

42nd Annual Meeting of the Waterbird Society

18-20 August, 2018

Vancouver, British Columbia, Canada



Held in conjunction with:

the 27th International Ornithological Congress

19-26 August, 2018

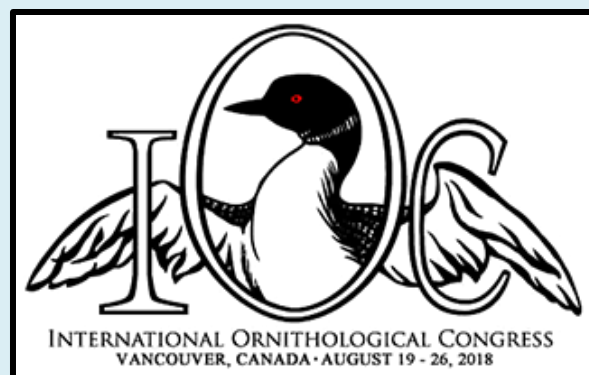


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The Waterbird Society <https://waterbirds.org/>

OUR MISSION

The Waterbird Society is an international scientific, not-for-profit organization whose mission is to foster the study, management and conservation of the world's aquatic birds. The Society's primary goals are to: (1) promote basic and applied research on waterbirds and their habitats, (2) foster science-based waterbird conservation globally, and (3) enhance communication and education at all levels - among professionals, policy makers, and citizens. To accomplish these goals, the Society publishes an international peer-reviewed journal, hosts scientific meetings, provides grants and awards, and facilitates other activities.

OUR HISTORY

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.

WATERBIRD SOCIETY COUNCIL

Officers

| | |
|-------------------------------|------------------|
| President: | Clay Green |
| Vice President: | Dave Moore |
| Secretary: | Patty Szczys |
| Treasurer: | Christine Custer |
| Editor of <i>Waterbirds</i> : | Stephanie Jones |

Elected Board Members

| | |
|-----------|--|
| 2016-2018 | Sandra Bouwhuis, Jim Fraser, Juliette Lamb |
| 2017-2019 | Dale Gawlik, Erik Mellink, Sarah Schweitzer |
| 2018-2020 | Dan Catlin, Sean Murphy, Kate Sheehan, Kate Shlper |

Past Presidents Susan Elbin, Erica Nol

Welcome from the President of the Waterbird Society

I am excited to welcome all of you to beautiful Vancouver for the 42nd Annual Meeting of the Waterbird Society. As this is my first meeting as President of the Waterbird Society, I cannot think of a better city and surrounding landscape for us to gather, learn and celebrate all things “waterbirds”. Vancouver was recently ranked as one of the cleanest and most liveable cities in the world and is an ideal setting for our meeting with its beautiful geography, rich avian diversity and commitment to sustainability and the environment.

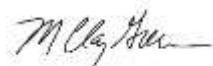
While we are meeting as a society with scheduled two full days of scientific program including a plenary by Rob Butler (former President of the Waterbird Society), this year we have the extra benefit of the 27th International Ornithological Congress beginning as we conclude our scientific program. This opportunity provides Waterbird Society members to enjoy the many events, presentations and symposia offered as part of the IOC. Society members should pay special attention to two waterbird symposia during the IOC: Loss of Tidal Wetlands Worldwide – Direct Anthropogenic Effects and Sea Level Rise (conveners Bruno Ens and Richard Fuller) and Foodwebs in Marine and Freshwater Systems – The Importance of Long-chained Fatty Acids for Shorebirds and Seabirds (conveners Pat Baird and Stephanie Jones).

I want to personally welcome all students to our society’s annual meeting. Our society has always valued students and I believe we as fellow members make a sincere effort to welcome you to the meeting and encourage your active and enthusiastic participation in our society. Likewise, welcome to all members who are attending their first Waterbird Society meeting. I hope you will find it as rich and rewarding as my first meeting many years ago. Our society cannot sustain itself nor grow without students and new member participation. We as Council are always looking for new people to actively participate in the society. I encourage everybody to attend our Business Meeting on Monday, August 20 at 15:15 to learn more about the society and how you can get involved.

In closing, I want to thank all those who made this meeting possible. I thank the Society’s officers, councilors, and committees for the many hours they volunteer to support our society and keep us progressing forward to promote waterbird research and conservation. I especially want to thank Dave Moore, our President-Elect, for assembling an excellent scientific program, Amanda Moore and Nellie Tshipoura for managing our website, Patty Szczys for organizing and gathering committee reports for our Council meeting, Chris Custer for all her tireless efforts as our Treasurer, Stephanie Jones for her 4th year of service as our Editor and especially Pat Baird, our local host, who along with the IOC Convener Bob Elner, have put together an excellent Waterbird Society meeting while juggling the demands of organizing the International Ornithological Congress.

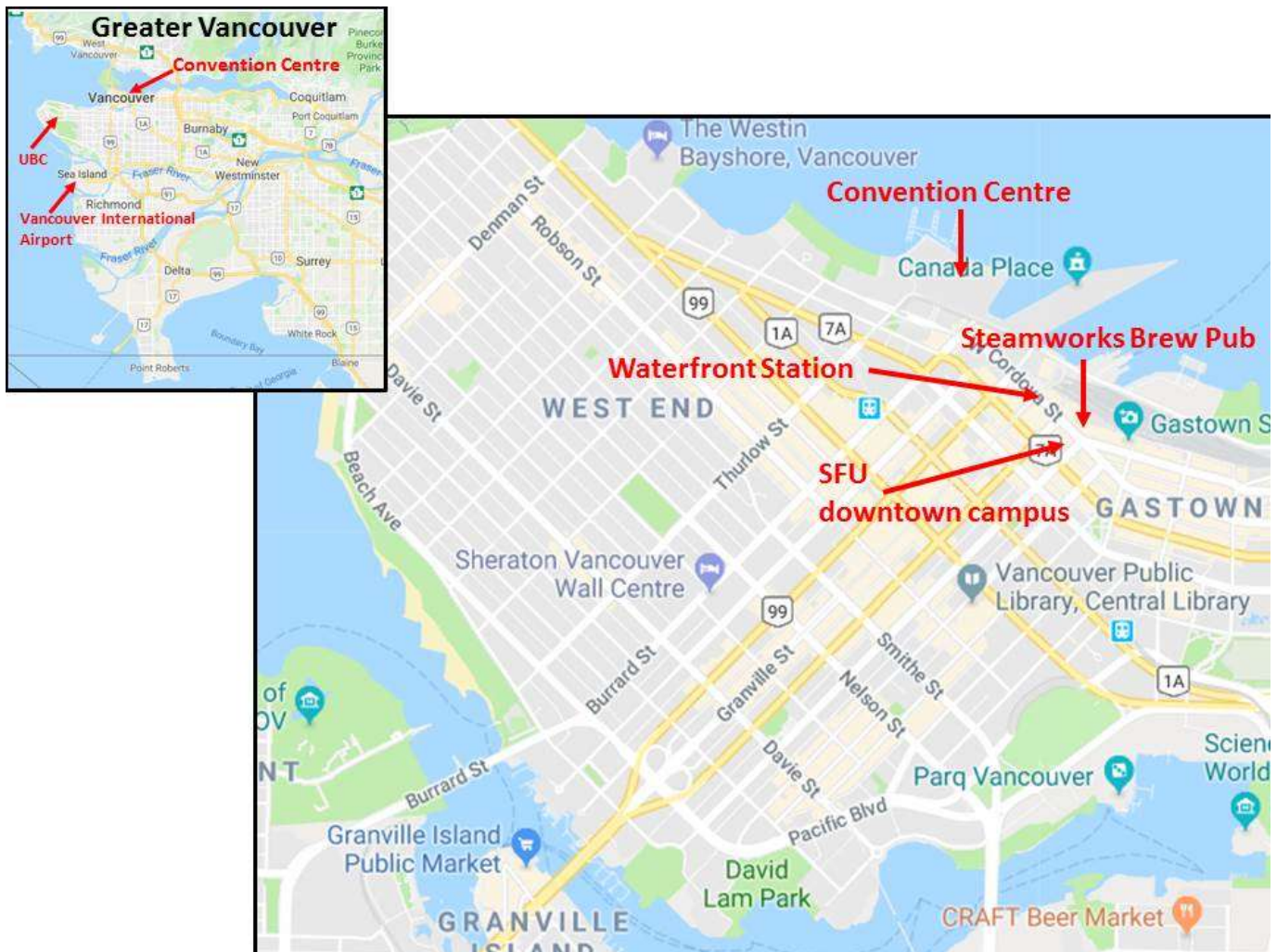
I look forward to catching up with all of you in Vancouver. Hope everybody enjoys their time together in beautiful Vancouver and British Columbia.

Yours sincerely,



Clay Green

Conference Map



Option for travel from Vancouver International Airport: Use the SkyTrain (Canada Line) to travel to Waterfront Station (closest station to conference venue). Trains run frequently from ~6am to ~1am
<https://www.translink.ca/>

Council and Committee meetings, Icebreaker (18 Aug)

Simon Fraser University - Vancouver Campus, Harbour Centre, 515 West Hastings Street
<http://www.sfu.ca/campuses/vancouver.html>

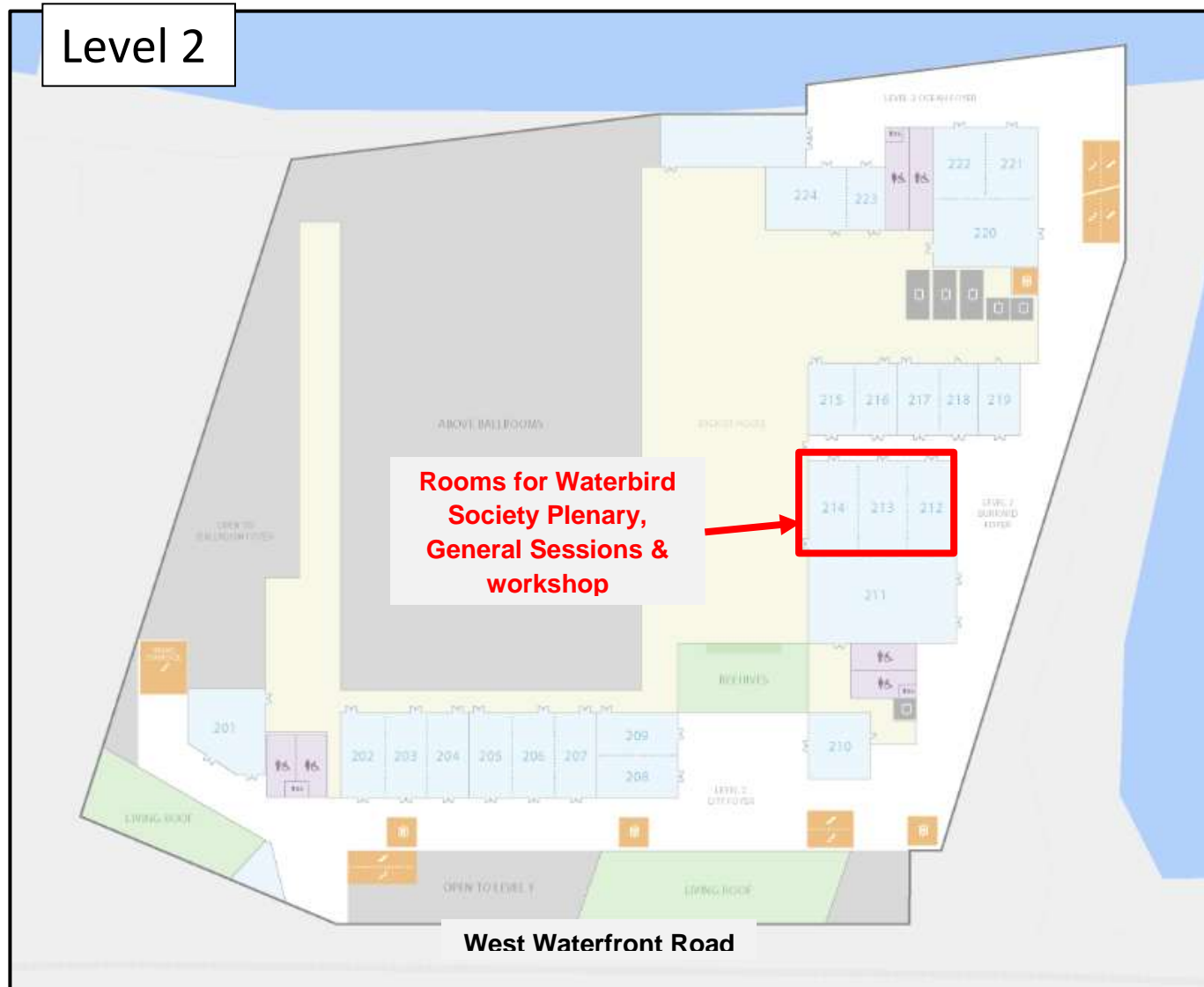
Conference (19-20 Aug)

Vancouver Convention Centre, West Building, Level 2, 1055 Canada Place
<https://www.vancouverconventioncentre.com/>

Banquet (22 Aug)

Steamworks brew pub, 375 Water Street <http://www.steamworks.com/>

Vancouver Convention Centre – Floor Plan



<https://www.vancouverconventioncentre.com/>

Social Media: #waterbirds2018



For meeting announcements, reminders, sharing, etc.

Scientific Program – at a glance

| Saturday, 18 August - AM & PM | | |
|-------------------------------|---|--|
| Time | Room 1500 Simon Fraser University - Vancouver Campus Harbour Centre, 515 West Hastings Street | Room 1510 Simon Fraser University - downtown campus Harbour Centre, 515 West Hastings Street |
| 8:30 | Council Meeting | Committee Meetings and WbS registration desk |
| 17:00 | Waterbird Society Icebreaker - Mixer (Hors d'oeuvres + cash bar) Rooms 1420-1430 Simon Fraser University - downtown campus Harbour Centre, 515 West Hastings Street | |
| 21:00 | | |

| Sunday, 19 August | | | |
|-------------------|--|-------------|--|
| Time | Rooms 212-214 Vancouver Convention Centre (VCC) West Building, Level 1 | Time | |
| 09:00-10:00 | <u>Plenary</u> <i>Rob Butler: Flyways to Culture: How birds give rise to a cultural awakening</i> | | |
| | VCC - Room 214 | | |
| 10:30-14:30 | WORKSHOP - Ecology and conservation of North American Black Terns | | |
| | VCC - Room 212 | | VCC - Room 213 |
| 10:30-12:10 | Behaviour & Breeding Ecology | 10:30-12:10 | Foraging |
| 13:20-15:00 | Breeding Ecology (cont'd) | 13:20-14:20 | Foraging (con't) |
| | | 14:20-15:20 | Contaminants |
| 15:50-17:30 | Population Monitoring & Ecology I | 15:50-18:10 | SYMPOSIUM - Ecological Energetics of Waterbirds: From Biochemistry to Biomes |

| Mon., 20 August | | | |
|-----------------|------------------------------------|-------------|------------------------------|
| Time | VCC - Room 212 | Time | VCC - Room 213 |
| 9:00-10:20 | Population/Conservation Genetics | 9:00-10:20 | Movement & Migration |
| 10:50-12:00 | Population Ecology & Demography I | 10:50-12:00 | Movement & Migration (con't) |
| 13:30-14:50 | Population Ecology & Demography II | | |
| 14:50-15:10 | Miscellaneous | | |
| 15:15-16:30 | Waterbird Society AGM | | |

Symposium – Ecological energetics of waterbirds: From biochemistry to biomes – Sun., 19 Aug., 3:50 – 6:10 pm;

Workshop – Ecology and conservation of North American Black Terns – Sun., 19 Aug., 10:00 am – 3:00 pm.

Social / Other Events

Waterbird Society

1. Saturday, **18 Aug.** - **Waterbird Society Council Meeting (8:30 am-5:00 pm)** – Room 1500, Simon Fraser University - Vancouver Campus, Harbour Centre, 515 West Hastings Street.
2. Saturday, **18 Aug.** - **Committee Meetings / Registration Desk (8:30 am-5:00 pm)** – Room 1510, Simon Fraser University - Vancouver Campus, Harbour Centre, 515 West Hastings St.
3. Saturday, **18 Aug.** - **Icebreaker (5:00-9:00 pm)** - Rooms 1420 & 1430, Simon Fraser University - Vancouver Campus, 515 West Hastings St. (hors d'oeuvres + cash bar)
4. Sunday, **19 Aug.** – **Yoga session** (led by Michelle Stantial) **(6:30-7:30 am)** – Harbour Green Park, 1199 W Cordova St. (weather permitting; venue subject to change). All skill levels - beginner to advanced - everyone's welcome! **Bring a yoga mat.**
5. Sunday, **19 August** - **Student-Mentor event (6 pm)** - Vancouver Convention Centre (VCC), West Building, Level 1 - meet in front of Room 101/102
6. Sunday, **19 August** - **Mixer (6:15-10 pm)** – VCC, Room 101/102. (hors d'oeuvres + cash bar)
7. Monday, **20 August** – **Waterbird Society Annual General Meeting (3:15 pm)** - VCC - Room 120
8. Monday, **20 August** – **Annual “Selfish Herd” Swim (9:30 pm)** – CRAB Park at Portside, 101 E Waterfront Rd. (date, time, & venue subject to change)
9. Wednesday, **22 August** - **Waterbird Society Banquet (6-10 pm)** - Steamworks Pub, 375 Water Street

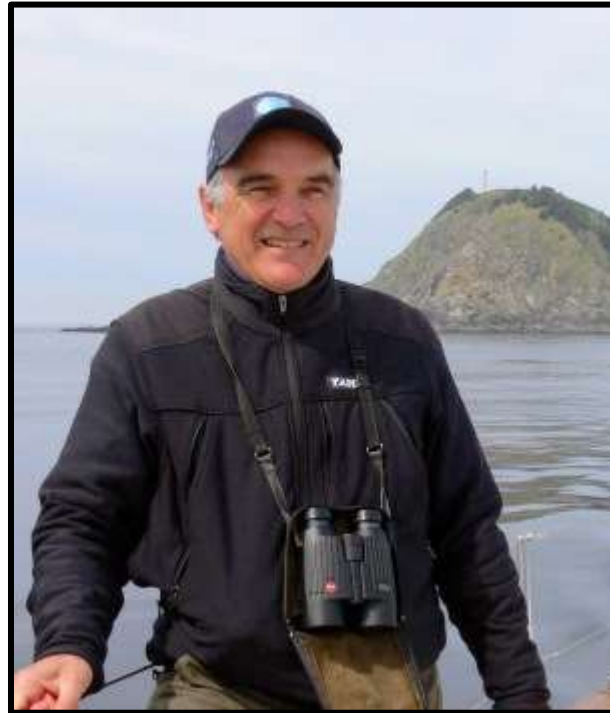
IOC

(see IOC website for full list and details: <http://www.iocongress2018.com/>)

1. Monday, **20 Aug.** - **IOC Opening Ceremonies (4:30-7:00 pm)** - VCC plaza
2. Monday, 20 Aug. – IOC Opening talks and welcome (6:00-7:00 pm) – VCC, West English Bay Ballroom A
3. Monday, **20 August** - **IOC Welcome Reception (7:00- 9:30 pm)** – VCC, West English Bay Ballroom D
4. Tuesday, **21 August** - **Canada Evening (6:45-10 pm)** – VCC, West English Bay Ballroom A

Plenary Speaker

Dr. Rob Butler (www.robbutler.ca)



Flyways to Culture: How birds give rise to a cultural awakening.

An emerging interest in birds encouraged by bird science and health benefits from nature is fostering a green lifestyle. A new economic market arising from the green lifestyle is creating a case for businesses to be on the leading edge of nature conservation. Rob Butler will present the case of how bird science gave rise to the engagement of the City of Vancouver to adopt a bird strategy that led to the Vancouver International Bird Festival. He will also describe how the interest in birds in particular and nature in general, is creating the foundation for a Nature Culture in which nature becomes embedded into a culture.

Dr. Rob Butler is an ornithologist, author, filmmaker and artist. He holds graduate degrees from Simon Fraser University (MSc) and the University of British Columbia (PhD). He spent 40 years, mostly with the Canadian Wildlife Service, as a biologist and then a scientist, researching birds. His research career began with the social behaviour of crows followed by the ecology of great blue herons that led to the publishing of *The Great Blue Heron* (UBC Press) in 1997, and then to the migration and ecology of shorebirds.

Rob is an adjunct professor of Biological Sciences at Simon Fraser University and has published over 140 works for scientific and popular audiences. He has scores of appearances on television, radio and in newspapers on bird related stories. He wrote and co-produced a film on nature and culture in the Salish Sea with Mike McKinlay in 2015.

Rob is a past-President (2000-2002) of the Waterbird Society. He serves on many boards including The Nature Trust of British Columbia, President the Pacific WildLife Foundation, Chair of the Vancouver International Bird Festival, and is Honorary Director of Nature Kids that he co-founded (with Daphne Solecki) in 2000.

He is a fellow of The Explorers Club, Royal Canadian Geographic Society, and American Ornithologists Union, an outstanding alumnus of Simon Fraser University and Capilano University, and Signature Member of Artists for Conservation. His art has appeared is in mostly private collections in Canada and abroad.

Waterbird Society at the IOC

1. SYMPOSIUM: Wednesday 22 August 10:00-11:00

Loss of Tidal Wetlands Worldwide – Direct Anthropogenic effects and sea level rise

Co-Conveners:

Dr. Bruno J. Ens, Team Leader Coastal Ecology, Sovon, Dutch Centre for Field Ornithology The Netherlands

Dr. Richard Fuller, School of Biological Sciences, University of Queensland Australia

KEYNOTE SPEAKERS

Dr. Richard Fuller: *"Mud, Glorious Mud! Global Distribution and Conservation of Intertidal Wetlands"*



Dr. Yvonne Verkuil: *"The Collapse of Intertidal Wetlands in the Yellow Sea: A Crucial Habitat for Migratory Waterbirds"*



2. SYMPOSIUM: Thursday 23 August 10:00-11:00

Wetland Foodwebs - the importance of long-chained fatty acids for shorebirds and seabirds

Co-Conveners:

Dr. Patricia Baird, Centre for Wildlife Ecology, Simon Fraser University, Canada

Dr. Stephanie Jones, Editor *Waterbirds*, USA

KEYNOTE SPEAKERS

Dr Patricia Baird: *"DHA and EPA – Essential in physiology of birds for reproduction, migration, and homeostasis"*



Dr. Christopher Guglielmo: *"Do polyunsaturated fatty acids matter for bird migration?"*



3. ROUNDTABLE DISCUSSION THURSDAY 23 AUGUST 2000-2200

Biofilm Quality in Mudflat Estuarine Environments: What does this mean for Shorebirds?

21-26 AUGUST | THE WATERBIRD SOCIETY - BOOTH # 137, VCC Exhibitor Hall

Please drop by to visit us and learn how you can participate in the Society, see copies of our international journal, *Waterbirds*, and try it out for free for 3 months.

Scientific Program – full schedule

[] indicates abstract number

| Sunday, 19 August - AM | | |
|------------------------|--|---|
| Time | Rooms 212-214 Vancouver Convention Centre (VCC) West Building, Level 2 | |
| 8:30 | Welcome, announcements | |
| 9:00 | <u>Plenary</u> <i>Dr. Rob Butler</i> Flyways to Culture: How birds give rise to a cultural awakening | |
| 10:00 | Break (VCC West - Room 213/214 foyer) | |
| Time | Room 214 VCC West | |
| 10:30-12:10 | [36] WORKSHOP - Ecology and conservation of North American Black Terns (Chairs: <i>Dave Moore & Patty Szczys</i>) | |
| Time | Room 212 VCC West | Room 213 VCC West |
| 10:30 | Behaviour & Breeding Ecology (Chair: <i>Golya Shahrokhi</i>) [56] <i>Natalie Thimot</i> Cues used by parasitic Red-breasted Mergansers for detecting and selecting host nests | Foraging Session (Chair: <i>Betsy Evans</i>) [17] <i>David Essian</i> Prey selectivity decreases along a gradient of prey density for a searcher, but not an exploiter |
| 10:50 | [9] <i>Shawn Craik</i> Costs and response to conspecific brood parasitism by colonial Red-breasted Mergansers | [18] <i>Betsy Evans</i> Hydrologic conditions and colony location influence diet breadth and productivity of nesting Wood Storks in South Florida |
| 11:10 | [31] <i>Dawn Marsh</i> Black tern nest success and response to invasive plant species in northern Michigan, USA | [34] <i>Katsutoshi Matsunaga</i> Can Grey Herons obtain information on temporal variation of food availability at a breeding colony? |
| 11:30 | [13] <i>Brandon Edwards</i> Assessing the effects of beach raking on piping plover reproductive success using an environmental agent-based model | [32] <i>Marisa Martinez</i> Spatiotemporal modeling of wading bird habitat in intertidal systems |
| 11:50 | [26] <i>Eunbi Kwon</i> Responses of neighboring piping plover populations to habitat creation, conservation, and disturbance | [27] <i>Elizabeth Lago</i> Changes in Foraging Behavior of Roseate Spoonbills (<i>Platalea ajaja</i>) Nesting in Florida Bay |
| 12:10 | Lunch | |

Sunday, 19 August - PM

| | | |
|--------------------|---|--|
| Time | Room 214 VCC West | |
| 13:20-15:00 | [36] WORKSHOP - Ecology and conservation of North American Black Terns (Chairs: <i>Dave Moore & Patty Szczys</i>) | |
| Time | Room 212 VCC West | Room 213 VCC West |
| 13:20 | Breeding Ecology (cont'd) (Chair: <i>Brandon Edwards</i>) [58] <i>Hannah Uher-Koch</i> Response of loons to oilfield development activities in the National Petroleum Reserve-Alaska | Foraging (con't) (Chair: <i>Émile Brisson-Curadeau</i>) [47] <i>Lauren Scopel</i> How can seabird diet data be used to inform fisheries management? |
| 13:40 | [53] <i>Hannah Specht</i> Habitat use by upland-nesting waterbirds is negatively affected by oil well infrastructure and activity | [4] <i>Émile Brisson-Curadeau</i> Location, location, location: the geographic association of thick-billed murre with their prey promises a new economic way to map fish distribution in the Arctic |
| 14:00 | [50] <i>Katherine Shlepr</i> Potential adaptive responses by the threatened Wood Stork (<i>Mycteria americana</i>) to altered Everglades hydrology | [8] <i>Elizabeth Craig</i> The upside to getting pooped on by terns – A fecal DNA analysis of tern diet on the Isles of Shoals, New Hampshire. |
| 14:20 | [43] <i>Jaime Ramos</i> Vegetation cover and environmental variability in explaining local and regional fluctuations in Little Terns' breeding population size. | Contaminants [10] <i>Christine Custer</i> Contaminants of emerging concern: assessing their impact on tree swallows, a model avian species |
| 14:40 | [3] <i>Sarah Bolinger</i> Modeling nest survival of Least Terns in Southeast Louisiana with multiple sources of failure | [11] <i>Shane de Solla</i> Influence of PAH exposure and diet on metabolomic responses of double-crested cormorants |
| 15:00 | | [1] <i>Stephanie Avery-Gomm</i> Plastic pollution in the Labrador Sea: An assessment using the seabird northern fulmar <i>Fulmarus glacialis</i> as biological monitoring species |
| 15:20 | Break (VCC West - Room 213/214 foyer) | |

Sunday, 19 August - PM

| Time | Room 212 VCC West | Room 213 VCC West |
|-------------|--|---|
| 15:50 | Population Monitoring & Ecology I (Chair: <i>Michelle Stantial</i>) | [42] SYMPOSIUM - Ecological Energetics of Waterbirds: From Biochemistry to Biomes (Chairs: <i>Allison Patterson & Patricia Baird</i>) |
| 16:10 | [39] <i>Sean Murphy</i> Describing the detection process of the endemic Cape Sable Seaside Sparrow in the Everglades ecosystem | [28] <i>Thomas Lazarus</i> Energy management during the breeding season in thick-billed murre |
| 16:30 | [5] <i>Corey Callaghan</i> Assisted monitoring of large wading bird colonies using unmanned aerial vehicles | [23] <i>Jennifer Howard</i> The fine-scale flight performance of Nazca boobies |
| 16:50 | [45] <i>Esther Rickert</i> Comparison of Aerial Survey Methods for Seabird and Marine Mammal Monitoring | [14] <i>Kyle Elliott</i> Using conservation energetics to link individual behaviour with population- and ecosystem-level processes |
| 17:10 | [7] <i>Robin Colyn</i> Directing conservation efforts for the Critically Endangered White-winged Flufftail using predicative modelling and remote photography | [49] <i>Emily Shepard</i> High winds act as invisible barrier preventing cliff-nesting seabirds from accessing their nests |
| 17:30 | | [21] <i>David Gremillet</i> Avian energetics and the conservation of seabirds facing global |
| 17:50 | | Discussion/Wrap-up |
| 18:10 | Student-Mentor meeting place outside room 201 VCC, West Building, Level 2 | |
| 18:15 | Waterbird Society - Informal Mixer Hors d'oeuvres + cash bar Room 201 VCC, West Building, Level 2 | |
| 22:00 | | |

Mon., 20 August - AM

| Mon., 20 August - AM | | |
|-----------------------------|--|---|
| Time | Room 212 Vancouver Convention Centre (VCC), West Building, Level 2 | Room 213 VCC, West Building, Level 2 |
| 8:45 | Announcements | |
| 9:00 | Population/Conservation Genetics (Chair: <i>Kate Shlepr</i>) [44] <i>Kristina Ramstad</i> Are American wood storks panmictic? | Movement & Migration (Chair: <i>Jenny Howard</i>) [25] <i>Martha Kawasaki</i> Nā kūkuluae'o lele ma luna o ka'āina i māhele'ia: Hawaiian stilt movements through an urban landscape |
| 9:20 | [48] <i>Golya Shahrokhi</i> Sex-biased dispersal between management units of a rare waterbird | [54] <i>Michelle Stantial</i> Using miniaturized GPS tags to study breeding season habitat use and migration in threatened Piping Plovers |
| 9:40 | [51] <i>Hanneline Smit-Robinson</i> Genetic sequencing to unravel the mysteries and aid the conservation of the critically endangered White-winged Flufftail | [12] <i>Sjoerd Dirksen</i> Origin of Ruddy Shelducks moulting in the Netherlands |
| 10:00 | [59] <i>Charles van Rees</i> Navigating a paved paradise: landscape genetics of an endangered Hawaiian waterbird | [41] <i>Allison Patterson</i> Quantifying the prospecting behavior and breeding networks of a ground-nesting colonial waterbird |
| 10:20 | Break (VCC West - Room 213/214 foyer) | |
| Time | Room 212 VCC West | Room 213 VCC West |
| 10:50 | Population Ecology & Demography I (Chair: <i>David Essian</i>) [24] <i>Daniel Catlin</i> Plover paparazzi: using nest video cameras to estimate survival and population size of breeding Piping Plovers | Movement & Migration (con't) (Chair: <i>Stephanie Avery-Gomm</i>) [6] <i>Yat-tung Yu</i> Satellite tracking to find the breeding origin of Greater Crested Terns wintering in the tropical Asia and Australia region |
| 11:10 | [15] <i>Lisa Elliott</i> Effects of wetland area and habitat heterogeneity on species richness and abundance of waterbirds | [37] <i>Dave Moore</i> Migration patterns and overwintering distribution of Black Terns breeding on the Laurentian Great Lakes. |
| 11:30 | [33] <i>Miyuki Mashiko</i> Site fidelity in lineages of mixed-species heron colonies | [29] <i>Pamela Loring</i> Annual-cycle Movements of Common Terns Tracked with Satellite Telemetry |
| 11:50 | [35] <i>Audrey Taylor</i> Using long-term citizen science data to examine trends in Common and Pacific Loon demography in southcentral Alaska | [30] <i>Donald Lyons</i> The Aleutian Tern: a tropical pelagic tern lost in the predator-infested sub-arctic? |
| 12:00 | [19] <i>Daniel Gibson</i> Assessing the impacts of hurricanes on American oystercatcher behavior and demography throughout coastal Georgia | [7] <i>Corey Clatterbuck</i> Contaminants as ecological tracers: does mercury load reflect foraging habits of a generalist seabird? |
| 12:20 | Lunch | |

| Mon., 20 August - PM | | |
|-----------------------------|--|------------------------------|
| Time | Room 212 VCC West | Room 213 VCC West |
| 13:30 | Population Ecology & Demography II (Chair: <i>Sean Murphy</i>) [16] Bruno Ens CHIRP: Assessing the Cumulative Human Impact on a declining population of Eurasian Oystercatchers | |
| 13:50 | [20] <i>Clay Green</i> Population Viability of Reddish Egrets in Texas | |
| 14:10 | [40] <i>Erica Nol</i> Weather-related effects on seasonal demography, and life-time reproductive success in a small arctic-breeding shorebird | |
| 14:30 | [46] <i>Daniel Roby</i> Modeling population dynamics of a conservation reliant seabird: Caspian Terns in the Pacific Flyway of North America | |
| 14:50 | Miscellaneous [38] <i>Dave Moore & Liz Craig</i> Gender equity in the Waterbird Society?: an assessment and starting point for discussion | |
| 15:10 | <i>Clay Green</i> Closing remarks | |
| 15:15 | Waterbird Society Annual Business Meeting Room 212 - VCC West | |
| 16:30 | IOC Opening Ceremonies VCC Plaza | |
| 18:00 | IOC Opening Talks & welcome West English Bay Ballroom A - VCC West | |
| 19:00 | IOC Welcome Reception (hors d'oeuvres + cash bar) West English Bay Ballroom D - VCC West | |
| 21:30 | | |

| Tues., 21 August - PM | | |
|------------------------------|--|--|
| 18:45 | IOC Canada Evening West English Bay Ballroom A - VCC West | |
| 22:00 | | |
| Wed., 22 August - PM | | |
| 18:00 | Waterbird Society Banquet (cash bar) Steamworks Pub 375 Water Street | |
| 22:00 | | |

Alphabetical list of abstracts for oral presentations

Bolded names (and emails, in blue) are the presenters. An * next to a name indicates that the presenter is a student.

[1] **Avery-Gomm, Stephanie***¹, Jennifer F. Provencher², Max Liboiron³, Florence E. Poon⁴ and Paul A. Smith⁵

¹Centre of Excellence for Environmental Decisions, University of Queensland, St. Lucia, Brisbane, Queensland, Australia; ²Acadia University, Biology Department, Wolfville, Nova Scotia, Canada; ³Memorial University of Newfoundland, Department of Geography, St. John's, Newfoundland, Canada; ⁴Carleton University, Institute of Environmental Science, Ottawa, Canada; ⁵Wildlife Research Division, Environment and Climate Change Canada, Ottawa, Canada; stephanie.averygomm@gmail.com

Plastic pollution in the Labrador Sea: An assessment using the seabird northern fulmar *Fulmarus glacialis* as biological monitoring species

Plastic is now one among one of the most pervasive pollutants on the planet, and ocean circulation models predict that the Arctic will become another accumulation zone. As solutions to address marine plastic emerge, is essential that baselines are available to monitor progress towards targets. The northern fulmar (*Fulmarus glacialis*), a widely-distributed seabird species, has been used as a biological monitor for plastic pollution in the North Sea, and could be a useful monitoring species elsewhere. We quantified plastic ingested by northern fulmars from the southeastern Canadian waters of the Labrador Sea with the objective of establishing a standardized baseline for future comparisons. Over two years we sampled 70 fulmars and found that 79% had ingested plastic, with an average of 11.6 pieces or 0.151 g per bird. Overall, 34% of all fulmars exceeded the Ecological Quality Objective for marine litter, having ingested > 0.1 g of plastic.

ENERGETICS SYMPOSIUM

[2] **Baird, P.**¹ and R.W. Elnor²

¹Kahiltna Research Group & Centre for Wildlife Ecology, Simon Fraser University, Vancouver, British Columbia, Canada; ²Environment and Climate Change Canada, Pacific Wildlife Research Centre, Delta, British Columbia, Canada; pab7@sfu.ca

Revelations: Alpha and the Omega – or why diatoms matter for shorebirds

Plants at the base of the food chain, produce energy through photosynthesis using Chlorophyll- α (alpha) and sunlight. However, diatoms, phytoplankton, not only produce energy (alpha-based) but are also the major source of omega-three long-chain highly unsaturated fatty acids when they bloom. Omega-3's are essential for various physiological processes in all animals. Heterotrophs cannot produce these fatty acids and fare poorly without them. Productivity and growth are poor in species ranging from zooplankton to seabirds if their prey are depauperate in these compounds.

Omega-3 fatty acids appear critical for successful shorebird migration, and species such as Western Sandpiper move down the trophic web to graze diatoms at their major stop-over sites before during their migratory leaps to Arctic breeding grounds. Certain omega-three fatty acids produced by diatoms in bloom are postulated to prepare shorebird flight muscles for endurance flight as well as enable fats to be shunted into storage to power long-distance migration. We present evidence and a new approach to understanding marine food webs, migration and conservation in shorebirds centered on ω (omega-3 fatty acids) production rather than α (Chlorophyll-a derived) energy. Viewing shorebird migration through the lens of access to ω as opposed to α represents a major paradigm shift in ornithology.

[3] Bolinger, Sarah M.^{1,2}, Erik I. Johnson¹ and Scott M. Duke-Sylvester²

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Modeling nest survival of Least Terns in Southeast Louisiana with multiple sources of failure

Beach restoration and renourishment projects in Southeast Louisiana create new sparsely vegetated beach, thought to be attractive nesting habitat for Least Terns. Our analyses suggest that these restoration projects improve nest survivorship during storms due to the increase in elevation, but how they affect predation is largely unknown. In addition, the nesting season brings large storm events that may mask the effects of predation. We estimated nest survivorship for the 2016 and 2017 nesting seasons on a 4-km stretch of beach in the Elmer's Island Wildlife Refuge, part of the Caminada Headlands Phase II dune renourishment project (completed in fall 2016). To account for multiple sources of nest failure (predation and washout), we used a Markov Chain model (Etterson 2007). Because the 2016 season had no major storm events, we included a year effect in one model to look for a masking effect of storms on predation rate. Using synthetic nest data, we were able to better quantify potential bias due to storm events, which needs to be considered in future analyses. Continued monitoring by Audubon Louisiana and graduate students will provide insight into how these trends in predation, washout, and nest survival evolve in the years following restoration.

[4] Brisson-Curadeau, Émile*¹ and Kyle H. Elliott¹

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Location, location, location: the geographic association of thick-billed murre with their prey promises a new economic way to map fish distribution in the Arctic

Seabirds have long been proposed as indicators of the marine fauna to complement the traditional sampling from fishing vessels. The thick-billed murre (*Uria lomvia*), a deep-diving seabird, is one of the potential indicator species of the polar region, as it is a generalist predator distributed all around the Arctic. However, little is known about how the different foraging strategies among individuals influence the prey type captured in a dive, which is crucial to use the species as indicator of the Arctic ocean. The objective of our study was to identify how foraging behaviour varies with the prey type caught during a dive by combining GPS-depth loggers with observations of adults feeding their chick at colony. We built a predictive model using dive shape, dive depth, distance from the colony and distance from shore to forecast the prey type caught in the dive. The results show that the location where a murre dives is the most important factor to predict prey type, with maximum depth and dive shape having only minor effect on the predictions. Our study demonstrates that murre can target areas where a given prey type is abundant, therefore opening the possibility that murre distribution can be used to infer on prey distribution.

[5] Callaghan, T. Corey*¹, Mitchell B. Lyons¹, Kate J. Brandis¹ and Richard T. Kingsford¹

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Assisted monitoring of large wading bird colonies using unmanned aerial vehicles

Monitoring bird populations is critical in assessing the impacts of conservation and management practices. Unmanned aerial vehicles (UAVs) have seen a marked increase in the last decade throughout all of wildlife research, and have also been increasingly used to monitor colonial breeding waterbirds. Importantly, we highlight that they are not a panacea for monitoring of colonial breeding waterbirds, as human intervention is still required (e.g., flying the UAV, processing the imagery, and assessing accuracy). Based on monitoring of large colonies in central and eastern Australia (ranging in size from ~15,000 - ~100,000 breeding pairs) we present a semi-automated approach which uses drone imagery to assess colony size, extent, and numbers of individuals based on mapping of nest area and modelling of nest size. This approach is pertinent in circumstances in which traditional remote sensing classifications fail, including complex features with relatively low contrast to background imagery, as well as high variability in target features (e.g., different species, varying nest age and condition, very large numbers of highly mobile birds). This methodology relies on some counting of nests in images to train a machine learning algorithm to classify nest material in the drone imagery. Ultimately, UAVs show a bright future in wildlife research and specifically in colonial wading bird monitoring.

[6] Chan, Simba¹, Ria Saryanthi², Ferry Hasudungan², Fransisca N. Tirtaningtyas³, Dewi Malia Prawiradilaga⁴, Donald E. Lyons⁵ and Yat-tung Yu⁶

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Satellite tracking to find the breeding origin of Greater Crested Terns (*Thalasseus bergii*) wintering in the tropical Asia and Australia region

The Greater Crested Tern (*Thalasseus bergii*) has a large geographical distribution from China in the north to Australia in the south. The breeding population in China is known to winter in the Philippines and west to Myanmar from recent satellite-tracking studies, but the overseas movement or migration of the Australian population is still largely unknown despite colour-marking of some individuals in the breeding grounds. Therefore, the Greater Crested Terns found wintering in Indonesian waters still had an uncertain breeding region origin and migration route. Our study targeted individuals residing in the Maluku area of eastern Indonesia during the period of northern winter. A trapping and ringing operation was conducted on 8 to 11 February 2018 by an international team of tern researchers. Seven Greater Crested Terns were captured and fitted with metal and engraved plastic colour rings, and three of them were fitted with 5g satellite telemetry (PTT) tags to study their movements and migration routes.

The three PTT-tagged individuals, two adults and one immature, behaved differently after release. The two adults started their migrations on 13 February, quickly headed southeast through the Arafura Sea and arrived to the northern coast of Australia on 20 and 21 February. One individual migrated 1,936km in 9 days and the other 2,009km in 8 days. Subsequently, both birds stayed in southeast corner of the Gulf of Carpentaria through at least early April. The immature individual stayed in coastal areas up to 80 km away from the trapping site through at least early 9 April. Its average movement was 26.3 ± 32.7 km. To our knowledge, this is the first satellite-tracking study of Greater Crested Terns in the tropical Asian-Australasian region. Our results not only reveal a previously unknown migration route, but also identifies key coastal areas utilized by the Greater Crested Terns within Indonesia. This could lead to the discovery of major feeding and high-tide roosting areas of this and other tern species present in the area. Our research plan is to continue this marking and tracking study, and to encourage more local academics and conservationists taking part in seabird research in this region.

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Contaminants as ecological tracers: does mercury load reflect foraging habits of a generalist seabird?

Mercury is a commonly monitored contaminant in birds because of its adverse impacts on avifaunal reproduction and survival, but is rarely used as an ecological tracer. Biogeochemical processes can alter mercury bioavailability at multiple spatial scales and habitats, resulting in complex signatures among free-ranging animals. However, when combined with additional foraging data, mercury may be an ideal tracer to link contaminant load to exposure risk among colonies and associated foraging pathways or sites. Here, we pair blood mercury concentrations and GPS tracking data in breeding western gulls (*Larus occidentalis*, N=156) from five colonies in coastal California and Oregon, USA, to explore the extent to which blood mercury burdens reflect short-term gull foraging spatial patterns. We analyzed tracks using multiple movement analyses, including trip-based metrics and mechanistic movement models to determine foraging locations at land and sea. We then compare individual and colony movement metrics to measured blood mercury values both within and among colonies. Our results connect mercury concentrations with marine and terrestrial foraging in gulls and provide insight into the foraging differences and differences in mercury exposure among breeding western gulls across their range.

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Directing conservation efforts for the Critically Endangered White-winged Flufftail (*Sarothrura ayresi*) using predicative modelling and remote photography.

The Critically Endangered White-winged Flufftail *Sarothrura ayresi* is regarded as one of the rarest and most threatened rallids in Africa. The species' low density, habitat preference, cryptic colouration, elusive behaviour and lack of auditory cues have resulted in it being one of the most challenging species to survey using traditional methods such as auditory surveys and rope dragging. Subsequently, numerous data deficiencies exist regarding facets of the species ecology, distribution, habitat-use and population status. Through a novel combination of remote sensing and camera trapping our study was able to estimate both macro- and micro-habitat status utilised by White-winged Flufftail. Micro-habitat survey results yielded the first confirmed breeding records for southern Africa, the first robust detection history of independent sightings (> 60 sightings) ever recorded, first documented territoriality displays and intra- and inter-specific associations, activity patterns, site occupancy and detection probability of this species. Site occupancy was positively influenced by both basal and canopy cover, whilst detection probability was negatively influenced by water depth. Macro-habitat results displayed less than 10 core habitat strongholds available for this species across its range between Ethiopia and South Africa. Our study supports the need for conservation initiatives focused on securing contiguous sections of connected suitable wetland habitat in order to accommodate the persistence of this Critically Endangered species.

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The upside to getting pooped on by terns – A fecal DNA analysis of tern diet on the Isles of Shoals, New Hampshire.

The Gulf of Maine is one of the fastest warming marine habitats on earth, causing shifts in the abundance and distribution of many marine species in the region. Breeding seabirds constantly sample the marine environment surrounding their colonies and therefore their foraging locations and diets can provide information about changes to the ecosystem. However, seabird diets can be difficult to monitor. Here, we trialled a fecal DNA method to monitor Common and Roseate Tern diets at a mixed breeding colony in the Gulf of Maine. Adult Common Terns defecate upon intruders as a defence mechanism, and so, as we conducted normal colony monitoring efforts, we collected the feces that rained down on us. We also collected fecal samples from chicks of both species as they were being banded. We then used metabarcoding to identify prey items from the DNA contained in the fecal samples. We used a hierarchical approach, employing universal eukaryotic primers to determine the breadth of the diet and fish-specific primers to identify fish prey items with higher resolution. We compare these results with chick-provisioning observations to assess the suitability of this technique for long-term and range-scale monitoring of tern diets.

[10] Craik, Shawn R.¹, Rodger D. Titman², Jean-Pierre L. Savard³, Mohammadi Kaouass¹, Natalie Thimot² and Kyle H. Elliott²

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Costs and response to conspecific brood parasitism by colonial Red-breasted Mergansers

Costs of conspecific brood parasitism (CBP) are expected to vary according to a species' life history traits. For birds with precocial young, costs of caring for additional newly-hatched young can be small. Precocial birds, however, lay large clutches, and host fitness may be affected when clutches are heavily parasitized. We examined costs and response to CBP by hosts in a population of colonial Red-breasted Mergansers (*Mergus serrator*, $n = 400$ nests over 8 years) within which 30% of parasitized nests were enlarged considerably (≥ 15 eggs). Hatching success declined with clutch size. Hatchability of host (52%) and parasite eggs (50%) was nearly identical, implying that hosts incur greater costs of CBP with clutch size. For a nest with ≥ 15 eggs, one or more fewer host eggs hatch relative to an unparasitized nest with the same number of host eggs. A nest abandonment model showed that when prospects of heavy CBP are detected early during laying, it is advantageous for the host to abandon and reneest. Indeed, nests receiving 2 or 6 experimental eggs during the host's laying cycle were more likely to be deserted than unparasitized nests. Hosts did not respond to experimental nest parasitism by reducing the size of their clutch. All ducklings in the largest broods (9-10 young) were as likely to remain with the hen during the first week of rearing as for broods with ≤ 5 ducklings. Our results suggest that costs of CBP to hosts during breeding occur only during the nesting phase, and that these costs are limited to the small proportion of hens incubating the largest clutches (~30% of nests). The study provides novel insight into how frequent CBP can be maintained in colonial waterfowl.

[11] Custer, Christine M.¹, Thomas W. Custer¹, Paul M. Dummer¹ and Marc Mills².

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Contaminants of emerging concern: assessing their impact on tree swallows, a model avian species

Thousands of chemicals are entering the environment each year overwhelming the ability of regulatory and management agencies to identify, understand, and manage any possible adverse effects. Tree swallows (*Tachycineta bicolor*), an avian aquatic insectivore, has been used in Canada and the U.S. to understand contaminant exposure and effects. This species closely tracks, and can react to, bioavailable sediment contaminants. Because of their natural history characteristics, many bioindicators of contaminant exposure have been, and are being, developed to use with this species. A suite of contaminants of emerging concern (CECs), as well as legacy contaminants, were assessed in the Maumee River region of Ohio and included new pesticides, pharmaceuticals and personal care products (PPCPs) along with the little studied polycyclic aromatic hydrocarbons (PAHs). Simultaneously, a suite of bioindicator analyses, such as EROD, oxidative stress measures, and genetic damage along with both transcriptomic and metabolomic profiles were measured. Only 8 of 141 PPCP were detected in swallow liver tissue. Only 19 of 141 were detected in sediment samples. Some of these CECs were only detected in sediments, others only in bird tissues, and some in both matrices. Multivariate analyses of 192 metabolites indicated that the GSH oxidative stress pathway and the SM (OH) C22:2 pathway differed among sites in the river basin. A combination of these techniques offers promised to understand whether, and how severe, effects may be from these newly emerging contaminants.

[12] de Solla, Shane¹, Valerie Langlois², Sarah Wallace², Philippe Thomas³, John Cosgrove⁴ and Bharat Chandramouli⁴

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Influence of PAH exposure and diet on metabolomic responses of double-crested cormorants

Earlier research indicated that airborne exposure to PAHs increased the incidence of mutations in double-crested cormorants that were breeding in Hamilton Harbour relative to those from a Lake Erie reference site; further, alterations in gene expression in the putative p53 (tumor suppression gene) pathway were observed. We examined the metabolomics responses from cormorant chicks from each colony, using 3 tissues (blood, liver, lung). Over 200 metabolites, including acylcarnitines, amino acids, glycerophospholipids, hexose, sphingolipids, and biogenic amines, fatty acids, and bile acids, were measured by flow injection- or liquid chromatography-tandem mass spectrometry. Although all three tissues easily differentiated the three colonies, the majority of differences observed were between the Lake Erie colony and the other two Hamilton Harbour colonies. Based upon estimates of diet using regurgitates and stable isotopes ($\delta^{13}C$, $\delta^{15}N$), most of the differences in metabolomics responses appear to be due to diet, as opposed to either airborne PAH exposure, or dietary exposure to POPs. Metabolomics are a useful tool in determining responses of wildlife in field studies where there are multiple, sometimes confounding, stressors including contaminant exposure and ecological drivers.

[13] Dirksen, Sjoerd¹ and Erik Kleyheeg²

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Origin of Ruddy Shelducks moulting in the Netherlands

Since 1995, an increasing number of Ruddy Shelducks (*Tadorna ferruginea*) are moulting at Eemmeer, The Netherlands. In 2013, over 800 individuals were present from shortly before moult, in July, and leaving The Netherlands by early October. The Dutch breeding population, consisting of 10-30 pairs, is much too small to be the source, rendering the origin of moulting birds unclear. In several European countries, Ruddy Shelducks have established feral populations originating from captivity, but even combined the population estimates of these populations seemed unlikely to explain the rapid increase of moulting birds in the Netherlands. Hence, an origin from the natural range in the Mediterranean, eastern Europe or even west Asian steppe areas could not be excluded. Ruddy Shelducks migrate over long distances. In Poland a bird with a ring from Kirgizistan was found, so Ruddy Shelducks may end up far from their natural range. Therefore, the primary question in this study was: does (a proportion of) the moulting population of Ruddy Shelducks at Eemmeer originate from the species' natural range, or are they from feral populations in neighbouring countries? In 2013 - 2016 we caught 333 moulting Ruddy Shelducks at Eemmeer and 16 birds at other locations in The Netherlands, of which 198 and 14 respectively were given neckrings. Seven birds at Eemmeer were equipped with a GPS-GSM-transmitter. We will present the movements of these birds, which were seen mainly in Germany and Switzerland. Population numbers in these countries appear to be higher than previously thought. Also timing and duration of moult, weight in relation to moult stage, selection of moult sites, individual fidelity to moult sites will be presented. All in all, we present how the species uses this extension of its range, from in between mountains in Middle Europe to the delta of the river Rhine. The results prove that studying such a group of moulting birds leads to new insights in the ecology, distribution and numbers of a severely understudied species in NW-Europe. Additionally, this study demonstrates that field research provides relevant information for management of potentially invasive species.

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Assessing the effects of beach raking on piping plover reproductive success using an environmental agent-based model

The piping plover (*Charadrius melodus*) is an endangered species of shorebird native to North America. Through aggressive conservation efforts, piping plovers have begun to return to historical nesting grounds, with nests being established on all 5 Great Lakes in 2017. In the Great Lakes region, piping plovers nest on open sandy beaches. One area of concern is Sauble Beach, a popular tourist beach on Lake Huron in South Bruce Peninsula, Ontario. Piping plovers have used this beach as nesting grounds since 2007. Residents and tourists of the area prefer that the beach is fully raked and cleared of any vegetation and driftwood, materials that piping plovers use for nesting, feeding, and cover. In the past few years, this has caused significant tensions between municipal governments and biologists, where municipal government feels biologists have "taken over" the beach to try to protect the endangered piping plovers. There exists a need to create a predictive tool to assist in informing management decisions for protecting the piping plovers that can also benefit the tourism industry of the area. This study explores the use of environmental agent-based models (enviro-ABMs) on the Great Lakes piping plover. Enviro-ABMs are a type of simulation model that can be used to create simulations of a region to assess the effectiveness of various management scenarios. Using Python, a high-level programming language popular in scientific computing, an enviro-ABM is developed to provide simulations of piping plover hatchling growth during a given breeding season on Sauble Beach. We experiment with varying levels of simulated beach raking to assess their effects on piping plover hatchling growth. We conclude with recommendations for appropriate beach raking decisions and future directions of how this model should further be developed.

ENERGETICS SYMPOSIUM

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Using conservation energetics to link individual behaviour with population- and ecosystem-level processes

Ecosystem dynamics are ultimately the consequence of movements by individual organisms, whose behaviour, in turn, is regulated by internal biochemistry. From mitochondria to food webs, such links are controlled by energy flux. The biologging revolution has allowed scientists unprecedented insight into the movement of individual animals. By using an energetics framework and a model species with high energy costs, the thick-billed murre, I will use biologging to link cellular metabolites to individual behaviour and fitness. Energy hormones, such as corticosterone and thyroid hormones, regulate behaviour, with individuals working harder to gain less, reducing fitness, as energy (controlled by sea ice dynamics) becomes sparser. I will then link individual fitness to population- and ecosystem-level processes to construct an 'energyscape'. The 'energyscape' can then be used to define marine protected areas that will benefit both murre populations and other components of the ecosystem. By accounting for the trend that individual birds will sample larger prey farther from the colony to optimize energy gain per unit time, the 'energyscape' can be used to determine prey availability at sea. Thus, 'conservation energetics' can be used at multiple biological scales to answer policy questions of concern to managers responsible for ocean health.

[16] Elliott, Lisa H.*¹, Douglas H. Johnson² and Lawrence D. Igl³

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Effects of wetland area and habitat heterogeneity on species richness and abundance of waterbirds

Recommendations for conserving biodiversity and promoting abundant populations of species of conservation interest often focus on protecting the largest possible blocks of contiguous habitat. However, we also expect that species richness will be higher when habitat heterogeneity is high and can therefore accommodate the various niche requirements of different species. At the same time, we expect that individual species will be abundant only at those sites with an adequate area of the particular habitat types that define their niches—a low or moderate amount of heterogeneity may be superior. In order to develop better recommendations for conservation and management of wetland obligate birds, we analyzed three years of data from the Prairie Pothole Region of North and South Dakota to assess whether breeding season avian species richness was (1) higher in larger wetlands than in smaller wetlands, and (2) higher in wetlands with greater habitat heterogeneity than in wetlands with lower heterogeneity. We similarly examined how the abundance of individual species responded to wetland area and habitat heterogeneity. We first modeled total species richness and the richness of several avian functional groups (e.g., wading birds, shorebirds, waterfowl, grebes, rails, and other colonial-breeding waterbirds) using wetland size (area). We then modeled the residuals from these area models in relation to Simpson diversity indices of proximate cover and surrounding land cover, as well as wetland class and ownership. We found that wetland size accounted for the majority of variation in total species richness and richness of functional groups, explaining as much as 64% of the observed variation. Habitat heterogeneity explained only modest additional variation in avian richness. In most cases, wetland size was also more important for individual species than habitat heterogeneity and species respond to other wetland features as well. Our findings support conventional wisdom that reserve size is critical for wetland waterbirds. To a lesser degree habitat heterogeneity also promotes avian richness. The abundance of individual species of concern can be managed at multiple scales based on species-specific responses to wetland features.

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CHIRP: Assessing the Cumulative Human Impact on a declining population of Eurasian Oystercatchers

An unsolved problem in nature protection is how to assess the cumulative impact of human activities, operating at different times of the year and at different spatial scales. It is impossible to perform multifactorial experiments to tease apart the contribution from each of the pressures. We have embarked on a major research effort to parameterize and validate a set of interlocking models, applied to an iconic declining wild bird species: the Eurasian Oystercatcher (*Haematopus ostralegus*). This species occupies habitats that are of significant conservation concern (protected intertidal mudflats in winter; coastal areas and inland meadows in summer). We capitalize on knowledge and data from an existing large citizen science network as well as detailed long-term studies, supplemented by targeted field measurements on the impact of a variety of human activities. Our approach integrates effects of activities on different spatiotemporal scales that occur in different parts of the life-cycle during which birds live in different habitats. We start with existing behaviour-based models that capture the accumulation of local activities on a short time scale, and scale these effects up to a metapopulation model dealing with the national population on a long time scale. This will allow us to compare the importance of different pressures on the number of birds in the metapopulation and identify the most cost-efficient mitigation, compensation and conservation actions. During the winters of 2016/2017 and 2017/2018 we captured and colourmarked 900 Oystercatchers. We measured body condition as a currency affecting both survival and future performance (carry-over effects from winter to summer). We equipped 80 Oystercatchers with GPS trackers and collected data on space use and foraging time budgets following disturbance from various human activities, including military exercises. We used the data on 30 populations of individually colour-marked Oystercatchers, most started in 2008, to estimate survival in relation to habitat, as well as connectivity between wintering and breeding areas. Our current efforts focus on stimulating volunteers to measure reproductive success in different habitats and constructing the overarching metapopulation model to estimate the relative impact of various human activities on oystercatcher population numbers. This should allow scenario calculations to estimate cumulative effects of combinations of activities across all stages in the life cycle and predict effects of management and mitigation actions.

[18] Essian, David A.*¹, Jennifer E. Chastant², Jenna May³, and Dale E. Gawlik^{1,3}

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Prey selectivity decreases along a gradient of prey density for a searcher, but not an exploiter

Human disruption of hydrologic patterns has resulted in widespread decline of wading bird populations. Reduced prey availability is one of the primary mechanisms by which hydrological disruptions has influenced wading bird populations, though the response of wading birds to hydrological disturbance in South Florida is species-specific. Populations of some species, like the Great Egret (*Ardea alba*), have increased in the past century, while others, like the Snowy Egret (*Egretta thula*), have declined sharply. Differences in foraging thresholds, prey selection, and diets of wading bird species have been described, but few studies have examined patterns of prey selection across years with high variation in prey densities. For six breeding seasons (2011-2013, 2015-2017), we concurrently sampled prey communities using throw-traps, and nestling diets of Great Egrets and Snowy Egrets at Lake Okeechobee, Florida. Our objective was to test for differences in prey selection at different levels of prey availability. We quantified prey selection by measuring the degree of similarity between nestling diets and prey assemblages for each year. Estimated prey densities ranged between 49 fish m⁻¹ in 2016 to 161 fish m⁻¹ in 2016. Annual differences in prey assemblages and wading bird diet composition were both small. Great Egret prey selectivity was relatively high across seasons, and there was no obvious trend in selectivity based on prey densities. The relatively high selectivity observed in Great Egrets is likely related, to some degree, to the underrepresentation of larger prey items in throw trap samples. Snowy Egrets displayed high selectivity in the three seasons when prey availability was lowest (< 100 fish m⁻¹), modest selectivity in two seasons when prey availability was high (100 and 125 fish/m²), and no selectivity

when prey density was extremely high (160 fish m⁻¹). These results suggest that unlike Great Egrets, Snowy Egrets respond to low prey availability by increasing prey selectivity, perhaps mitigating some of the influence of low prey availability on nest survival and abundance.

[19] Evans, Betsy A.*¹, Jessica A. Klassen² and Dale E. Gawlik¹

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Hydrologic conditions and colony location influence diet breadth and productivity of nesting Wood Storks in South Florida

Urbanization is one of the most drastic human alterations to ecosystems due to its long-term influence on the landscape. In South Florida, Wood Storks (*Mycteria americana*) have declined due to human-induced landscape change, which has altered the natural hydrologic conditions of the Everglades. Despite well-documented sensitivity of storks to hydrologic conditions and human disturbance, storks are frequently observed foraging in created wetlands and nesting in urban environments. To assess how storks are responding to urbanization in South Florida, we examined the influence of colony location (urban or natural wetland) and hydrologic conditions on diet breadth, productivity (chicks fledged/nest), and nestling physiological condition (pectoral muscle mass score). Based on foraging theory, we expected that diet breadth would increase during suboptimal hydrologic conditions, which is linked to low prey density. Furthermore, if urban storks have access to alternative food sources, we would expect them to have a greater diet breadth and to produce more young during suboptimal hydrologic conditions than storks in natural wetlands. We found that urban storks had greater diet breadth than natural wetland storks. Diet breadth of urban and natural wetland storks was greatest when hydrologic conditions were suboptimal. When hydrologic conditions were optimal, urban and natural wetland storks had decreased diet breadth. Similarly, productivity varied with hydrologic conditions and colony location. Urban storks produced significantly more chicks than natural wetland storks. When hydrologic conditions were suboptimal, urban storks produced more young than natural wetland storks. When hydrologic conditions were optimal, both urban and natural wetland storks produced more young than when hydrologic conditions were suboptimal. Overall, physiological condition of nestlings did not differ significantly between natural and urban storks. However, physiological condition was significantly higher for all storks when conditions were optimal than when conditions were suboptimal. Overall, urban storks had greater diet breadth and produced more chicks than natural wetland storks, suggesting that urban storks may be more resilient to hydrologic fluctuations. The increased diet breadth of urban storks may be due to proximity of alternative food sources, such as created wetlands and urban refuse, which provide more predictable food sources when natural wetlands are suboptimal.

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Assessing the impacts of hurricanes on American oystercatcher behavior and demography throughout coastal Georgia

Intense, large-scale weather phenomena (e.g., hurricanes, wildfires) can alter population trajectories. However, it is uncertain if shifts in population size are a direct result of weather or indirectly related through a shift in ecological function of the surrounding landscape. Additionally, it remains unclear the extent to which organisms can detect and react to the various weather phenomena. Although generally protected from direct strikes, coastal Georgia experienced major hurricanes in concurrent years from 2016–2017, which each occurred during the fall migration of American oystercatchers (*Haematopus palliatus*). We developed a generalizable open population robust design model (OPRD) parameterized in a Bayesian hierarchical multistate framework to assess the impacts of these hurricanes on the various demographic rates (e.g., apparent survival, temporary emigration, entry rates) or abundance measurements (e.g., local population size, off site population size) for American oystercatchers at a dynamic stopover and overwintering site in coastal Georgia. We also incorporated age data from photographs of flock surveys into the general demographic model to estimate variation in age-specific abundances among sites and

throughout the non-breeding season. Although patterns differed between years, we observed that hurricanes temporarily, but often substantially, altered local population abundances of American oystercatchers through increased movements of individuals into and out of the observable population, but mortality rates were largely unaffected. Together, our results suggest that American oystercatchers were largely able to avoid the immediate demographic consequences (i.e., reduced survival) of hurricanes, but the long-term consequences of increased hurricane activity along the Atlantic remain unclear.

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Population Viability of Reddish Egrets (*Egretta rufescens*) in Texas

Reddish Egrets (*Egretta rufescens*) are a threatened waterbird species that inhabit coastal areas of North, Central, and South America, including Cuba and the Bahamas. 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. The plume trade of the late 1800's drastically reduced global population numbers of Reddish Egrets so that by the 20th century, the species was decimated and possibly extirpated in many parts of its range. While population numbers may be increasing throughout portions of the range, many factors continue to threaten the persistence of the species in Texas. Population viability analyses (PVAs) are a common method of predicting a species' persistence into some future time. We developed a population viability analysis for Reddish Egrets to identify possible factors that affect the growth of the Texas population. We found that four-year-old female survivorship during the non-breeding and breeding seasons to be the most influential model parameters. Our findings are similar to other studies that have found adult survivorship to be the most influential factor to population growth in other long-lived avian species that reach sexual maturity late. Additionally, we found that while the breeding population is projected to remain relatively stable over the next 50 years there is only a ~6% probability of increasing the breeding population to 2,000 breeding pairs without direct management actions, a stated goal within the Reddish Egret Working Group Conservation Action Plan. These findings suggest that management actions focusing on increasing adult survivorship, such as foraging habitat protection, would be most beneficial to population growth and persistence of Reddish Egrets in Texas.

ENERGETICS SYMPOSIUM

[22] Grémillet, David^{1,2}

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Avian energetics and the conservation of seabirds facing global change

Seabirds are the most threatened avian group and there is an urgent need for rating the short-term impact of global changes on their fitness. Energetics appear as a powerful tool to inform seabird conservation, as I will illustrate using selected recent studies. Notably, I will report on the first validation of energetic fitness as a complement to conventional fitness metrics. To this aim, 3D accelerometry was used to estimate Adélie penguin (*Pygoscelis adeliae*) field metabolic rates, which were significantly linked to bird body condition and multiyear reproductive performance as determined through multi-decadal monitoring. Further, I will illustrate how mechanistic models allow forecasting energyscapes (spatio-temporal distributions of energy expenditure) in wintering little auks (*Alle alle*), as well as the forthcoming impact of North Atlantic climate change on their migratory strategies. Also, using the energy balance of Cape gannets (*Morus capensis*) as determined with multiple bird-borne data loggers, I will show that this species performs unprofitable foraging when competing with industrial fisheries, pointing to unsustainable harvesting practices. Finally, I will present a worldwide assessment of food competition between seabirds and fisheries, on the basis of modeled energy requirements for 276 seabird species in 1482 populations belonging to all seabird families. Through these case studies, I hope to demonstrate that avian energetics do not only serve the purpose of understanding the ecophysiology and evolution of birds in their natural environment, but also function as operational metrics for rating the fitness of wild animals in a rapidly changing world.

ENERGETICS SYMPOSIUM

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The fine-scale flight performance of Nazca boobies (*Sula granti*)

Although growing evidence indicates that actuarial and reproductive senescence is universal in long-lived birds, the underlying processes remain elusive. Foraging, and flapping flight required to reach a foraging location, is energetically costly. Therefore, a decline in physiological ability with age may manifest in various aspects of foraging behavior, and be an important mechanism for senescence. Few studies of long-lived organisms have tracked known-aged individuals with ages spanning the entire lifespan because of the time-scale required to follow individuals from birth to death. Our long-term study of Nazca boobies (*Sula granti*) on Isla Española, Galápagos, Ecuador, with known-aged individuals, allows us to evaluate the relationship between age and flying performance in a long-lived tropical bird. Reproductive success declines with age in Nazca boobies, and a decline in flight performance during foraging behavior could be a proximate explanation. We tested the prediction that old Nazca boobies show reduced flight performance during level flapping flight compared to young or middle-aged birds. Tri-axial accelerometer and GPS data were collected during the incubation period in 2015 and 2016. Biologgers were deployed on ages matching transitions in reproductive success: young (4-7), middle-aged (12-14), old (18-20), and oldest (21+) categories. We only analyzed the first 30 minutes of flapping flight after departure from the colony to try to control motivation across individuals, and to eliminate the effect of variable body mass due to recent feeding. We extracted flight performance parameters: wing beat frequency, downstroke and upstroke force, flap-glide ratio, and overall dynamic body acceleration, a proxy for energy expenditure. We used mixed effects models with age, sex, mass, and bird's bearing from colony (relative to wind vector) as fixed effects and year as a random effect. Results will be presented on the significance of age effects on fine-scale measures of flight performance as measured by accelerometers.

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Plover paparazzi: using nest video cameras to estimate survival and population size of breeding Piping Plovers

Recently, wildlife camera technology and ecological modeling techniques have improved substantially. In this study, we paired methods of nest camera video monitoring and modeling for a novel approach to estimate survival and population size of threatened Piping Plovers (*Charadrius melodus*) breeding on the Missouri River. The objective of this study was to estimate shifts in breeding abundance in the absence of rigorous resighting efforts, following a ten-year demographic study. From 2015–2017, we placed small video cameras at nests to determine whether the associated adults were banded and, if so, to conduct 'resightings' and record the unique band combination. Using the video data, we estimated survival and population size using the Jolly-Seber superpopulation and binomial band ratio models. During this study, we observed an increase in the number of breeding individuals ($N_{2015} = 455.75 \pm 39.65$, $N_{2016} = 527.71 \pm 34.98$, $N_{2017} = 595.11 \pm 62.90$), which was associated with a major habitat creating event. Additionally, we found that mean apparent survival (ϕ) was 0.76 ± 0.05 , which was similar to previous estimates from an extensive capture-mark-recapture study based in this system. Videography has been used to improve resight rate, but our novel application of the Jolly-Seber model illustrates the 1) flexibility of both the model and the data; and 2) utility of integrating data sources to answer ecological questions. Our approach is applicable to other avian species and could be used to estimate survival and breeding population size with relatively low effort, when compared to traditional mark-resight field methods.

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Ka lele ana o nā kūkuluae'o ma ka 'āina kūlana kauhele: Hawaiian stilt movements through an urban landscape

Natural wetlands in Hawaii create isolated habitats widely dispersed across the islands, but much of the historical wetlands have been lost through anthropogenic activities, leading to an overall reduction in functional waterbird habitat. The endangered Ae`o or Hawaiian stilt, *Himantopus mexicanus knudseni*, is dependent on healthy wetlands that are largely found along Hawaii's coastal plains yet can use other upland habitats. Hawaiian stilt populations fell to numbers below 1000 historically, although have been slowly recovering since the 1900s. Observations of Hawaiian stilts have demonstrated them to be a highly mobile species using multiple habitats and thus difficult to track, especially across urban environments. We used GPS satellite tracking devices to provide a glimpse into the dynamic habitat uses of Hawaiian stilt. Five Hawaiian stilts on 'Oahu were outfitted with satellite transmitters and tracked over multiple months. We will discuss the movement behaviors observed by these birds and describe the variety of habitats we documented them using. Our work provides important information on habitat needs for this species, which can help conservation strategies consider the use of non-wetland habitats Hawaiian stilts use.

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Responses of neighboring piping plover populations to habitat creation, conservation, and anthropogenic disturbance

The southernmost breeding population of the federally threatened piping plover (*Charadrius melodus*) nests on the Outer Banks, NC, where plovers share the beach with more than two million tourists each summer. At two neighboring national seashores, Cape Hatteras and Cape Lookout, numbers of breeding pairs decreased by –87% and –62% respectively from 1989–2002, but they subsequently recovered to 4 and 7.5 times larger than their historic lows by 2012. To identify factors correlated with population changes at both seashores, we tested the effects of 1) climatic condition at both wintering and breeding locations, 2) annual variation in the availability of nesting habitat, 3) reproductive output at the seashores and the surrounding region, 4) management practices (i.e., protection from off-road vehicles [ORV] and predator control), and 5) the number of park visitors on the population size. From our results, the number of park visitors showed the strongest, negative correlation with breeding pair counts at both seashores. This effect disappeared at Cape Lookout, but not Cape Hatteras, when protection buffers from ORV traffic were implemented for nests and chicks. Breeding pair counts also were greater following a warmer winters in the Bahamas where the two populations primarily winter. Although the habitat expansion following two hurricanes coincided with the population recovery at both seashores, habitat availability was not an important driver for the long-term population trends. Our study shows the potential negative human impact on the long-term growth of a small population and the effect of localized management practices and habitat in regulating those effects.

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Changes in Foraging Behavior of Roseate Spoonbills (*Platalea ajaja*) Nesting in Florida Bay

Roseate spoonbills forage in Florida Bay's dwarf mangrove habitats and depend on receding water levels reaching a 13 cm prey concentration threshold. Water levels did not reach this threshold level during the 2015-2016 breeding season and is a cause concern for this species. From 2005 to 2007, roseate spoonbills were satellite-tracked in Florida Bay during two breeding and two non-breeding seasons. This study proposes a second satellite-study to track roseate spoonbills for two years. Kernel Density Estimation will determine core foraging areas and assist in estimating changes in the distribution and size of foraging areas. Home range, foraging range, trip duration, and trip distance will be compared within each breeding season and between years. Results from the 2005 to 2007 include locating primary foraging habitats north of Florida Bay from Taylor Slough to Turkey Point, an average flight distance of 12 km between nesting colony and feeding sites, and a maximum flight distance of 65 km. Continuing the satellite-tracking of roseate spoonbills can assist managers in understanding how foraging areas and behaviors are linked with changes in nesting locations and nesting success.

ENERGETICS SYMPOSIUM

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Energy management during the breeding season in thick-billed murres

Breeding seasons are typically energetically demanding for parents. For some species which are breeding in colonies (central place foragers), reproduction has an additional cost: commuting. Because of the increased competition and the local depletion of resources around the colony, foraging gets harder and forces individuals to forage further as time goes on (Ashmole's halo theory). Seabirds, tend to adapt to long commuting by fasting: one parent forages for up to several days while the other one takes care of the offspring at the colony and fasts. Effort reaches its maximum during chick-rearing, when parents also have to feed their chicks and therefore carry food when commuting. In that regard, thick-billed murres (*Uria lomvia*) seem doubly handicapped: 1) they are constrained to only carry one prey item to their chick per foraging trip and 2) they have the highest recorded flight cost in vertebrates, which makes the commuting flights very expensive. Yet, despite impressive constraints, thick-billed murres are performing extended foraging trips (up to 300 km away from their colonies, for up to three days), with a lot of inter-individual variability. In this study, we propose to investigate what makes a foraging trip successful by exploiting this variability, and linking foraging behavior, energy expenditure and hormonal levels as proxies of stress, foraging effort and energetic condition. 251 GPS units were deployed on sexed, weighted and measured birds on the colony of Digges islands between 2014 and 2016. 106 of these birds were also bled before and after the GPS deployment to get corticosterone, beta-hydroxybutyrate, non-esterified fatty acids and triglycerides. After analysis of GPS data, we correlate six key foraging parameters with hormonal levels, mass and energy expenditure estimated using previous doubly-labeled water measurements. Impact of sex and environment are also considered. The goal is to develop a general model which can predict the impact of stress on energy expenditure, and how it is done via foraging behavior, or how energy management and foraging behavior can improve energetic condition.

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Annual-cycle Movements of Common Terns Tracked with Satellite Telemetry

The recent availability of light weight (<2 g) satellite transmitters now makes it possible to track small-bodied seabirds across the globe. In this study, we piloted new 2-g solar-powered Argos satellite transmitters to track the movements of Common Terns from nesting colony on Petit Manan Island in Gulf of Maine, USA. We trapped five adult Common Terns (2 females and 3 males) at their nest sites during the mid-incubation period and attached the transmitters using a Teflon harness. Daily monitoring (nest cameras and direct observation) of tagged and control birds at the colony indicated no evidence of a tag effect on behavior or productivity. During the breeding period, tagged terns made daily flights to foraging areas located up to 50 km from the colony. Post-breeding dispersal movements from the colony occurred primarily at night, with all five birds staging on Cape Cod, Massachusetts, USA. Females initiated migration from Massachusetts to South America in mid-August, and took a direct route across the western Atlantic Ocean with mean travel time of 6 days and flight distance of 3,400 km. Males initiated migration in mid-September and followed a similar route as the females, but each encountered multiple hurricanes that deflected them off-course with a mean travel time of 8 days and flight distance of 4,200 km. Three terns (two females, one female) continued to transmit data during the non-breeding period. In South America, core-use area of two females overlapped, primarily occurring from eastern Suriname to Marajo Bay, Brazil. The male traveled more extensively, ranging southward to Argentina. During the non-breeding period, all three terns spent the majority of their time offshore, with mean distance of 20 km from the nearest coastline (maximum distance was 150 km). This pilot study has revealed new insights into the annual-cycle movements of Common Terns, with wide potential applications for conservation efforts, including: assessments of offshore wind energy areas, management of forage fish, identifying key habitat such as foraging areas and roost sites, contributions to on-the-ground conservation efforts in South America, and outreach to communities throughout the migratory range.

[31] Lyons, Donald E.¹, Nesvacil, Kelly², Oehlers, Susan³, Mondragon, Jeff², Skinner, John²

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The Aleutian Tern: a tropical pelagic tern lost in the predator-infested sub-arctic?

Aleutian Terns (*Onychoprion aleuticus*) are a member of the genus of “brown-winged terns”, which also includes Sooty Terns (*O. fuscata*), Grey-backed or Spectacled Terns (*O. lunata*), and Bridled Terns (*O. anaethetus*; Bridge et al. 2005). While the other members of this genus breed in the tropics on predator-free islands, Aleutian Terns migrate long distances from the tropics to breed in mainland coastal areas of Alaska and the Russian Far East. Their congeners have large, apparently stable populations (IUCN: Least Concern), but Aleutian Terns have a small population (likely < 20,000 individuals) and have experienced large declines at known colonies in Alaska over the last several decades (IUCN: Vulnerable). In light of these declines, we initiated a satellite telemetry tracking study in 2017 to better understand Aleutian Tern movements during the breeding season and migration, while other efforts have begun to characterize the breeding biology and population status of this little-studied species. Early in the 2017 breeding season, we tagged 15 individuals split across two sites; one each in southwest and southeast Alaska. A majority of tags provided movement data throughout the breeding season (n=11) and their migration to Southeast Asia (n=8). Tagged terns exhibited primarily local-scale movements (within 100km of capture site) during the breeding season, with movement among previously documented (n=4) and undocumented colonies (n=2). Breeding season foraging occurred both in nearby estuarine habitats and offshore, with some trips extending to the continental shelf break (~100 km offshore). The post-breeding migration occurred mostly over continental shelf habitats, with some terns migrating through areas immediately offshore of known colonies in Russia. The Sea of Japan, areas of coastal China, and the Malacca Strait were all hotspots of migratory activity, with tagged individuals subsequently dispersing into a variety of nearshore locations across Southeast Asia prior to the onset of winter. Aleutian Terns appear to display a mix of movement behaviors, some being consistent with their tropical congeners (e.g., likely no use of land outside the breeding season), but others more consistent with predator-adapted species such as the “marsh terns” (e.g., Black Terns, *Chlidonias niger*; frequent movements between colonies).

BLACK TERN WORKSHOP

[32] Marsh, Dawn S.*¹ and Patrick W. Brown¹

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Black tern nest success and response to invasive plant species in northern Michigan, USA

Black Terns (*Chlidonias niger*) are semi-colonial nesting waterbirds that require highly productive and ecologically diverse wetlands for breeding. Black Terns commonly nest in Great Lakes marshes (herbaceous wetland communities found along the Great Lakes shorelines and major connecting rivers), which are currently facing a loss of diversity and community structure due to the introduction of invasive plant species. The Black Tern population has noticeably declined rangewide (northern North America), and in Michigan, they are listed as a species of special concern. Through this study, I monitored nest success in two established Black Tern colony sites in Michigan's Upper Peninsula during the summers of 2017 and 2018. I documented nest success and related behaviors (parent-chick interactions, mortality events, and foraging behaviors) of Black Terns at coastal and inland nesting sites in Michigan using camera traps and traditional nest searches on foot or by kayak. Wetland vegetation assessments were conducted when nests were located and again post-breeding season. My objectives for this study were to: 1) document nest success and monitor populations in breeding Black Tern colonies in inland and coastal wetlands in northern Michigan, 2) determine whether invasive plant species influence Black Tern nest site selection and wetland use, and 3) provide recommendations for management that enhances Black Tern nest success in coastal and inland wetlands throughout the Great Lakes region. Ongoing restoration work at the study sites provided unique opportunities to study the influence of invasive species on nest site selection, nest success, and Black Tern responses to invasive species management. Colony sites included in this study are currently threatened by encroaching invasive plant species including *Phragmites*, hybrid cattail, and European frog-bit. Preliminary analyses indicate greater nest success at the inland site than the coastal site. Invasive plant species appear to have little influence on nest success, but may influence nest site selection. Due to limited sample sizes, my results are presented as a descriptive study and may provide context for future studies and restoration work throughout the Great Lakes.

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Spatiotemporal modeling of wading bird habitat in intertidal systems

Our understanding of mechanistic processes underlying resource availability and habitat selection by wading birds in intertidal ecosystems is critically lacking. Wading birds are limited to foraging in water depths shorter than their leg length (0–50 cm) and consequently are influenced by tides that restrict when and where they can feed. We identified factors affecting the distribution and abundance of Little Blue Herons (*Egretta caerulea*) in intertidal systems. We performed bi-weekly surveys during the breeding season (February–July) in Florida Bay, USA (n=49) and lower Florida Keys, USA (n=22) in 2016 and 2017 by boat to locate birds foraging in intertidal areas. We evaluated parameters to predict little blue heron abundance using Akaike's Information Criterion (AIC_c). Nesting period was the only parameter with high support for predicting abundance ($w=0.969$). Abundance was significantly higher ($p<0.001$) in the pre-nesting period (February–April) than in the nesting period (April–July). During the nesting period abundance was highest in areas nearest nest colonies. The selection to forage near the nest colony may be particularly strong in intertidal systems where the spatiotemporal availability of foraging habitat is constrained by the tide. We used the tidal inundation model of shallow-water availability to calculate foraging habitat availability (FHA) in the lower Florida Keys (range: 937–4,531 hectare-hours) and evaluated competing models representing moon phase, FHA, and nesting period. FHA was the most competitive model in predicting abundance of little blue herons in the lower Florida Keys ($w=0.868$).

The effect of FHA on abundance was positive and ranged between a 1.67-fold change in abundance under minimum FHA and an 11.98-fold change in abundance under maximum FHA. Our results indicate that little blue herons respond more to changes in the availability of shallow water driven by daily tides than biweekly spring-neap

tidal cycles. Foraging habitat availability may explain spatiotemporal patterns of resource use and habitat selection by wading birds in dynamic environments. These data can be used to monitor high-use wading bird foraging areas, assess intra- and inter-annual resource fluctuations, and evaluate outcomes of sea level rise scenarios on wading bird populations.

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Site fidelity in lineages of mixed-species heron colonies

As heron and egret colonies are sometimes abandoned due to human activity and subsequently newly established at nearby locations, colony locations per se cannot represent colony fates. Here, “colony lineages” were traced by connecting short-distance location shifts between colony sites in consecutive years to quantify the site fidelity of heron colonies themselves rather than the breeding-site fidelity of individuals. Site fidelity of 61 colony lineages recorded from 1963 to 2013 in and around Ibaraki Prefecture, Japan, was evaluated by persistence periods with survival analysis and shapes of historical trajectories by applying the correlated random walk analysis. While 36% (n = 22) of colony lineages did not show site fidelity and lasted only 1 year or indicated untangled shapes of historical trajectories, 64% (n = 39) of colony lineages exhibited site fidelity by reusing the same locations for multiple years or by staying within a small area with entangled shapes of historical trajectories. Even though suitable breeding sites were abundant in the study area and site fidelity of colony members was low, a high rate of site fidelity in colony lineages may be achieved when a few faithful pioneer herons and egrets are followed by many others.

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Can Grey Herons obtain information on temporal variation of food availability at a breeding colony?

Many researchers have discussed information transfer at a breeding colony concerning the spatial distribution of food resources, but few concerning temporal variation of food availability. To determine this possibility, I studied departure and arrival patterns of Grey Herons (*Ardea cinerea*) at a colony near a feeding site in Hokkaido, Japan, where food availability was known to change according to tidal cycle. These herons exclusively used this feeding site, which was remote from the colony. I found that the duration of a feeding trip was significantly shorter when herons departed to the feeding site at low tide, which provided greater food availability to herons than high tide. This indicates that the herons can shorten the duration of a feeding trip, if they know the timing of low tide without having to leave the colony. By doing this, the herons may feed and care for their chicks more efficiently, and accordingly achieve higher reproductive success. The number of departures from the colony to the feeding site was significantly larger than that of arrivals at low tide in the late breeding season, which indicates that some herons waited for the timing of low tide. Like many studies, this study showed that the frequencies of arrivals were greatest at low tide; it was about 15X larger at low tide than at high tide in the late breeding season. This conspicuous visual change of arrival patterns between low and high tides may be used by herons to know the timing of low tide. Thus, I consider that herons may use a colony as a place to obtain the information on temporal variation of food availability at least in specific habitats like this study site.

[36] McDuffie, Laura A.¹, Julie Hagelin¹, Marian Snively¹, Grey Pendleton¹ and Audrey R. Taylor²

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Using long-term citizen science data to examine trends in Common and Pacific Loon demography in southcentral Alaska

For 30 years the Alaska Loon Watch (1985-1999) and the Alaska Loon and Grebe Watch (2000-2016) engaged citizen scientists to record over 10,000 observations of Common (*Gavia immer*) and Pacific Loons (*G. pacifica*) at 346 lakes in five regions of southcentral Alaska. We used generalized linear mixed models (GLMM) to estimate long-term trends in adult loon abundance and chick survival for each region. We also correlated environmental variables with loon abundance. Our analyses were conservative, given high annual variability in participant effort common to many citizen science programs. Common Loons increased significantly in all southcentral regions of Alaska by 0.6–3.6% (median=2.2%) per year, whereas Pacific Loons exhibited no clear trend. Lake area was positively associated with abundance of Common Loons, but not Pacific Loons. Environmental variables indicative of the magnitude of lakeside development and human or natural disturbance accounted for only a small fraction of the total variation in adult loon counts. Annual chick survival was estimated to be 0.64–0.85 (median=0.80) for Common Loons and 0.38–0.95 (median=0.55) for Pacific Loons, with little evidence for a trend in annual survival over time. Lastly, Common Loon presence on a given lake in one year was a strong predictor of Pacific Loon absence in the next year, consistent with the notion of competitive exclusion. We discuss these patterns in the context of trends in loon abundance observed in other parts of the U.S., and describe the benefits and challenges of using citizen science data to estimate demographic parameters for long-lived species like loons.

BLACK TERN WORKSHOP

[37] Moore, David J.¹ and Patricia Szczys² (Chairs)

¹Canadian Wildlife Service, Environment & Climate Change Canada, Burlington, Ontario, Canada; ²Department of Biology, Eastern Connecticut State University, Willimantic, Connecticut USA; dave.moore2@canada.ca; szczysp@easternct.edu

Ecology and conservation of North American Black Terns

In North America, the Black Tern (*Chlidonias niger*) has undergone long-term, range-wide population declines. Declines may be linked to low adult survivorship, low recruitment, the loss or degradation of wetland breeding habitat, or processes occurring during the non-breeding phase. However, the factors contributing to these declines remain unclear, and basic questions regarding distribution and abundance, breeding ecology, demography, movement, migration, non-breeding ecology and population dynamics remain unanswered. This workshop will bring researchers together from across the continent to present and summarize current work on this species, identify and prioritize monitoring, research and conservation gaps and needs, and explore opportunities for collaboration.

Participants:

Annie Bracey

Dept. of Fisheries, Wildlife and Conservation Biology, University of Minnesota, St. Paul, Minnesota, USA

Danielle E. D'Auria

Maine Dept. of Inland Fisheries & Wildlife, Bangor, Maine, USA

Donald Lyons

Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon

Dawn Marsh

Department of Biology, Northern Michigan University, Marquette, Michigan, USA

Ann McKellar

Canadian Wildlife Service, Environment & Climate Change Canada, Saskatoon, Saskatchewan, Canada

Dave Moore

Canadian Wildlife Service, Environment & Climate Change Canada, Burlington, Ontario, Canada

Caleb Putnam

Audubon Great Lakes / Michigan Department of Natural Resources, Lansing, MI, USA

Dave Shealer

Department of Biology, Loras College, Dubuque, Iowa, USA

Patty Szczys

Department of Biology, Eastern Connecticut State University, Willimantic, Connecticut, USA

BLACK TERN WORKSHOP

[38] Moore, David J.¹, Jeffrey N. Costa¹, Jade Bassler¹, David A. Shealer², Caleb G. Putnam³ and James Fox⁴

¹Canadian Wildlife Service, Environment & Climate Change Canada, Burlington, Ontario, Canada; ²Loras College, Dubuque, Iowa, USA; ³Audubon Great Lakes/Michigan Department of Natural Resources, Lansing, Michigan, USA; ⁴Migrate Technology Ltd., Cambridge, United Kingdom; dave.moore2@canada.ca

Migration patterns and overwintering distribution of Black Terns breeding on the Laurentian Great Lakes.

Limited information exists on the migration and wintering ecology of Black Terns (*Chlidonias niger*) breeding in North America. The objectives of this project were to: (1) fill gaps in our basic understanding of the migratory and non-breeding ecology of this species, which has undergone long-term declines throughout its range, and (2) identify critical habitat and timing of use throughout its annual cycle. We deployed leg-mounted geolocators (light-level data loggers) on 40 adult Black Terns breeding on the Great Lakes at two sites: southern Georgian Bay, Lake Huron (in 2016; n=31) and Lake St. Clair (in 2017; n=9). Tags recovered with full-cycle information (n=12 to date), reveal high levels of individual variation in the timing of migration and paths taken, and in the locations of and durations at winter quarters. Fall (southward) migration included staging on the Atlantic coast of the Carolinas (range: 5-18 d) and in Panama (range: 11-65 d). Individuals wintered (range: 50-119 d) in discrete locations from Panama to southern Peru; three (of five) terns spent significant time at sea during this period (50 d and 96 d, respectively). Spring (northward) migration included staging (range: 5-11 d) on the US coast of the Gulf of Mexico. Birds returned to breeding areas using both the Mississippi (n=4) and Atlantic (n=1) flyways. The estimated total distance traveled over the annual cycle also varied among individuals (mean: 15,700 km; range: 13,400-18,200 km). This information will be used to identify stressors and assess causes of long-term population decline to inform conservation planning for this species.

[39] Moore, David J.¹ and Elizabeth C. Craig²

¹Canadian Wildlife Service, Environment & Climate Change Canada, Burlington, Ontario, Canada; ²Shoals Marine Laboratory, University of New Hampshire, Durham, New Hampshire, USA; dave.moore2@canada.ca

Gender equity in the Waterbird Society?: an examination, as a starting point for discussion.

One of the goals of the Waterbird Society (WbS) is to foster diversity and inclusivity in our organization, and act to overcome barriers that prevent equity and opportunity. As first step, we asked the question: Is the WbS equitable with respect to gender? The purpose of this talk is to examine that question, as a starting point for further discussion, and to identify potential current barriers to full participation or representation by women members. We looked at gender ratio (simplified as binary 'male' or 'female') within the WbS by assessing a number of metrics: leadership (representation in executive roles, on Council and on committees); conferences (participation as presenters and invited speakers); applications for and success in being awarded WbS research grants; and, publications in *Waterbirds*. Equity was assessed against either: the gender ratio of the WbS membership, or relative to the gender ratio in science, technology, engineering and mathematics (STEM), as appropriate. Another goal of this talk is to highlight and celebrate the important contributions that women have made, and continue to make, in shaping and leading the WbS and making it a vital and relevant organization.

[40] Murphy, Sean P.¹ and Tom Virzi¹

¹Conservation InSight, Happy Valley, Oregon USA; smurphy@conservationinsight.org

Describing the detection process of the endemic Cape Sable Seaside Sparrow in the Everglades ecosystem

Point-count surveys are commonly used to determine abundance and population trends of breeding birds. In order to accurately estimate population abundance, it is imperative to account for detection probability. Researchers studying the endangered Cape Sable Seaside Sparrow (*Ammodramus maritimus mirabilis*), which is endemic to the Everglades ecosystem and at risk of global extinction, conduct extensive annual aural counts of singing males across the range of the subspecies to compute an index of total population. Here, we use a time-of-detection approach incorporated into the point-count survey methods to better describe the detection process including site- and survey-level effects. The time-of-detection method divides detection probability into separate intervals allowing for a singing rate effect. We tested for variation in detection among count-time intervals, heterogeneity, distance, replicate, observer, seasonal, and time effect. The best fit model predicted detectability of singing sparrows varied among interval and supports shortening the currently used 7-min survey period. Moreover, detection varied by observer, distance of detection, and day of season. Our results suggest that detection is not constant and should be considered during the collection and analysis of the range-wide annual surveys to accurately estimate the global population of Cape Sable Seaside Sparrows. Understanding the detection process will improve population estimates with an accurate estimation of uncertainty and allow stakeholders to make stronger inferences about population change and better informed management decisions.

[41] Erica Nol¹

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Weather-related effects on seasonal demography, and life-time reproductive success in a small arctic-breeding shorebird

Long-term studies of arctic-breeding shorebirds are rare, but valuable for understanding the effects of climate change on reproductive success, and for determining life-time reproductive success. I studied demography and lifetime reproductive success of Semipalmated Plovers (*Charadrius semipalmatus*) over 25 years in the Churchill, Manitoba region. Like many income breeders, dates of nest initiation are strongly determined by temperatures during June, their month of arrival on the breeding grounds. Annual variation in hatching success, chick survival and local breeding population size is relatively low. Hatching success is about 60% regardless of temperature. The strongest deviations in local breeding populations or chick survival are due to unusually low temperatures in June or July. A threshold of about 5 C during June results in population sizes less than 50% of the long-term average, and a threshold of 7 C during July results in very low chick survival. Annual adult apparent survival is not related to variation in weather in previous, current or subsequent years. Like many species of birds, most breeding adults raise few young over their lifetime, while there are a few 'super' birds who contribute most to future generations. My results suggest that the advancing ice out documented for Hudson Bay as a consequence of a warming arctic, has not yet had an effect on the seasonal demography of this small plover. Greening of previously open nesting habitats has been detected in the last 3-4 years, and this may negatively impact local population sizes more than impacts of changing annual weather patterns.

[42] Patterson, Allison¹, Donald Lyons², Timothy Lawes² and Daniel Roby³

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Quantifying the prospecting behavior and breeding networks of a ground-nesting colonial waterbird

Ground-nesting waterbirds that breed colonially on islands in wetlands, rivers, and estuaries must be adapted to deal with high inter-annual variability in habitat availability. Potential colony sites are subject to fluctuating water conditions, nesting substrate is subject to vegetation succession, and colonies are susceptible to discovery by

predators. Therefore, we expect such species to display high connectivity among colonies and for individuals to regularly evaluate alternative breeding sites. To quantify the degree of regional connectivity and prospecting behaviour of Caspian Terns (*Hydroprogne caspia*), a continental tern species that nests in sparsely vegetated insular habitats, we used a combination of network and spatial analyses to evaluate a satellite tracking dataset from 64 Caspian terns tagged at two colonies in central Washington, USA. Tagged terns visited 21 known colonies from Alaska to Southern California. Over the entire tracking period, each colony was visited by 26 terns on average. Twenty of the 21 colonies were directly linked to at least ten other colonies. The average shortest path between pairs of sites was two sites; three colonies served as network centres connecting multiple colonies. Terns tracked for at least two breeding seasons visited an average of ten colonies overall, and each year individual terns visited more than 70% of all the colonies in their personal network. Prospecting activity was more intense during the post-breeding period, with individual terns visiting seven colonies during post-breeding and five colonies during the pre-breeding period in the same year. The networks of individual terns occurred over large spatial extents; the area encompassing all sites visited each year averaged 235,000 km² per individual, with a maximum area of 865,000 km². Consistent with predictions based on their nesting habitat selection, colonies within the Pacific Coast region showed strong connectivity and Caspian Terns regularly sampled a significant proportion of all potential breeding colonies across their entire breeding range, revisiting alternative sites each year or multiple times within the same year. Network analysis allowed us to quantify regional connectivity in this Caspian Tern population; this approach can be used to prioritize species and sites for conservation and restoration.

ENERGETICS SYMPOSIUM

[43] Patterson, Allison¹ and Patricia Baird² (Chairs)

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SYMPOSIUM - Ecological energetics of waterbirds: From biochemistry to biomes

Birds, for their body mass, burn brighter than any other organism, and some waterbirds, with their high wing-loading and distant migrations, burn brightest of them all. This symposium will feature a series of speakers investigating waterbird energetics over a range of scales from biochemistry to biomes. Early speakers will examine the cellular mechanisms, such as fatty acids or antioxidants, which generate or accommodate the tremendous chemical power needed to fuel avian metabolism. Later speakers will focus on how energetics influence physiology and life history at multiple spatial and temporal scales. The final speakers will discuss how high energy lifestyles can influence movements of waterbirds across landscapes, and how waterbirds can engineer and alter entire biomes. A final period will be reserved for a discussion of the links between energetics in waterbirds across ecological scales. A final product will be a review paper on the conservation energetics of waterbirds at different ecological scales.

Speakers:

Biochemistry

Pat Baird, Fatty acids

Individual animals

Thomas Lazarus, Physiological mechanisms underlying energetics

Jenny Howard, Flight energetics

Kyle Elliott, Conservation energetics in pagophilic seabirds

Biomes

Emily Shepard, Energetics of wind-propelled flight

David Gremillet, Energy landscapes in seabirds on ocean scales

[44] Ramos, J. A.¹, C. Lopes¹, A. Correia¹ and V. Paiva¹

Mare – Marine and Environmental Sciences Centre, Department of Life Sciences, University of Coimbra, Coimbra, Portugal; jramos@uc.pt

Vegetation cover and environmental variability in explaining local and regional fluctuations in Little Terns' (*Sternula albifrons*) breeding population size.

The availability of suitable breeding habitats is an important factor in explaining seabirds' demographic fluctuations. For ground nesting seabirds such as Little Terns (*Sternula albifrons*), an essential characteristic is the proportion of vegetation cover. However, environmental variables, such as the climatic proxy North Atlantic Oscillation (NAO) index, are known to affect the distribution of food resources in the marine environment which can cause declines in the availability of prey fish for seabirds, thereby influencing the size of the breeding population at a regional scale. This study evaluated if the long-term fluctuations (1979-2018) in Little Tern breeding numbers on local sandy beach colonies of Ria Formosa, Algarve (Portugal), could be explained by (1) changes in vegetation cover at each colony, (2) environmental variability, measured by the NAO index, or (3) a combination of both. The percentage of vegetation cover for each colony was calculated from aerial photos of Ria Formosa barrier islands from 1976 to 2012, and related to breeding census data from the same period. The climatic variation measured by the NAO index did not show a significant relation with the number of breeding pairs nesting in each sandy beach colony, but it had a significant effect in explaining interannual oscillations and foraging parameters in the regional breeding population of Ria Formosa. A segmented regression model between breeding population size and vegetation cover for each colony, controlling for the effect of the NAO index, estimated an optimal of vegetation cover around 10% and overall below 42% for a high percentage of breeding pairs on a given sandy beach location, and predicted that only ~4% of breeding pairs would endure with 90% vegetation cover. Little Terns in Ria Formosa appear to adopt a fugitive strategy moving their colonies to locations with better breeding conditions in response to the overgrowth of vegetation. We suggest that the percentage of vegetation cover is important in explaining the breeding population size on a local scale, whereas food availability, influenced by the climatic conditions (proxied by the NAO index), should play an important role in explaining the number of breeding Little Terns at a regional scale.

[45] Ramstad, Kristina M.¹, Natalia J. Bayona-Vásquez², Silvia Nassif Del Lama³, Stacey L. Lance⁴ and A. Lawrence Bryan⁴

¹Department of Biology and Geology, University of South Carolina Aiken, Aiken, South Carolina USA; ²Department of Environmental Health Science, University of Georgia, Athens, Georgia USA; ³Universidade Federal de Sao Carlos, Sao Carlos, Sao Paulo Brazil; ⁴Savannah River Ecology Lab, University of Georgia, Aiken, South Carolina USA; kristinar@usca.edu

Are American wood storks panmictic?

American wood storks (WOST, *Mycteria americana*) are large wading birds native to the southeast US, the Caribbean, Central America, and South America. They are the only stork species found in North America and are federally protected under the Endangered Species Act. WOST use thermals to soar such that air uplifting off the surface of the earth allows them to travel distances over land, but infrequently over open water. Thus, post breeding dispersal varies geographically among WOST and gene flow is likely restricted between colonies on opposite sides of the Caribbean Sea and the Gulf of Mexico. Several studies have tested for genetic population structure in WOST and concluded that they are panmictic (comprise a single population throughout their global range) due to recent colonization events and high gene flow. These studies, however, suffered from severely limited sampling and low statistical power. In this study, we are using a powerful genomics approach to test for genetic differentiation between WOST at their range extremes and among US WOST colonies. Specifically, we are asking (1) Are WOST panmictic throughout their global range?, (2) What is the level of connectivity between WOST populations in Brazil and the US?, and (3) How many populations of WOST are there in the US? We sequenced reduced representation libraries of US (n=19) and Brazilian (n=20) WOST and identified over 7600 loci containing multiple single nucleotide polymorphisms (SNPs). Preliminary analysis of 3RAD data suggests significant genetic divergence between WOST that nest in the US and Brazil and rejects previous findings of panmixia, but also suggest differentiation among nesting colonies within the US and Brazil. RADcap baits are currently being designed to further capture and sequence ~5000 loci simultaneously in WOST broadly (n=~600). The resulting data will allow for the most powerful analysis of WOST genetic populations structure to date, which is critical for defining the proper scale of management

for WOST, understanding dispersal and connectivity among nesting colonies, and assessing the susceptibility of individual colonies to local extinction.

[46] Rickert E.¹, N. Markones¹, K. Borkenhagen¹ and S. Garthe¹

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Comparison of Aerial Survey Methods for Seabird and Marine Mammal Monitoring

Seabird and marine mammal abundance and distribution is monitored in German waters within the German “Seabirds at Sea” (SAS) monitoring program since 1990. The SAS monitoring is performed by means of internationally standardized observer-based line transect counts from ships and aircrafts. With the spread of offshore windfarms in the North Sea, observer-based aerial surveys became problematic due to their low altitudes (approx. 75 m) and the resulting collisions risk with windmill blades. As a consequence, observer-based aerial surveys have been forbidden in offshore wind farm areas since 2012. This resulted in the rise of digital aerial survey methods, which are performed in significantly higher altitudes (typically >400 m). Although digital aerial survey methods have already been used commercially within environmental impact studies in offshore windfarm areas, the methods are a relatively new element of large-scale monitoring and still need evaluation.

To this end, we compared two digital aerial survey methods (a video- and photo-based method) and the observer-based aerial survey method to test the methods for their comparability and to assess the species-specific detectability in digital survey methods. Our study encompasses eight comparison surveys performed during different seasons in selected areas of the German North and Baltic Sea. During these surveys all three survey methods recorded simultaneously seabirds and marine mammals at the study site. The study sites were chosen due to their wide variety of seabird species. For example, loons, common murre and razorbills are abundant at our North Sea study site during spring and harbor porpoises are common at this site during summer. The Baltic Sea study site hosts large concentrations of long-tailed ducks, common scoters, and velvet scoters and is thus a representative survey site for large and mixed bird flocks. In addition, the area allows testing the detectability of small inconspicuous species (black guillemot, horned grebe).

Our study revealed that the tested survey methods differ from each other in the detection of certain species. We present and discuss the found (dis)similarities in detection.

[47] Roby, Daniel D.¹, Yasuko Suzuki², Donald E. Lyons², Julie Heinrichs³ and Nathan Schumaker⁴

¹U.S. Geological Survey-Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis, Oregon USA; ²Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon USA; ³Computational Ecology Group Canada, Canmore, Alberta, Canada; ⁴Western Ecology Division, U.S. Environmental Protection Agency, Corvallis, Oregon USA; daniel.robby@oregonstate.edu

Modeling population dynamics of a conservation reliant seabird: Caspian Terns in the Pacific Flyway of North America

Caspian Terns (*Hydroprogne caspia*) in the Pacific Flyway population have come into increasing conflict with restoration efforts for threatened anadromous salmonids (*Oncorhynchus* spp.). Several of the largest breeding colonies of Caspian Terns in the Flyway are now actively managed to reduce colony size and increase survival of salmonid smolts. Caspian Tern management has consisted of modifying nesting habitat to control the numbers and locations of breeding pairs, which in turn alters colony carrying capacity. The vast majority of breeding pairs in the Pacific Flyway population of Caspian Terns now nest in anthropogenic habitat, and the population is reliant on the conservation of these artificial colony sites. To evaluate the effects of current and prospective management actions on future trends in the Pacific Flyway population, we developed a comprehensive and data-rich demographic model. The model is structured in HexSim, a spatially-explicit life history simulator capable of accounting for empirically-derived vital rates and between-region movement rates. Age-structured survival, movement, and breeding propensity were estimated from multi-state analyses of mark-recapture data using program MARK. Based on current demographic parameter estimates, model simulations assuming status quo habitat management projected an increasing Flyway-wide population of Caspian Terns. Current rates of survival and fledgling production, if sustained, appear sufficient to allow population persistence at or somewhat above the current level, even given recently proposed reductions in future tern nesting habitat. Nevertheless, the presence of a sizable colony (> 1000 pairs) at

East Sand Island, an anthropogenic colony site in the Columbia River estuary, appears to be critical to the long-term persistence of a Caspian Tern population in the Pacific Flyway. A hypothetical scenario to simulate complete elimination of the colony at East Sand Island, formerly the largest for the species in the world, produced a persistent decreasing trend in the Pacific Flyway population. In particular, a substantial reduction in the unique capacity for fledgling production at the East Sand Island colony, if not compensated for by a similar high capacity for fledgling production elsewhere in the Pacific Flyway, is likely to result in a sustained downward trajectory that could put the Flyway-wide population at significant risk.

[48] **Scopel, Lauren C.*¹**, Antony W. Diamond¹, Stephen W. Kress², Adrian R. Hards³ and Paula Shannon⁴

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How can seabird diet data be used to inform fisheries management?

Commercial fisheries have traditionally been managed as single-species harvest operations, but managers are increasingly calling for a more holistic, multi-species approach to fisheries management, called ecosystem-based fishery management (EBFM). EBFM seeks to manage fisheries in a sustainable way, by incorporating environmental variability and the needs of other fish predators in an ecosystem. Many fisheries suffer from gaps in ecological knowledge, particularly regarding the youngest age classes of harvested fish, which makes EBFM difficult to implement in practice. Where seabirds act as predators of juvenile stages of harvested fish species, they may be able to predict future cohort sizes, overcoming some of these knowledge gaps, but few studies have attempted to link seabird and fishery data. We used data from four seabird species at nine seabird colonies in the Gulf of Maine ecosystem, near the Atlantic Canada-USA border, to investigate the relationship between seabird diets and data collected on the Atlantic herring stock. We used an exploratory regression approach to identify pairs of seabird and fishery data that would provide a potential predictive relationship regarding the size and quality of the herring stock. This talk will address three of the major findings of our analysis: 1) seabirds are best divided into three geographical subregions within the Gulf of Maine, where trends in herring abundance have changed over the past two decades; 2) juvenile herring show spatial movements at much smaller scales than are currently incorporated into fisheries assessments; and 3) “unusual” fish datasets not currently used in stock assessment show strong trends with seabird data. We show that seabird data can be used to estimate recruitment and cohort size, but spatial variability and species differences show that these seabird datasets are not interchangeable. The Common Tern (*Sterna hirundo*) is likely the most useful seabird to incorporate into future EBFM in the Gulf of Maine, based on its distribution and strong relationships with a variety of fishery datasets.

[49] **Shahrokhi, Golya*¹** and M. Clay Green²

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Sex-biased dispersal between management units of a rare waterbird

Reddish Egret (*Egretta rufescens*), the rarest Ardeid in North America, has recovered from historic population lows in the 19th and 20th centuries however, the species remains threatened by coastal habitat loss, sea level rise and other factors. Additionally, the global population is restricted to coastal areas and hence patchily distributed across the species' extensive range from Baja California to the Bahamas. Therefore, geneflow is a significant factor for the Reddish Egret to maintain genetic variation across populations. Until recent, Reddish Egrets were considered as weakly migratory birds. However, banding and telemetry data has revealed several long-distance migrations between some populations, especially among juvenile males. In this study, we sought to characterize gene flow among three pre-defined distinct management units (Western, Central, and Eastern) by using 10 nuclear microsatellites and a part of the mitochondrial (mtDNA) control region. We collected 192 nestlings' blood samples from eight localities (Western – Baja California; Central – Chiapas, Texas, Tamaulipas, Yucatan and Louisiana; and Eastern – Florida and the Bahamas). The mtDNA analyses support the three management units while the microsatellites suggest five units (1. Bahamas; 2. Louisiana and Florida; 3. Chiapas; 4. Texas, Yucatan, and Tamaulipas; and 5. Baja California). Analyses of molecular variance (AMOVA) showed a higher percentage of

variation among management units than within each for both series of markers. The hierarchical structure with five genetic sub-demes nested within two major demes proposes a common ancestor or similar evolutionary pattern for some localities. There are 7 unique haplotypes in the examined mtDNA control region. Chiapas and Bahamas each contained a single haplotype, whereas Yucatan, Florida, and Baja California each has at least one specific haplotype to themselves. Our results reveal five isolated breeding centers, one in each management unit (Baja; Chiapas; Louisiana; Texas; and the Bahamas), with the remaining populations exhibiting higher gene flow among each other within each region. Although the comparison between population differentiation (F_{st}) of microsatellite and mtDNA data supports the telemetry findings with higher dispersal for males than females, the isolated genetic structure in each management unit is a stronger evidence to keep considering this species globally as a non-migratory one.

ENERGETICS SYMPOSIUM

[50] Shepard, Emily L.C.¹, Emma-Louise Cole¹, Andrew Neate² and Andrew N. Ross³

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High winds act as invisible barrier preventing cliff-nesting seabirds from accessing their nests

Wind can affect the distribution, energy expenditure, movement paths, and reproductive success of a range of seabirds. For birds that nest on cliffs, such as auks, strong winds could also affect their ability to land, because, unlike other birds, those landing on cliffs may have a limited ability to modify their landing trajectory in relation to wind direction. Auks also have relatively low manoeuvrability, which may constrain their ability to respond to turbulence at the cliff face. We investigated how wind affected landing success in two species of auk breeding on Skomer Island, UK, by combining field observations with computational fluid dynamics models. The results show that airflows around the cliffs have a profound effect on landing ability, with success decreasing to some 20% in the highest wind speeds. Landing success also decreased with ledge size, cliff height and species. This provides evidence of a new mechanism by which wind can affect energy expenditure and provisioning rates in seabirds.

[51] Shlepr, Katherine R.¹, Betsy A. Evans¹ and Dale E. Gawlik¹

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Potential adaptive responses by the threatened Wood Stork (*Mycteria americana*) to altered Everglades hydrology

25% of avian species worldwide face an elevated risk of extinction, primarily due to rapid environmental change induced by humans. Population modelling is a tool commonly used by wildlife managers to help prioritize and plan conservation actions. However, these models frequently assume stationarity whereby static demographic parameters are used to estimate the probability of species extinction over a chosen timeframe. This assumption disregards species' potential to adapt to environmental change; adaptations which could alter not only a species' extinction outlook but its legal protection status too. In this study, we review evidence of adaptation by one threatened species, the Wood Stork (*Mycteria americana*), in human-altered South Florida, USA. Since the 1970s, Wood Storks have shifted the timing of their breeding season, expanded their range into novel habitats in urban areas, and began consuming non-native marsh fishes. Future aims of our research are to compare the diet, physiology, and genetics of Wood Storks nesting in their historical range with those occupying novel habitats in urban areas. Improved growth rate, health indices, and survival by nestlings in urban areas would be evidence that colonies on the leading edge of the species' range may be capable of sustaining growth of the whole population. Increased population size and stability are recovery criteria which must be met before Wood Storks can qualify for removal from the federal Endangered Species List. Understanding Wood Stork response to human development in the Everglades may also illuminate general patterns in avian species response to extreme changes in landscape.

[52] Smit-Robinson, Hanneline A.^{1,2}, Desiré Dalton³, Robin B. Colyn¹ and Antoinette Kotzé^{3,4}

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Genetic sequencing to unravel the mysteries and aid the conservation of the critically endangered White-winged Flufftail *Sarothrura ayresi*

The White-winged Flufftail *Sarothrura ayresi* is a small, elusive bird listed as Critically Endangered by the IUCN and is considered to be on the brink of extinction. It is estimated that there are as few as 250 birds remaining which are only known to occur, with any regularity, in the high-altitude wetlands of South Africa and Ethiopia. Destruction and degradation of the species' preferred habitat have rendered the species' survival in the wild uncertain. The migratory connection, if any, between the populations of White-winged Flufftail in South Africa and Ethiopia, is poorly understood. In this study, analysis of mitochondrial (COI, Cytb, 12S/Val/16S) and nuclear (ADH-5, GPD3-5 and bfib7) markers was conducted on South African and Ethiopian birds. The whole mitochondrial genome was sequenced using Next-generation sequencing. In addition and to our knowledge this is also the first account of Toll-like receptor genetic diversity in this critically endangered species. Analyses of the DNA regions identified only three interspecific variations, supporting the hypothesis that these two populations are not different species. We further confirm low genetic diversity in the innate immune regions of the White-winged Flufftail similar to that observed in other bird species that have undergone population bottlenecks and indicates that this species is more likely to be threatened by changes to the environment. The implementation of a conservation plan through the collaborative efforts of BirdLife South Africa, Middelpunt Wetland Trust and the Ethiopian Wildlife and Natural History Society is undertaken under the auspices of the African Eurasian Waterbird Agreement (AEWA).

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Habitat use by upland-nesting waterbirds is negatively affected by oil well infrastructure and activity

Development of the Bakken shale is occurring in a portion of remaining North American grassland that supports some of the highest remaining populations densities of upland nesting waterbirds, which have declined due to extensive habitat loss. Life history characteristics of these species suggest vulnerability to fragmentation and development. I used field surveys and site occupancy models to examine the effects of oil extraction activities and associated traffic on habitat use by low-density upland-nesting waterbirds at 396 sites. Traffic negatively affected site occupancy of willet and pintail breeding pairs and of brood-tending shorebirds after accounting for habitat suitability and seasonality. Well density negatively affected occupancy of Wilson's phalarope breeding pairs and broods. These patterns indicate that suitable habitat is being avoided by some species for recruitment-related behaviors. Given the habitat requirements that render upland-nesting waterbirds sensitive to reduced quality in grassland or wetland resources, ongoing review of the habitat impacts on these species will be needed as additional impacts of oil extraction become evident. Traffic should be concentrated along development corridors to the extent possible and easement acquisition should focus on higher quality habitat between development corridors to address both habitat suitability and infrastructure avoidance.

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Using miniaturized GPS tags to study breeding season habitat use and migration in threatened Piping Plovers (*Charadrius melodus*)

Until recently, our ability to track small-bodied birds to understand individual space and habitat use was limited to the use of radio-telemetry or archival geolocators. Recent progress in miniaturizing archival global positioning system (GPS) units provides the opportunity to track birds across their annual cycle with high accuracy. During the 2017 breeding season, we tested and deployed newly developed miniaturized GPS units with 10-m spatial accuracy and weighing 1 g on piping plovers. We tagged 5 adult males to examine breeding season habitat use, as well as determine the safety of the tags before deploying the units for long-term tracking. For short-term tracking, GPS units were set to collect spatial data 4 times per day at 6-hr intervals and were retrieved after approximately 2 weeks. For long-term tracking, we tagged 10 males near the end of the breeding season and set their tags to collect locations every 2 days during migration. We observed no injuries and no evidence of a negative effect of tagging on nest survival, chick survival, and adult survival. We observed males to use previously-undocumented foraging locations including at midnight. Miniature GPS tags have helped to identify areas that are highly used within breeding territories and will help to identify highly used areas during migration and on the wintering grounds to inform habitat management across the annual cycle. Because data on migration and wintering habitat use are sparse, our results will provide information regarding periods of the life cycle that are largely unknown.

BLACK TERN WORKSHOP

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Population genetic analysis of the declining North American Black Tern

The North American Black Tern (*Chlidonias niger surinamensis*) has experienced drastic continent-wide declines in population size and colony-site occupancy. Annual survival estimates for adults in two well-studied populations converge around 66%, substantially lower than most other tern species. Mark-recapture models do not distinguish between mortality and permanent emigration, however, so it remains possible that the survival estimates are confounded with a high degree of nomadism in this species. If Black Terns lack breeding site fidelity and instead change breeding sites frequently, this should be reflected in the degree of genetic structure across a broad geographic range. To explore the degree of population connectivity across North America, we collected blood samples from individuals breeding in Maine, Ontario, Michigan, Wisconsin, Iowa, Nebraska, and Oregon between 2005-2017. Here we report genetic data from eight microsatellite loci which indicate high genetic diversity ($A_R > 6.5$, $H_E = 0.76$) but no differentiation between breeding colonies in Maine, Ontario, and Michigan ($F_{ST} < 0.04$). A 483 bp portion of cytochrome-*b* sequences obtained from 95 individuals representing all sampled colonies (continent-wide) revealed 13 unique haplotypes, with the most common haplotype shared among all colonies in high frequency (0.4-1.0). Oregon and Nebraska harbored the greatest diversity (six and seven haplotypes respectively). Based on findings to date, there is no genetic structure among colonies east of the Rocky Mountains, however without inclusion of the Oregon population this conclusion cannot be extrapolated as a continent-wide pattern at this time.

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Cues used by parasitic Red-breasted Mergansers (*Mergus serrator*) for detecting and selecting host nests

Conspecific brood parasitism (CBP) is an alternative breeding tactic wherein a female (the parasite) lays her eggs in the nest of a conspecific (the host) that provides all subsequent parental care. CBP is particularly common among waterfowl; however, little is known about the cues used by parasites seeking suitable places to lay eggs parasitically. The aim of this study was to determine how parasitic females detect and select host nests in a colony of Red-breasted Mergansers (RBME; *Mergus serrator*) nesting on islands at Kouchibouguac National Park, New Brunswick, Canada from 2014 – 2016. This population exhibits high rates of CBP; up to 75% of nests are parasitized annually. We predicted that host activity is a cue used by parasitic RBME for finding nests given that nest sites are concealed by vegetation and that there are risks to laying in an unattended nest. To test this hypothesis, we created fourteen experimental nests

containing chicken eggs painted to mimic merganser eggs and examined whether parasites lay in nests in which there is no host activity as frequently as unmanipulated nests with a host. The rate of parasitism at experimental nests (21 %) was nearly 3 times lower than that at natural nests with a host (60 %). We examined whether nest selection by parasitic Red-breasted Mergansers is based on timing of nest initiation and habitat cues. Some habitat characteristics may afford greater safety from predators. We measured nest concealment, distance to shore, density of RBME nests, and density of sympatric Common Terns (*Sterna hirundo*) between parasitized and non-parasitized nests. Parasitized nests were initiated on average 10 days earlier than non-parasitized nests ($p < 0.001$). There was no difference between parasitized and non-parasitized nests for habitat characteristics. Our results suggest that host activity and early nest initiation are important cues for parasitic Red-breasted Mergansers. Early timing of parasitism may imply females lay parasitically before initiating their own nest.

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Automatic Bird Sound Detection: Logistic Regression Based Acoustic Occupancy Model

Avian bioacoustics research was revolutionized by the introduction of the digital audio recorder, which not only allows remote-monitoring but also makes large-scale studies possible. However, manual inspection of recordings is not feasible given increasingly larger datasets. The need for an automatic bird sound detection algorithm as a pre-filtering step prior to other acoustic analyses has arisen. In this research, we developed logistic models to predict the probability of bird presence in a recording using frequency percentiles. Our smartphone-derived recordings covered a wide range of environments (e.g., grassland, forest, urban areas) with the presence of noise due to weather, traffic, insects, and human speech. A wide range of bird species was included. Based on leave-one-out validation and using an optimal cut-off of 0.35 (i.e., probability ≥ 0.35 indicates the presence of birds), our model resulted in 70% accuracy with a 14% false negative rate. Our model took less than one hour to process 15,690 ten-second recordings (i.e., 44 hours in duration). This acoustic occupancy model opens up new possibilities toward automatic, accurate, and efficient analysis of large remote-monitoring audio datasets.

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Response of loons to oilfield development activities in the National Petroleum Reserve-Alaska

The National Petroleum Reserve-Alaska (NPR-A) is an area that will see continued oil and gas development in the future. Establishing an understanding of the effects of such development on the natural environment is crucial to successful management of waterbird populations using the NPR-A for breeding and raising young. To better understand the immediate versus long-term response of Yellow-billed and Pacific Loons to human activity, we addressed the activity budgets of loons in regularly disturbed vs undisturbed habitats and their behavioral responses to helicopters and human activity. Additionally, we estimated nest survival for loons at different disturbance regimes and in response to different disturbance types. In the summers of 2016 and 2017, we established two field camps in the Fish Creek Watershed in the NPR-A; one site was at a long-term BLM field station with helicopter flights coming and going daily whereas the other was at a nearby but undisturbed location where loons were unlikely to be habituated to human presence. Nesting loon behavior was collected with the help of nest cameras and visual observation with and without helicopter and human experimental disturbances. Individual nesting loons showed little to no response to helicopter overflights, but loons in the undisturbed/unhabituated location had a higher flush initiation distance for disturbances involving a human walking at or near their nest than did loons near the permanent field station. Our preliminary results show a high level of nest failure for both species at both research sites (24% survival in 2016 [n=54] and 29% survival in 2017 [n=55]), but we will also discuss influences of disturbance type, timing, and location on daily nest survival rates for each loon species. Our results demonstrate the importance of site-and disturbance-specific studies set management strategies prior to the initiation of industrial development in the NPR-A.

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Navigating a Paved Paradise: Landscape Genetics of an Endangered Hawaiian Waterbird

The Hawaiian gallinule (*Alae`ula*, *Gallinula galeata sandvicensis*), is a behaviorally cryptic, endangered waterbird currently restricted to the Hawaiian Islands of O`ahu and Kaua`i. O`ahu, the most heavily urbanized island in the state, supports a population of <500 gallinules scattered across fragmented, relict wetland habitats. Poor understanding of the movement behavior of Hawaiian gallinules has led to uncertainty around the impacts of habitat fragmentation on the island's gallinule population. We combined simulation modelling, geospatial analysis, and population genetics to examine the impacts of habitat fragmentation on population connectivity in Hawaiian gallinules, and to take a first look at the movement behavior of this poorly-studied taxon. We genotyped 154 gallinules from the 12 major breeding habitats on O`ahu at 12 microsatellite loci and via sequencing of a 520bp fragment of the ND2 region of microsatellite DNA to examine genetic differentiation between subpopulations. We then created a suite of spatially-explicit models of hypothesized movement behaviour patterns, and compared their ability to explain patterns of observed genetic structure. We detected moderate to high genetic differentiation (overall microsatellite $F_{ST} = 0.098$, mtDNA $F_{ST} = 0.248$) at surprisingly small spatial scales (1.5 – 55km) for highly vagile organisms like waterbirds. Our landscape genetics analysis found that models treating water features (e.g., streams, drainage canals) as dispersal corridors best explained observed genetic structuring among subpopulations on O`ahu. Our findings suggest that lentic water features and wetland habitats otherwise unfit as breeding habitat may provide dispersal habitat for gallinules and other waterbirds, increasing population connectivity in developed landscapes.

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