Nature Trails

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Photos by Claudio Mello

Of Bird Genes and Bird Brains: What Science Can Teach Us About Avian Singing and Seasonality

Claudio Mello, Professor of Neuroscience,
Oregon Health Sciences University, Portland, Oregon

Co-sponsored by Lane County Audubon Society

Friday, 18 November 2016, 7:30pm

Room 100 Willamette Hall, UO Campus

Claudio Mello is a neuroscientist. He's a professor of behavioral neuroscience at the Oregon Health Sciences University. His academic profile lists these research interests: neuroethology, molecular neuroscience, vocal communication, vocal learning, central auditory processing, learning and memory, neurogenomics, neuronal plasticity, activity-dependent gene regulation, avian physiology, comparative neuroanatomy, sex steroid actions on brain and behavior, and adult neurogenesis. One entry in this list jumps out as not belonging. The internal editor seizes the word "avian" and attempts to find the typo that will let it back into the fold. Nothing short of a complete replacement seems to work. Albino physiology? Simian physiology? What?

No, it actually belongs. Mello really is interested in avian physiology—specifically the physiology of bird song—because there are similarities in the genetic components of human speech and the singing of birds. Mello has an international reputation for his research on brain mechanisms of learning and memory. An integral feature of his work is learning how birds learn to vocalize (*vocalize* is a better word here than *sing* because not all sounds birds make are songs—Polly want a cracker?).

Two years ago a flock of papers came out—eight in *Science* and 15 more in *Genome Biology, BMC Genomics*, and other journals—detailing work done by a consortium of over 200 scientists on the complete genomic sequences of 48 species of common birds. Mello was co-author of three of the *Science* papers and senior author of two other papers. His contributions centered on the Anna's Hummingbird. Together, the work represents over 400 years of supercomputer processing time and reveals a new family tree for birds, extending to their dinosaur parents. In an OHSU press release Mello says, "This project generated an unprecedented amount of genomic data for a single group of vertebrates. The high diversity of birds is fascinating to us all, and definitely influenced Darwin when he used finches on the Galapagos Islands to help formulate his theory of evolution. But that diversity has also presented challenges in understanding birds' family tree. The new data helped build a more accurate tree of life of birds, but also led to a much deeper understanding of how changes in the genome of a dinosaur ancestor gave rise to many typical bird traits." The work by the consortium has revealed surprising connections among apparently disparate species. "Our data helped solidify the surprising notion that parrots and songbirds are sister groups in the tree of life of birds, so their shared ability to learn songs—in the case of parrots, human speech sounds [as well]—likely had a common origin. In contrast, hummingbirds are separate, so their ability to learn songs—yes, hummingbirds sing and learn how to sing from their parents—arose separately in evolution," Mello said.

The consortium's efforts also get at how songbirds "learn" their songs. The connection between Mello's work on birds and his concentration on how humans learn to vocalize becomes clear with the finding that many of the genes involved in bird vocalization are similar to genes involved in human speech! Mello said, "we believe that finding these genes takes us one step closer to understanding the biological and genetic basis of vocal learning—which in humans is the basis for speech and language learning. This may help us to better understand how speech and language work, and also identify some possible genetic causes of speech and language impairments, a novel and exciting area of research that sounded very esoteric not too long ago. The studies in birds will help us understand where and how these genes work in the brain, and thus devise better approaches to combat speech problems in humans."

Mello was born in Brasilia, Brazil. As a youngster he got lots of exposure to biodiversity (there are lots of birds in Brazil). He went to medical school right out of high school—career decisions are made earlier there than here—and after finishing his bachelor's degree went to Rockefeller University in New York City for his Ph.D. He worked under Prof. Fernando Nottebohm, who introduced Mello to bird research. Nottebohm was an early champion of research into bird song learning. He was among the first to show that there are many commonalities between the way birds and humans learn to vocalize. He discovered the brain areas involved in singing and learning to sing, showed that (in birds at least) males and females learn to vocalize in different ways, and showed that these brain areas undergo remarkable seasonal changes, like adding new cells every year during the breeding season.

Mello was at Rockefeller for 12 years, first as a graduate student, then as a post doc, and finally as an assistant professor—all in Nottebohm's lab. He went from New York City to OHSU in Portland, where he's been for the past 15 years. In both locations at least part of his research has been on the genetics of bird vocalization. At Rockefeller his main research animal was the Zebra Finch—the lab rat of avian research—and now he is also interested in hummingbirds and parrots. The recent genomic results show that hummingbirds are clearly a separate group from songbirds and parrots, and one of the most surprising things to Mello has been the finding that the ability to learn songs and other vocalizations has evolved separately in these three groups. He has become more interested in wild behavior in birds and so has been doing more fieldwork, a change that has brought him back to his roots. For the past 6 or 7 years he has been collaborating with researchers in Brazil, looking at hummingbirds, parrots, and some passerines such as ovenbirds ("horneros") and antbirds, which are somewhat related to phoebes.

Mello's enthusiasm for his work comes across in the way he talks about it. "Hummingbirds are incredible!" he said. Hummingbirds are highly specialized machines, with great hearts, beating over 1,000 times per minute while they are active and very slowly at night when they go into a hibernation-like state called torpor, and they are also very smart. Chicks learn to vocalize from their fathers, and their dialects differ from area to area. "Parrots are also incredible!" Again Mello's words. They live in large communities with complex social structures, and their ability to generate complex sounds no doubt is necessary for interacting with each other. But how they vocalize in the wild is hard to study because they're always in groups, all making noise at once.

Mello's presentation is co-sponsored by the Lane County Audubon Society and ENHS. Mello will talk about bird behavior and their ability to learn to vocalize, an ability shared among a surprisingly small number of animals: some birds, humans, whales, dolphins, and probably bats. He'll go into how much we have learned from birds about brain structure, genetics, and genes related to vocalization and speech. Finally, in an interesting aside, he'll touch on how the massive deforestation in Brazil not only hurts the global environment, it threatens future research by destroying habitats for these amazing animals. You should come early to hear Claudio Mello's presentation, "Of Bird Genes and Bird Brains: What Science Can Teach Us About Avian Singing and Seasonality." It's at 7:30pm on Friday, 9 December, in room 100 Willamette Hall on the U of O Campus.

John Carter

Mystery Bird by Reida Kimmel

The face on the cover page of *Audubon* for Fall 2016 demands attention. Pale brows and a mustache frame golden eyes and a dainty yellow beak. Nearly three feet tall with a five-foot wingspan, round faced, mottled gray-brown and white all over, this is the Great Gray Owl (*Strix nebulosa*). Our tallest owl, it is slender, only about two-thirds as heavy as a Great Horned Owl. Inhabiting the boreal forests of the Northern Hemisphere, its North American range stretches from north of our Great Lakes through Canada's North Woods and throughout much of Alaska, extending into our Northern Rockies and Cascades, and then, oddly, because it is a denizen of the cold north, the Great Gray Owl also inhabits a part of California's Sierra Nevada in the Yosemite area. And herein lies one of several mysteries surrounding this beautiful bird.

As Nancy Bazilichuk tells in her article "Hoot Recognition," Great Grays were discovered in Yosemite under brutal circumstances, typical of the science of natural history in the past. Joseph Grinnell's job was to catch and catalog specimens of every creature found in the area, ultimately 4,354 of them. He discovered a Great Gray Owl and shot it but did not kill it immediately. Then he killed its mate. The live bird was tied up and brought to camp for photographing. He coldly noted the brood patch on its breast and concluded that he had bagged a breeding pair for the collection of the University of California's Museum of Vertebrate Zoology. He did note his surprise to find the northern birds so far south of their normal range and concluded that they must be rare in Yosemite.

Nearly 70 years later, a new breed of naturalists returned to the mystery of Yosemite's Great Grays. By this time, the standard, nonlethal way to find the birds was to broadcast taped male territorial calls and hope that the calls would be answered. However, the Great Grays are shy birds, easily disturbed, and a hooting researcher stomping about frightens them away. It was very hard to estimate populations or get any information about breeding. In 1979, Jon Winter's careful study led him to believe that there were only 53 Great Grays in all of California. The next year they were listed as endangered in the state.

A new problem for the owls came with the spread of West Nile virus to California in 2004. Canadian Great Grays had proved to have no resistance to the disease. To determine whether the Sierra population also lacked resistance, John Keane and Josh Hull, California wildlife biologists, wanted blood samples

from the California population to compare with the blood samples from Great Grays in Ontario who had recovered from the disease. They soon realized that DNA comparisons would also give them the answer to the mystery of the Sierra population's origins. How long had they been separated from the rest of the Northern Hemisphere birds? Just recently, since European settlement and habitat destruction? Since the end of the Ice Ages? Since the early Pleistocene?

To track the spread of West Nile virus, it would be necessary to capture, tag, and keep track of individuals from California's small, elusive population. They worked with UC Davis graduate student Joe Medley. The team set out baited traps, managed to catch 32 birds, tagged them, and took blood samples, which showed that these owls also lacked resistance to the disease. But the owls' leg feathers concealed the tags and the tagged birds were hard to find again. Perhaps if they could collect molted feathers, Hull could extract DNA information from those. Then they could identify individual birds and their young even if they could not identify them by sight. But how could they find the birds, their roosts, and their feathers?

Medley had developed and perfected a computer program to sift out the vocalizations of Great Grays from other background noise. The system was more or less perfected by 2008. He hung twin microphones from tree branches in possible owl territory. Great Grays prefer to hang out in clumps of tall trees overlooking wet meadows. From their perches they can hear the movements of small mammals below and quickly and lethally drop down on them. Knowing this, Medley could hang his microphones in likely spots. Medley's devices could capture and record a week's worth of owl vocalizations. But there were problems besides the bears that occasionally crunched the microphones. Douglas Squirrels' alarm calls sounded just like the calls of the Great Gray Owl chicks, but more computer ingenuity and a statistical tool called a random forest analysis solved that problem. It seems that Great Gray Owls are actually very talkative when not disturbed. Working in the Stanislaus National Forest and in Yosemite National Park, Medley identified 7,445 male, 13,163 female, and 43,004 juvenile calls. The owls were nesting and reproducing—more elusive than rare.

The DNA analysis did indeed solve the old mystery of the California Great Gray Owl's origins. They had been separated from their northern relatives for 27,000 years. They are a remnant population from the Ice Ages when the species had been forced south of its traditional northerly range. The descendants of those owls that remained in the Sierra Nevada are now a subspecies. *S. nebulosa yosemitensis*.

The DNA from those dropped feathers can also solve other mysteries about Great Grays. How much do they move about? How loyal are they to particular meadows? How long do they live? As California wildlife biologists learn more, they can act to protect this unique population. Great Grays are listed among the species especially vulnerable to climate change. Yosemite's catastrophic fires in 2013 burned 10 of its 18 meadows with suitable nesting sites. Recently biologists have discovered that outside the park the birds often prefer warmer lower elevation sites where open space is in danger of development for vacation homes. Loss of large dead trees for nesting, fires, and destructive cattle grazing also put great pressure on the owls outside the park.

Unfortunately, unlike their northern cousins who choose to lay their eggs in abandoned stick nests, California's Great Grays nest only in snags—large dead trees with broken tops. Because of logging, there are few snags left, and Forest Service managers are trying to create artificial snags by topping remaining large trees in suitable sites. To address the problem of cattle grazing, the new ways of finding where the owls are and where they are nesting can help Forest Service personnel protect those areas from trampling bovines. Only if nesting sites can be protected and more created can this special population of Great Gray Owls hope to survive in our hotter, drier, and crowded world.

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Order and Chaos by Tom A. Titus

Life seems chaotic at the moment. Yet as I sit on my beloved porch at the cabin in the Coast Range, late November nightfall begins its orderly progression, a weighty silence sifting in around me. The deepening hush is part of a larger seasonal progression of noise. In late winter there is the raucous winter *ribbit* of Pacific Chorus Frogs from the darkening wetland below, in early summer the spiraling calls of Swainson's Thrushes, followed by a stridulating September chorus of crickets. These sequential auditory hullaballoos were created by animals obsessed with an evolutionary mandate for making more of themselves. Each din bloomed and faded in a predictable order that I have come to recognize and embrace in two decades of porch-sitting at this deteriorating cabin, watching and listening and smelling and feeling the withering daylight. Now the only sound is the jangling of my own neurons.

My internal chaos comes mainly from the current level of social discord that is beyond my previous

experience. There is also the heart-rending disparity between four blissful weeks on an artist residency at the Playa Institute and the recent maelstrom. Thank goodness for those two days before returning to work and social obligations. That first Saturday back, I puttered around in my home garden. The following Sunday I took the cider press to the apple orchard here at the cabin where I now sit. That early October morning was like warm milk and brandy, and I drank it alone for several hours, picking apples and pressing juice, a cider day experience completely different from boisterous family events of past years. Memories slid over me like old jeans. I was wistful but not sad. Change is, after all, ever after. In the afternoon, my friends Jerry and Martha came by for the more familiar community cider jam. But along came Monday and work and deadlines and 300 emails, a contentious election process, and a four-day trip to southern California. I began to pull my head into my shell like a wannabe turtle.

Despite the predictable progression of nightfall, despite my well-tended garden beds and linear rows of garlic planted earlier in the afternoon, despite the organized organismal systems of chanterelle, Douglas-fir, chorus frog, and my own body, I am not inclined to become too Pollyanna-ish about order in the universe. There is plenty of chaos beneath these orderly systems. Imagine being a single molecule in the company of other molecules experiencing Brownian motion, tumbling and gyrating and spinning and bumping at the whim of thermodynamic forces over which you have no control. Evolution would not be possible without a little genomic chaos in the form of random mutations, glitches in the replication of DNA molecules that otherwise reproduce themselves faithfully. Chaos is so important that the field of chaos theory has arisen to study how small fluctuations in the early development of orderly systems can cause huge differences in the final character of those systems.

Yet order is widespread and obvious. We live in a solar system that exists because of rules imposed by gravity. Life persists because it has developed the parlor trick of harvesting energy to increase organization and complexity, thumbing its nose at the disorder predicted by the Second Law of Thermodynamics. Even though evolution requires random mutations, change could not proceed if a replicating DNA molecule could become any collection of nucleotides rather than a new molecule that is mostly, if not entirely, the same as the parent template. Likewise, organisms develop in constrained ways, and without these predictable developmental pathways, biological chaos would ensue. Sorry, but humans will never have wings.

We need not aspire toward disorder—chaos manages to occur without any help on our part. Living things can only acquire enough energy to keep their orderly juggling pins aloft for a finite amount of time. All organisms eventually die. At some point gravity will cause our solar system to be engulfed by the collapsing sun, Earth will be gone, and all life will end. Period. As soil scientist and previous ENHS speaker James Cassidy would say, “back to normal.” What he means is, back to a normal state of chaos. States of organization and orderliness are abnormal and require energy to sustain them.

So what exactly is bothering me as I am enveloped by this very polite, very quiet November nightfall? Nature has underlying chaos but is also highly organized. Human social systems can also be organized but are fraught with chaos (even though right now the level of social bedlam seems to have risen a notch). Darkness progresses, the air chills. I turn up my collar, shiver, and realize that I suffer under the illusion that social progress should proceed with no underlying disorder. Moreover, I suffer because I think that my particular ideas for organizing society are the best way forward. Don’t get me wrong. We don’t need to hold hands and agree or worse yet pronounce all ideas equally worthy. Some ideas are better than others. Look at all of the death and destruction, some of it human and far more that is not, that occurs in the wake of bad ideas. The paradigm of infinite economic growth has been particularly damaging.

In these turbulent times we cannot look to Nature for order without also acknowledging the disorder that seethes below the surface. My future as a transcendentalist is not bright. I don’t believe that Nature always reflects back to us some higher manifestation of organization that can be transposed onto human society, providing some enlightened way out of our predicaments. If anything, Nature shows us who we are: a species that has evolved in a disorderly process on this disorderly earth, a once-wild animal that persists by capturing energy and imposing organization. Order and chaos are literally carved into our chromosomes. How could we possibly expect human society to proceed decorously at all times, along with the added constraint that society behave in the ways we think it should? I hope we can make things work for a while longer. I hope we can maintain enough order to continue to fly in the face of chaos. I hope we can persist.

A good place to park for our meetings is the Physical Plant lot: turn north (left) from Franklin onto Onyx, go about a block and you will be in the lot. After 6pm it's open to the public.

Events of Interest in the Community

Lane County Audubon Society

Friday, 9 December, 7:30pm. Of Bird Genes and Bird Brains: What Science Can Teach Us About Avian Singing and Seasonality. Claudio Mello. This is a joint meeting with the Eugene Natural History Society. See pp. 2–3 of this issue of *Nature Trails* for details.

Sunday, 1 January 2016, 8am to dark. Eugene Christmas Bird Count. This will be the 75th ECBC and the 117th National Audubon Society Christmas Bird Count. The ECBC is open to everyone, and the more counters the merrier, so please join us. Dick Lamster is the Coordinator again this year, supported by the Steering Committee of Allison Mickel, Herb Wisner, Dan Gleason, and Barbara Gleason and 27 great birders as Team Leaders. If you are just starting to get interested in birding this is a great opportunity to learn from experienced birders. Watch for more information in the December–January issue of *The Quail* or contact Dick Lamster at 541-343-8664 or maeveanddick@q.com.

Mt. Pisgah Arboretum

Saturday, 10 December, 1–4pm. Origami Temple of Kindness Paper Arts Workshop. Come and make your own Temple of Kindness, complete with secret little messages of love, joy, and happiness. Artist Glenda Goodrich guides you in creating a delightful three-dimensional work of art to give as a gift for the holidays. That is, if you can bear to part with it! Follow step-by-step instructions to fold Origami bowls, cover mat board lids, adding beads and charms to create a sweet temple of delight! Members $20, non-members $25. Plus $10 materials fee paid to instructor. Pre-registration is required. To register call 541-747-3817. When registering, please note which color of materials you would like provided for you: gold, red, blue, green, pink, purple, or black & white.

Sunday, 11 December, 8:30–11am. Late Fall Bird Walk. Join Julia Siporin and Joni Dawning for another monthly bird walk intended for people with all levels of birding experience. Come discover the Arboretum's avian diversity. Please bring binoculars. Option to continue the walk until noon for those who are interested. Rain or shine. Meet at the Arboretum Visitor Center. Members free, non-members $5.

Wednesday, 21 December, 10am–12pm. Winter Solstice Family Walk. Come celebrate the shortest day of the year with a family friendly walk and hot chocolate! Search for animals and plants taking advantage of the daylight while it lasts. Learn what causes the winter's darkness and how life in the Arboretum has adapted to it. Then warm up before you head back home with a build-your-own hot chocolate bar. Led by the Arboretum's Education Coordinator Jenny Laxton. Rain or shine. Meet at the Arboretum Visitor Center. Don't forget your parking pass. Members $5 per family, non-members $8 per family.

Friends of Buford Park and Mt. Pisgah

Monday Morning Regulars. 9am–12pm. Contact volunteer@bufordpark.org for more information.

Tuesdays and Thursdays, 9am–12pm. Nursery Work. Meet and work at the Native Plant Nursery at Buford Park. Enter Buford Park from Seavey Loop Road. Turn LEFT after crossing the bridge and drive ¼ mile to the nursery.

WREN (Willamette Resources and Educational Network)

T**uesday, 13 December, 9–11am. Wetland Wander at Hansen See-Sil.** Bird expert Dave Bontrager will lead our group back to Hansen See-Sil and discuss birds wintering in this unique habitat. Directions: Head west to the end of Royal Ave. toward Fern Ridge Reservoir. Park in the ODFW lot, or if you do not have a permit, parking is available along Royal Ave.

The University of Oregon's Museum of Natural and Cultural History
Exhibit Hours: Tuesday through Sunday, 11am-5pm

Cascade Mycological Society

Wednesday, 7 December, 7–9pm. Truffles: The Mycorrhizal Hitchhiker. Ryan Stephens of the University of New Hampshire will talk about truffle diversity in the Northeast and the mechanisms by which these subterranean fungi disperse. Most tree species require mycorrhizal fungi for growth and establishment, and these fungi disperse to new areas by producing spores within mushrooms or truffles. Unlike mushrooms, truffles have lost the ability to disperse their spores through the air and require mycophagist animals for dispersal. Primary among dispersers are small mammals, which often consume truffles as a major food source. Thus, this mutualistic interaction between truffles and small mammals is extremely important in forest ecosystems. **The talk is free and open to the public.** There will be a mushroom identification session prior to the talk. Bring what's in your basket, edible or not, and learn from the experienced members of our community. Amazon Community Center, 2700 Hilyard St., Eugene.

Native Plant Society of Oregon, Emerald Chapter

Thursday, 15 December, 7pm. Holiday Social and Picture Show. Bring 10 to 12 digital photos and a snack to share if you wish. Come and socialize with others who share your interest in native plants. Location: The Stellaria Building, 150 Shelton-McMurphey Blvd. suite 104, Eugene just south of Skinner Butte. Head east on West 3rd Ave. until it turns into Shelton-McMurphey Blvd. Stellaria is inside Hummingbird Wholesale.

North American Butterfly Association, Eugene-Springfield Chapter

Monday, 12 December, 7pm. Burning for Butterflies, Birds, and Blooms. Amanda Stamper, Oregon Fire Management Officer for The Nature Conservancy, will address the role of fire in the Willamette Valley. She will delve into the history and foundation of fire in the valley and how prescribed burns are being used to restore and conserve native species and habitats. Eugene Garden Club, 1645 High St., Eugene.

Nearby Nature

Saturday, 10 December, 1–3pm. Hendricks Park Nature Quest. Wander through the tall trees in Hendricks Park and afterwards enjoy hot cider and warm yourself by the hearth at the Wilkins Shelter as you listen to nature tales. A family-paced nature adventure. Members free, non-members $5 per family. Meet at the Wilkins Shelter in Hendricks Park. To pre-register call 541-687-9699.

ENHS welcomes new members! To join, fill out the form below. Membership payments allow us to give modest honoraria to our speakers, as well as to pay for the publication and mailing of *Nature Trails*. Our web address: http://biology.uoregon.edu/enhs

MEMBERSHIP FORM

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I (we) prefer electronic copies of *NT* rather than paper copies. ___Yes ___No

If yes, email address (if different from the one above):_____

ANNUAL DUES:	Family	$25.00
	Individual	15.00
	Life Membership	300.00
	Other Contribution	_____

Annual dues for renewing members are payable in September. Memberships run from September to September. Generosity is encouraged and appreciated.

Make checks payable to:
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Mello (right) in Brazilian jungle

Canary. Photo by Claudio Mello

Green Parrots in Brazilian jungle. Photos by Claudio Mello

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Schedule of Speakers and Topics for 2016-2017

9 Dec.	– Claudio Mello	– Of Bird Genes and Bird Brains: What Science Can Teach Us About Avian Singing and Seasonality
20 Jan. 2017	– Kelly Sutherland	– Sea Jellies
17 Feb.	– Terry Hunt	– Easter Island Archaeology
17 Mar.	– William Cresko	– Sea Horses and Sea Dragons
21 Apr.	– Svetlana Maslakova	– Pythons of the Sea: Natural History of the Nemertean Worm
19 May	– Ed Alverson	– Southern Willamette Valley Natural Areas Through the Seasons