



Newsletter of the National Evolutionary Synthesis Center, an NSF-funded collaborative research center operated by Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University.

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10 years of NESCent

A special look back at a remarkable decade of research, outreach and collaboration at NESCent.

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Next proposal deadlines

Dec. 1: Short-term visitors, journalists-in-residence

Feb. 1: Summer 2015 graduate fellows (off-site)

April 1: Fall 2015 graduate fellows (off-site)

For more information, see page 3 or visit nescent.org/science/proposals.php

RESEARCH HIGHLIGHTS



Seabirds like puffins and auks are especially sensitive to climate and environmental shifts
PHOTO COURTESY OF U.S. FISH AND WILDLIFE SERVICE, WIKIMEDIA COMMONS

A canary for climate change

Researchers find a strong correlation between Northern Hemisphere seabird diversity and environmental stressors

Modern-day puffins and auks have long been recognized as environmental indicator species for ongoing faunal shifts, and fossil records now indicate that ancient relatives were similarly informative. Researchers have found that puffins and auks may have been at their most diverse and widespread levels during a relatively warm period of Earth's history. The results also explain how past extinctions have shaped the geographic distribution and population size of existing species.

Authors Adam Smith of the National Evolutionary Synthesis Center (NESCent) in Durham, N.C., and Julia Clarke of the University of

Texas at Austin examined 28 extinct species in addition to 23 living species. Whereas previous research focused primarily on surviving members of the alcid family, this study was able to paint a more comprehensive picture of their evolution. The findings, which were just published online at the *Journal of Avian Biology*, support a connection between the diversification of wing-propelled diving seabirds and major climatic events. Such environmental conditions also appear to have influenced the physical traits observed in existing alcids like dovekeys, murrelets, puffins, auklets and auks.

see **CLIMATE CHANGE**, p16

ABOUT NESCENT:

NESCent is a scientific research center dedicated to cross-disciplinary research in evolution. The center's mission is to promote the synthesis of information, concepts and knowledge to address significant, emerging, or novel questions in evolutionary science and its applications. NESCent achieves this by supporting research and education across disciplinary, institutional, geographic, and demographic boundaries.

NESCent is a collaborative partnership between Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University, and is funded by the National Science Foundation (award #EF-0905606). For more information about research and training opportunities at NESCent, visit www.nescent.org.

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Letter from the director

Today was a good day at NESCent. I always think it's a good day when I learn something new, and today, Alex Weiss, a short-term visitor from the University of Edinburgh gave a talk on his research on personality, well-being, and health in humans, chimpanzees, and other non-human primates. I learnt that a strong argument can be made that some personality traits— for instance, subjective well-being and dominance— are essentially manifestations of the same suite of genes.

If you've been to NESCent, you know of course that it is not unusual to have anthropologists giving talks, paleontologists running working groups, and computational biologists hacking away at hackathons. Add to this mix a resident community that includes postdocs studying viruses, ocean biodiversity, and protein folding, and at times there is an almost surreal quality to the conversations that one overhears.

This is NESCent's legacy: Providing an outlet for unusually innovative ideas posited by researchers from the broadest reaches of evolutionary science. One former postdoc put it best when he compared the center to a "supercollider" for scientists: It makes remarkable things happen. You can read his full reflection and others in the special "10 Years of NESCent" section of this special edition newsletter. In addition to the usual research stories and center news, we've looked back over the past decade to follow up with past participants and share intriguing anecdotes.

I am also excited to look forward, not only to the many vibrant projects and collaborations first realized at NESCent, but also to a new Triangle-based synthesis center that will, in a sense, carry the

mantle. Envisioned as a localized entity that will focus on evolutionary medicine, the center is still in a fledgling state, but its progress and promise (as discussed in this issue) offer an optimistic view of the future of evolution-focused research in North Carolina and beyond.

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I invite you all to continue the projects conceived, developed, and advanced here at NESCent and to keep in touch. After all, the center may close, but NESCent has evolved into a self-sustaining community, and we have you to thank for it.



Dr. Allen Rodrigo
Director of NESCent

Comings and Goings

As NESCent winds down, we are very happy and a bit rueful that many of our colleagues have already transitioned into exciting new opportunities. We wish them well (way to go!) and anticipate more bittersweet departures in the coming months.

Jonathan Lombard has hopped across the pond to work as a Postdoctoral Fellow in Thomas Richards's lab at the University of Exeter.

Adam Smith is a John Caldwell Meeker Postdoctoral Fellow at the Field Museum of Natural History in Chicago.

Kate Hertweck began teaching as an Assistant Professor at the University of Texas-Tyler.

Communications Manager and Newsletter Editor/Writer Emeritus **Robin Smith** now pens science stories at the Duke Office of News & Communications.

System Administrator **David Palmer** is now the Linux Administrator on Duke's Trinity College of Arts and Sciences.

Postdoc **Dan Ksepka** is the new Curator of Science at the Bruce Museum in Greenwich, CT.

Jeff Sturkey has moved down Main Street to Duke Medicine Development and Alumni Affairs where he works as the Special Events coordinator.

CALL FOR PROPOSALS

Call for proposals

Looking for support for a short-term visit or science journalism project? NESCent welcomes your proposals. We are looking for innovative approaches to outstanding problems in evolutionary biology. Short-term visitor proposals that have a clear interdisciplinary focus or involve evolutionary concepts in nontraditional disciplines are strongly encouraged. Proposals for both awards last two weeks to three months; the deadline is December 1.

We are also inviting graduate students at accredited North Carolina institutions to apply for special Triangle Graduate Fellowships in Evolutionary Medicine. We seek applicants who are interested in any field of evolutionary science that is relevant to medicine, or to human or animal health. This semester-long fellowship would be offsite, at the student's host institution. The deadline is February 1 for Summer 2015 and April 1 for Fall 2015.

For more information, please visit nescent.org/science/proposals.php.

COMING SOON

Darwin Day hits the road again

What: Darwin Day Roadshow

When: February 2015

Where: Coming to a state near you

To celebrate its fifth anniversary, Darwin Day Roadshow will do what it has done each February for the last four years: Hit the road to share the excitement of evolutionary science with students, teachers, and the general public in communities around the country, on the occasion of Charles Darwin's birthday. The Roadshow sends NESCent scientists, educators, and collaborators into K-12 classrooms all across the US with a particular focus on small, rural communities and those with high numbers of under-represented minority students to talk about evolution research and career opportunities in science.

The Roadshow has now visited thousands of students and teachers across 22 different states, including settings as diverse as a middle school on a Native American reservation in Arizona, a high school within a boys' correctional facility in West Virginia, and a school for student-patients at a psychiatric hospital in Massachusetts. There is no charge to teachers and schools to participate, and each host teacher receives an extensive collection of evolution teaching resources.

The success of the Roadshow is illustrated by comments from host teachers. One said, "It made the whole school community aware of the importance of evolutionary theory and its implications," while another added, "The resources helped me become updated on the science surrounding the topics. Therefore, I created better lessons for my students."

To find out more, including how to apply to be a stop on the 2015 version of the Roadshow, visit our website at roadshow.nescent.org. The deadline to apply for the 2015 Roadshow is November 21, 2014.



Congrats to the winners of the 2014 Evolution Film Festival

The votes are in! Nearly 200 people viewed and voted on their favorite short videos at the 2014 NESCent Evolution Film Festival in Raleigh on Saturday, June 21. This was a very competitive year with more than 30 submissions– the most we’ve ever had– and the voting for the final 12 was unusually close because there were so many great finalists. (Every video got at least one first place vote!)

When the votes were counted, the winner was “Drift,” submitted by Lauren Anderson, Monique Boileau, Zach Boudreau, Sarah Jezierny, Julia Kunberger, and Will Ryan of Florida State University. The runner-up was “Dinosaur,” a song written, composed, and performed by Lori Henriques of Portland, OR with video animation by Joel Henriques.

The first- and second-place winners will receive a travel allowance of up to \$1,000 and \$500, respectively, for travel expenses to attend the scientific meeting of their choice. Thanks to our filmmakers for some fabulous videos! Watch this year’s finalists at filmfestival.nescent.org/2014-entries and check the website (filmfestival.nescent.org) in early spring for info on how to submit your own video for the 2015 Film Festival.

Evolution 2014 welcomes the next generation of scientists

As in years past, Evolution 2014 attracted researchers, university scholars, evolution educators, science journalists, and policy makers from around the world. But for the first time, this year’s meeting included activities specifically designed to welcome members of the K-12 community and citizen scientists. These special guests included 18 high school students from the North Carolina School of Science and Math and two teacher chaperones; Orange County, NC elementary school teacher Kristin Bedell; the elementary school-aged daughters of organizing committee members Karin and David Pfennig; and Wake County middle school-aged student Carson Cope along with his mother Jasmine.

NESCent was thrilled to co-host the Evolution 2014 conference in downtown Raleigh from June 20 to 24. Here’s a brief rundown by the numbers:

Registered Attendees: **1,958**

Presentations: **1,014**

Posters: **436**

Lightning Talks: **64**

Symposia and Special Lectures: **62**

Booth Exhibitors: **26**

Average registration cost: **\$378.93**

A successful and stimulating conference: **PRICELESS**

Evolution 2015 is already set for June 26 to 30 at the lovely Casa Grande Hotel Resort in São Paulo, Brazil. Visit <http://sbg.org.br/Evolution2015/> for more details!

“The overwhelming sentiment was that of passionate, intelligent people who love their work and have so much fun doing it that it seems the lines of life and work are blurred,” Jasmine Cope wrote in a post-conference e-mail. “It was also a great insight into the life of an evolutionary biologist.”

The conference offered these students and educators unfettered access to symposia, contributed talks, and special events including the NESCent Evolution Film Festival and Super Social at the North Carolina Museum of Natural Sciences. Additionally, the participants presented at the first poster session, which was held Saturday, June 21. NESCent covered the cost of conference registration fees for all the K-12 and Citizen Science participants as a way of reducing barriers to their attendance. Upon their arrival at the Raleigh Convention Center, they received a personal greeting and welcome from NESCent Director and head conference organizer, Allen Rodrigo.

Carson Cope presented “Phenotypic Plasticity of the Pharyngeal Jaw in the Parachromis Managuensis Cichlid Fish” along with professor and research mentor Brian Langerhans. Carson volunteers at Langerhans’s evolutionary ecology lab at N.C. State and was able to parlay his research on the freshwater fish into a well-received poster.

The inaugural K-12/Citizen Science Poster Session was first envisioned by NESCent Assistant Director of Education and Outreach Jory Weintraub who has ties to the various school systems in the Triangle.

“It was an experiment, but one that worked very well,” Weintraub said. He noted that it was the first time a large number of K-12 students have participated in a poster session. Because the location of the Evolution conference changes annually, it can be difficult to reach local educators and students each year. Nevertheless, the success of this year’s event could serve as the jumpstart needed to establish a regular program.

“It worked so well that we’re going to advocate to make it a part of Evolution and grow it each year,” Weintraub said.

N. C. State researcher Lea Shell, who collaborated with Bedell, furthered the outreach mission of the K-12/Citizen Science Poster Session with their poster, “Citizen Science: Engaging Students in Authentic Scientific Research.” The poster detailed how to introduce citizen science to learners ranging from pre-K to adults.

Students from the School of Science and Math also worked together to present their own posters. The topics ranged from genetic drift of eye color in common fruit flies to cancer-related genes in signal transduction pathways to the effects of UV radiation with and without DNA-repair mechanisms.

In addition to meeting scientists from all around the world and presenting his poster, Carson Cope received a collection of textbooks from several science publishers when he visited their sponsor booths. Just a week after the conference concluded, he had already whirled through several chapters and completed a guidebook.

His mother Jasmine noted that the value of his Evolution 2014 participation reaches far beyond books and presentations.

“It took an abstract love and passion that was being sustained by museum visits, documentaries, and books and turned it into a tangible reality,” Cope wrote. “Not only can he ‘practice’ his love for the field, but he can see that the profession is an attainable reality.”



“A canary for climate change” (EurekaAlert!)

The old adage about canaries in coal mines might hold true for another type of bird: Puffins, auks, and other relatives are the species to watch when it comes to environmental changes. NESCent researchers Adam Smith and Julia Clarke find a strong correlation between

climate and the population size and geographic range of these birds, as well as their ancient relatives. Ironically, these wing-propelled divers enjoyed the greatest diversity during a relatively warm period. <http://bit.ly/1pcsRvm>

“Open data for evolutionary synthesis: an introduction to the NESCent collection” (Scientific Data)

NESCent’s open-data policy coupled with the wealth of data stored in Dryad has now led to the NESCent Collection in the newly launched *Scientific Data* platform. This collection, which already has four Data Descriptors, will expand on a rolling basis. Todd Vision and Karen Craston discuss the importance of such repositories for data that do not fit the traditional publication model. <http://bit.ly/1rAb40H>

“Social network research may boost prairie dog conservation efforts” (EurekaAlert!) As particularly “chatty” mammals, prairie dogs are well-known for being social creatures. A new study used statistical tools to better understand hidden aspects of these complex social networks. Former NESCent postdoc Jennifer Verdolin and N.C. State researchers hope these results can be used to decrease the spread of bubonic plague among prairie dog colonies. <http://bit.ly/1w8zUcA>

“Evolution experts convene at Raleigh Convention Center” (News & Observer) Evolution 2014 featured nearly 2,000 attendees from 38 countries with highlights including K-12 research presentations, a genome software school, and a public lecture on the relationship between evolution and science. <http://bit.ly/1zdtVJ9>

PUBLICATIONS

Recent publications & products by NESCent authors

Conner, J. et al. (2014). “Patterns of phenotypic correlations among morphological traits across plants and animals.” *Philosophical Transactions of the Royal Society B: Biological Sciences* 369:20130246.

Conner, J. and R. Lande. (2014). “Raissa L. Berg’s contributions to the study of phenotypic integration, with a professional biographical sketch.” *Philosophical Transactions of the Royal Society B: Biological Sciences* 369:20130250.

Conner, J. et al. (2014). “Artificial selection on another exertion in wild radish, *Raphanus raphanistrum*.” *Scientific Data* 1:140027. doi:10.1038/sdata.2014.27

Govindaraju, D. (2014). “Opportunity for selection in human health.” *Advances in Genetics Vol. 87, Academic press.*

Harnik, P., et al. (2014). “Phylogenetic signal in extinction selectivity in Devonian terebratulide brachiopods.” *Paleobiology* 40:675-692. doi: 10.5061/dryad.8mc3s.

Hofmann, H. (2014). “An evolutionary framework for studying mechanisms of social behavior.” *Trends in Ecology & Evolution.* doi: 10.1016/j.tree.2014.07.008.

Kuester, A., J. Conner, et. al. (2014). “How weeds emerge: a taxonomic and trait-based examination using United States data.” *New Phytologist* 202:1055-1068 doi: 10.1111/nph.12698.

Maherali, H. (2014). “Is there an association between root architecture and mycorrhizal growth response?” *New Phytologist.* doi: 10.1111/nph.12927.

Moghe, G. et. al. (2014). “Consequences of whole-genome triplication as revealed by comparative genomic analyses of the wild radish *Raphanus raphanistrum* and three other Brassicaceae species.” *The Plant Cell* 26:1925-1937.

Plooij, F. (2014). “Longitudinal recordings of the vocalizations of immature Gomba chimpanzees for developmental studies.” *Scientific Data.* 1:140025 doi: 10.1038/sdata.2014.25.

Ramírez, M. (2014). “The morphology and phylogeny of dionychan spiders (Araneae: Araneomorphae).” *Bulletin of the American Museum of Natural History,* 390: 1-394. doi: 10.1206/821.1.

Smith, N.A. and J.A. Clarke (2014). “Systematics and evolution of the Pan-Alcidae (Aves, Charadriiformes).” *Journal of Avian Biology.* doi: 10.1111/jav.00487

Tree of Sex Consortium (2014). “Tree of sex: a database of sexual systems.” *Scientific Data.* 1:140015 doi:10.1038/sdata.2014.15.

Verdolin, J. et al. (2014). “Key players and hierarchical organization of prairie dog social networks.” *Ecological Complexity,* 19: 140 doi: 10.1016/j.ecocom.2014.06.003.

Vision, T. and C.K. Cranston (2014). “Open data for evolutionary synthesis: an introduction to the NESCent collection.” *Scientific Data.* 1:140030 doi:10.1038/sdata.2014.30.

Vogan, P. and H. Maherali (2014). “Increased photosynthetic capacity as a mechanism of drought adaptation in C3 plants.” *International Journal of Plant Sciences,* in press (to appear Dec. 2014)

Zehr, S., et al. (2014). “Life history profiles for 27 strepsirrhine primate taxa generated using captive data from the Duke Lemur Center.” *Scientific Data.* 1:140019 doi: 10.1038/sdata.2014.19.

What has NESCent

As the 10-year mark approaches and NESCent prepares to close our doors next summer, we've begun to reflect on the community—how it has grown and continues to evolve even in the final year. Former participants, ongoing partners, and veteran collaborators have used their time and connections forged at NESCent to do extraordinary things. We asked them to share their experiences:

Science

“NESCent has been instrumental in developing the new field of evolutionary medicine. Thanks to its early support via several Working Groups, support for a summer course, and a current Working Group developing curricular materials, NESCent has brought together scientists and clinicians who have created the International Society for Evolution, Medicine, & Public Health to move the field ahead for the long run, starting with an inaugural meeting March 19-21 in Arizona. See <http://evolutionarymedicine.org> for more information. Thanks,

NESCent!” –Randy Nesse, Working Group participant and President of the Foundation for Evolution, Medicine, & Public Health

“Our recent Catalysis Meeting on Venom Evolution was one of the most stimulating scientific gatherings I've ever attended. The intellectual buzz of having about 25 smart accomplished people all focusing on the same topic for three days nonstop was energizing, enlightening, and already has spawned all sorts of collateral activities which we are now sorting through. It was amazing!” –Lisle Gibbs, Catalysis Leader, and Professor at Ohio State University

“I have been to NESCent as a Catalyst Meeting organizer, a Sabbatical Scholar, a Short-Term Visitor, and a Working Group Leader. It has been an essential part of my career and research and I mourn its passing.” –Roy Plotnick, perennial NESCentian and Professor at University of Illinois at Chicago

“The NESCent Working Group on body size evolution gave me the chance to meet and work with a wonderful group of colleagues in paleontology and ecology very early in my career. It was a wonderful opportunity to quickly build up a group of professional colleagues and personal friends due to the intimate atmosphere at NESCent. It also sparked several research ideas regarding body size evolution that I am continuing to pursue, often in collaboration with Working Group colleagues.” –Jon Payne, Working Group and Catalysis Leader and Associate Professor at Stanford University

“Our NESCent Catalysis Meeting on the genetics of adaptation to high altitudes resulted in a new collaboration and a publication that transformed the field.” –Cynthia Beall, Catalysis Leader and Distinguish Professor at Case Western Reserve University

“NESCent has offered the luxury of time and space to think and work collaboratively,

meant to you?

I consider my time at NESCent both within Working Groups and as a short-term visitor as mini-sabbaticals. The productivity of our working groups would not have been possible if attempted from afar; we needed chunks of time during which we could all justifiably unplug from the rest of our academic endeavors and focus deeply on a few topics. I consider the collaborations forged after sitting together for long hours as lifelong and transformative.” –Rebecca Safran, Short-term visitor, Working Group Leader, and Associate Professor at University of Colorado

“My experiences at NESCent, both as co-PI of a working group and as a postdoctoral scholar, shaped my current research program in too many ways to enumerate; isolating any single project doesn't do it justice. NESCent's legacy in my work and that of others is that it provided the food for interdisciplinary engagement by supporting a dynamic community of individuals from across the biological sciences who challenged, taught, and

worked with each other and shared those activities through scholarship, outreach, art, and journalism. It was tremendously rich and I am grateful for my time at the Center.” –Paul Harnik, former Postdoc and Assistant Professor at Franklin & Marshall College

Informatics

“NESCent makes exciting things happen: It is like a supercollider for biologists. NESCent invested heavily in the Fossil Calibration Database and helped us push it across the finish line, and brought together 30 separate perspectives on the avian brain for a meeting that synthesized dinosaurs, cell layers, and 300 endocasts into an exciting story. There is simply no place that matches what NESCent does, and I will never forget the experience, the people, and the science.” –Dan Ksepka, former Postdoc and Curator of Science at the Bruce Museum

“Co-leading the Primate Life History Database Working Group has been a unique experience. The opportunity to

interact with colleagues at NESCent has been instrumental not only in our creation of an individual-based database from long-term studies of seven species of wild primates, but also in the development of comparative analyses that advance our understanding of the evolution and ecology of primate life histories.” –Karen B. Strier, Working Group Leader, Vilas Research Professor of Anthropology at University of Wisconsin-Madison

“NESCent gave me the opportunity to summarize the insights and results of a major portion of my career; review and scan the most important experimental data of my former professor, Thomas Park; and the opportunity to participate in several Working Groups on cutting-edge topics. The NESCent Sabbatical fellowship opportunity allowed me to finish one book manuscript (due out in fall 2015, University of Chicago Press) and begin another and to publish two papers from workshops and another two with a faculty member at Duke University. The best and



“interdisciplinary exchange”

“...the chance of a lifetime”

most productive sabbatical of my 39-year career!!” –*Mike Wade, Sabbatical Scholar and Professor at Indiana University*

“It is no exaggeration to state that my Sabbatical at NESCent was the chance of a lifetime. Besides the ever-present expertise, the high level of communication and interdisciplinary exchange enabled me to achieve even more than planned. Without the four months at NESCent my project would not have seen the light of day. Period.” –*Carola Borries, Sabbatical Scholar and Research Associate Professor at Stony Brook University*

“I have been a PI of two different NESCent Working Groups: linguistic diversity and cultural evolution. NESCent has been a vital foundation for all of our projects, by providing the opportunity to bring together a diverse set of people from multiple disciplines and countries to seek ways to synthesize methods and theories from diverse disciplines. Critical to this process has been the support of NESCent’s

Informatics team. We simply could not have gotten to where we are now without their support. As evidence of this the NESCent’s informatics team has worked to build a web-portal that will serve as the interface for D-PLACE, a new global database linking data on peoples, languages, cultures and ecology to help empower a new line of research in cultural evolution.” –*Mike Gavin, Working Group Leader and Associate Professor at Colorado State University*

Education & Outreach

“I feel that NESCent has had a huge impact on evolution education outreach through its workshops, programs like Darwin Day, site visits and the many publications that it had to offer to educators. I know that I and many other educators from across the state learned enormous lessons from our involvement with the NESCent staff and also from many of the visiting researchers and their work. Losing the program will leave an unfortunate void in the education community.” –*Bruce Boller, Working Group participant and Teacher at*

“...a vital foundation”

Bertie Early College High School

“NESCent has been pivotal in the Museum’s effort to bring attention to the fascinating and complex world of evolution and evolution outreach by partnering with us to first, celebrate Darwin’s bicentennial with a lecture series. Our partnership deepened with the creation of our annual Darwin Day, which brings together Museum researchers and educators, as well as organizations and researchers from around the state, to strengthen the public’s understanding of evolution and celebrate Darwin’s contributions to science. NESCent’s real contributions as a true partner were not only the genesis of this successful event, but a keystone for its continued success.” –*Kari Wouk, NESCent collaborator and Senior Manager of Educational Collaborations at N.C. Museum of Natural Sciences*

“NESCent has been instrumental in the curriculum reform process and training of teachers in the Caribbean as it pertains to biology. Through a collaborative effort

“Without the four months at NESCent my project would not have seen the light of day. Period.”

“intellectual buzz”

“...huge impact”

with the Caribbean Examination Council and the University of the West Indies, Jory and the team spent three years (2011-2013), exposing high school and university teachers to central concepts regarding biological evolution. Specifically, NESCent has allowed me to organize and facilitate workshops in my hometown thus bridging the gap between my background as a teacher and more recently, science education researcher/curriculum consultant.” –*Elvis Nuñez, NESCent collaborator and Learning Specialist at Manu Kai Educational Services*

“NESCent’s efforts to increase the diversity of the undergraduate participation in the Evolution conference provided me with an opportunity to present my work to researchers throughout my field. I received an employment opportunity and was recruited into a Ph.D. program as a result of my participation in Evolution 2013. This would never have happened without NESCent and Jory Weintraub in particular!” –*Jay Bundy, Undergraduate Diversity participant and current BEACON/Michigan State researcher*

“Attending the NESCent Working Group ‘Communicating the Relevance of Human Evolution’ and Catalysis Meeting, ‘Reporting Across the Culture Wars: Engaging Media on Evolution’ have been pivotal to the aspect of my career that has focused on education and outreach around human evolution. Aside from creating and sustaining my growing network of like-minded scientists, educators, and others and two publications in the American Biology Teacher, one of the ideas generated in the working group led to my successful NSF DRK-12 grant creating materials for AP Biology classrooms that use human examples to teach evolution. We are now in the third year of the project, and preliminary results indicate that our materials increase students’ understanding of, acceptance of, and interest in evolution. These exciting outcomes are just one example of what I know will be related ideas, collaborations, and efforts that shape my career path—all starting with my time at NESCent!” –*Briana Pobiner, Working Group and Catalysis participant and Research Scientist at the Smithsonian Institution*

“Ever since I started in 2006, as the first faculty member specializing in evolutionary Biology at a small, historically black college like Spelman, both my students and I have benefitted tremendously from NESCent’s outreach activities. Students from my lab have been able to travel to the Evolution meetings, present their work, and seek graduate mentors through the undergraduate diversity programs run by NESCent each year. Additionally, I too have been benefitted from traveling to Evolution on a travel award for minority-serving institution faculty and more recently as a long-term Sabbatical Scholar at NESCent. These have gone a long way in helping me network with the rest of the evolution community and forge new collaborations. In sum, it would be hard for me to imagine what my career trajectory would have been like without NESCent’s efforts to reach MSI faculty and students!” –*Aditi Pai, Sabbatical Scholar and Professor at Spelman College* ●



Will rappel for fossils

Former NESCent postdoc accesses a wealth of megafauna data in Natural Trap Cave



Julie Meachen (above center and at right) and team descended 85 feet to examine and collect mammal fossils from the most recent Ice Age

Former NESCent postdoc Julie Meachen has reached new depths—quite literally—with her research on late-Pleistocene mammals. This summer Meachen and a team of paleontologists began exploring Natural Trap Cave in Wyoming, which may house one of the best preserved collections of Ice Age megafauna in North America. It is the first time in 30 years that scientists have been granted access.

The team, which performed its inaugural field season in late July and early August, is in search of ancient mammalian DNA. Using morphological, biogeochemical, and genetic techniques, the researchers hope to shed light on the relationship between climate change and genetic variation in mammal species.

Now an assistant professor at Des Moines University, Meachen studied skeletal morphology within living and extinct groups of mammalian carnivores while at NESCent. Her current project in Natural Trap Cave originated from the

Catalysis Meeting, “Integrating datasets to investigate megafaunal extinction in the late quaternary.”

“Alan Cooper, the co-PI, was also in the Catalysis group,” Meachen said. “He came up with the idea and asked if anyone wanted to join. I jumped up and was like, ‘Me! I want to participate!’”

The team also includes another NESCent connection: former postdoc Jenny McGuire who has studied paleontological extinction in the context of modern ecological threats. Meachen became the PI for the project, and they submitted their first NSF grant proposal in 2012 while she was completing her postdoctoral work.

“NESCent actually helped me get the stuff together,” Meachen said, noting that Associate Director Susan Alberts was especially helpful with feedback and encouragement during the process. Following two earlier proposals, the most recent grant application was accepted this past May and formal awards were conferred in October. The first field season was funded by Des Moines University and National Geographic.



The descent into this sink-hole can be daunting: Meachen and other paleontologists enter through a 15-foot-wide mouth to rappel down 85 feet. Cooper, who has extensive experience descending such caves, even wrote an article, “How do you get 10 scientists (safely) down a 100 ft. vertical shaft?” for his host institution, the Australian Centre for Ancient DNA at the University of Adelaide.

Researchers speculate that the cave is so rich in Pleistocene-Holocene era herbivores and carnivores because of its small and somewhat obscured opening that does not expand until farther down.

“There won’t be a shortage of fossils on this trip,”

Meachen said. Already the team has identified several species of megafauna including the woolly mammoth, dire wolf, American lion, American cheetah, and short-faced bear. Some of the collected specimens are housed at DMU while others with viable collagen for DNA extraction have been sent to labs for testing.

Although the 2014 field season has ended, Meachen says they will be visiting Natural Trap Cave for at least another two years. In November she will present findings from the first field expedition at the Society of Vertebrate Paleontology annual meeting in Berlin.

Until the next field season, she has plenty of fossils to examine. ●

Rediscovering an unconventional voice in evolutionary biology

For five years, journalists-in-residence have produced an impressive body of work during their tenure at NESCent, but only one has helped solve a nearly decade-old case.

Mike Martin came to NESCent in fall 2011 to research and write about Margie Profet, an evolutionary biologist who was the science “it” girl of the early 1990s. Without a Ph.D. or quantitative data, she theorized a number of evolutionary explanations for irksome biological functions including morning sickness, menstruation, and allergies. In addition to receiving a MacArthur Genius Fellowship, Profet wrote three notable papers in academic journals and two instructive books targeting mothers-to-be. Her unconventional approach and theories invited equal parts praise and criticism. By the late 1990s, her star was fading as she became more isolated from professional and personal networks. Profet slowly vanished from her life between 2003 and 2005.

Martin had already completed a story for *Psychology Today* on Profet’s unconventional career trajectory and subsequent disappearance when he arrived at NESCent. He had interviewed friends, family, and former colleagues.

While at the center, he continued the investigation by reading about two dozen academic papers related to Profet’s theories and receiving feedback related to the resident scientific community.

“I found two surprising things about Margie’s research while at NESCent,” Martin wrote in an e-mail. “Firstly, in several recent papers, she was

not getting credit for her ideas. Other scientists were unwittingly crediting themselves for ‘discovering’ one or more of her three seminal theories.”

A decade earlier, Martin’s reporting had helped rectify a similar case of neglected credit involving Canadian physicist John Moffat. But whereas Moffat was actively engaged in setting the record straight, Profet was nowhere to be found.

“A NESCent fellow who attended my talk put it this way: Margie has been gone for so long, out of the spotlight, not at conferences or places like this, so no one is around to defend her 20-year-old work; remind people where it came from; or even that it exists in the first place,” Martin wrote.

The second surprising revelation from Martin’s research at NESCent was the proliferation of experiments supporting Profet’s cancer-allergy connection. Given the enthusiasm for the topic, especially within oncology, Martin was able to do another feature: this one focusing more on Profet’s scientific legacy for the *Journal of National Cancer Institute*.

“I pitched a story [...] tying all this together and effectively re-introducing Margie—then missing for nearly seven years—to the wider scientific community,” Martin explained. “I wrote the piece and they published it, and ‘Margie Profet’ was back on the map.”

In the article, Martin revisits Profet’s 1991 paper that purported allergies as the naturally evolved “last line of defense” against carcinogens. He also pointed to a number of recent or ongoing studies that supported her hypothesis,



This picture of Profet accompanied Martin’s story in *Psychology Today*, which precipitated the reunion with her family

including one led by a neurobiologist-evolutionary biologist team at Cornell University.

In 2008, Paul Sherman and Janet Shellman-Sherman took Profet’s theory further when they examined 50 years-worth of studies to pinpoint a mechanism by which allergies expelled carcinogens. Unlike many contemporaries, the husband-wife team made a point to credit Profet.

Such studies have continued since Martin wrote his article in early 2012. As recent as this past March, researchers at Virginia Commonwealth University published a paper in the *Journal of Leukocyte Biology* that linked allergies to cancer and demonstrated an evolutionary advantage to histamine response.

In addition to reviving Profet’s name and legacy among the scientific community, his other article for *Psychology Today* precipitated another happy outcome. Less than a month after the story was published, Profet was reunited

with her family.

“If I could summarize my experience at NESCent, I’d say it led to the rediscovery—in more ways than one—of a fascinating and brilliant mind in evolutionary biology,” Martin wrote. “Margie Profet’s family rediscovered her after she had vanished as completely as anyone could and still be among the living.”

Following her return, Martin heard from her friends and colleagues the world-over who were both grateful and relieved to learn that she was well. At the same time, Profet’s theories enjoyed a revival.

“Science also rediscovered Profet and is now doing experiments that are validating her ideas,” Martin wrote. “Now rather than other scientists mistakenly taking credit or failing to give credit for her work, she is cited.”

As of his last correspondence with the family, Martin is pleased to report that Profet is now back at home in California and doing well. ●

New science center focuses on evolutionary medicine

Although NESCent will be closing its doors in June 2015, plans are under way to create a new center, this one specializing in Evolutionary Medicine. TriCEM, or Triangle Comparative and Evolutionary Medicine Center, will encourage collaboration among evolutionary biologists, physicians, veterinarians, public health experts, and more. The emphasis will be on research initiatives, meetings, and collaborations in the Triangle, yet TriCEM will also welcome collaborations with participants from outside the area, including international researchers.

Charles Nunn, Professor of Evolutionary Anthropology at Duke University and head of the TriCEM planning committee, offers a glimpse into the future of evolutionary science and synthesis in the Triangle.



Charles Nunn

What topics will groups and scholars study through TriCEM?

Evolutionary medicine is a big topic with connections to many areas of research that people might not immediately think of. We anticipate funding interdisciplinary groups to study cancer, the evolution of antibiotic resistant microbes, emerging infectious diseases in humans and animals, and the rise of autoimmune diseases in developed nations. We also aim to engage teams of researchers who are interested in evolutionary approaches to mental health, including depression, anxiety, and sleep disorders.

Many of the funded topics will have relevance globally, and also locally, such as the evolution of resistant microbes in farm animals in North Carolina or wildlife reservoirs of infectious disease in our region. Many of these topics are related to the idea of “One Health,” in which the health of humans is interconnected to the health of other animals and the environment. Genomics, phylogenetics, and computational biology will likely also play a large role in funded projects, as will global and public health and conservation biology.

In short, TriCEM will be very open-minded about the types of projects that are funded with an emphasis on taking novel, interdisciplinary approaches to apply evolutionary thinking to understand and improve the health of humans, animals, and the environment.

Why focus on evolutionary medicine?

Evolutionary medicine is a rapidly growing field of interdisciplinary research that seeks to improve our understanding of human health through the application of evolutionary and ecological principles. It involves both understanding disease—such as past selection pressures that make humans prone to obesity and heart disease—and treating disease, including new solutions to halt the evolution of drug-resistant pathogens and the creation of novel cancer therapies. Evolutionary perspectives are vital to tackling our most urgent global health challenges, including the emergence of new infectious agents, increases in autoimmune diseases, threats to food safety, and nutritional needs of growing populations.

What awards will TriCEM confer?

The main funding mechanism will involve working groups that are composed of faculty from the local institutions that will initially support TriCEM. Working groups will be required to meet at least monthly, and they will be given start-up funds to spend over one year for research activities. These funds can also be used to fly in other team members. In addition to working groups, we anticipate hosting catalysis meetings, invited speakers for seminars and interaction with working groups, sabbatical-type research opportunities, and fellowships for early-career students and researchers.

Many of the funded topics will have relevance globally, and also locally, such as the evolution of resistant microbes in farm animals in North Carolina or wildlife reservoirs of infectious disease in our region.

How do you plan to balance a variety of local and international participants?

TriCEM will be funded initially by the local institutions in the Triangle, and working groups will aim to bring together faculty from different universities and from different schools within those universities. Our region has many outstanding opportunities for interdisciplinary research among world class ecologists and evolutionary biologists, doctors, veterinarians, experts in public health and public policy, environmental scientists, and even nurses and dentists (with two schools of nursing and one of dentistry!).

While we envision great new opportunities locally, we also see important possibilities for experts from outside the Triangle to participate in working groups and to provide perspective, methods, or data that are important for a particular working group. We anticipate that many proposals will identify outside experts to participate in working groups, and we will be looking for teams to identify external expertise.

How soon do you anticipate TriCEM activities will begin?

We expect that TriCEM will begin activities in early 2015 with a first call for working group proposals by the end of this year or beginning of next year. It takes time to pull together the funds and build the collaborative agreements among universities, yet the great potential for interdisciplinary research on evolutionary medicine in the Triangle is propelling us forward. Thus, things are coming together quickly! ●

‘NESCent Collection’ houses decades-old chimpanzee calls

Frans Plooijs’ recordings of sub-adult chimpanzees were among the first Data Descriptors in the NESCent Collection of the newly launched *Scientific Data*. The open-access, peer-reviewed publication from the Nature Publishing Group now offers a unique platform for presenting results that might not fit the parameters of traditional print journals, including Plooijs’ more than 10 hours of chimpanzee calls and the accompanying metadata.

“I tried four years ago, and journals simply weren’t interested,” said Plooijs, who has visited NESCent as a short-term visitor in 2010 and 2014. “Things got rolling this year because it’s the idea that you publish an article and a database.”

Among other insights, the recordings could serve as a helpful tool in studying the emergence and evolution of human language.

As the current president of the International Research-Institute on Infant Studies, Plooijs is perhaps best known for his work in human development including *The Wonder Weeks*, a book and online resource for the earliest weeks of infancy. At NESCent, he has revisited his previous work, namely the audio recordings he and his late wife Hetty van de Rijt-Plooijs collected in Gombe National Park, Tanzania in the early 1970s.

The audio data were already stored in the Macaulay Library at Cornell University, but Dryad offered a rare opportunity to store the metadata. Plooijs translated and transcribed the field notes from Dutch to English during his first visit to NESCent. He also worked with Anne Pusey, chair of the Evolutionary Anthropology department at Duke University, to include demographic data on Gombe National Park chimpanzees.

“The idea was that it should have been finished then, but I was far too optimistic, as always,” Plooijs said. In 2010, he completed the transcription for the sub-adult chimpanzee recordings but not the adult portion. Four years later, an invitation to return to NESCent and the launch of *Scientific Data* revived the project.



The metadata for more than 10 hours of chimpanzee calls recorded by Frans Plooijs and Hetty van de Rijt-Plooijs is now in the open-access platform *Scientific Data*. PHOTO COURTESY FRIEDRICH BÖHRINGER, WIKIMEDIA COMMONS

“We focused on the infants [in the *Scientific Data* paper] because that was finished four years ago and the adults were not,” Plooijs said. “Now that this paper is out of the way, I might as well finish this whole thing.”

Plooijs completed the second half during his second stay in Durham this fall and plans to publish it as “part two” in the NESCent Collection. Although the data are more than 40 years old, Plooijs was compelled to complete the translation sooner rather than later.

“It is something that I felt obliged to do because we collected it and never did anything with it because we published the other data,” Plooijs said. “There is this

kind of feeling that you ought to do something with it, and it’s a unique collection. I don’t think anybody would ever record chimpanzee babies because it requires a close distance.”

Among other insights, the recordings could serve as a helpful tool in studying the emergence and evolution of human language. And given the adversity faced by chimpanzees and other primates, including loss of habitat, poaching, and trafficking, open access to such data is especially time-sensitive.

“Assuming that the species will die out—there’s a chance it will happen—it makes it all the more urgent to have it,” Plooijs said. ●

NESCent's longest-serving employee looks back

If you've visited NESCent, you undoubtedly know Barbara Mitchell. Our operations manager, who oversees the business side of the center, probably knows NESCent better than anyone since she helped open the grant in 2004. Back then, NESCent was housed

10 years of
NESCent

above the Cinelli's Pizza (now Vine Sushi & Thai) next to Whole Foods on

Broad Street. She started as an administrative assistant and today manages the entire financial aspect of the grant. If you ask Barbara what her proudest achievement at NESCent is, she will probably mention how the center passed two internal audits with flying colors.

We also picked her brain about the unexpected evolution of an evolutionary synthesis center:

How is NESCent today different from 10 years ago?

The growth, the location, the people, the changes in administration, and the hiring of a lot more people. I had no idea what form it would take.



Favorite NESCent experiences?

I enjoyed the reception we put on for the opening of the center. It was fun to bring together all the people who had been involved with the facility including the contractors and the science community, for the grand opening.

Weirdest grant-related purchase?

[Former graduate fellow] Pinar Yoldas's project. That variety of skulls is probably

the most bizarre purchase we've ever made: killer whale, toucan, an Amazon River dolphin, a gorilla, an African lion, and a Great Horned Owl. It is quite different from purchasing copy paper and file folders!

What will it be like to close the grant next year?

I feel like it's a great accomplishment to be able to see all the meetings that have occurred and the people. Working with the international people has probably been one of the most exciting experiences: to be able to learn about different countries and what the people have to say when they come to the U.S. ●

AWARDS

Congratulations to the newest award recipients for 2014

NESCent is pleased to announce the following new awards:

SHORT-TERM VISITORS

Lisa Boucher (University of Texas-Austin) *Landscape and Population Dynamics of the Cretaceous Angiosperm Radiation*

Martin Burd (Monash University) *Global patterns of color evolution of bird-pollinated flowers*

Brian McLoone (University of Wisconsin-Madison) *Variable Selection in Causal Models of Evolution*

Carl Rothfels (University of British Columbia) *Phylogenomic error and the molecular clock*

Don Dearborn (Bates College) *Balancing Selection and Mate Choice at the Major Histocompatibility Complex*

Frank Hailer (Senckenberg Research Institute & Goethe University) *Balancing Selection and Mate Choice at the Major Histocompatibility Complex*

TRIANGLE SABBATICAL SCHOLAR

Julie Horvath (North Carolina Central University) *Developing an Evolutionary Medicine Course at NC Central University*

5TH WORKING GROUPS

Norman Johnson (University of Massachusetts) *Communicating the Relevance of Human Evolution*

Mark Schwartz (New York University School of Medicine) *Infusing Premedical and Medical Education with Evolutionary Thinking*

Karen Strier (University of Wisconsin-Madison) *Evolutionary Ecology of Primate Life Histories: Ecological and Individual Variation*

Rafael Rubio de Casas (Universidad de Granada) *Germination and the evolution of environment-dependent life histories*

Michael Gavin (Colorado State University) *Explaining cultural diversity: A new evolutionary synthesis*

Jonathan Payne (Stanford University) *Is Macroevolution an Expression of Macroecology Across Time? A Synthetic Analysis of Animal Body Size Distributions*

Courtney Murren (College of Charleston) *Costs of Phenotypic Plasticity and Adaptation to Novel Environments*

Mary Shenk (University of Missouri) *Psychological Mechanisms of Human Fertility Change*

Arlin Stoltzfus (University of Maryland) *Organizing Scientific Hackathons: Lessons Learned*

Jason Hoeksema (University of Mississippi) *A working group to solve problems in model selection and phylogeny*

in mixed multi-factor meta-analysis

William Cornwell (University of New South Wales) *Tempo and mode of plant trait evolution: synthesizing data from extant and extinct taxa II*

Courtney Murren (College of Charleston) *Costs of Phenotypic Plasticity and Adaptation to Novel Environments*

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For more information about these scholars and their research projects, please visit <http://www.nescent.org/science/awards.php>.

World's biggest-ever flying bird

Long slender wings and soaring ability enabled the creature to stay aloft for long distances without flapping its wings

Scientists have identified the fossilized remains of an extinct giant bird that could be the biggest flying bird ever found. With an estimated 20-24-foot wingspan, the creature surpassed size estimates based on wing bones from the previous record holder— a long-extinct bird named *Argentavis magnificens*— and was twice as big as the Royal Albatross, the largest flying bird today. Scheduled to appear online the week of July 7, 2014, in the journal *Proceedings of the National Academy of Sciences*, the findings show that the creature was an extremely efficient glider, with long slender wings that helped it stay aloft despite its enormous size.

The new fossil was first unearthed in 1983 near Charleston, South Carolina, when construction workers began excavations for a new terminal at the Charleston International Airport. The specimen was so big they had to dig it out with a backhoe. “The upper wing bone alone was longer than my arm,” said author Dan Ksepka of the National Evolutionary Synthesis Center in Durham, North Carolina.

Now in the collections at the Charleston Museum, the strikingly well-preserved specimen consisted of multiple wing and leg bones and a complete skull. Its sheer size and telltale beak allowed Ksepka to identify the find as a previously unknown species of pelagornithid, an extinct group of giant seabirds known for bony tooth-like spikes that lined their upper and lower jaws. Named ‘*Pelagornis sandersi*’ in honor of retired Charleston Museum curator Albert Sanders, who led the fossil's excavation, the bird lived 25 to 28 million years ago -- after the dinosaurs died out but long before the first humans arrived in the area.

Researchers have no doubt that *P. sandersi* flew. Its paper-thin hollow bones, stumpy legs and giant wings would have made it at home in the air but awkward on land. But because it exceeded what some mathematical models say is the maximum body size possible for flying birds, what was less clear was how it managed to take off and stay



aloft despite its massive size.

To find out, Ksepka fed the fossil data into a computer program designed to predict flight performance given various estimates of mass, wingspan and wing shape. *P. sandersi* was probably too big to take off simply by flapping its wings and launching itself into the air from a standstill, analyses show. Like *Argentavis*, whose flight was described by a computer simulation study in 2007, *P. sandersi* may have gotten off the ground by running downhill into a headwind or taking advantage of air gusts to get aloft, much like a hang glider.

Once it was airborne, Ksepka's simulations suggest that the bird's long, slender wings made it an incredibly efficient glider. By riding on air currents that rise up from the ocean's surface, *P. sandersi* was able to soar for miles over the open ocean without flapping its wings, occasionally swooping down to the water to feed on soft-bodied prey like squid and eels.

“That's important in the ocean, where food is patchy,” said Ksepka, who is now Curator of Science at the Bruce Museum in Greenwich Connecticut.

Researchers hope the find will help shed light on why the family of birds that *P. sandersi* belonged to eventually died out, and add to our understanding of how the giants of the skies managed to fly. ●

CITATION: Ksepka, D. (2014). “Flight performance of the largest volant bird.” PNAS

COMING SOON

NABT evolution symposium focuses on Evolution in Action

What: National Association of Biology Teachers (NABT) Annual Evolution Symposium

When: November 14, 2014, 12:15 - 4:15 PM

Where: Cleveland Convention Center, Cleveland, OH

If you're planning to attend the annual meeting of the National Association of Biology Teachers (NABT) this November in Cleveland, OH, you won't want to miss this year's NABT Evolution Symposium. The symposium will focus on Evolution in Action by presenting scientists from the BEACON Center for the Study of Evolution in Action, an NSF Science and Technology Center founded with the mission of illuminating and harnessing the power of evolution to advance science and technology and benefit society. This year's speakers, who are all BEACON scientists, work with evolutionary processes in experimental systems, apply evolutionary principles of adaptation and resiliency in computer science and engineering design, or use computational systems in tandem with biological experiments to test complex biological hypotheses. The symposium is organized and sponsored by NESCent and BEACON.

You can find the talks— along with activities, websites, and other resources related to this year's symposium—after the meeting at nescent.org/media/NABTSymposium2014.php.

Also at NABT: For the third year in a row, NESCent is collaborating with BEACON on the NESCent/BEACON Evolution Scholar program. This travel award sends enthusiastic and dedicated biology instructors from high schools and community colleges to the conference to acquire new knowledge and pedagogical skills, which they will then share with their students (through classroom activities) and colleagues (through professional development activities).

CLIMATE CHANGE, continued

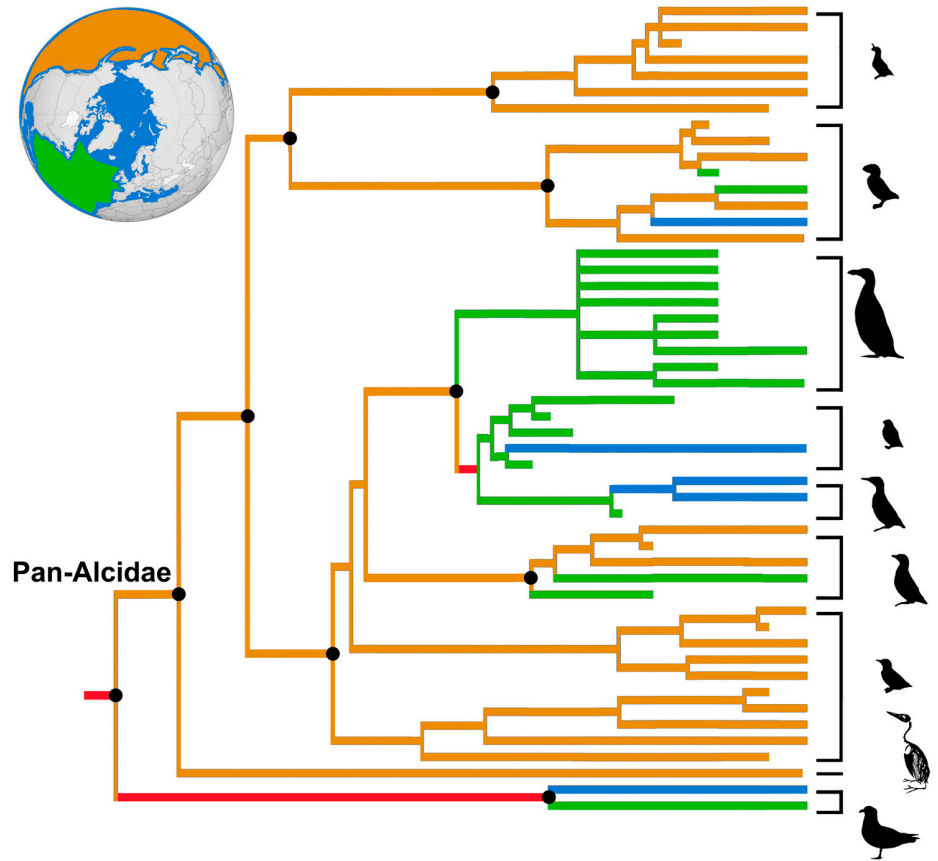
“When comparing how climate changes have affected puffin and auk populations in the past and present, it is critical to consider that global warming today has largely taken place over a few short decades.”

- Adam Smith, NESCent

The results indicate that the Pan-Alcidae clade, including all living auks and puffins as well as extinct species, first emerged about 35 million years ago. Through phylogenetic analyses of fossils and current species, the researchers were able to estimate “ghost lineages,” a method of approximating gaps in the fossil record. By using ghost lineages to extrapolate species diversity over time, the scientists found that pan-alcid species enjoyed the most variety and widespread ranges about 15 million years ago during a period that climate scientists refer to as the Middle Miocene Climatic Optimum.

“When comparing how climate changes have affected puffin and auk populations in the past and present, it is critical to consider that global warming today has largely taken place over a few short decades,” Smith explained. “The warm periods of the past that had very high auk and puffin species abundance, such as the Mid-Miocene Climatic Optimum, took place over millions of years.”

The researchers found that the geographic distribution and population size of modern alcids are primarily the result of extinctions corresponding with climate and ocean shifts over the last 5 million years. As ocean circulation changed and water surface temperatures cooled dramatically throughout a series of ice ages, species diversity bottlenecked for both Atlantic and Pacific Ocean species. More than 50 percent of species went extinct at this time, which



This phylogenetic tree illustrates the changes in geographic range of wing-propelled diving seabirds.

roughly coincided with changes in ocean basin circulation, such as the onset of Gulf Stream circulation. The results contextualize contemporary changes in geographic range and decreases in population sizes of seabirds due to global warming and overfishing.

“I recently visited Teuri Island, Japan where normally about 300,000 pairs of Rhinoceros Puffin reproduce each summer. Likely because of the unusually warm seas off the coast of the island this summer, less than ten chicks were fledged!” Smith said.

Smith and Clarke also considered the evolution of wing-propelled diving—a rare behavior found in only one-half percent of all birds. Previously assumed to be a nascent feature of the earliest alcid species, underwater diving could have first arisen as an escape tactic rather than a feeding strategy, according to the study results. Relatives like seagulls and terns

plunge from the air, whereas modern puffins and auks dive from a floating position. By reconstructing the ancestral diet, the authors found that early species most likely fed on vertebrates close to the surface; they hypothesize that alcids gradually began to dive deeper and hunt invertebrates such as crustaceans and shrimp, which are included in the diet of some modern species.

The study elucidates how extinct alcids were affected by climate change and other environmental pressures—an area that has been somewhat neglected. Smith and Clarke hope that the results will strengthen modern conservation efforts by lending context to the plight of their modern kin and other seabirds. ●

CITATION: Smith, N.A. and J.A. Clarke (2014). “Systematics and evolution of the Pan-Alcidae (Aves, Charadriiformes).” *Journal of Avian Biology*.