analysis also suggested a decline in annual abundance by approximately three birds per year, but lacked statistical significance. We found significant inverse relationships between year and count at the Al Aryam and Abu Al Abyad sites, suggesting annual abundance may be decreasing in these areas. Further research and monitoring of the U.A.E. western reef heron population is recommended due to habitat loss and potential declines of the species.

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Outlook not so good: the plight of the Black Tern in North America (Oral)

Nearly 20 years of intensive research on Black Terns (*Chlidonias niger*) in Wisconsin and elsewhere in North America predict a rather dismal future for this species. Surveys and censuses conducted regionally and continent-wide indicate severe population declines over the past 30 years. With few exceptions, most studies of reproductive productivity suggest variable, but usually poor, reproductive success. Adult annual survival probability estimates generated by long-term banding studies at two locations (Wisconsin, Maine) were consistent and alarmingly low (~65%) for a tern species. Survival from hatching to recruitment into the breeding population also appears to be too low (<2%) to sustain a viable population. Conservation and management efforts, either to improve reproductive productivity or provide supplemental nesting habitat, have met with little success. In this talk, I will review the known knowns and the known unknowns necessary to fully understand why this species appears to be in such serious trouble.

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How the metabolic theory of ecology helps us predict avian ectoparasite infracommunity carrying capacity (Oral)

Energetic models can be powerful tools that link the biology of individual animals to the ecology of their populations, communities, and ecosystems. These models account for energy inputs (e.g., dietary consumption) and energy outputs (e.g., metabolic rate). For birds, energy output is often associated

with thermoregulation, foraging, and breeding activities. However, parasitism may also account for a substantial proportion of energetic losses. Here we use the Metabolic Theory of Ecology to examine the energetic demands of ectoparasites on coastal birds from California. We use scaling relationships between metabolic rate and body size for both hosts and parasites to predict the energy flux and biomass of ectoparasites that an individual bird can support. We compare the theoretical maximums for energy limitation and space limitation to observed densities of mites and lice of birds collected in California estuaries. We initially predicted that ectoparasite carrying capacity would be limited by space (host surface area which scales to the $2/3$) and not energy supply; however, we find energy is more important and ectoparasite carrying capacity scales closer to $5/12$. Although parasite abundance did not increase with host body size, the average parasite body size increased. Our results suggest that ectoparasite infracommunities do scale in accordance with energetic constraints defined by host body size as predicted by the Metabolic Theory of Ecology.

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GPS tag attachment is likely to affect hatching but not chick rearing in Herring Gulls (*Larus argentatus*) (Oral)

With recent advances in technology, GPS tracking has rapidly become part of many seabird monitoring programs. The effect that trapping and tagging have on birds is specific to the species and the methods used, but documenting these effects is critical for both the protection of animal welfare and for gauging the scientific relevancy of the GPS data collected. In this study, we deployed GPS tags (“i-gotU” by MobileAction Technology and “HARIER” by Ecotone Telemetry; 17g with harness attachment) on adult Herring Gulls in early incubation on Brier Island, NS (n=9) and Kent Island, NB (n=14), and in late incubation on Great Duck Island, ME (n=6). At each location we monitored all tagged nests, a set of nests where gulls were trapped and handled but not tagged, and a set of control nests where no adult birds were trapped or handled. We found that nests of tagged gulls suffered lower hatch success compared to trap-only and control nests, but that (excluding failed nests) chick growth rate and fledge success were equal among all nest categories at a given location. We suggest that egg loss was due to erratic behavior by tagged birds in the first 24-48 hours after tag attachment, and that effects of tags on breeding success of birds in this study were minimal.

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Black Skimmer Management in New York State (Oral – Black Skimmer Symposium)

In 2014, the New York State Department of Environmental Conservation (NYSDEC) approved a comprehensive management plan for black skimmer nesting in New York. Since then the NYSDEC has used various methods to monitor, manage, and expand black skimmer habitat on properties controlled by county, city, and private landowners. This presentation will describe the methods and projects

initiated under the management plan, provide initial results, current status, discuss challenges, and outline the future of black skimmer management in New York State. Topics to be included in the presentation include: creation of decoys to encourage colony new formation, a New York/New Jersey banding project, development a low stress method to capture and hold pre-fledged black skimmer chicks during banding, the use of ArcGIS to create habitat suitability models designed to identify future restoration opportunities, foraging surveys, and the use of unmanned aircraft to reduce disturbance caused during surveys. Additionally, recent ecosystem based conservation action planning in New York City has identified a landscape scale trophic survey that will benefit shorebirds, colonial nesters, and long-legged waders that, when conducted, will focus on black skimmer as a specialized apex predator within New York's coastal system.

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Color-banding adult Wilson's Plover: A pilot study focused on small breeding sites. (Poster)

The need to understand nesting behavior of Wilson's Plovers during a monitoring program became apparent due to successive nesting attempts by individual pairs after failure of previous nest. A small number of the beach nesting Wilson's Plover adults were trapped and individually color-marked with a lime-green flag with an engraved 3 letter code in black over the period 2010 and 2014. The colonies were located on the Folly and Kiawah Islands barrier islands on the central coastal region of South Carolina. No injuries due to color marking have been observed and the normal behavior and movement of the birds was unhindered. Repeated resightings of individuals, including those from the general public, have helped this project increase the age of the oldest known bird (reported in 2015) to a minimum of 6 years. The use of individual marking has also allowed novel behavioral observations. Movement of individuals tracked through the study period and beyond are discussed.

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Assessment of Storm Impacts on Coastal Bird Populations, Behavior, and Nesting along the Outer Banks Barrier Islands, North Carolina (Poster)

In the face of sea level rise and as climate change conditions increase the frequency and intensity of tropical storms along the north-Atlantic Coast, predictions about response of coastal birds to effects of hurricanes will be essential for anticipating and countering environmental impacts. This work was the first stage of a project assessing coastal bird populations, behavior, and nesting in Hurricane Sandy-impacted North Carolina barrier islands. The project comprises three components: 1) ground-based and airborne lidar analyses to examine site specific selection criteria of coastal birds; 2) NWI classification habitat mapping of DOI lands to examine habitat change associated with Hurricane Sandy, particularly in

relation to coastal bird habitat; and 3) a GIS-based synthesis of how patterns of coastal bird distribution and abundance and their habitats have been shaped by storms such as Hurricane Sandy, coastal development, population density, and shoreline management over the past century. Future work will include further lidar analysis and synthesizing existing data on the distribution and abundance of shorebirds in North Carolina and changes in habitats related to storms, coastal development, inlet modifications, and shoreline erosion to give us a better understanding of historic trends for shorebirds and their coastal habitats. Data will be used in future models to assess storm impacts on nest locations, predict long-term population impacts, and influence landscape-scale habitat management strategies that might lessen future impacts of hurricanes on coastal birds and lead to better restoration alternatives. Results will provide guidance for long-term management of Outer Banks barrier islands and dredged-material islands in the sounds.

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Evaluating current limiting factors and future threats to recovery of endangered Roseate Terns (Poster)

The endangered NW Atlantic breeding population of Roseate Terns (ROST; *Sterna dougallii*) dropped by >25% from about 4,300 “peak period” breeding pairs in 2000 to about 3,000 pairs in 2008. The most important factors that caused the decline have not been determined, but the relatively slow rate of population growth from 2008-2013 compared to the greater growth rate from 1992-2000 indicated that there had been a major change in one or more aspects of the population dynamics of this species. Started in 1987, the USGS’s Cooperative Roseate Tern Metapopulation Project (CRTMP) is integrating results of several research studies to evaluate the relative importance of current factors and future threats that may limit population recovery. The CRTMP began expanding its Staging Site Studies (SSS) research in 2005 due to possible threats to this species from the construction and operation of offshore wind-energy turbines in the MA-RI-NY-CT area. Early SSS research (1) showed that most Hatch Year (HY) ROSTs and their single care-giving parents from throughout the entire breeding range become even more concentrated at a few staging sites around Cape Cod, MA from late August-September than they are at their nesting colony sites, and (2) demonstrated the previously unrecognized importance to this species of staging sites within Cape Cod National Seashore. This poster will present some recent CRTMP results and discuss some future research needs. The mobile nature of ROSTs and other species of terns, and the time they spend and the distances they travel when foraging offshore are major challenges to conducting the SSS research needed to understand the factors affecting HY first-winter survival and help promote population recovery.

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Survival and movements of Black-crowned Night-Herons in Lake Erie, Ohio (Poster)

Located 9 miles due north of the Ohio mainland, West Sister Island is home to 40% of the nesting herons and egrets in the U.S. Great Lakes. One such species of heron, Black-crowned Night-Heron, has experienced a decline in breeding pairs from 3,000 in 1977 to 387 pairs in 1999 and is currently listed as threatened in Ohio (Hothem et al. 2000). Understanding factors influencing movements of individuals across spatial and temporal scales is critical to the preservation of populations threatened by environmental change. Using this information, in accordance with survivorship estimates, is important in understanding population dynamics and the conservation needs of species. To estimate post-fledging survival and examine dispersal patterns, Black-crowned Night-Herons (n=15 fledglings) were marked with coded nanotags in Lake Erie, Ohio, in 2015. Adult night-herons (n=5) were captured at local marinas near public-use fish-cleaning stations using a baited woosh net technique. In combination with active hand tracking, automated telemetry towers were used to passively monitor movement activity of marked birds. During the 2016 nesting season, we will use the same techniques to deploy coded nanotags (n=60) and ARGOS satellite transmitters (n=15 adults). I will present preliminary results on fledging rates, survival, recruitment, and movements of juvenile and adult Black-crowned Night-Herons. Incorporating knowledge of night-heron movement and population demographics may help guide future management decisions to maintain a viable population.

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ARGOS tracking to understand the ecology and behavior of Agami Herons (Poster)

The Agami Heron is ranked 13th among the world's conservation priority heron species, and 2nd for the Americas. Until recently, nothing was known about the feeding grounds of this species during the breeding season, or about areas used during the nonbreeding season. In French Guiana, which holds the world's largest Agami Heron colony (representing over 95% of the known population), the location and characterization of these habitats as well as the identification of the geographic location and routes travelled by breeding and non-breeding individuals has been crucial to evaluate the threats on the species and develop an effective conservation action plan both in French Guiana and throughout its distribution in South and Central America. To achieve this objective, GEPOG (Group for the Study and Protection of Birds in French Guiana) tracked 8 Agami Herons in 2012 and 2013 via the European LIFE+ Cap DOM program. Data from 4 individuals show that this species migrates north and south along the coast (Brazil, Suriname and Venezuela) and is able to cover up to 1300 km within two months, including several stop-overs. Sizes and habitats of the breeding season home ranges are determined.

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From Argos to conservation: reporting 4 years of action for the Agami Heron (Oral – Heron Symposium)

The Agami Heron is ranked 13th among the world's conservation priority heron species, and 2nd for the Americas. In French Guiana, which holds the world's largest Agami Heron colony (representing over 95% of the known population), knowledge was lacking until recently to be able to evaluate the threats on the species and develop an effective conservation plan both for French Guiana and throughout its

distribution in South and Central America. To achieve this objective, GEPOG (Group for the Study and Protection of Birds in French Guiana) used the results of two years of Argos tracking of 8 individuals and built up a working group under Heron Conservation (Agami Heron Working Group - AHWG), including several experts and natural protected area managers across South America and beyond. To be effective to serve conservational purposes, research results need to be set in perspective with local and regional environmental, economic, social and political conditions, before being declined in concrete and adapted actions.

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Abundance and distribution patterns of two heron species in multiple agricultural landscapes of south Asia (Oral – Heron Symposium)

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. Nuanced understanding of how herons interact with the seasonal crops and persisting wetlands is absent. Comparisons across landscapes with different levels of cultivation and human densities are also absent. 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 five agricultural landscapes in lowland Nepal and north-central India during 2014-2016. This project is part of a long-term monitoring framework developed to track the status of large waterbirds in south Asia. We also generated detailed wetland maps for each landscape to determine if abundance and distribution of the two heron species was influenced by wetland extent and position. Both heron species showed: (1) significant spatial and temporal variations in both abundance and distribution in all five landscapes, and (2) considerable complexity in their associations with wetlands varying between landscapes and seasons. Agricultural landscapes showed considerable variations in their utility as heron habitat, with strong evidence of cropping patterns, agricultural intensity, and human population density influencing observed patterns. This is the first assessment carried out simultaneously in multiple landscapes and covering all three seasons for herons in agricultural landscapes. We will discuss the conservation implications of the findings, and future research needs.

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Making a case for long-term monitoring of large waterbirds in agricultural landscapes: preliminary findings from south Asia (Oral)

Scientific attention to large waterbird ecology outside of the United States and Europe, unfortunately, continues to be low. Understanding of large waterbird needs is therefore biased, with literature frequently suggesting that intensively-cultivated agricultural landscapes have poor utility as large waterbird habitat. Assumptions regarding the impact of areas with high human densities and long agricultural histories on waterbird populations drive global status assessments despite lack of empirical evidence. In south Asia, agriculture is the dominant land use with some areas experiencing cultivation for several centuries. In other areas, government policies are driving increases in cultivation with concomitant alterations in land use, particularly wetland persistence. These landscapes remain largely unexplored for biodiversity, with meagre to no information existing on large waterbirds in these areas. In 2012, as part of Program SarusScape, we instituted a systematic, spatially-explicit, landscape-scale, long-term monitoring program focusing on large waterbirds (cranes, storks, ibis, spoonbills and herons) in seven areas in lowland Nepal and north-central India. These areas were chosen to represent variations in cropping history, agricultural intensity, crop species, human population density, rainfall patterns, and wetland persistence. The effort has yielded: (1) new populations of species of global conservation concern (Sarus Crane, Lesser Adjutant, Asian Woolly-neck); (2) novel information on heronry ecology; (3) evidence for landscape-scale effects of croplands on large waterbird distribution; and (4) a high value of agricultural landscapes as habitat for several large waterbird species. We posit therefore that assumptions regarding status of large waterbird species using land use alone require to be revisited. Evidence-based understanding of the utility of different habitats and land uses to large waterbirds is critical to obtain realistic large waterbird status assessments.

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Range-wide patterns of population differentiation of Eurasian Black Terns (*Chlidonias niger niger*) related to use of discrete post-nuptial staging sites. (Oral)

The Eurasian Black Tern, *Chlidonias niger niger*, is a marsh-nesting tern continuously distributed across Eurasia; but migration routes, staging sites and non-breeding distributions are not well understood. In western Europe some populations have declined substantially (>90%) thus a more complete understanding of breeding site connectivity and migratory routes is needed. We sampled terns in breeding colonies in The Netherlands, Latvia, Ukraine, Siberian Russia and individuals at one important post-nuptial staging site in The Netherlands. We used traditional ringing studies and census work, four morphological measures, seven microsatellite loci and one mitochondrial sequence to estimate historical and contemporary dispersal among breeding sites and assigned terns at the staging site to a specific breeding population. Microsatellite data suggest significant differentiation among all breeding sites and is supported by differences among sites in most morphological measures. Conversely, mitochondrial DNA suggests similarity and population expansion mainly from the region around Ukraine. We assigned half of the birds sampled on the staging site to The Netherlands/Latvia breeding population, but none to the Ukraine or Russian populations. Our genetic data add substantially to conventional field methods used in migration studies to delineate migratory flyways and highlight the

importance of specific staging sites to specific breeding subpopulations. Conservation plans must include science-based knowledge of connectivity and site use throughout the annual cycle. Our data suggest that limited contact at post nuptial staging sites and breeding site isolation contribute to the genetic structure for this species.

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Shorebird utilization of horseshoe crab eggs at Cape Romain National Wildlife Refuge, South Carolina (Poster)

Eggs of American horseshoe crabs (*Limulus polyphemus*) provide shorebirds with an abundant food source at stopover sites, allowing the birds to rapidly gain weight for their long migration to arctic breeding sites. Shorebird use of horseshoe crab eggs has been well documented at northeastern stopover sites such as the Delaware Bay. However, this relationship has not been well studied in South Carolina, where horseshoe crabs are harvested for the biomedical industry. Cape Romain National Wildlife Refuge hosts thousands of shorebirds each year and supports a population of spawning horseshoe crabs. The objective of our study is to determine if there is a correlation between the density of horseshoe crab eggs and the abundance of foraging shorebirds during spring migration at Cape Romain National Wildlife Refuge. To accomplish this, we monitored 10 study plots between April and June 2015 at predicted horseshoe crab spawning sites throughout the refuge. We conducted weekly shorebird surveys, and surveyed plots twice a month to measure densities of horseshoe crab eggs. During our first field season, we collected 491 horseshoe crab egg samples and conducted 121 shorebird surveys. We used a linear regression to compare the density of eggs in each plot with the number of foraging shorebirds. Our results show a positive correlation between number of foraging shorebirds and horseshoe crab eggs ($r^2 = 0.63$, p value = 0.01). Our results suggest a correlation between shorebirds and horseshoe crab eggs at the refuge. The results of our study will help provide a better understanding of Cape Romain National Wildlife Refuge as a stopover site for shorebirds.

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Analysis of wintering whooping crane behavior along the Texas Gulf Coast (Oral)

The coastal marshes of the Aransas National Wildlife Refuge (NWR) are a dynamic coastal marsh complex that serves as critical wintering grounds for the Aransas-Wood Buffalo population of whooping cranes (*Grus americana*), the last natural flock of the species in the world. When overwintering at the Aransas NWR the cranes primarily feed upon blue crabs (*Callinectes sapidus*) and Carolina wolfberry (*Lycium carolinianum*) fruit, which are both greatly influenced by hydrological conditions in the estuary. Exceptional drought resulted in hydrological stress throughout the system in 2011, but increased local

precipitation and greater freshwater inflows in 2015-2016 worked to relieve a portion of this drought stress. To identify potential linkages between hydrology, key food resource availability and crane behavior, we conducted 80 detailed whooping crane behavioral surveys (20-minute observational periods) at 25 coastal marsh territories during the winter of 2016. Each crane behavior survey was paired with an assessment of coastal saltmarsh habitat quality using blue crab, Carolina wolfberry fruit and water quality metrics. Preliminary analysis of behavior data indicates that on average the whooping cranes increased the amount of time spent foraging as the winter season progressed (63.2% in January, 66% in February, and 75.3% in March), but not significantly ($P=0.833$). Adult cranes and juvenile cranes only varied significantly in behavior in regards to their time spent in “alert” behavior both overall and on a monthly basis ($P<0.05$). Habitat surveys indicted considerable spatial and temporal variability in blue crab and wolfberry fruit availability over the three-month experiment, likely driven by hydrological connectivity. Herein, we will discuss these and other results, such as the impacts of food availability and habitat type on whooping crane behavior.

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The role of environmental factors in influencing nest survival in Painted Stork populations of northern India (Oral)

Daily survival rate of Painted Stork (*Mycteria leucocephala*) nests from four different nesting colonies in northern India (Delhi Zoo, Keoladeo National Park, Chhata and Khanpur) were modeled as a function of several nest and colony specific parameters such as year, daily maximum and minimum temperatures and sizes of foraging wetlands in the vicinity. A total of 1,095 Painted Stork nests were monitored at an interval of 4-7 days during a study covering two breeding seasons (2013-2015). Considerable variations were observed in annual nest survival due to the amount of rainfall and hence availability of suitable wetlands for foraging in the vicinity of the colony. There is strong conservation significance to this in that, if the monsoon pattern is affected, as is widely feared to happen on account of global climate change, then populations of fish eating birds like Painted Stork would be adversely affected. Also, the additive effect of daily minimum temperature on the nest survival rate was positive ($\beta_{\text{Temp. min}} = 1.21$, $SE = 0.26$) indicating that lower temperatures in winter negatively influenced daily survival rate. As the nest survival in Painted Stork is significantly affected by environmental factors like rainfall and daily minimum temperature, it seems that its population in the periphery of its distribution range is restricted by the temperature extremes, especially minimum temperature. Comparative studies on Painted Stork nest survival rates in different climatic zones across India, e.g., in south Indian colonies where climate is benign and ambient temperatures rarely drop below 16 °C, will certainly help us understand how stork populations of different species globally are restricted by climatic regimes.

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Influences on detection and occupancy of black rails in Texas (Oral – Eastern Black Rail Symposium)

The black rail (*Laterallus jamaicensis*) occurs in wet meadows and marshes throughout the American continents. In spite of being a species of concern throughout North America, black rails have received little attention in Texas. We estimated the occupancy and detection probability of black rails in Texas. We collected data from repeated call broadcast surveys at six study sites along the Texas coast: Anahuac National Wildlife Refuge (NWR) (n=92), Brazoria and San Bernard NWRs (n=138), Mad Island Wildlife Management Area and Clive Runnel's Mad Island Marsh Preserve (n=64), and Powderhorn Ranch Preserve (n=41) in the spring of 2015. We detected no rails at Powderhorn Ranch Preserve. We estimated black rail occupancy and detection probability from the remaining five study sites in a twostep process. First we examined five models where detection was influenced by time of day, minutes since start of survey, Julian date, temperature, noise, wind, lunar phase, and/or speaker direction while occupancy was held constant. We selected a model where Julian date, temperature, noise level, and speaker direction influenced detection. We then estimated 12 occupancy models with the selected detection model. We examined 10 models with vegetation height, *Spartina* cover, herbaceous cover, woody cover, wetland plant dominance and/or site as influences on occupancy. We selected the model where vegetation height, *Spartina* cover, and herbaceous cover influenced occupancy. Black rail detection decreased with Julian date and noise level, and increased with temperature. Rails were also more likely to be detected when speakers were pointed in their general direction. Black rail occupancy increased with vegetation height, *Spartina* cover, and herbaceous cover.

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Collective Colony Formation Algorithm (Oral – Heron Symposium)

Colonies of breeding herons and egrets should be located so as to maximize individual resource intake. Food spectra of these species are relatively strict, and their colony sites are restricted to wood and wetlands, so it is relatively easy to specify their habitat requirements. But simple calculation of availability of food and nesting habitats often fails to explain why colonies were formed at specific locations. We tackled this problem by a different analysis of heronry locations, using long-term data for large study areas in Italy and Japan. First we incorporated not only favorable resource sites, such as nesting and foraging sites, but also unfavorable sites, such as urban and bare ground, for evaluating probability of colony formation. Second we incorporated site fidelity, or tendency to reuse the same places as colonial sites. The second aspect was inspired by the fact that nearly two thirds of colonies formed in the past 30 years in our study area in Japan, and in the past 43 years in Italy, were located exactly at the same or at nearby sites. We applied the random forest analysis to create the collective brain, or colony locating algorithms. Their collective brains show that they used specific scale and land use combinations for colony formation, avoiding urban or bare fields at the 10 km scale, but favoring ever green forest at the 4 km scale. Importance of site fidelity constantly increased after 1995 in Italy, and after 2005 in Japan. We discuss the change in colony formation algorithms according to the change of member species in colonies.

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Temporal changes of oligohaline emergent marsh and associated marshbird abundance in the lower Mobile-Tensaw River Delta, 2004-2015 (Oral)

Northern Gulf of Mexico (nGoM) tidal marshes provide habitat for a diverse array of marshbirds, many of which are designated “birds of conservation concern” by federal and state organizations. Although marshbirds of the nGoM have received some attention, details of how some species, particularly those associated with oligohaline habitats, will respond to anticipated habitat shifts remain scant. Research objectives were to identify changes in marshbird species’ abundance and supporting habitats in the oligohaline marshes of the lower Mobile-Tensaw River Delta (MTRD) in Alabama. Herein, point counts were conducted at fixed locations within oligohaline marsh of the MTRD during April – June 2004, repeated in 2015. Information on dominant plant communities was also collected. Marshbird species most commonly detected during the 2004 and 2015 survey periods were Common Gallinule (*Gallinula galeata*), King Rail (*Rallus elegans*) and Least Bittern (*Ixobrychus exilis*). Vegetation surrounding marshbird points were classified into three types: 1) *Typha*, 2) *Sagittaria*, and 3) *Phragmites*. During the 2015 census period, Common Gallinule and King Rail were most abundant in marsh-type 3 (0.03 birds/ha and 0.15 birds/ha, respectively), and Least Bittern in marsh-type 1 (0.06 birds/ha). Abundance of King Rail increased 37% between survey periods, Least Bittern declined 11% while Common Moorehen exhibited a population decline to 45% of 2004 abundance across the survey area. Such changes may parallel transitions of marsh habitats, as anticipated for the nGoM. Insight gained will provide an adaptive assessment by which the impacts of ecosystem change, including the loss of specific ecosystem services, can be evaluated.

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Breeding site longevity and site characteristics have intrinsic value for predicting persistence of colonies of an endangered bird (Oral)

Centralized, aggregative breeding locations have been long recognized as conservation priorities for many vertebrates and invertebrates. However, fluctuations in size and turnover of these sites is attributable to both natural and anthropogenic causes, and distinguishing between these is critical to prioritizing sites for conservation, and interpreting responses to management actions. We used a 40-year data set in the occupancy modeling framework to examine the relative importance of colony variables to colony dynamics of breeding Wood Storks (*Mycteria americana*) within the United States. Larger colonies, and those of greater longevity were more likely to be recolonized and were less prone to extinction, suggesting size and previous history have intrinsic value to Wood Storks. Colonies with a higher degree of physical connection to the mainland were more likely to be abandoned, probably because the isolation reduces access for mammalian nest predators. Proximity to human activity was

positively related to the probability of re-colonization, indicating either that Wood Storks and humans are attracted to similar ecological features, or that there may be some positive benefit from nesting near human activities. These relationships with colony site characteristics can be used directly by managers to prioritize stork colonies for management or conservation action. Local rainfall in the 12 months prior to nest initiation was positively related to colonization rates and negatively related to extinction rates, suggesting both that colony-site effects on persistence are mediated by annual weather patterns, and that locations of stork colonies may be affected by precipitation patterns driven by global change.

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Assessing the status of Eastern Black Rail (*Laterallus jamaicensis jamaicensis*) in New Jersey. (Oral – Eastern Black Rail Symposium)

The Eastern Black Rail has experienced significant declines over the last twenty years throughout its range. Historical records suggest that Black Rails were once more abundant and widespread in New Jersey than they are today, particularly in southern New Jersey Atlantic coast marshes and the Delaware Bayshore. New Jersey Audubon (NJA), the New Jersey Endangered and Nongame Species Program (ENSP), and Conserve Wildlife Foundation conducted statewide surveys in 2015 and 2016 to identify the current distribution of Black Rail in New Jersey, and to determine changes since the last systematic survey conducted in 1988. In 2015, over 40 Citizen Science volunteers trained in nocturnal playback survey methodology by the NJA Citizen Science Program and Cape May Bird Observatory, surveyed a broad area in North and South NJ. ENSP staff surveyed water accessible sites in the Tuckahoe/Great Egg Harbor Watershed area. More than 250 points located in suitable high marsh and freshwater marsh habitats were surveyed. Statewide, Black Rails were detected at 10 of those survey points (about 3.9%). In 2016, we repeated a subset of points to examine inter-annual variability, and expanded the survey to new areas. Results of this survey will contribute to the regional dataset of Black Rail locations, coordinated by the Eastern Black Rail Conservation and Management Working Group, and will be used for regional status assessments and management plans.

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Improving Bullfrog Capture Methods to Benefit Hawaii's Endangered Endemic Waterbirds (Poster)

American bullfrogs were introduced to Hawaii's wetlands from California in the late 1800's. As has occurred in other areas where American bullfrogs have been introduced, these voracious predators threaten Hawaii's native fauna. Of particular concern are Hawaii's endangered endemic waterbirds the Hawaiian Stilt, Hawaiian Coot, Hawaiian Gallinule and Hawaiian Duck. Wetland managers in Hawaii

control bullfrogs as part of nonnative predator control programs for the benefit of the endangered waterbirds. U.S. Fish and Wildlife Service National Wildlife Refuges in Hawaii manage several key wetlands necessary for the survival of the waterbirds. These refuges include bullfrog control as a component of predator management. Unpublished studies on James Campbell National Wildlife Refuge (Refuge) have documented bullfrogs as a major predator of newly hatched endangered waterbird chicks. The Refuge currently maintains a year-round bullfrog trapping program with increased effort in the spring during waterbird breeding season. Existing trapping methods employ a simple fish style funnel trap with red flagging used as an attractant. As part of an effort to improve current bullfrog trapping methods, in this study we investigated the effectiveness of different attractants in the traps. In addition to red flagging, we tested light, bullfrog call acoustic recordings, and life-size bullfrog decoys. We found that most of the treatments were no more effective than our control (no attractant) except for bullfrog calls. If we can improve bullfrog trap yields, we expect greater survivorship for the endangered Hawaiian waterbirds.

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Detecting Hotspots of Seabird Abundance off Southeastern Massachusetts. (Oral)

We conducted thirty-eight (38) aerial surveys of seabirds south of the islands of Nantucket and Martha's Vineyard, Massachusetts between 22 November 2011 and 14 January, 2015. The study area, which extends approximately 85 km offshore to the 60-m depth contour, has been designated as a "Wind Energy Area" (WEA) by the federal Bureau of Ocean Energy Management. We sampled approximately 23,000 linear km of transect over the three years. We mapped the distribution of all birds from data sampled along standardized strip transects. One of our goals was to detect the presence of persistent "Hotspots" of seabird activity; that is, locations where larger than average aggregations of seabirds occurred on a regular or repeated basis. We identified two Hotspots of seabird abundance: one near the western edge of the Nantucket Shoals, consisting mainly of Long-tailed Ducks and White-winged Scoters during winter, and Common and Roseate Terns during spring, and a second one in the Muskeget Channel area, consisting of scoters and eiders, loons, and terns.

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Habitat Selection in the Leach's Storm Petrel on Great Duck Island (Poster)

The Leach's Storm Petrel (*Oceanodroma leucorhoa*) is a pelagic bird that breeds on islands. One of the largest known Storm Petrel colonies in the eastern United States is on Great Duck Island (Lat. 44.14 N, Long 68.24 W). Great Duck is a 95-ha granitic island, oriented due north to south with a log axis of 1,928 m, and a maximum width of 764 m. Approximately 5000 pairs of petrels share the island with Herring and Great Black-backed Gulls (*Larus smithsonianus* and *L. marinus*) The island's vegetation is dominated by spruce forest at its center and open meadow at the south end and along portions of the west side.

During the summer of 2016 I identified habitat types on Great Duck preferred by the Leach's Storm Petrel based on burrow occupancy, density, hatching success, and breeding success measured within a grid composed of 20 by 20 m squares. Habitat type was divided into three main categories – forest, forest edge, and meadow. Areas within these categories were then described by factors including soil moisture, soil density, and distance to gull nests. I also examined differences and similarities between burrows in different habitats including burrow aperture and depth below the surface. Preliminary results suggest that the Leach's Storm Petrel prefers forest and forest edge to meadow habitats. These habitats were also furthest from nesting gull sub-colonies. My results are of particular concern due to the on-going decline of the island's spruce forest.

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Seasonal variation of Reddish Egret movement along the Gulf of Mexico (Poster)

Understanding seasonal variation in waterbird movement is essential for conservation management of key habitats used during breeding, post-breeding and wintering seasons. Reddish egrets (*Egretta rufescens*) are a near threatened waterbird species with the breeding population primarily occurring along the Texas coast. There has been limited knowledge on their movement especially changes in movement from juvenile dispersal to breeding adult. In this study, we estimate seasonal variation in home range size and site fidelity of reddish egrets. Data was analyzed from five years of satellite telemetry data collected during 2010-2015 from 25 individuals along the Texas Coast in the Laguna Madre. Our results show individual home range sizes were the largest during the 2010 breeding season 3825 km² ($n=20$) and decreased to 145km² ($n=19$) in the 2010 winter season. Home range size varied between age and season with an overall decrease during the study. During 2013-2015, home range size significantly decreased to <3km² suggesting further evidence for weak long distance migration in this species. Of the remaining tagged birds from 2013-2015, there was no evidence of site fidelity to the natal colony. All of these birds settled in the southern tip of Texas and the Laguna Madre y Delta del Río with the largest dispersal of 165km. Our study is the first study to track individual Reddish Egret movement from juvenile age class to breeding age class.

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Piping Plover nesting habitat selection on Fire Island, New York following Hurricane Sandy (Poster)

Barrier islands are dynamic coastal ecosystems that serve as breeding habitat for numerous species of shorebirds, such as the Piping Plover (*Charadrius melodus*). Piping Plovers nest in open dry sand, and sites are often limited by vegetation growth and erosion. In 2012, Fire Island, NY was hit by Hurricane Sandy, which overwashed multiple locations on the island. The storm removed dunes and vegetation and created dry sandy habitat. To determine how Piping Plovers are using this storm-created nesting habitat, we used 7 coarse scale habitat variables and ArcGIS to conduct logistic regression using 2015

nest locations and random points. Model selection indicated that least cost distance to bay, least cost distance to ocean, and amount of dry sand within a 500-m radius were important predictors of nest site selection. The highest ranked model included least cost distance to bay ($\beta = -1.51$, $SE=0.50$) and least cost distance to ocean ($\beta = -0.49$, $SE=0.25$). These variables are consistent with the understanding that Piping Plovers select nesting habitat which allows for chick access to moist substrate foraging habitats on both the ocean and bay sides of barrier islands, and select for large expanses of sand for predator avoidance. The results of this analysis will be applied to a finer scale nesting probability model, focusing on micro-habitat variables. Moreover, it will allow an estimate of the amount of nesting habitat that was created by Hurricane Sandy. Further analysis will help us to better understand the effect of storm events on Piping Plover habitat and nest site selection and to aid in future management efforts on Fire Island.

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Status and distribution of the eastern black rail (Oral – Eastern Black Rail Symposium)

The eastern black rail (*Laterallus jamaicensis jamaicensis*), appears to have experienced dramatic declines over much of its range and has been placed on several state lists of imperiled species. Due to its secretive nature and use of remote locations, our understanding of status, distribution and habitat use for eastern black rails is poor. We compiled black rail locations documented during the breeding season from a wide range of source materials to assess distribution and habitat use. We mapped occurrences to the finest scale possible ranging from point locations to the county level. Point locations were overlaid on National Wetland Inventory maps to classify habitat types. We identified several historic strongholds and compiled accounts and surveys over time to evaluate temporal trends in the number of calling birds. The historic breeding population was distributed along the outer coast from southern New England to Florida and west to Texas and widely throughout the eastern Piedmont and Midwest. Some minor contraction has occurred along the northern coastal range limit and reports within the Piedmont have declined coincident with reforestation in this region. More significant than changes to the extent of the breeding range has been changes in occupancy within the range. Coastal strongholds have experienced dramatic (>90%) declines in recent decades and the use of other areas has become increasingly sporadic. Coastal pairs use the highest areas within tidal salt marshes. Inland pairs utilize a wider range of habitats from wet fields to meadows. Despite the diversity in landscape setting and floristics, many sites share common structural characteristics.

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Carryover Effects of Reproductive Performance and Density Dependence Influence Breeding Propensity in a Short-lived Species (Oral)

Breeding propensity is perhaps the least understood demographic process influencing annual fecundity. Most research on breeding propensity has focused on long-lived organisms where environmental conditions, population density, and other factors affect individual breeding propensity. The extent to which breeding propensity in shorter-lived organisms is regulated by similar constraints is less clear. Additionally, individuals that opt not to breed are more difficult to detect, making estimation of breeding propensity difficult and potentially biasing other demographic estimates. We studied the effects of sex, age, reproductive success, and habitat on the survival and breeding propensity of piping plovers (*Charadrius melodus*) on the Missouri River. We used a robust design Barker model to estimate survival and breeding propensity. Survival decreased as birds aged, particularly for males, and was lowest during the breeding season. Males were less likely to skip breeding (1–15%) than females (2–24%), and both were less likely to return to breed following years of high reproductive success. If birds did return following high reproductive success, they were of lower condition and produced lighter clutches than years after lower reproductive success. Younger birds and females left the breeding area before older birds and males, but all birds stayed longer when nest survival was low. Although breeding propensity was relatively low during historic flooding (85–90%), it was lowest following habitat creation (77–85%). Apparently, piping plovers use a variety of environmental and demographic cues to inform reproduction. Despite a positive demographic response following habitat creation, relatively low breeding propensity could outweigh these benefits.

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Using Seabirds to Track Ecosystem Change in the Gulf of Maine (Oral)

For the past 30 years, Maine Coastal Islands National Wildlife Refuge, National Audubon Society, and Maine Department of Inland Fisheries and Wildlife have documented annual population levels, productivity rates, diet composition and feeding rates on 11 managed seabird colonies in Maine. While extensive data has been collected at the colonies, we know very little about the at-sea ecology of birds in the Gulf of Maine. While seabirds must return to land to raise their young, they spend the majority of their time at sea foraging for themselves and their chicks. As a result, seabirds are intimately linked to physical and biological characteristics of marine ecosystems. Seabirds need persistent aggregations of prey to be located within commuting distance of their breeding colonies. Recently, seabird managers have observed what appear to be significant changes in forage fish abundance and availability for breeding seabirds. Several colonies have abandoned or experienced complete reproductive failure due to lack of available forage fish. We have also observed declines in chick growth and productivity rates. Seabirds are more easily observed, counted, and studied than other marine organisms and changes in ecosystem function will be evident in these upper trophic level predators. We believe that our long-term monitoring efforts at the breeding colonies provide critical evidence that the productivity of the Gulf of Maine has significantly decreased in recent years.

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Satellite Tracking Highlights Use of Ocean Habitat by Diving Bird Species in Federal Waters of the US Mid-Atlantic (Poster – Atlantic Marine Bird Cooperative)

Offshore wind facilities may impact many bird species through increased mortality by turbine collisions, and by altering behavior and flight pathways. To evaluate this impact in Federal waters (>5.6 km from shore), there is a need to collect information on the distribution, seasonal occupancy and behavior of a broad suite of species. We evaluated the fine-scale occurrence and movement patterns of three diving bird species with different flight and foraging characteristics in the near-coastal federal waters of the U.S. mid-Atlantic area. From 2012-2016, we tracked the movements of northern gannets (n=75) and red-throated loons (n=66), and from 2011-2016, surf scoters (n=177), on their northward migration to their breeding colonies, and back to and through the mid-Atlantic region. The mid-Atlantic region and the Gulf of Mexico are hotspots for northern gannets during winter and use of coastal waters appears to be more pronounced among females. Red-throated Loons' winter use near potential wind energy areas (WEAs) was greatest along the western edge of the North Carolina; migration movements also overlapped with that area, although the greatest chance for interaction between red-throated loons and potential WEAs occurred during the migration rather than winter. Similarly, scoters followed a migratory route that brought them offshore the Atlantic coastline to staging areas near the Gulf of St. Lawrence, although wintering grounds were concentrated at inland bays. Although surf scoters are not likely to be as heavily impacted by Federally-managed wind facilities as other marine bird species, concurrent state-managed leases (<5.6 km offshore) may directly impact birds through mortality and/or drive moving birds in-land or further offshore. Data are designed to inform permitting and regulation of future offshore wind development in the Atlantic region and provide important information on key habitat use and migration of a suite of species with different ecological niches.

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Habitat characteristics and seasonal numbers of Great Egrets at 70 roost sites in the area of Southern Ontario, Canada (Poster)

Roosting sites of Great Egrets (*Ardea alba*) away from breeding colonies are little known and studied. Our objective was to identify roosting sites, their size and habitat, annual usage and rarity, and to answer the question of whether roost sites should be Important Bird Areas (IBAs). We searched for and monitored roosting sites annually, 2008-15; 70 confirmed roosting sites were located in southern Ontario and adjacent U.S. states; 18 other sites were suspected of being roosts. All roosts were located in wetlands where microhabitat included: adjacent to water in trees on mainland (40%) or islands (11%), shallow water or mudflats (25%), trees in water (11%), bushes in water (7%) and herbaceous vegetation in water (6%). The most common size categories were 6-15 birds (30%) and 16-40 birds (24%) but individual roosts ranged in size from 1 to 816 birds. Most roosts consisted of a single site in a wetland, however, at 38% of the wetlands, egrets roosted sequentially at 2 or more sites within the wetland, i.e. they moved to a 2nd site within the wetland, often within the same season. They often moved from trees to mudflats as water levels receded. Roosts usually became active during mid-June to early August,

had peak numbers in late August- early September and declined in numbers during late September – late October. Not all roosts are worthy of IBA designation.

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At-sea sightings and model predictions of Black-capped Petrels (*Pterodroma hasitata*) north of Cape Hatteras, North Carolina (Poster – Atlantic Marine Bird Cooperative)

Black-capped Petrel occurrence in the vicinity of Cape Hatteras, N.C. is well documented; however, sightings collected aboard research vessels confirm a distribution that extends northward following the Gulf Stream. We examined the locations of at-sea sightings of this species from the Northwest Atlantic Seabird Catalog, and compared the sighting data with predictions of relative occurrence and abundance from environmental-based species distribution models. Model predictions of relative occurrence and abundance north of Cape Hatteras in spring and summer were driven by depth and Gulf Stream associated predictors (e.g., surface current velocity and probability of cyclonic eddies). Model predictions corresponded well with at-sea sightings. We also investigate how Black-capped Petrel sightings documented from shore and inland correspond with Atlantic tropical cyclones that make landfall, but that cyclones do not account for the spatial pattern of Black-capped Petrels offshore.

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Evaluating seabird persistence in the Northwest Atlantic (Oral)

We derive metrics of seabird spatial persistence over time from seabird sightings collected on at-sea transects from ship and aerial surveys over a timespan of approximately 40 years (1978 – 2014), contained in the Northwest Atlantic Seabird Catalog. Seasonal and annual measures of persistence were quantified in areas with repeated survey effort and for 40 species. We present examples of data-derived persistence metrics and compare them with recent predictive species distribution modeling results. Metrics of persistence may aid offshore marine spatial planning by identifying areas where seabird aggregations tend to endure, highlighting areas with low survey effort, and validating model predictions.

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Cow Trap Lake Shoreline Protection: A Wetland, Reef and Colonial Waterbird Nesting Island Restoration Project, San Bernard National Wildlife Refuge, Texas (Poster)

In Texas, many colonial waterbird nesting sites have been lost to erosion and subsidence. The ability to address wetland loss as well as aquatic and upland features is feasible by using specialized equipment and multi-discipline working groups. The Cow Trap Lake Project addressed shoreline erosion, wetland loss and habitat conversion as well as restoring features that benefit colonial waterbirds. A terrace field project was constructed with two terraces built to elevations of +4.5' NAVD. Higher elevations supported colonial waterbirds and increase nesting potential in the area from high tides and storm events. After completion, the site has supported two nesting seasons and is now one of the largest colony sites for Gull-billed Tern in Texas. Other species include Least Tern, Forster's Tern and Black Skimmer. The next phase of the project will include placement of shell or shell-like material on the nesting terraces to support these species. This project was implemented by a working group consisting of federal, state, non-governmental organizations and private industry.

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Evidence of Predation and Disturbance in Nesting Waterbird Colonies on a Louisiana Barrier Island System using Video Monitoring (Oral)

The Isles Dernieres Barrier Islands Refuge (IDBIR) in coastal Louisiana provides critical breeding habitat for numerous species of colonial nesting waterbirds. These islands are also inhabited by mammalian and avian species that have the potential to reduce overall waterbird breeding success, primarily through nest predation and disturbance. Nutria (*Myocastor coypus*) and Laughing Gull (*Leucophaeus atricilla*) are two primary species that are believed to affect the breeding success of waterbirds on IDBIR. In conjunction with in-situ nest monitoring, three video systems were deployed for the first time on East Racoon Island to determine disturbances to nesting colonies and specific nest predators of Royal Tern (*Thalasseus maximus*) and Sandwich Tern (*Thalasseus sandvicensis*) during the 2015 breeding season. In addition, we also identify egg scavengers. Our video recordings indicated recurrent and oftentimes aggressive predation of tern eggs by nutria. Video footage (1,834 hours) revealed that nutria predation accounted for 42.3% of all recorded predation events and that nutria were the most common cause of disturbance. Laughing Gulls contributed the most to predation of tern eggs, accounting for 52.6% of all predation events. Ruddy Turnstones (*Arenaria interpres*) preyed the least amount of eggs, however they were the most common scavenger. To our knowledge, this is the first non-anecdotal evidence of nutria predation of bird eggs. Our video data from the 2015 breeding season illustrates the important effects that nutria have on waterbird nesting success. Video monitoring for predation in Royal and Sandwich tern colonies will continue during the 2016 breeding season.

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Integrated Waterbird Management and Monitoring and the Avian Knowledge Network: a Partnership to Enhance Conservation of Nonbreeding Waterbirds. (Poster)

For decades, migration and wintering waterbird habitats have been the target of intense management efforts by agencies, non-profits, and private land stewards. Despite parallel objectives, however, the various monitoring and decision support efforts of Federal, State, NGO and private partners have largely been disparate and not always aligned to the multi-scale nature of the objectives. After a five-year pilot phase, Integrated Waterbird Management and Monitoring (IWMM) has produced a nationally approved protocol framework for monitoring waterbirds and their habitats, as well as ecological models that inform conservation decisions from the flyway to the management unit. In support of this wide-ranging effort, IWMM has also created a centralized, online data management system as a thematic node of the Avian Knowledge Network (AKN). The IWMM-AKN partnership is beneficial because the AKN provides a common platform for different organizations to store, share and access data, improving awareness and use at multiple scales. As a thematic node of the AKN, the IWMM database supports managers and partnerships by enabling users to organize scientific data for analysis, maintain their data on a secure site, and share data and technology. This poster highlights how the IWMM node supports station-level monitoring of waterbirds, simplifies data entry and storage, and enhances decision making, data sharing and report generation capabilities to help inform management decisions. Through the partnership with AKN, IWMM's broader goal is to enhance the conservation of nonbreeding waterbirds.

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Long Term monitoring of egrets and herons in Hong Kong (1989 – present) (Poster)

Systematic, territorial-wide monitoring of egrets and herons has been conducted in Hong Kong since 1989. Through the population change, this monitoring could reveal how egrets and herons make use of fragmented wetlands and adapt dynamic change in urbanized landscapes. In recent years, the annual population of five species (Great (*Ardea alba*), Little (*Egretta garzetta*) and Cattle Egrets (*Bubulcus coromandus*), Black-crowned Night Heron (*Nycticorax nycticorax*) and Chinese Pond Heron (*Ardeola bacchus*)) fluctuated around 1000-1400 nests, with Little Egret and Chinese Pond Heron were the dominant species. The Great Egret exhibited a long term increasing trend (from zero in 1989 to 283 nests in 2015, while Cattle Egret showed a long term decline in the number of nests (from 118 nests in 1989 to 54 nests in 2015). Although pond type wetlands, and farmlands in Hong Kong were degraded in terms of fragmentation and shrinking in area during the period, both the total number of nests and the number of colonies in 2015 are higher than 1989. This may imply that nesting birds tend to split into more small colonies, and these colonies could be situated in close proximity to feeding habitats. This may help reducing energetic costs. Also, their feeding habitat use pattern may shift to coastal wetlands in order compensate to the loss of pond type wetlands and farmlands. Pollution control in coastal areas, and better management of protected wetlands (for instance the Mai Po Nature Reserve and Hong Kong Wetland Park) may also provide prime feeding habitats although the wetland area was shrinking.

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Texas Rookery Island Project – A Deepwater Horizon Early Restoration Project. (Oral)

As part of Phase IV Early Restoration of the Natural Resource Damage Assessment and Restoration (NRDAR) process implemented by federal and state trustees, the Texas Rookery Island Project was successfully negotiated and awarded ~ \$20M in funds to restore four colonial waterbird islands on the upper Texas Coast. This project targeted the restoration of colonial waterbird resources injured as a result of the oil spill. Four islands were selected for restoration: Rollover Bay, Smith Point, Dickinson Bay II, and Dressing Point Islands. Coastal restoration methods and historical colonial waterbird data were used to develop restoration designs and biological targets respectively for each island project. Species selected for restoration included Laughing Gull, Sandwich and Royal Tern; Snowy, Great and Reddish Egret; Tricolored, Great Blue and Black-crowned Night Heron; and Roseate Spoonbill. Technical considerations and constraints associated with site conditions and physical processes were assessed and evaluated for each of the four projects. Factors that might affect the biological restoration goals were also considered and incorporated into the projects design and expectations.

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Potential Impacts in heron populations due to scenarios of climate change in South America: focus in Paraguay and bordering countries (Oral – Heron Symposium)

Climate change affects ecosystems, habitats and species with increasing velocity and continuity. Climate change is expected to cause shifts in the geographic distribution of species worldwide as species track their optimal habitat which will likely shift as a result of rearrangement of climate zones. 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. We here analyze the historical information on climate for Paraguay and the distributional ranges for the 14 Ardeidae species occurring in the Paraguayan territory and their contribution to the 57 country's Important Bird and Biodiversity Areas (IBAs). Though most of the Paraguayan heron species may not be severely affected by the different climate change scenarios, this contribution highlight some of the threats and identify strategies for creating conditions towards more resilient heron populations which will serve to decision makers for improving their response and support for natural resource management.

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Camera traps as an effective monitoring tool for low detectability species - A rail tale (Oral)

Most conventional monitoring techniques to describe occurrence patterns and estimate population trends rely on observational data, and are well suited to large, widespread and/or abundant species. For small populations, strict habitat specialists and highly cryptic species, an absence of observational records need not indicate actual absences, complicating monitoring and confounding management. Rails (Rallidae) are a ubiquitous group of notoriously cryptic species, making them an ideal group to test novel monitoring techniques. Here we present field trials using camera traps in three settings: Lewin's Rail (*Lewinia pectoralis brachipus*) in dense heathland on Tasman Island Australia, Cocos Buff-banded Rail (*Gallirallus philippensis andrewsi*), on a series of isolated islands within a coral atoll in the Indian Ocean, and an assemblage of rails in managed and natural wetlands in South Carolina USA. We biased camera trap placement to maximize detection probability based on known habitat requirements with fine scale camera positioning. Data collected have provided information on behaviors previously not described, recruitment, conspecific and heterospecific interactions, the detection of invasive species, rare species including Black Rail (*Laterallus jamaicensis*) and Yellow Rail (*Coturnicops noveboracensis*) and vagrant species. As well as providing a window into a previously unseen world, resultant images proved to be a powerful tool for engaging land managers and the wider community. Although camera traps are not a replacement for all survey methods, they provide an alternative method for minimizing disturbance to species and habitat. We conclude that they are a useful inclusion in designing monitoring approaches for rails and ecologically similar species.