oceanic midwater to freshwater occurred?" the authors write. The two environments are remarkably different and require fish to be adapted to remarkably different ecological and physiological constraints. The authors consider whether there was a gradient in productivity between freshwater and marine environments at the time of the evolution of these eels. Another possibility the authors consider is that there was a vacant niche in freshwater when multiple marine species were emerging. "Multiple lineages of marine eels in marine environments, including voracious predators such as moray eels," may have led to a vacant niche in freshwater, they suggest.

"How can we explain why this apparent evolutionary shift of the freshwater eel life history from the oceanic midwater to freshwater occurred?"

The authors speculate that some ancestral forms may have come to estuaries during their larval or juvenile phases and developed an adaptive behaviour of regularly inhabiting estuaries and occasionally entering freshwater in tropical regions because of higher food availability, better survival or to escape from predators. "Once natural selection resulted in the emergence of eels that regularly used freshwater for growth," a new life history was established, they suggest.

But what is most evolutionarily remarkable is the return to the deep ocean by these species to breed. "Reproductive behaviour is typically conservative and constrained by many ecological and physical factors," the authors say. So the migration of freshwater eels back to their offshore habitats over an evolutionary timescale represents a remarkable relic of the reproductive behaviour of these enigmatic animals that share a common ancestry with pelagic eels of the deep ocean, they write. "This surprising discovery offers a new perspective on the evolutionary origin of the freshwater eels," and may provide novel insights into the evolutionary process of their unique migrations, they believe.

Q & A

Çağan H. Şekercioğlu

Born in Istanbul, Turkey, Çağan Şekercioğlu came to the USA in 1993 to study biology and anthropology at Harvard University, after reading books by Stephen Jay Gould, Ernst Mayr, and Edward O. Wilson in his high school, Robert College of Istanbul. Books by Paul Ehrlich similarly inspired him to get his Ph.D. in ecology and evolution from Stanford University in 2003. He is a senior research scientist at Stanford, Fellow International of the Explorers Club, and president of the Turkish environmental organization KuzeyDoğa. His conservation ecology and population biology research combines long-term field studies with global meta-analyses. His major projects include the Costa Rican bird ecology and population dynamics project he started in 1999 and the world bird ecology database he initiated in 2000. He has done field work on all continents, in places like Alaska, Angola, Australia, Ethiopia, Malaysia, and Uganda. His research covers the entire spectrum of biodiversity, from ethnobotany surveys with village medicine women to mark-recapture analyses of bird populations to camera trap surveys of bears to building Turkey's first man-made bird nesting island. His conservation efforts have been rewarded with Ramsar recognition, the European Destination of Excellence ecotourism award, and the Whitley Gold award for grassroots conservation given by HRH Princess Anne of the United Kingdom. His work has frequently been featured in the media, including on AP, BBC, CNN, Discover, National Geographic, Newsweek, NPR, Reuters, and USA Today.

I do not know of another Turkish tropical biologist: how did it happen? E.O. Wilson calls it 'biophilia'. I always knew I was going to study nature, and it has been my main motivator. I learned to read at four because my parents got sick of reading to me about animals. I read about Darwin at age five and thought he wrote '*On The Evolution of Turks*': the Turkish for 'species' is 'Tür'. Instead of playing soccer, I brought home insects, lizards, hedgehogs, and other critters. My mom, a worrywart, took me to a child psychiatrist to cure me of this nature madness: he reassured her that I was not a budding psychopath and told her to encourage my interest in nature. However, I had no role models, no natural history museum in Istanbul, and no mentors until I was in high school. I saw my first field guide at 15 and started birding immediately. I wrote my college application essay on insect collecting. The lack of natural history books in Turkish made me read many books in English, boosting my SAT and other relevant test scores. At age 16, I contributed the rare beetle *Propomacrus bimucronatus* to the Harvard entomology collection, initiating the Turkish urban legend that "someone bribed Harvard with a cockroach to get in". In college, I worked in that collection as a curatorial assistant and inventoried that very beetle. My inventory still hangs on the MCZ beetle cabinets after 16 years. At Harvard, Peter Ashton's graduate class in tropical biology was my introduction to the subject and I never looked back.

You have successfully combined long-term field projects with global meta-analyses: do you think biologists are doing enough field research? No. There is a massive need for long-term field research, especially in the tropics, but funding is hard to find and it is easier to analyse already-collected data. There is growing pressure to get papers out quickly, so biologists increasingly work with existing datasets. This is a huge loss, both personally and professionally, especially for students who graduate with little field experience.

Besides the pleasure of studying nature, field work enables me to collect essential population dynamics data and obtain ecological insights I would not get otherwise. Combining field work with analyses of global databases, I can see the big picture, understand conservation priorities worldwide, and find answers to important questions, such as what percentage of the world's bird species are migratory and what percent of those are threatened with extinction.

Long-term field work is also essential for solving conservation problems. My Costa Rican research, supported by National Geographic Society, Sigma Xi, Stanford University, and the Wildlife Conservation Society, has shown the importance of forest remnants, riparian strips (riverbanks), and even individual trees for the survival, breeding, and persistence of forest birds in agricultural countryside. To do that, since 1999 we have mistnetted about 50,000 birds of 260 species, radio-tracked over 450 birds of 12 species, and monitored hundreds of bird nests. It was a tremendous time commitment, but we built research capacity among Costa Rican farmers, raised environmental awareness, and collected critical data on tropical bird ecology, population dynamics, and conservation biology. The trend towards less field work is worrying, because without detailed long-term field datasets, ecology and conservation will suffer. An ecologist who never leaves the office will not have the insights of one with extensive field experience.

How did you become involved in community-based conservation?
It is impossible not to for an ecologist working in the developing world. Support by the Christensen Fund of California enabled me to focus more on community-based conservation, and integrate it with ecological research, environmental education, habitat restoration and capacity-building. Besides conducting important ecological research in a little-known part of the world, we monitor biodiversity and conduct Turkey's biggest ecological restoration project (with Sean Anderson of California State University Channel Islands) at the confluence of the Caucasus and Irano-Anatolian biodiversity hotspots.

Is teaching important for your research? It is critical, personally and professionally. Students' excitement is rejuvenating and inspiring. Their questions keep you on your toes (in a good way) and on top of current science. Answering questions requires one to communicate the science concisely, a skill essential for thinking about science and for informing the public. Some student questions are provocative and may inspire me towards a new research direction. Training students and local people also builds capacity to conduct long-term environmental research. I am devoted to environmental education because I want to give my students the mentorship I craved while growing up in Turkey.

What are your thoughts on public and media outreach by scientists?
Scientists have to communicate the science well, especially to inspire young people. It is a double-edged sword, however. It can add stress and time to a busy schedule and one's research can be over-simplified and incorrectly summarized.

I had a 'perfect storm' of inaccurate media coverage this year. A Turkish journalist writing on US birds shifting their ranges because of climate change asked me if any of these birds lived in Turkey. I told him that the red-breasted merganser did, but emphasized that the report covered the US only and we had no data on bird shifts in Turkey. To my horror, the draft title was "Birds begin to leave Turkey", implying climate change. I told him that the title was absolutely incorrect. He said it would be fixed, but the article was printed with the incorrect title. His excuse was "My editor did it. We have to make the science accessible, interesting, and relatable. No one will notice". I was furious. Two days later, a Fijian colleague congratulated me on my climate change research on Turkish birds! A competing Turkish newspaper, without permission, had translated the article and published it in English online, with the title "Turkey too hot for the red-breasted merganser, ornithologists say". Then the CBD news aggregator highlighted it as a major story, for all the world to see. I am still mortified. This is a lesson in the global reach of even local news in local languages. An inaccurate story can spread globally, so press coverage can be risky for a scientist.

Nevertheless, it is my duty as a scientist and conservationist to inform the public, especially about conservation problems whose solutions need global support. Media coverage is valued by decision-makers. News stories multiply our educational reach a million-fold, so press is critical in public outreach and environmental education. But it is a constant, time-consuming struggle to keep the science accurate. Graduate programs in science, especially in environmental fields, must include media training.

You have published high-impact papers while advancing conservation in Turkey: are conservation biologists doing enough real-world conservation?
Unfortunately not. Actual conservation is mostly done by working with people, and is as much politics and human relations as science. But most ecologists get little training in social sciences and academia does not value conservation success without papers in peer-reviewed journals. Your high-impact paper will get you tenure, but means nothing to an impoverished villager poaching in a national park. A million-dollar grant used to protect a biodiversity hotspot will not interest a university if it does not receive overhead funds. Therefore, non-governmental organizations do the bulk of actual conservation work, but conservation success often requires the day-to-day involvement, feedback, oversight, and credibility of top-notch scientists, who are mostly in universities.

Involvement in real-world conservation is also essential for improving conservation science. I work hard to balance field research, global meta-analyses, and community-based conservation. We need far more conservation biologists, especially high-ranking academics, on the ground, directing conservation teams, working with local people, and convincing decision makers. More papers alone detailing conservation problems will not prevent extinctions. This is the equivalent of everybody shouting "Fire!", but few people fighting it.

We need conservation biologists' long-term involvement with local communities. However, this often has a big opportunity cost. More time meeting with villagers and politicians means less time writing papers and proposals. I work around the clock and do not have a family. This is not an ideal choice for everyone. Universities should weigh actual conservation work more when evaluating conservation biologists. People with such experience will also be better mentors for students. We ecologists also have to practice what we preach and live low-impact, low-consumption lives. I do feel guilty about my flights, but I compensate by planting trees, restoring wetlands, not owning a car, and living in a 7 m^2 cottage.

Any advice for someone starting a career in ecology and conservation science? Field work is not like watching documentaries. An hour-long program can take years to shoot and shows only the most exciting stuff. You don't see the tedium, the sweat, and hard work required. Most field research is tedious, often requires long days, and an early rise. It can be brutal, especially if you spent the night working on a paper. Field work is safer than traffic, but to a city-dweller, the imagined possibilities can be terrifying. Some eager students fled my Turkish research station after one day because they were terrified about harmless wild boars. By volunteering, you are doing yourself a favor. If you have a positive attitude and good work ethic, volunteering can be a ticket to a paying position. Ecology and conservation are highly competitive, so field experience will increase chances of landing a job or graduate position. For your PhD, research your potential advisors well. Find the right people, rather than focusing on schools. Your PhD advisor will shape your career, so ask around and talk to his/her students and colleagues. A good, supportive mentor at an apparently 'mediocre' school is much better for you than a bad advisor at a top school.

Collaboration or competition? Science thrives on both, but we need more collaboration, especially in conservation. The academic model parallels the business world, with ruthless competition between individuals, groups, and ideas. An assistant professor is much like an entrepreneur establishing a start-up. Competition is valuable in motivating good research and pushing the boundaries of science, but competition at all costs is unhealthy and reduces collaboration that is essential for good science and conservation. Academic careers can last 50–60 years. Collaboration and being a good colleague will pay off in the long-term. Increasing competition is encouraging unethical behavior in science which is often ignored or tolerated. A cut-throat, non-collaborative mindset will lead to failure in conservation, where solution is often based on consensus, compromise, and conflict resolution among multiple stakeholders.

What are some of the big questions to be answered next in your field? How much longer can the biosphere tolerate human abuse before we have a civilization-threatening collapse of the world's ecosystems and their life-support services? The most important question for humanity, period. A related question is how biodiversity declines affect ecosystem processes. What are the determinants of species richness, especially with respect to the tropics and lesser known groups? We don't even know how many species there are on the planet!

What are the dangers of fieldwork in the tropics? Most recently, I was charged by a Tanzanian elephant, but field dangers pale in comparison to dangers posed by people, especially homicidal drivers. The most terrifying ordeal I experienced was being lynched by machete-wielding Nicaraguan vigilantes while searching for an owl in Costa Rica. I have had some tense moments with wildlife, including extracting a live puffadder from a mistnet in Uganda, being stung on the head by wasps in Ecuador, almost having to shoot a charging grizzly bear in Alaska, startling a forest cobra in Ethiopia, and unknowingly swimming with box jellyfish in Australia. I fell into ice (Ecuador) and lava (Hawaii) crevasses, caught leishmaniasis in Peru, acquired lymph system infection in Papua New Guinea, and drained a massive tropical ulcer on my leg in Costa Rica, but the outdoors is safer than people. Most dangerous is driving in the developing world.

If you could be one person in history, who would it be? Alfred Russel Wallace. In addition to being the 'father' of biogeography and co-discoverer of evolution, he was an expert naturalist, professional collector, conservationist, and social activist. He wrote about tropical deforestation and invasive species over 130 years ago. What especially inspires me about Wallace is that besides being a world-class field naturalist, he synthesized his experience into the big picture, coming up with some of the most important ideas in ecology and evolution.

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Quick guide

Perceptual learning

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What is perceptual learning? Perceptual learning is experience-dependent enhancement of our ability to make sense of what we see, hear, feel, taste or smell. These changes are permanent or semi-permanent, as distinct from shorter-term mechanisms like sensory adaptation or habituation. Moreover, these changes are not merely incidental but rather adaptive and therefore confer benefits, like improved sensitivity to weak or ambiguous stimuli.

Why is it interesting? Three aspects of perceptual learning make it of general interest. First, perceptual learning reflects an inherent property of our perceptual systems and thus must be studied to understand perception. Second, perceptual learning is robust even in adults and thus represents an important substrate for studying mechanisms of learning and memory that persist beyond development. Third, perceptual learning is readily studied in a laboratory using simple perceptual tasks and thus researchers can exploit well-established psychophysical, physiological and computational methods to investigate the underlying mechanisms.

What is its history? Perceptual learning was among the earliest research topics in perceptual psychology. Studies from over 150 years ago examined training-induced improvements in the ability to distinguish two points touched to the skin. These improvements included a nearly 100-fold decrease in the distance between two points that could be distinguished when placed on a human subject's back. The improvements were assumed to be too dramatic and rapid to involve changes in the number of peripheral receptors and instead likely involved changes inside the nervous system. This idea has remained a dominant theme of perceptual learning