AWCF NEWS

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In this AWCF Newsletter

Simulating multi-scale movement decision-making and learning in grizzly bears using agent-based modeling.

Alejandra Zubiria Perez, University of Victoria, British Columbia, Canada

Funded by AWCF 2019

Grizzly bear in Alberta, Canada. Photo by fRI Research

Anthropogenic landscape change in many parts of the world is increasingly jeopardizing the survival of wild animals, particularly apex species at the top of their respective food chains (Estes et al., 2011). In addition to persecution and overhunting, large predators usually have high metabolic demands that result in the use of extensive territories or home ranges and the need for large prey, making them prone to conflict with humans and livestock. These factors require apex species to constantly adapt to dynamic and complex landscape characteristics to find adequate food resources, mates, and avoid areas of human-caused mortality risk. Grizzly bears (*Ursus arctos*) are an example of a large carnivore that travels relatively long distances in search of seasonally available food resources, and are hence greatly affected by landscape change (Cristescu et al., 2016). Grizzly bear abundance and distribution has been significantly reduced in North America due to habitat loss and human hunting pressure, habitat fragmentation, conflict with

humans, and increased mortality related to anthropogenic features.

Grizzly bear research has shown that individuals sense and react to features in the landscape resulting in modified movement decisions that affect space use and subsequent home range size, and that these responses differ based on age-sex classes and seasonality. Recent work has also emphasized how grizzly bears make movement decisions at multiple scales, with bears avoiding high-risk habitat near human activity at large scales and preferring resource availability at finer scales. While these findings provide valuable insight into grizzly bear movement behavior, most approaches are limited in their ability to study the way grizzly bears acquire and use knowledge about their surroundings over time. Despite the understanding that learning and memory play an important role in animal movement, cognitive function and its effects on movement behavior of grizzlies are not well studied.

In this AWCF-funded study, we harnessed the benefits of simulation modeling to study the effects of learning and memory on grizzly bear movement behavior. A primary goal includes assessing the impacts of landscape changes on grizzly bear movement and population success in the Rocky Mountains of Alberta. Agent-based modeling (ABM) is one type of simulation modeling that can be used to represent individual animals as autonomous agents, and to simulate how they respond to other agents and their environment over time. Here, we present an ABM computer simulation model informed by animal telemetry and environmental data that accounts for landscape dynamics at two scales and uses a learning algorithm to simulate how grizzly bears acquire information from their surroundings and make informed movement decisions based on that knowledge.

Grizzly bear study evaluating landscape disturbances such as quarry mining, mountain pine beetle, and forestry practices in Alberta, Canada. Photo by fRI

Our model simulates movement decisions of a single female bear during a 5-month period between May – October for 30 years. The bear moves within a simulated environment consisting of two landscapes: a 1 km^2 cell grid (the global-scale landscape) and 1 ha cell grid (local-scale landscape). Each global and local cell is characterized by a measure of quality, (derived from GPS data

Nature Sleuth

by Daniel Leete, President

In the previous edition of the AWCF Newsletter, you were shown the following photo:

Could you guess what the artifact is? Answer: This is an egg case of a fish called a skate. There are approximately 150 species of skates and the author is not able to be specific in the species shown here. The outer covering is made of a material called keratin, which is roughly the same material found in your fingernails. Most skate egg cases contain one embryo, except for big skates and mottled skates. Those might contain as many as seven embryos. A skate is a ray, a member of the family Rajidae in the superorder Batoidea of rays. This particular egg case was found on the shore on Martha's Vineyard, MA.

Here comes the next item for you to identify. Each of these hollow cases are approximately three inches long. It is a native species found in eastern North America. Good luck!

consisting of trajectories of grizzly bears collected between 2013-2018 in west-central Alberta by the fRI Research Grizzly Bear Program), including landscape characteristics such as topographic complexity, land cover type, and anthropogenic and natural disturbances. Bears can move through a random walk represented by selecting neighboring cells with high quality values in a multi-scale approach (Figure 1).

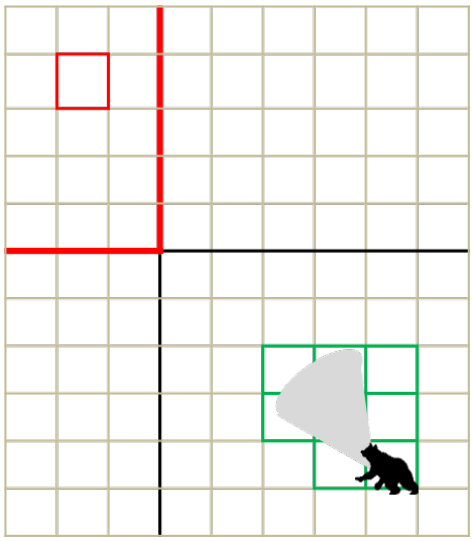


Figure 1. Diagram depicting bear movement during exploitation. Once the current 1 km² cell (black border on bottom right) is depleted, the bear assesses the eight neighboring 1 km² cells and selects the one with the highest global quality value, (red border on top left) and faces a random 1 ha cell within the target 1 km² cell (red border). The bear then moves towards this target by selecting the 1 ha cell with the highest local quality value, within a visual cone of 90° and 250 m radius (grey cone, available cells for selection shown in green).

We modeled three scenarios: 1) *random*, where bears only explore and do not use information about the landscape, 2) *learning*, in which bears learn to exploit their surroundings and use landscape data to make movement decisions, and 3) *learning with memory*, where bears learn to exploit and a memory component is incorporated that allows bears to utilize previously-collected information to make movement decisions.

Simulated bear trajectories produced results consistent with measurements obtained from radio-collared females for home range sizes, daily distances travelled, and daily displacement measures. Average home range size for simulated bears ranged from 83.97 km² to 1475.64 km² while radio-collared bears had home range sizes between 73.57 km² and 820.73 km².

Out of the three scenarios tested, only the *learning with memory* scenario led to the emergence of home ranges comparable to those observed in radio-collared female bears (Figure 2), showing the success of our model in simulating repeated space-use by grizzly bears. Our model simulates how grizzly bears will return or visit spaces close to previously used areas (Nielsen et al., 2013), using memory to exploit resources within a known area and avoid

Fun Facts-Bird Songs & Calls

Typically bird songs are a structured vocalization while attracting a mate or defending a territory. Bird calls tend to be shorter, less rhythmic sounds used to convey a nearby threat or an individual's location.

Birds produce vocal sounds using a syrinx, an organ located where the trachea splits into two bronchial tubes. In songbirds, each side of the syrinx is independently controlled, allowing birds to produce two unrelated pitches at once with some birds able to sing rising and falling notes simultaneously, like the wood thrush (*Wood thrush song*)

Wood thrush. Photo by fws.gov

Nestlings begin learning their songs in the nest as they listen to their parents. After they've fledged, young birds begin to practice and early songs are messy. Over time, maturing songbirds refine their songs and settle on a repertoire.

In many bird species, the males sing from high, exposed perches so their song will travel greater distances. Some birds, such as larks, bobolinks and buntings, sing while flying. In some species, including Northern cardinals, Baltimore orioles and rose-breasted grosbeaks, the female also occasionally breaks into song.

The best time to hear birds sing is at dawn on a spring morning, often called the "dawn chorus", reaching a a fever pitch at daybreak in late May and early June which is the peak of breeding season in most parts of the United States.

Some bird species perform duetting: in courtship rituals, both genders will sing in a complex duet that strengthens their pair bond.

unnecessary travel to new and unknown habitats. Our model was successful in simulating multi-scale movement decisions in a dynamic landscape and promoting the emergence of home ranges through the use of reinforcement learning and memory.

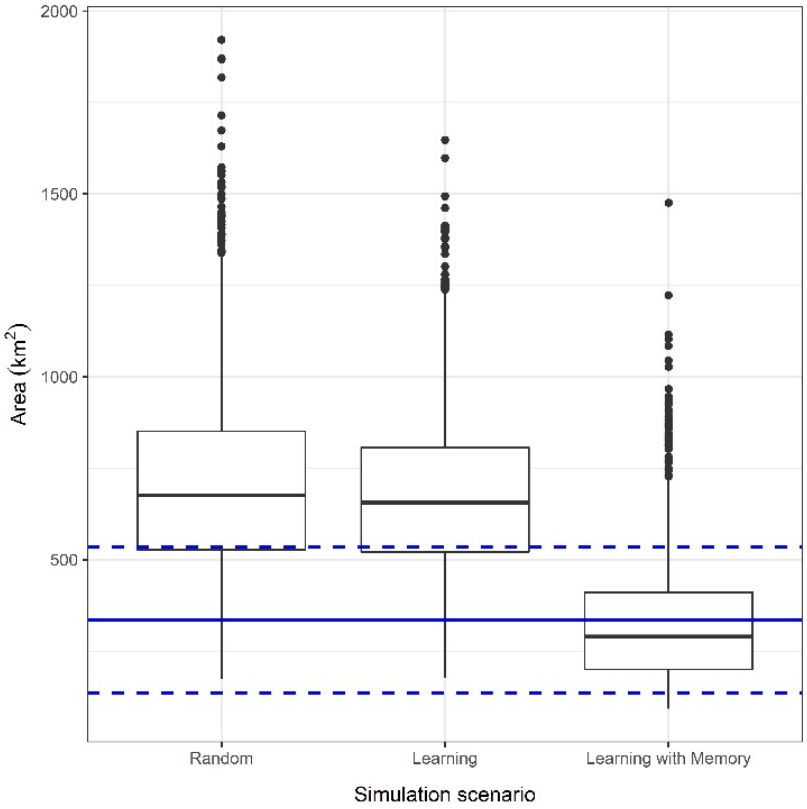


Figure 2. Box plot showing home range sizes for bears in the *random*, *learning*, and *learning with* memory scenarios. Black dots represent outlier simulated home range sizes. Blue lines show mean home range size (solid) and standard deviation (dashed) for radio-collared female bears.

The current model is useful for assessing the role of memory-informed movement in optimal use of resources and may support future research in this area. Additional studies could focus on utilizing this model as a tool for assessing movement and learning behaviors in wide-ranging species like the grizzly bear. There is high potential for using ABM as a tool to understand how landscape changes might affect wildlife space-use and the ability of individuals to access adequate resources in new environments.

Supporting Information:

1. Cristescu, B., G.B. Stenhouse, B. Goski, and M.S. Boyce. 2016. Grizzly bear space use, survival, and persistence in relation to human habitation and access. Human-Wildlife Interactions: Vol 10: Iss. 2, Article 10.

August 2020 Grants Committee Report

by Robert F. Gotie

The Grants Committee received 13 grant applications by August 1, 2020. One application was rejected because the applicant was looking for a grant outside of the Foundation's financial capability. Of the 12 applications reviewed, six were received from colleges or universities, five were from other organizations, and one was from an individual. The applications ranged from wildlife habitat relationships, climate change on prairie lizards, reproductive success of mussels, to a virtual wildlife program for children. All had some or all of the AWCF components (Conservation, Research & Education) in their proposals. All proposals were well written, but not all met our criteria that focus on wildlife research, wildlife conservation, habitat conservation and management, human-wildlife interactions, and public education. Proposals that meet all or most of AWCF's mission and focus, as judged by the selection protocol, are most likely to receive funds from AWCF.

It is with regret that we say goodbye to Dr. Peg Sauer, a long time and valued Grants Committee member. Her expertise will be sadly missed. If any AWCF members are interested in filling behind Peg on the Grants committee, please let me know. Following is a brief synopsis of the three proposals

2. Estes, J.A., J. Terborgh, J.S. Brashares, M.E. Power, J. Berger, W.J. Bond, S.R. Carpenter, T.E. Essington, R.D. Holt, J.B.C. Jackson, R.J. Marquis, L. Oksanen, T. Oksanen, R.T. Paine, E.K. Pikitch, W.J. Ripple, S.A. Sandin, M. Scheffer, T.W. Schoener, J.B. Shurin, A.R.E. Sinclair, M.E. Soulé, R. Virtanen, and D.A. Wardle. 2011. Trophic downgrading of planet earth. Science Vol. 333, Issue 6040, pp. 301-306.

3. fRIresearch Grizzly Bear Program. Website: www.friresearch.ca/program/grizzly-bear-program.

4. Nielsen, S.E. A.B.A. Shafer, M.S. Boyce, and G.B. Stenhouse. 2013. Does learning or instinct shape habitat selection? PLoS ONE 8(1):e53721.

About the Author: Alejandra Zubiria Perez is a recent Master of Science graduate from the University of Victoria, British Columbia, Canada. Her work focused on developing an agent-based simulation model to study the way grizzly bears acquire and use information about the landscape at multiple scales to make movement decisions. Her model is currently being used to understand the factors affecting the way translocated individuals interact and adapt to their new environment in an effort to increase the success of translocation efforts. She is also involved in work on home range dynamics of wolf mortality in North America and African lions. She has previously worked on vegetation restoration in Yellowstone National Park. For more details on this project and the full paper that is in preparation, please contact her at aleja.zubiria@gmail.com. Alejandra is collaborating with Dr. Christopher Bone (University of Victoria) and Gordon Stenhouse (fRI Research).

Assessing mercury concentrations in alligator snapping turtles (*Macrochelys temminckii*) and red-eared slider turtles (*Trachemys scripta elegans*) in Mississippi - *Update*

Lucas Haralson. Master's Candidate, University of Southern Mississippi, Mississippi

Funded by AWCF 2020 - 6 Month Progress Report

The goal of this study is to determine the presence and suspected

August 2020 Grants Committee Report continued:

awarded AWCF Grants:

1. Ms. Allison Litmer, PhD Candidate, University of Arkansas, Fayetteville, AR 72701.

"Influence of climate change and prey availability on prairie lizards *(Sceloporus consobrinus)"*.

The objectives of this study are to create a predictive model for analyzing the interaction of temperature and prey abundance on energy allocation important for survival and reproduction in prairie lizards. The study will also compare physiological data under daily temperature swings and constant temperatures to assess the influence of temperature swings on energy available from prey under different climate change regimes. Field and lab work will be done in Arkansas. The results of this study will establish a baseline model of varying temperature swings and its effect on energy available from reptile prey necessary for survival. Such information will help in predicting the effects of temperature changes on the survival of prairie lizards as global temperatures increase. Using our project, a wildlife conservation program with the local environmental science center has already begun outreach to local public schools and will continue throughout the project's duration.

Prairie lizard. Photo by Missouri Department of Conservation staff

differences in concentrations of mercury and methyl-mercury at different trophic levels/age between a long-lived apex predator, like the alligator snapping turtle, and a shorter-lived omnivore, like the red-eared slider. Both turtles are abundant in freshwater ecosystems in Mississippi and both species provide an excellent model for pollution studies due to their widespread distribution and longevity. Mercury and methyl-mercury have been shown to accumulate in greater quantities and at higher trophic levels and ages in aquatic organisms. While methyl-mercury can cause acute and chronic toxicity in wildlife, the threshold for these effects is still unknown in turtles. Both species are consumed by humans and our proposal will allow for an instructive comparison of mercury concentrations between two very different turtle species and potentially shed light on the serious neurological threats to humans consuming these animals.

Red-eared sliding turtles sunning on a log. Photo by Jessica Bolser/USFWS

Alligator snapping turtle. Photo by www.nwf.org

In 2020, after missing a month of field work due to the University of Southern Mississippi's (U.S.M.) response to COVID-19, we have thus far sampled 16 sites in western Mississippi. Fourteen sites are in the Yazoo River watershed, with the remaining two sites situated in the Mississippi River drainage. Blood and claw samples have been collected from 171 red-eared sliders and 205 alligator snapping turtles in addition to the approximately 190 slider samples from the Tombigbee River drainage and 400 alligator snapping turtle samples from

August 2020 Grants Committee Report continued:

2. Dr. Christoper Rota, Assistant Professor, Division of Forestry & Natural Resources, West Virginia University, Morgantown WV

"Quantifying the effects of local habitat factors, patch size, management activities, and landscape context to openings for game bird occupancy and overall avian diversity".

Dr. Rota proposes to study avian use and diversity in response to specific site attributes and landscape-level effects in eastern forest types. The specifics of this study will involve how localized habitat attributes, such as opening size, management actions, and landscape context relate to avian richness, occupancy, and abundance of game birds, breeding songbirds, and post-breeding song birds in wildlife openings. The study will take place throughout the Monongahela National Forest in eastern West Virginia. The project will provide science-based recommendations to the U.S. Forest Service and private landowners to improve regional conservation efforts by identifying an optimal design for wildlife openings that support game birds and avian diversity.

3. M.S. Salvador Gonzalez-Guzman, Education Coordinator, Conservacion de Fauna del Noreste A. C., Ensenada, Baja California, Mexico.

"Nest tracking for burrowing owls (*Athene cunicularia hypogea*) ***in*** the Tombigbee, Pascagoula, and Pearl River drainages that were collected in prior field seasons. Weather permitting, it is our intention to sample an additional 8-11 sites from the Yazoo River drainage this year.

Covid-19 closures at U.S.M. and the University of North Florida (U.N.F), where our collaborator is located, delayed the laboratory analysis of mercury concentrations in blood and claw samples. We have been in constant contact with Dr. James Gelsleichter at U.N.F. throughout the pandemic and he has assured us that he will be able to complete the needed laboratory work. To prepare for when Dr. Gelsleichter can receive the bulk of our samples, we have cleaned approximately 250 alligator snapping turtle claw samples from the Pascagoula and Pearl River drainages and it is our goal to send out the first shipment of samples in September.

About the Author:

Lucas Haralson is a wildlife biologist with a focus in herpetology from Brooklyn, New York. After receiving his B.A. from Colby College in 2014, he helped initiate a long-term mark-recapture project with white-lipped mud turtles in Belize. He has also assisted in research concerning the spatial ecology of boreal toads in Wyoming and the management of invasive reptiles in Everglades National Park. Lucas is now working toward his M.S. at the U.S.M., where his research deals with anthropogenic impacts on freshwater turtle assemblages and health.

Guest Writer: Do Your Career Choices Truly Impact Wildlife?

A case study from the glamorous to the grueling and everything in between

by Autumn Larkins

August 2020 Grants Committee Report continued:

urban and suburban areas at Bahia de Ensenada, Baja California, Mexico".

Mr. Gonzalez-Guzman's project involves five specific objectives:

- identify the number of burrowing owl nests
- determine breeding success
- determine the number of eggs, chicks raised, and predators that prey on owl nests with remote camera traps
- prepare and offer educational materials to local schools
- give presentations to 7th thru 12th grade students about the importance of this species and conservation efforts in the area.

The project will take place within the California Mediterranean region of Bahia de Ensenada, Mexico. This study will provide scientific information on the nesting status of burrowing owls and involve educating local school children on the importance of this species in the ecosystem where they live.

Western burrowing owl. Photo by fws.gov

Some of us know what we want to be when we grow up from an early age, some of us figure it out along the way, and some of us are still trying to figure it out. As a child growing up in Detroit, Michigan, I had no idea that Wildlife Biologist was even a career. I knew that I loved animals and like most city girls, I thought that meant I wanted to be a veterinarian. I proceeded through life thinking this was the best option for me to make meaningful contributions to the critters that I loved. It was midway through my college education when I discovered Fisheries and Wildlife Management. Honestly, I felt like I had stumbled onto some great treasure. This field simultaneously quenched my thirst for the outdoors, travel, wildlife, and adventure. I had hit the JACKPOT! I immediately switched majors and immersed myself into all things wildlife. My whole world was about to change.

Mountain lion capture in western Oregon for telemetry work

All through my undergraduate education I continued to work as a veterinary technician to pay my bills, but I also volunteered for every possible wildlife-related position including banding Canada geese, capturing white-tailed deer fawns, digging through barrels of deer and elk lymph nodes to test for TB, laboratory work to age teeth, and of course data entry and statistical analysis. I loved all of it. I was not sure what I was going to do for a job when I graduated but I was pretty sure it was going to be out in nature and with wildlife so I was going to be happy. Sure enough, after a summer of running statistical computer programs in a dark and dingy computer lab for a graduate student, I began my career with my dream job of conducting a moose population assessment by Michigan State University and the Michigan Department of Natural Resources in Michigan's upper peninsula, snowmobiling, snowshoeing, and flying in a fixed wing aircraft most days of the week (somebody pinch me)!

This first job opened opportunities that would shape the rest of my career. The telemetry experience from the moose job combined with some capture experience working on a swift fox project in southeastern Colorado landed me a position with Oregon Department of Fish and Wildlife (ODFW). I accepted the position as a limited duration Experimental Biology Aide. This

Species Watch: Spotlight on Alewives: Another Fishy Story

by Katherine W. Stuart

According to the Online Etymology Dictionary, the curious name of the alewife fish (or alewives, *Alosa pseudoharengus),* can be traced back to the 1630s when colonists in North America gave the alewife fish its name because of its paunchy belly. Before the fish got its name, chubby tavern keepers were called alemen or alewives.

The alewife is an anadromous fish native to the Atlantic coast and associated freshwater streams, rivers, lakes, small streams and ponds, although some populations live entirely in fresh water. Similar in appearance to the blueback herring and also in the herring family, they are collectively referred to as "river herring". Native alewives occur from Newfoundland to South Carolina and usually spawn three to four weeks earlier in the spring than the blueback herring in the same watershed. They spawn in a diversity of habitats including large rivers, small streams and ponds. An alewife may produce tens of thousands eggs per season but less than 1% of the eggs survive early life phases. Once hatched, juvenile alewives remain in freshwater lakes and ponds, feeding on zooplankton, before migrating downstream to the ocean where they grow to adulthood. While some adults die after spawning, many adults return to the ocean and may return the following spring to spawn again.

was the entry level for ODFW but I could not have been more thrilled. I was hired onto a Nutrition-Predation project in southwest Oregon where I captured and tracked almost every mega fauna in the area. We captured and radio-collared Columbian white-tailed does and fawns, black-tailed does and fawns, Roosevelt elk cows and calves, black bears, and cougars. My crew members and I worked countless hours (many unrecorded) because we loved it that much. We all thought we were living the dream. We were exposed to many different capture methodologies all on one project: clover traps, drop nets, spotlighting, helicopter capture, chemical immobilization, vaginal implant transmitters (VITs) for pregnant ungulates, padded foot snares, jab sticks for bears, as well as utilizing hounds and dart guns for cougars. We hiked miles and miles in those mountains every day tracking the telemetry collars (this was pre-GPS collars) by ground and flying in a fixed wing aircraft a few times a week. That project went on for a few more years and then the ODFW research department shifted gears to focus on an East Slope Cascades Mule Deer Project. I captured and collared mule deer for another four years along with a variety of other job tasks related to the objectives of the research project.

Aerial surveys of elk in eastern Oregon for population inventories

Aerial net capture of mule deer for telemetry in central Oregon

There comes a time in every wildlife biologist's career where you are working on a project (in my case scraping maggot-infested deer roadkill to determine age, health, and pregnancy status) when you ask yourself why I went to college for this? But those are the moments that make you a better biologist. Those grueling days make you appreciate

Species Watch: Spotlight on Alewives: Another Fishy Story Continued:

Alewives are important to the ecology of freshwater, tidal, and marine environments and are prey for eagles, great blue herons, osprey, loons and other fish-eating birds. They provide "cover" from predators for upstream migrating adult salmon, downstream migrating juvenile salmon, and salmon in the estuaries and ocean by the sheer abundance of migrating alewives.

Alewives connect our oceans, rivers and lakes, providing nutrients for healthy watersheds. Many fish and wildlife species prey on alewives including bass, crappie, tuna, cod, haddock, halibut, American eel, trout, landlocked salmon, pickerel, pike, perch, seabirds, seals, whales, otter, mink, fox, raccoon, skunk, weasel, fisher and turtles. Historically, when alewives were abundant, humans used alewives for fertilizer, to feed hogs and they were salted or smoked so they could be eaten for several weeks.

While alewives once numbered in the millions and lived in fresh water lakes accessible from the sea, they disappeared from many waters in the 19th and 20th centuries when dams were built for power production, mills and logging blocked their migration routes; road development and water pollution degraded water quality; and overfishing compounded their declining populations. For example, the

a great conference call. You need all of these experiences to be well-rounded including the exciting field work, the horrible field work, the angry constituents, and the never-ending meetings. But, after 8 years of research that was often incorrectly applied or not referenced at all, my frustration fueled my passion to make a difference in more concrete ways. Like any self-respecting biologist I wanted my efforts to mean something. At the time I did not feel like the risks to the wildlife that I was working on was incorporated into the evolution of management the way it was intended. I began to envision a better use of my time and energies that might not lay within wildlife research but in management.

So, I became an Assistant District Wildlife Biologist (aka management bio) for one of the largest districts in Eastern Oregon. Once again, I was beyond excited and thrilled to be living the dream. It was a shift from predominately animal capture and monitoring to more inventory, population modeling, land use planning, tag recommendations, and landowner and hunter interactions. I reveled in this new role and its responsibilities. I believed that this job was the best way to make positive impacts for the betterment of wildlife in Oregon. My coworkers and cohorts in this subset of our state wildlife agency (the "dirt bios" as we called ourselves) are perhaps the hardest working and most passionate people I have ever known. But after a decade of dedication to the management side of the agency, I felt I still was not doing enough for wildlife. Working for a state agency is not just about the biology, but also the social and political pressures that drive decision-making, and how wildlife management can occur. While we try to include science and biology in the management equation, my experience has been that it falls short of the other requirements for state management of wildlife populations and their habitat. There are political pressures from sportsmen's groups, environmental groups, or others who may fail to see the significance or necessity of wildlife population management as a tool for sustainability. There are also a lot of other political and financial players that influence the decision makers of the state wildlife agency that

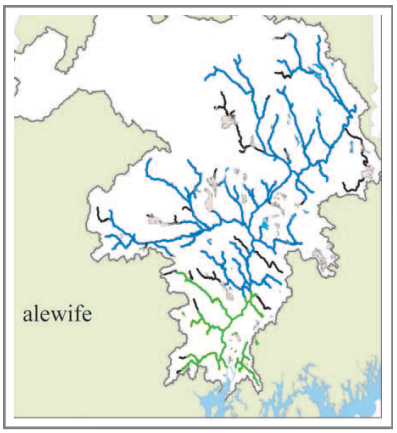
Bighorn sheep capture for in-state translocations and population and animal health monitoring

Species Watch: Spotlight on Alewives: Another Fishy Story Continued:

School of alewives. Photo by usgs.gov

Penobscot River in Maine had an estimated historic run of 14 to 20 million alewives (NOAA 2016). With recent restoration activities the 2020 estimated run size for alewives was almost 2 million returning adults in the Penobscot (Bangor Daily News, 2020).

Penobscot River			
	# Historic Estimate	# pre dam removal	# post dam removal
Alewives	14-20 million	50-2000	1.9 million



Spatial distribution of current (green) , predicted post restoration (blue), and historic (black) habitat in the lower Penobscot River alewives (Trinko et al, 2012)

dictate how we manage wildlife in Oregon.

After nearly 2 decades as a wildlife biologist for a government agency, I wanted to do more. While I've had countless amazing wildlife experiences in the field over the years, I asked myself what my contributions to wildlife have truly been. My research work helped inform management to more accurately manage populations through corrected and appropriate harvest tag allocations. During my tenure we (the dirt bios) urged the agency to evolve and grow by instituting the best available science into our inventory and population modeling methodologies, many of which were successful and improved previous techniques. But no matter how hard we worked and no matter how strong the biology and science was behind our findings, politics often influenced the decisions. So, I recently left my agency position and tried my hand at a new venture.

I now work for a non-profit organization in southeastern Oregon. I still consider myself a wildlife biologist but with emphasis on wildlife habitat. I work with private landowners and a huge variety of partners (federal and state agencies, private landowners, and other non-profits) to enhance and restore some of the most important habitats to wildlife species. Low elevation private lands in eastern Oregon are typically the best winter range. Large private landowners have kept these areas intact which provide a sanctuary for wildlife. When these areas are subdivided, fenced, or otherwise fragmented, wildlife are the first to suffer. When I work with private landowners to manage their properties for multiple uses such as grazing, ranching, and timber production, the wildlife also benefits. As the Uplands Coordinator for the Lake County Umbrella Watershed Council, I leverage grant funding with partners to restore watersheds and maintain working landscapes from ridge top to ridge top.

As an example, juniper is a native species but its expansion in the absence of historic wildfires has shown a negative impact on forage production, wildlife habitat, fire cycles, and overall watershed functions. In taking a landscape scale approach to forest and sagebrush steppe health, we utilize treatment options that can reverse this trend. We have strong partnerships with entities such as the Klamath-Lake Forest Health Partnership to promote cooperative, holistic restoration across jurisdictional boundaries to better Lake County's watersheds. It has been a rewarding experience to use my years of skills and knowledge and incorporate them into a highly functional natural resources community that shares common goals and objectives. I have been part of multiple projects that immediately benefit a variety of

Species Watch: Spotlight on Alewives: Another Fishy Story Continued:

Many river, brooks, and lakes that once had alewives no longer have the species. In response to declining population trends, many states in the Northeast and along the Atlantic have instituted prohibitions on take and possession. The US National Marine Fisheries Service (NMFS) conducted a status review but determined that listing as endangered or threatened was not warranted. They identified it as a Species of Concern and also noted a need for increased measures to conserve the fish, including increased monitoring and further research to track population trends. With work on preventing overfishing and removing obstacles like dams that allow for migration, alewives are beginning to recover in some rivers.

Ironically, alewives are also known for their invasion of the Great Lakes by using man-made channels, such as the Erie and Welland canals, and artificial stocking, causing declines in native freshwater fisheries. In the Great Lakes, the alewife was notorious for occasional massive die-offs impacting recreation users and homeowners with mass quantities of dying fish, although recent trends signal that the alewife population is declining and native fisheries are rebounding.

Even in its historical native range, owing to alewives being a plankton-feeder, there have also been concerns over alewives in competition with other native and

Juniper treatments to support restoration of rangelands and wildlife habitat

wildlife species and make the overall habitat and landscape healthier and more fire resilient. The outreach and engagement portion of this work is also extremely satisfying and important. Natural resources are at the core of Lake County's economy, making the conservation of lakes, streams, forestlands, and rangelands a priority for all. However, this is not driven by economic interests only, as there is major ecological significance too. *Developing yet protecting* the county's natural resources are practices central to sustaining our rural communities for years to come. In my mind, conservation efforts by landowners that live here and depend on the land may be one of the most important variables to maintain quality habitat and resources for our native wildlife species in Oregon. The following 2 websites highlight some of the great landscape and habitat work done in Lake County, Oregon: Lake County Umbrella Watershed Council: www.lakecountywsc.com and Klamath Lake Forest Health Partnership: www.klfhp.org.

The lesson is that while jumping out of a helicopter to capture an elk calf may be amazingly fun, you must ask yourself why you are doing it. This is especially true when collecting biological samples, collaring animals, or other research needs are not being effectively utilized, or if conducting the most technologically advanced sampling or inventory analysis is not being incorporated into better management of the population. Find a career that truly makes a difference. Do something that may entail long hours of grant writing to secure funds to provide the opportunity to improve habitat. Believe me - a deer will appreciate the removal of encroaching and overstocked juniper forests when new forbs, shrubs and a natural spring rebound in the summer, far more than a tackle from biologists jumping out of a helicopter to place a GPS collar that she has to wear for the rest of her life. There are more ways to positively impact not only individuals of a particular species but also the betterment of the entire herd. Your career choices can foster a sustained effort across a landscape scale that may improve the whole population.

Species Watch: Spotlight on Alewives: Another Fishy Story Continued:

and non-native species that are plankton feeders as well as water quality issues associated with phosphorous.

In Maine, as some dams have been removed and water quality restored, the prospect has raised questions about how the influx of alewives will affect water quality and interact with other resident fish. The size of young alewives in relation to other fish influences competition for resources among newer, non-native species such as smallmouth and largemouth bass, lake chub, and crappie, which are popular among anglers. Alewives evolved to take advantage of zooplankton feeding during the year when lakes and ponds are most productive in the summer and fall, spawning in the spring and providing an abundance of small alewives for resident species to prey upon. Alewives then leave the freshwater when zooplankton production declines in the fall and winter. Thus, lake productivity can accommodate both alewives and other freshwater species. In Maine, there are over 90 lakes and ponds where anadromous alewives coexist with healthy populations of freshwater resident fish species.

When adult alewives migrate into a freshwater lake or pond, there is an influx of phosphorous to the lake. However, the majority of spawning alewives return to the ocean, taking phosphorus with them. Further, young alewives that grow in freshwater incorporate phosphorous from

Choose wisely and be happy and fulfilled for a lifetime of career memories.

About the Author:

Autumn Larkins received her B.S. from Michigan State University in Fisheries and Wildlife Management. She recently changed careers after 18 years with the Oregon Department of Fish and Wildlife where she worked in research and management primarily focusing on big game species. She now works for the Lake County Umbrella Watershed Council as the Uplands Coordinator. She strives to integrate her wildlife knowledge into valuable habitat improvements by working with private landowners and federal and state agencies across jurisdictional boundaries to effect change on a landscape level. While not working, Autumn and her fabulous bird dog Scarlett are backpacking, hiking, and chukar hunting. She can be reached at her work email: www.lakecountywsc@gmail.com.

President's Message

by Daniel Leete

In this newsletter, I am combining the President's Message with the book report I usually submit. As you read this, you'll see why. The general topic is: Island Biogeography Expanded.

During the past 300 years or so, the concept of reasoning as a thinking process has been successfully combined with the concept of "science". As science has married with logic, more people have learned that myth, folklore, and even intuition do not activate the same neurologic process for thinking in the brain. Through using Functional Magnetic Resonance Imaging (fMRI) techniques, we can now plot brain scans which illustrate different portions of our brains (or in some cases - different

Species Watch: Spotlight on Alewives: Another Fishy Story Continued:

lakes into their bodies which is removed when the young migrate to the sea. Studies conducted from the 1970s to the present show that the alewife effect varies by lake, but the fish are part of the historical and natural lake cycle. The major factors that cause algal blooms are anthropogenic sources, and by any measure, any nutrient input from alewives is overwhelmed by runoff caused by humans directly linked to residential development such as leach fields, roads and soil erosion, and fertilizers.

Coastal rivers are like aquatic highways for alewives and other species that use both freshwater and saltwater habitats to complete their life cycle. Habitat fragmentation caused by dams and undersized and perched culverts that block alewife movement have significantly impacted their abundance and distribution. Culverts and aging dam infrastructure are vulnerable to storms and flooding causing erosion and structural damage. These impacts have been further aggravated by increased precipitation with more frequent intense storms and increasing temperatures due to climate change.

How you can help: Alewives are important because of their role in sustaining freshwater and saltwater food webs and are a focus of restoration. You can learn more about alewife natural history and increase the visibility of the species by sharing stories.

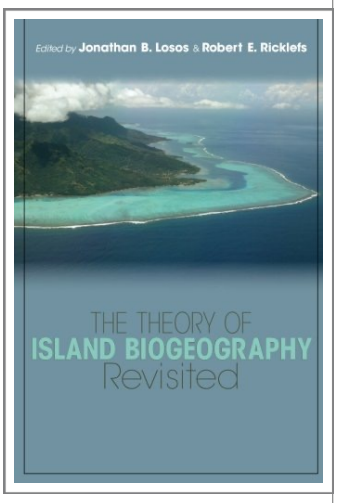
pathways), in use when applying various forms of thought. This will become important as this story continues.

In the early 1830's, Darwin and Wallace explored all over the planet, frequently focusing on islands (e.g., Galapagos Islands, West Indies, Aegean Islands, etc.) to further their research on evolution. What they independently deduced caused an explosion of scientific reasoning. One of the concepts which both Darwin and Wallace investigated has now become what is called the theory of island biogeography. I'd like to introduce you to a book, currently recognized as a masterful culmination of that theory. However, if you are going to read this book, please entertain the following three questions and pass a "test" to see if you can answer all three questions with a resounding "Yes."

Question #1: Do you consider yourself to be a "scientist?"

Question #2: Do the biological sciences and related research philosophies and methods appeal to you (perhaps even as a profession)?

Question #3: Are you familiar and even comfortable with moderately advanced mathematics?



If you answered "Yes" to all three of the above questions, then I suggest that you read The Theory of Island Biogeography, written by Robert H. MacArthur (ecologist) and Edward O. Wilson (taxonomist and zoographer), in 1967, copyrighted by Princeton University Press, published by the Maple Press Company. A follow-up edition, The Theory of Island Biogeography Revisited (J. Losos and R. Ricklefs, editors) published in 2009 evaluates and demonstrates how the field has extended and confirmed--as well as challenged and modified--MacArthur and Wilson's original ideas.

Interesting stories illustrate the various research methods used to validate their theory. Perhaps you remember reading about the island of Krakatau in Indonesia. In 1883, the entire island exploded, and after 3 months of explosions, this island and two other nearby islands were buried with hot pumice and ash up to 60 meters in depth. All flora and fauna were killed. Repopulation commenced soon after, and that provided a primary research site to study repopulation, as well as for the

Species Watch: Spotlight on Alewives: Another Fishy Story Continued:

Get involved in efforts to help restore alewife habitat such as conserving lakes, rivers, and streams for anadromous fisheries. Become an active proponent in restoring fish migration such as removing dams or creating fishways so fish can migrate around dams and the needs of both fish and people are considered. For example, in the Penobscot River in Maine, more than 30 projects, large and small, have been conducted in the last few decades to restore flows in the river and re-connect tributaries. Support conservation organizations and agencies active in restoring fish-friendly road crossings that are properly sized and designed to reduce flood threats, enhance transportation safety, and decrease repair costs. Support or partner with organizations such as The Nature Conservancy that promote policies to encourage habitat conservation for fish and wildlife while supporting communities that rely on safe roads and clean water.

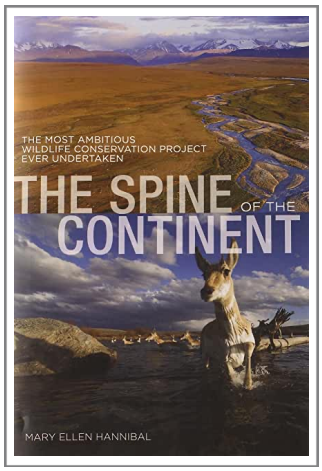
References:

Barber, B.L., A.J. Gibson, A.J. O'Malley, and J. Zydlewski. 2018. Does what goes up also come down? Using a recruitment model to balance alewife nutrient import and export. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science. 10:236-254.

Bangor Daily News. 2020. Fish are thriving in the Penobscot as shad returns shatter record. Bangor Daily News. June 19, 2020. Bangor, Maine.

justification (proof) of MacArthur and Wilson's 20th century theories.

A portion of the developing theory in MacArthur's and Wilson's book is: "Island populations are fragmented and the boundaries of their subunits set by factors have little to do with innate biological properties." Perhaps you already know and understand that theory. Let us make this a little more complicated. I used to define the word "island" as a piece of land (rock, soil, etc.) surrounded by water. The literal definition has expanded. Paraphrasing the American College Dictionary, "island" can now also mean a thing resembling an island especially in being isolated, detached, or surrounded completely by something else, radically different, in every way.



Let's expand on this "island biogeography" theory, using the second definition. Back in 2012, I read a fascinating book titled The Spine of the Continent, by Mary Ellen Hannibal, Lyons Press, Guilford, CT. One of the purposes of this book was to examine mountain tops as a type of island. Many large mammals travel vast distances during their yearly cycles of living. This is true for bears, caribou, elk, buffalo, etc. When the types of habitat for these creatures are reduced in volume or size, or by increasing distances, it becomes difficult for many of these species to survive.

During this past century, those special places needed for survival by many species - including birds - have been reduced. Picture a topographic map of a particular mountain range on your computer screen, with elevations ranging from 3,000 feet at the lowest elevation up to 12,000 feet at the highest elevation. Using a mapping application, select all areas on your computer screen from the 3,000 foot level to the 9000 foot level, and turn all of the selected area to the color blue, eliminating all contour lines. I'll submit that you are now able to see the 9,000 to 12,000 foot elevations appearing as islands floating in an ocean. For the aforementioned mammals, the metaphorical water level is rising, creating islands difficult to reach, threatening their survival as a species. Why? How is the "water level" rising? We humans are responsible. Timber extraction is occurring at ever higher elevations. Homes are being built at higher elevations, further back in the hills. More farmland is being developed at

Species Watch: Spotlight on Alewives: Another Fishy Story Continued:

Kircheis, F.W., J.G Trial, D.P Boucher, B. Mower, Tom Squiers, Nate Gray, Matt O'Donnell, and J.S. Stahlnecker. 2004. Analysis of Impacts Related to the introduction of Anadromous Alewife into a Small Freshwater Lake in Central Maine, USA. Maine Inland Fisheries & Wildlife, Maine Department of Marine Resources, Maine Department of Environmental Protection. 53 pp.

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Trinki, T., K.R. Ravana, and R. Saunders. 2012 Evaluating Changes in Diadromous Species Distributions and Habitat Accessibility following the Penobscot River Restoration Project, Marine and Coastal Fisheries, 4:1, 284-293, DOI: 10.1080/19425120.2012.675971

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US FWS. 2018. The Natural History of River Herrings (*Alosa pseudoharengus* and *Alosa aestivalis*). www.fws.gov/northeast/cnefro/species/riverherring.html https://fws.gov/r5crc/species.html

U.S. NOAA. 2016. Penobscot River Habitat Focus Area Implementation Plan. 51 pp.

Wildlife Management Institute. 2018. The Comeback: Restoring free-flowing rivers in Maine. www.wildlifemanagement.institute/outdoor-news-bulletin/august-2018/

higher elevations than ever before, with the lack of water being one of the reasons for the move. Aha: Mountain Islands!

While I was working in the cloud forests of Ecuador with Dr. Dusti Becker on an Earthwatch expedition, one component of the project was to collect data on a specific species of bird in an effort to determine the number of hectares required to maintain a healthy population of that species. From this, I realized that even a single consolidated unit of a specified ecological type could be accurately considered as an "island."

When you travel in Arizona and New Mexico, and work with various natural resource agencies such as the Bureau of Land Management or various National Forests, as I have, a familiar term shows up: sky islands. What is meant by sky islands is that portions of mountainous areas, (far removed from each other perhaps by hundreds of miles), each become their own island. Frequently, each sky island may have species of birds, lizards, and even cacti not found in neighboring sky island mountains.

Choose any state in the East. Can you imagine what the forests in that state looked like in the year 1700? Now, picture the forest in the same place in that same state today. Would you suppose that the amount of forest acreage has been reduced? Can you picture the "islands" of forests that now exist there? Note Figure 1 on the next page as an example from Wisconsin.

I observed another weird adaptation of this concept of island biogeography on a trip to the Shetland Islands, north of Scotland. Family tradition there would let you define the land you owned by constructing rock walls around the perimeter of your land.

Once you died, your children were given the land, frequently in equal amounts per child. Guess what the children of the children did? They defined their property by building rock walls around their perimeters. And then the next generation, and the next generation continued to split the property. Eventually, each individual unit was so small that farming was no longer sustainable. They were inadvertently making their own islands, each becoming increasingly unsustainable.

Another theory of island biogeography to consider: We humans are creating too many, too small, too isolated islands. The result is as islands become too isolated, or too small, or overpopulated, frequently the plants and animals which depend on that island leave the island to never return again or become extinct. Almost universally, this is not good news. Why? Generally, diversity implies sustainability, and diversity is declining around the globe.

CALENDAR OF EVENTS

Oct 6-8, 2020: (Virtual) Land Trust Alliance Rally 2020. The National Land Trust Conservation-Conference. www.alliancerally.org

Oct 6-8, 2020: (Virtual) North American Invasive Species Management Association Annual Conference. www.naisma.org/conferences/

Oct 8, 2020: (Virtual) Alabama Chapter of The Wildlife Society Annual Meeting. Registration: https://www.eventbrite.com/e/2020-actws-annual-meeting-registration-99020088751

Oct 8, 9, 15, 2020: (Virtual) Pennsylvania Chapter of The Wildlife Society Annual Meeting. www.wildlife.org/pennsylvania-chapter/annual-meeting/

Oct 10 & 17, 2020: (Virtual) 2020 Wildlife Conservation Expo. www.wcnexpo.org

Oct 13-16, 2020: (Virtual) 2020 Natural Areas Conference. Sierras to Sagebrush: integrating management and stewardship across landscapes. www.naturalareas.org/2020_conference.php

Oct 18-Nov 30, 2020: (Virtual) Winter Raptor Festival. www.winterraptorfest.com

Oct 20-22, 2020: (Virtual) 20th Annual North American Pollinator Protection Conference. www.pollinator.org/nappc/registration

Oct 23, 2020: (Virtual) California Central Coast Chapter of The Wildlife Society Annual Meeting. www.wildlife.org/cali-centralcoast/events/

Oct 28, 2020: (Webinar) Wildlands & Woodlands RCP 90-minute pre-Gathering Webinars: 1:00-2:30 pm ET.www.wildlandsandwoodlands.org/2020-rcp-network-gathering

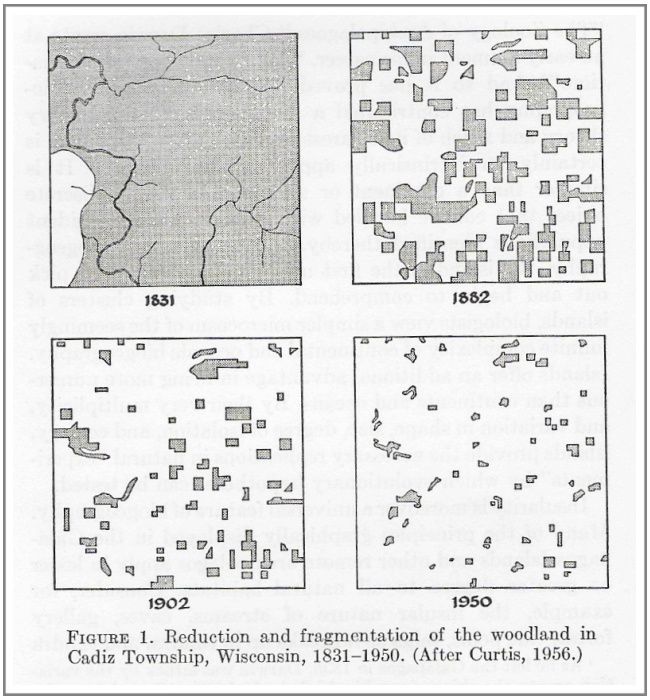

FIGURE 1. Reduction and fragmentation of the woodland in Cadiz Township, Wisconsin, 1831–1950. (After Curtis, 1956.)

By now you might be asking yourself why I have written this article. Here's why. I believe how I traditionally thought about islands was not well thought out, nor completely accurate. So now I have learned something new, fascinating, and important by reading these books. Hence I can change my actions based on new knowledge. As people who care about land and species conservation, it behooves us to persistently have the courage and emotional stamina to evolve with what we once thought to be true, or learn what we didn't know. There are things that we do which result in consequences that we don't know, don't think about, don't recognize, or don't understand. In my experience, both scientists and non-scientists struggle with unlearning, new learning, and even relearning. I suggest that we have to learn and understand - at a deeper level than ever before - that every single thing that we do has an impact on the world's environment. Perhaps this is why the rigor and discipline of science needs to be upheld and challenged at the same time. I hope you learned something new about islands in this article and I hope you challenge this research as well. Thank you for taking the time to read about island biogeography.

Photographer's Corner: Nate Peters

Nate Peters is a native of western New York, but has called Randolph, NH home since 2004. Nate works for the USFS as a Recreation Specialist and spends his free time filling memory cards capturing images of just about anything he finds interesting. His pursuits often lead him into the depths of the mountains chasing Alpenglow or in search of any critters willing to reveal themselves. He is a self-taught photographer who started shooting

CALENDAR OF EVENTS

Nov 2-6, 2020: (Virtual) Upper Midwest Invasive Species Conference. www.umisc.net

Nov 5, 2020: (Webinar) Wildlands & Woodlands RCP 90-minute pre-Gathering Webinar. www.wildlandsandwoodlands.org/2020-rcp-network-gathering

Nov 12-13, 2020: (Zoom) Western Pennsylvania Land Conservation Summit.www.conserveland.org/wpa_summit/

Nov 13, 2020: (Webinar) Wildlands & Woodlands RCP 90-minute pre-Gathering Webinar. www.wildlandsandwoodlands.org/2020-rcp-network-gathering

Nov 19, 2020: (Virtual) Wildlands & Woodlands RCP: One day of panel discussions, networking, and brainstorming. www.wildlandsandwoodlands.org/2020-rcp-network-gathering

Nov 26-29, 2020: Waterfowl Weekend at Chincoteague National Wildlife Refuge. Chincoteague, VA. https://www.allaboutbirds.org/news/event/waterfowl-weekend-at-chincoteague-national-wildlife-refuge/

Jan 31- Feb 3, 2021: 81st Annual Midwest Fish & Wildlife Conference: Fostering Diversity. Saint Paul, MN. www.midwestfw.org

Jan 14-17, 2021: Willcox Birding and Nature Festival. Willcox, AZ. www.wingsoverwillcox.com/index.asp

Jan 14-18, 2021: Everglades Birding Festival. Fort Davie, FL http://www.evergladesbirdingfestival.com

Jan 16-17, 2021: 30th Annual Tennessee Sandhill Crane Festival. Birchwood, TN. www.allaboutbirds.org/news/event/30th-annual-tennessee-sandhill-crane-festival/

more than 25 years ago, long before memory cards were a thing. Nate specializes in Wildlife and Mountain Landscapes, and his images have been printed in many scientific journals and publications over the years. To see more of Nate's work please visit:

www.natepetersphoto.homestead.com