@NESCent

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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If evolutionary history repeats itself, woody plants may have a harder time than herbaceous plants keeping pace with global warming. **P2**

ABOUT NESCENT:

NESCent is an NSF-funded collaborative research center operated by Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University. For more information about research and training opportunities at NESCent, visit **http://www.nescent.org**.

SENIOR LEADERSHIP:

Kathleen Smith, Director

Susan Alberts, Associate Director of Science and Synthesis

Todd Vision, Associate Director of Informatics

Brian Wiegmann, Associate Director of Education and Outreach

RESEARCH HIGHLIGHTS

Humans likely to evolve at the same rates as other living things

New analysis of human health measures patterns of selection still at work in humans

Although advances in medical care have improved standards of living over time, most evolutionary biologists agree that humans aren't sheltered from the forces of natural selection. But while the notion that humans continue to evolve may be obvious to biologists, the media frenzy surrounding a recent study by a NESCent working group suggests it is big news to the wider public.

"There is this idea that because medicine has been so good at reducing mortality rates, that means that natural selection is no longer operating in humans."

–Stephen Stearns, Yale University

"There is this idea that because medicine has been so good at reducing mortality rates, that means that natural selection is no longer operating in humans," said Stephen Stearns of Yale University.

A recent analysis by Stearns and colleagues turns this idea on its head. In a paper published in the Oct. 19 issue of PNAS, the team of researchers estimated patterns of selection still at work in humans today by analyzing medical data from more than 2000 women in the Framingham Heart Study. The result? Humans are likely to evolve at roughly the same rates as other living things, findings suggest.

In a paper published in the Oct. 19 issue of PNAS, a NESCent working group estimated patterns of selection still at work in humans today by analyzing 60 years of medical data from the Framingham Heart Study.

Taking advantage of data collected as part of a 60-year study of more than 2000 North American women, the researchers analyzed a handful of traits important to human health. By measuring the effects of these traits on the number of children the women had over their lifetime, the researchers were able to estimate the strength of selection and make short-term predictions about how

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RESEARCH HIGHLIGHTS

Woody plants adapted slowly to past climate change

If past is prelude, trees and shrubs may have a harder time keeping pace with global warming

Can we predict which species will be most vulnerable to climate change by studying how they responded in the past? A new study of flowering plants by NESCent postdoctoral fellow Stephen Smith provides a clue. His analysis of more than 5000 plant species reveals that woody plants – such as trees and shrubs – adapted to past climate change much more slowly than herbaceous plants did. If the past is any indicator of the future, woody plants may have a harder time than other plants keeping pace with global warming, the findings suggest.

In a new study, Stephen Smith and colleague Jeremy Beaulieu of Yale University teamed up to find out how flowering plants adapted to new climates over the course of their evolution. By integrating previously published genealogies for several plant groups with temperature and rainfall data for each species, they were able to measure how fast each lineage filled new climate niches over time.

When they compared woody and herbaceous groups, they found that woody plants adapted to new climates 2 to 10 times slower than herbs. "Woody plants eventually evolved to occupy about the same range of climates that herbaceous plants did, but woody plants took a lot longer to get there," said Smith.

The researchers trace the disparity to differences in generation time between the two groups. Longer-lived plants like trees and shrubs typically take longer to reach reproductive age than fast-growing herbaceous plants, they explained. "Some woody plants take many years to produce their first flower, whereas for herbs it could take just a couple months," said Beaulieu.

> "If woody and herbaceous plants were running a race, the herbs would be the hares and the woody plants would be the tortoises."
>
> – Jeremy Beaulieu, Yale University

Because woody plants have longer reproductive cycles, they also tend to accumulate genetic changes at slower rates, prior research shows. "If genetic mutations build up every generation, then in 1000 years you would expect plants with longer generation times to accumulate fewer mutations per unit time," said Smith. This could explain why woody plants were slower to adapt to new environments. If genetic mutations provide the raw material for evolution, then woody plants simply didn't accumulate mutations fast enough to keep up. "If woody and herbaceous plants were running a race, the herbs would be the hares and the woody plants would be the tortoises," said Beaulieu.

see WOODY PLANTS, p6

Many of the world's ecosystems–especially forests–depend on woody plants to thrive.

OPPORTUNITIES

Call for Proposals

Looking for funding for a sabbatical, postdoc, or meeting? Since its beginnings in 2004, more than 3,000 scientists have turned to NESCent for research funding in evolutionary biology. Find out how you can take advantage of what NESCent has to offer.

NESCent is now accepting applications for postdoctoral and sabbatical fellowships, short-term visitors, and meetings. The next deadline for short-term visitors is January 1. For sabbatical fellows, working groups, and catalysis meetings, the next deadline is July 10. For postdoctoral fellows, the deadline is December 1 annually.

To learn more about funding opportunities at NESCent, visit our website at **www.nescent.org**

Job Openings

Interested in employment opportunities at NESCent? Our Center runs with the help of a dynamic team of programmers, financial experts, event planners, and other specialists. To find out about job openings as they become available, visit **http://www.nescent.org/about/employment.php**

Stay Informed

Subscribe to the NESCent email newsletter to receive news about funding, research and training opportunities, and upcoming events. Comments, story ideas and photo contributions are welcome.

Please send corrections and suggestions for future newsletters to Robin Smith at **rsmith@nescent.org** To unsubscribe, visit: **https://lists.nescent.org/mailman/options/news** You can also visit NESCent on **Twitter**, **Facebook**, and **YouTube**.

A YEAR IN REVIEW

Letter from the director

2009 marked NESCent's fifth year and the completion of our first grant. We have accomplished much during this period, and we invite you to explore our website to see the projects we've funded, the products that resulted, and the activities undertaken by our outstanding informatics and education and outreach programs. During these years we have hosted over 3,000 visiting scientists and sponsored nearly 200 meetings. Importantly we were also successful in obtaining funding for another 5 years, and look forward to many exciting new programs at the Center.

KATHLEEN SMITH

The end of year 5 marks a transition as well. Joel Kingsolver, who has been with the Center since the first proposal to the NSF, will be stepping down as Associate Director of Science, and I will also be departing as NESCent's director. We are both going back to full time faculty duties at our respective universities, although Joel will be enjoying NESCent from the other side, as a Triangle Sabbatical Scholar in the spring of 2010.

We will be replaced by two outstanding scientists. Allen Rodrigo from the University of Auckland will be joining NESCent in February 2010 as its new Director, and Susan Alberts from Duke University will be the new Associate Director of Science. Todd Vision and Brian Wiegmann continue as Associate Directors for Informatics and Education and Outreach respectively. With this leadership group, NESCent will be in very capable hands as it goes forward.

It has been a pleasure for me to work with the wonderful NESCent staff and in house scientists over the past 4 years, and I've been delighted to meet many of you as you have passed through the Center. We'll be discussing NESCent's exciting new plans as we move into years 5-10, and profiling Allen and Susan further in future newsletters, so please stay tuned.

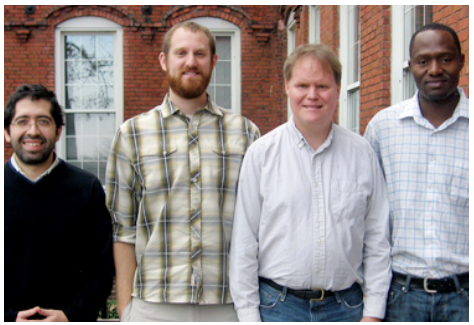
Kathleen K. Smith
Director, NESCent
Professor of Biology, Duke University

NEW ARRIVALS

NESCent is pleased to welcome the following new arrivals:

Juan Santos joined our Center in October 2009 as a postdoctoral fellow from the University of Texas-Austin. While at NESCent, Juan plans to extend his work on multivariate methods. Juan's postdoctoral project is titled "Multivariate evolutionary analysis: integrating structural equation modeling and phylogenetics." **Read more: http://www.nescent.org/science/awards_summary.php?id=185**

Chris Shields joined NESCent in September 2009 after completing his Master's degree at Clemson University. As the new assessment coordinator for the "Science of Science" project, Chris's current interests are in how scientists communicate with one another and with the general public. He is also interested in fostering relationships between traditionally distant groups, such as the scientific community and the general public or among researchers in different disciplines. **Read more: http://www.nescent.org/science/sos.php**



New arrivals from L to R: Juan Santos, Chris Shields, Peter Midford, Mtakai Ngara

Peter Midford arrived in September as a short-term scholar from the University of Kansas. While at NESCent, Peter plans to extend existing methods of matching terms across ontologies to incorporate phylogenetic information and to construct different types of matches. Peter's project is titled "Alignment of Phenotype Ontologies." **Read more: http://www.nescent.org/science/awards_summary.php?id=196**

Mtakai Ngara visited NESCent for 2 ½ months this fall as a Phenoscape Fellow from Nairobi. For his project, titled "Linking Evolution to Genomics Using Phenotype Ontologies," Mtakai worked in collaboration with NESCent scientists Jim Balhoff, Cartik Kothari, and Wasila Dahdul.

UPCOMING EVENTS

Darwin Day 2010

What: Darwin Day celebration

When: Friday Feb. 12, 2010, 6:30pm

Where: North Carolina Museum of Natural Sciences, Raleigh

Join us for a special evening in honor of Darwin Day, an annual event to commemorate the birthday of Charles Darwin. NESCent's 2010 Darwin Day celebration will be held on Friday Feb. 12th 2010, at the North Carolina Museum of Natural Sciences.

ADAM SUMMERS

We are excited to announce Dr. Adam Summers as the keynote speaker for this year's event. Dr. Summers is the Associate Director of the Friday Harbor Laboratories at The University of Washington and a noted researcher in the biomechanics and evolution of sharks and rays.

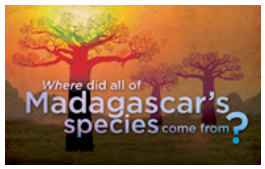
He also served as a "shark consultant" to Pixar during their production of the movie *Finding Nemo* and is widely recognized as an outstanding communicator of science to the general public.

Darwin Day 2010 coincides with the opening of a traveling exhibit at the museum entitled "Megalodon: Largest Shark That Ever Lived." To kick off the exhibit, Dr. Summers will share his expertise on the fascinating evolutionary history of extinct shark species such as Megalodon, and their modern counterparts.

LATEST HAPPENINGS

Fall podcasts track the Year of Science

You and your students can track the Year of Science via the latest installments from the Evolution in the News story and podcast series. The September story addressed biodiversity and conservation with David Jablonski, who discussed his recent paper showing that extinction risk is clustered in evolutionarily related groups.



Geosciences and planet Earth was the theme for October, when Anne Yoder talked about the unique evolutionary events that occurred on Madagascar. And for the November story on chemistry, a NESCent working group discussed research showing an unexpected pattern of body size increases that correlates with spikes in atmospheric oxygen.

Help us understand how to make our "Evolution in the News" stories better by participating in a simple assessment program. Contact Kristin Jenkins for more information.

Announcing Phenex 1.0, software for ontology-based phenotype curation

The Phenoscape project has publicly released Phenex 1.0, a platform- independent desktop application for annotating the character-by-taxon matrices with ontology terms.

Phenex is the tool used by the Phenoscape curators to encode over 300,000 phenotype statements from over 2000 taxa from the systematic literature of the Ostariophysi, a group of fishes comprising 68% of all freshwater species. The result of this curation can be seen in the beta version of the Phenoscape Knowledgebase. Phenex 1.0 outputs its ontology-based phenotypic data annotations within the NeXML format standard, and it can be configured for curation of data from any taxonomic group for which adequate ontologies are available. Phenex is open source software, released under the MIT license. The developers look forward to working with anyone interested in making use of Phenex with their own data. A paper describing the software is forthcoming. For more information, see http://phenoscape.org/wiki/Phenex

Researchers meet to develop data integration vocabularies

Similar to hackathons, or Code Camps, for software development, a Vocabulary Camp (or VoCamp, for short) is a working meeting for the collaborative development of ontologies and lightweight vocabularies.

A group of collaborators that emerged from NESCent's EvoInfo Working Group, the recent Evolutionary Database Interoperability Hackathon, and the TDWG Interest Group on Phylogenetic Standards, held a Phyloinformatics VoCamp in Montpellier, France, from November 7-11th in conjunction with the annual Biodiversity Information Standards (TDWG) Conference.

The event brought together 32 participants from 7 countries and 28 institutions under the common goal to promote the community development of shared formal vocabularies for data integration in the fields of evolutionary biology, biodiversity, and ecology.

The results include a standard and vocabulary for referencing nodes in a phylogeny using common ancestry, integrating data on traits, taxonomy, and species occurrences using ontologies from different domains, and linking molecular data to geography and climate using ontologies and web services.

For information on the aims of each subgroup at the event, the outcomes, and plans for follow-up work, please see: http://evoio.org/wiki/VoCamp1

Classroom materials from 2009 NABT Evolution Symposium now available

Did you miss this year's meeting of the National Association of Biology Teachers (NABT) in Denver? Videos, classroom activities, and other educational materials from the 2009 NABT Evolution Symposium are now available.

The topic for this year's symposium was "Evolution in Extreme Environments." Cynthia Beall talked about her research on people in the Andes and Himalayas who have adapted to living at high elevations, while Stephen Haddock took us to the opposite extreme with a tour of life in the deep sea. Jody Deming provided a glimpse into the thriving bacterial life in Arctic ice, and William Jefferies explained the evolution behind the morphology and behavior of blind cave fish.

NABT National Association of Biology Teachers

These talks and other materials from the symposium can be accessed at http://www.nescent.org/media/NABT.php#nabt2009.

Watch for next year's NABT Evolution Symposium in Minneapolis!

NESCent in the News

- Study paints sabertooths as relative pussycats (*MSNBC News*)
- Climate change may be especially tough on trees (*USA Today*)
- Africa's rarest monkey may have bred with baboons (*NatGeo News Watch*)

NEW AWARDS

WORKING GROUPS:

Germination, trait coevolution, and niche limits in changing environments PIs: Kathleen Donohue and Rafael Rubio de Casas

Grass Phylogeny working group II: Inferring the complex history of C4 photosynthesis in grasses PIs: Erika Edwards, Nicolas Salamin, and Stephen Smith

Communicating the relevance of human evolution PIs: Norman Johnson, Louise Mead , and James Smith

CATALYSIS MEETINGS:

Evolution of G protein coupled signaling: lineages, constraints, and tempo PIs: Alan Jones, Joe Thorton, Jotun Hein, and Etsuko Moriyama

Integrating datasets to investigate megafaunal extinction in the Late Quaternary PIs: Jessica Metcalf, Robert Guralnick, and Alan Cooper

SHORT-TERM VISITORS:

Movement paleoecology, trace fossils, and the evolution of behavior: Roy Plotnick

The origin of evolutionary novelties in amphibian head development: Lennart Olsson

Translation of field notes for developmental study of chimpanzee vocal communication: Frans Plooij

LONG-TERM SABBATICAL SCHOLARS:

Sex, cells: an evolutionary inquiry into sexual reproduction: John Logsdon

RECENT PUBLICATIONS

Recent publications by NESCent authors

Auld, J., A. Agrawal, et al. (2009). "Re-evaluating the costs and limits of adaptive phenotypic plasticity." Proceedings of the Royal Society B doi: 10.1098/rspb.2009.1355.

Auld, J. and **R. Relyea** (2009). "Inbreeding depression in adaptive plasticity under predation in a freshwater snail." Biology Letters doi: 10.1098/rsbl.2009.0726.

Byars, S., D. Ewbank, et al. (2009). "Natural selection in a contemporary human population." Proceedings of the National Academy of Sciences doi: 10.1073/pnas.0906199106

Eckert, C., S. Kalisz, et al. (2010). "Plant mating systems in a changing world." Trends in Ecology and Evolution doi:10.1016/j.tree.2009.06.013.

Faith, D., C. Lozuone, et al. (2009). "The cladistic basis for the PD (Phylogenetic Diversity) measure links evolutionary features to environmental gradients and supports broad applications of microbial ecology's "phylogenetic beta diversity" framework." International Journal of Molecular Sciences 10: 4723-4741.

Garamszegi, L. Z., S. Calhim, et al. (2009). "Changing philosophies and tools for statistical inferences in behavioral ecology." Behavioral Ecology 20(6): 1363-1375.

Hadley, E., P. Spaeth, et al. (2009). "Niche conservatism above the species level." Proceedings of the National Academy of Science 106: 19707-19714.

Heaney, L. R. and **T. E. Roberts** (2009). New perspectives on the long-term biogeographic dynamics and conservation of Philippine fruit bat. Ecology, Evolution, and Conservation of Island Bats. T. H. Fleming and P. A. Racey. Chicago, University of Chicago Press.

Johnson, M. A., L. J. Revell, et al. (2009). "Behavioral convergence and adaptive radiation: Effects of habitat use on territorial behavior in Anolis lizards." Evolution doi: 10.1111/j.1558-5646.2009.00881.x.

Kingsolver, J. (2009). "The Well-Temperatured Biologist (American Society of Naturalists Presidential Address)." The American Naturalist 174(6): 755-768.

Laikre, L., F. Allendorf, et al. (2009). "Neglect of genetic diversity in implementation of the convention on biological diversity." Conservation Biology DOI: 10.1111/j.1523-1739.2009.01425.x.

Meachen-Samuels, J. and **W. Binder** (2009). "Sexual dimorphism and ontogenetic growth in the American lion and sabertoothed cat from Rancho La Brea." Journal of Zoology doi:10.1111/j.1469-7998.2009.00659.x.

O'Meara, B. (2009). "New heuristic methods for joint species delimitation and species tree inference." Systematic Biology 59: DOI:10.1093/sysbio/syp077.

Revell, L. J. (2009). "Size-correction and principal components for interspecific comparative studies." Evolution 63(12): 3258-3268.

Roberts, T. E., T. Davenport, et al. (2009). "The biogeography of introgression in the critically endangered African monkey Rungwecebus kipunji." Biology Letters doi: 10.1098/rsbl.2009.0741.

Smith, S. A. and **J. M. Beaulieu** (2009). "Life-history influences rates of climatic niche evolution in flowering plants." Proceedings of the Royal Society B 276(1677): 4345-4352.

The predicted rates of change in humans are no different from those observed elsewhere in nature, researchers say.

HUMANS, continued

each trait might evolve in the future. After adjusting for factors such as education and smoking, their models predict that the descendents of these women will be slightly shorter and heavier, will have lower blood pressure and cholesterol, will have their first child at a younger age, and will reach menopause later in life.

> "Humans aren't that special with respect to how fast they're evolving. They're kind of average."
>
> –Stephen Stearns, Yale University

The changes may be slow and gradual, but the predicted rates of change are no different from those observed elsewhere in nature, the researchers say. "The evolution that's going on in the Framingham women is like average rates of evolution measured in other plants and animals," said Stearns. "These results place humans in the medium-to-slow end of the range of rates observed for other living things," he added. "But what that means is that humans aren't special with respect to how fast they're evolving. They're kind of average." ●

The team's findings were published online in the October 19th issue of Proceedings of the National Academy of Sciences.

CITATION: Byars, S., D. Ewbank, et al. (2009). "Natural selection in a contemporary human population." Proceedings of the National Academy of Sciences 106(42). doi: 10.1073_pnas.0906199106.

WOODY PLANTS, continued

By understanding how plants responded to climate change in the past, scientists may be better able to predict which groups will be hardest hit by global warming in the future. Unlike the tortoise and the hare, however, in this case slow and steady may not win the race. "Woody groups are obviously at a disadvantage as the climate changes," Beaulieu explained.

Does this mean that ecosystems dominated by trees – such as rainforests – will be more likely to disappear? Possibly. "If we look to the past for our clues, chances are trees will continue to respond much slower than herbs – as much as 10 times slower," Smith said. "But if the rate of climate change is 100 times faster, then they could all be in trouble. The kind of change we're experiencing now is so unprecedented," he added. While this study focused on long-term change over the last 100 million years, most climate models predict significant warming in the next century, the researchers explained. "That time frame may be too quick for any plant," Beaulieu said. ●

The team's findings were published online in the Sept. 23 issue of Proceedings of the Royal Society B.

CITATION: Smith, S. A. and J. M. Beaulieu. (2009). "Life-history influences rates of climatic niche evolution in flowering plants." Proceedings of the Royal Society B doi: 10.1098/rspb.2009.1176.