College of Letters & Science
UNIVERSITY OF WISCONSIN–MADISON

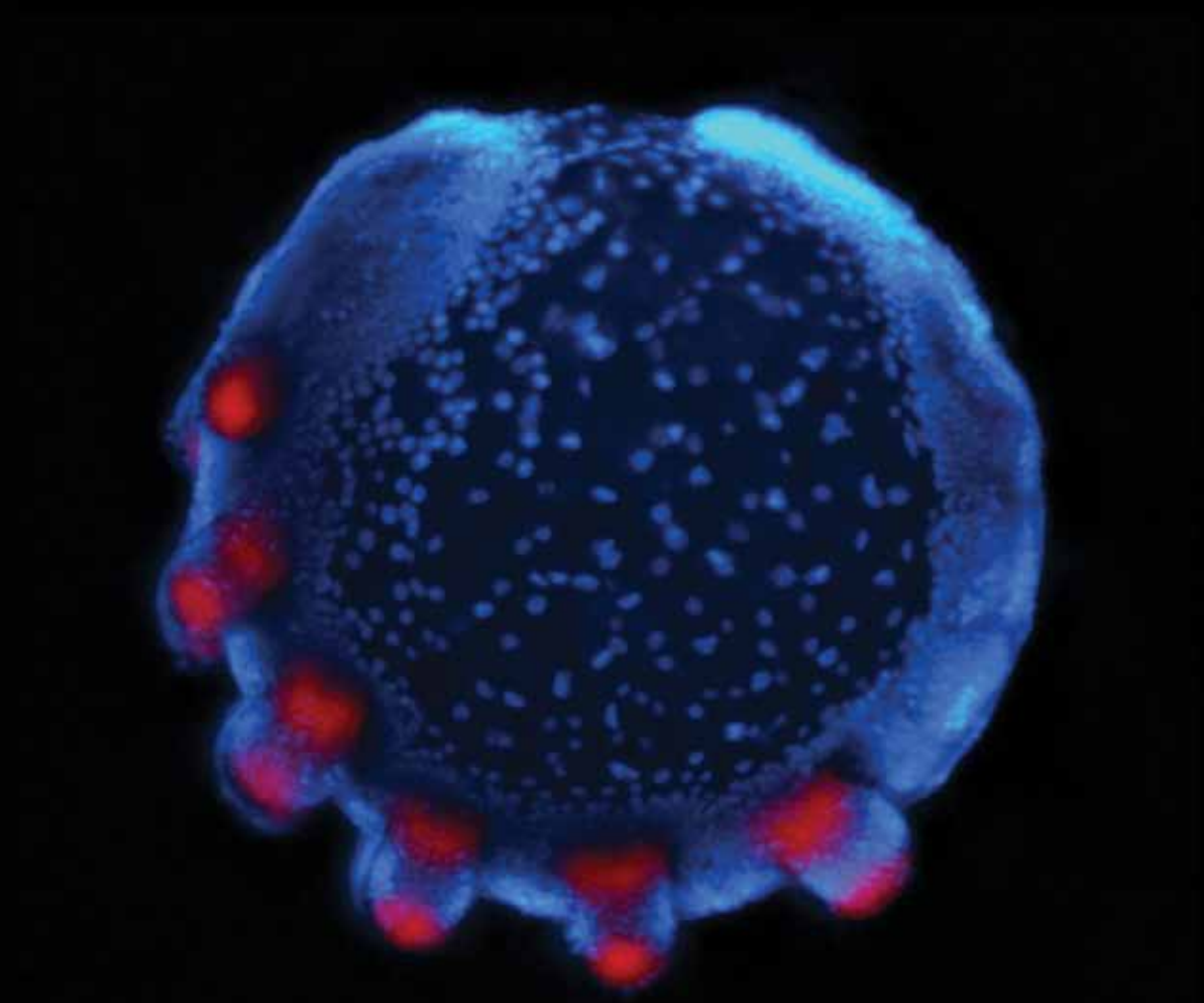
BioScience Now

News for Alumni and Friends of the Department of Integrative Biology

FALL 2017

FAREWELL, ZOOLOGY. HELLO, INTEGRATIVE BIOLOGY.

New name reflects the content, scope, and emphasis of the department's teaching and research.



Embryonic expression of the gene Sp6-9 in the cobweb spider.
Image by Prashant Sharma

Department of Integrative Biology
UNIVERSITY OF WISCONSIN–MADISON

BioScience Now
is the alumni newsletter of the
Department of Integrative Biology
at the University of Wisconsin–Madison.

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From the Chair

Welcome to the inaugural edition of *BioScience Now*! You may have noticed the new name. It signals an exciting milestone. After many years of behind-the-scenes effort, the University approved our request to change our name to the Department of Integrative Biology. Our new name better reflects our department's mission and vision as a leader on the campus in biological science research and education.

Our name change is just the tip of the iceberg. We officially launched the new, incredibly popular Neurobiology major, which already has more than 400 majors. The University review of the Zoology Graduate Program was very successful. New research funds for 2016–17 brought in an additional $3.6 million dollars to the department. Lauren Riters received a prestigious Kellett Mid-Career Award, and Jeff Hardin became the Raymond E. Keller Professor of Integrative Biology. Dr. Hilary Dugan, a new faculty member in the Center for Limnology, will start in January 2018. The inaugural Wayland Noland Distinguished Chair was awarded to Professor Tony Stretton, an award made possible through the generosity of Dr. Wayland Noland, Professor Emeritus of Chemistry at the University of Minnesota, and son of Lowell E. Noland.

We also celebrated three successful careers. Our department artist, Bill Feeney; our information technology specialist, Ray Lord; and the Director of the Center for Limnology, Professor Steve Carpenter, all announced their retirements. We are grateful for their many years of service.

None of these achievements would be possible without your generous support. Your partnership is crucial for the future of the Department of Integrative Biology. We hope our new website will help you stay in touch. You can check it out at **http://integrativebiology.wisc.edu**. If you have interesting stories and photos, please send them to **jzlindsey@wisc.edu**.

Best regards,
Jeff Hardin
Professor and Chair

From Dean John Karl Scholz

Here at UW–Madison, the leaves are turning and the view from Bascom Hill is as beautiful as ever. But under the tranquility is a current of unrest. Issues of race, inclusivity, and free speech have caused (and will likely continue to cause) divisiveness on our campus, just as they have on many other campuses around the country. There is a tension in the air, the likes of which has not been felt here since the Vietnam War era.

In this climate, what we do in Letters & Science is more important than ever. We are fiercely committed to an institution where every student has the opportunity to reach their full potential, and where the campus environment and the knowledge discovered here become guiding lights for Wisconsin, the nation, and the world.

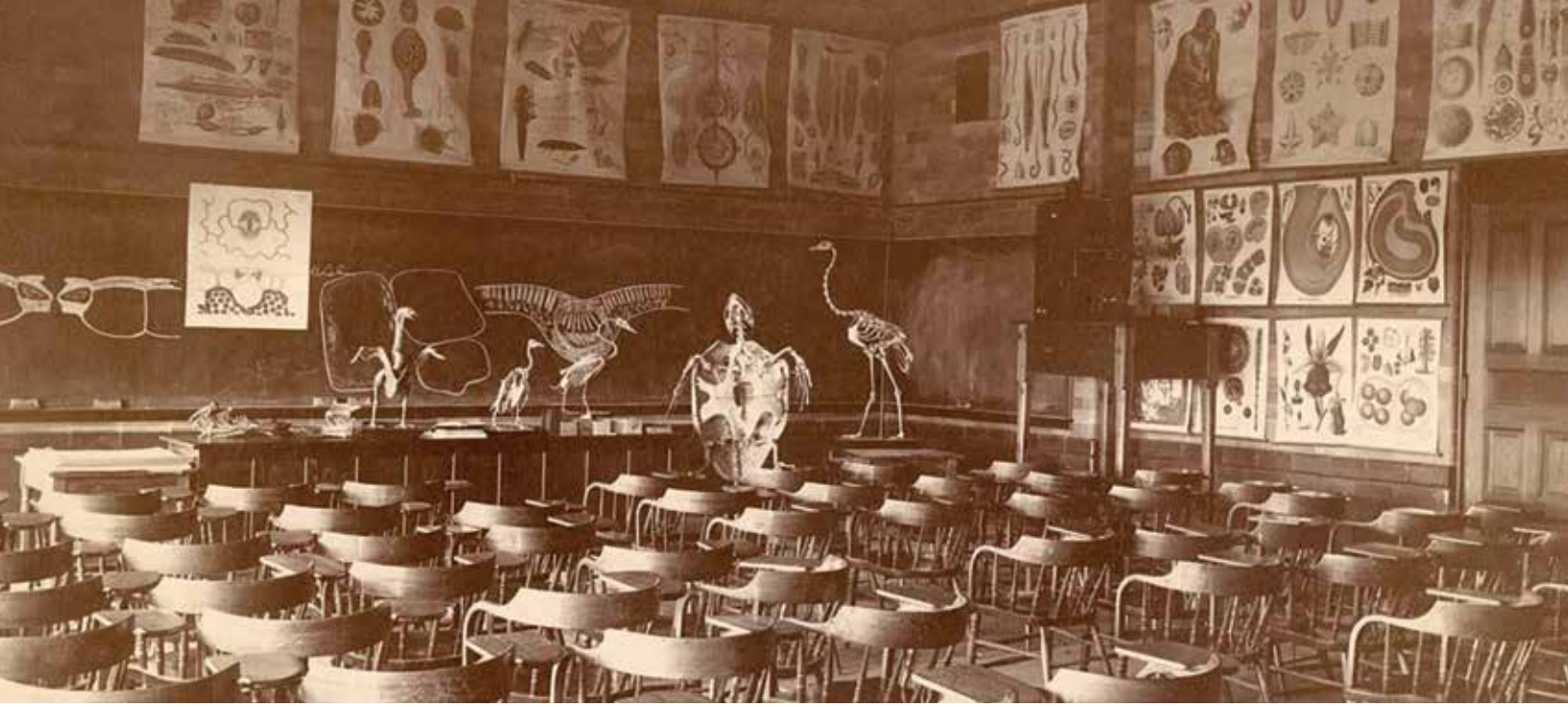
As the Chancellor has emphasized, only in an environment safe and free from harassment can our primary mission of teaching, learning, research, and service take place.

For many students who arrive on campus, UW–Madison is the most diverse place they've seen. Others have never seen a less diverse place. But the education we provide in Letters & Science teaches people to confront problems from many perspectives, to imagine alternatives, to put themselves in others' shoes. Together, we create a welcoming place to learn.

We are grateful for the unwavering support and advocacy our alumni and friends offer on behalf of our faculty, our research endeavors, and our great students.

As Letters & Science alumni we hope you draw daily, not only on the knowledge you gained, but on the values you absorbed here. We are counting on you in an uncertain world. Thank you for all you do to support the College of Letters & Science at UW–Madison.

On, Wisconsin!



Farewell, Zoology. Hello, Integrative Biology.

What's in a name? A whole lot of history, but not much zookeeping

Karl Scholz, dean of the College of Letters & Science (L&S), used to brag that departments in L&S spanned the alphabet from A to Z. It was a neat opener in talks to alumni and parents about the breadth and depth of an L&S education. But this fall, the Department of Zoology will change its name to Integrative Biology, and Dean Scholz will have to drop his favorite line.

That's okay, he says. It was high time for a change.

"There is historical significance in the name 'Zoology,' but it's antiquated," says Scholz. "Worse, it confuses students and parents—if inquiries we receive about careers in zoos are any measure."

Since 2013, the department has been working on a new name, tapping campus colleagues for ideas that better signify the content, scope, and emphasis of the teaching and research that happens there.

"There was uniform support that a new name was needed," says department chair Jeff Hardin. "But there was not uniform agreement—at first—on what names would be acceptable."

The formerly named Department of Zoology supports the cross-college Biology major, sharing oversight with the College of Agriculture and Life Sciences (CALS). It is also the home for undergraduate majors in Molecular Biology, Neurobiology, and Zoology. While half the faculty members do study animal biology (the primary focus of the traditional field of zoology), the others focus on diverse areas such as molecular and cellular processes, evolution, neurobiology, nutrient cycling, and forest fire ecology. Collaborations with the UW School of Medicine and Public Health and the School of Veterinary Medicine, not to mention CALS and Botany, occur frequently.

With so much biology happening in this department—and with students looking specifically for strong programs in that field—it seemed natural that "biology" be reflected in the department's new name. But since many units can lay claim to studying some aspect of biology, a name other than "biology" was needed.

The name Integrative Biology hit the sweet spot.

"We think our collaborations across campus will be strengthened with this name, and it communicates right away, to students, what can be found here," says Hardin.

Despite the department name change, there will be no changes to the names of the academic programs in the Department of Integrative Biology. This means there will still be an undergraduate major and a graduate program called Zoology, and the Zoology course listing will remain the same.

Coinciding with the new department name, the Lowell E. Noland Zoology Building, where most Zoology courses are taught, will now be called Lowell E. Noland Hall. The hall is named for the esteemed professor of Zoology who made significant contributions to the growing field of "protozoology," focusing on single-celled organisms. Bringing an "infectious warmth" to the classroom, as well as a belief in the intertwining of science and the humanities, Noland shaped teaching and learning within the department for more than 40 years.

Though bidding farewell to the old, 19th-century name, the department intends to cherish its long and storied history as the Department of Zoology. Upon the founding of the university in 1849, noted scientist Increase A. Lapham donated many samples of fossils (as well as a list of the "known vertebrates and molluscs of the state") to assemble a zoological teaching collection. In the 1880s, Edward A. Birge was hired as Zoology instructor and "cabinet curator." Birge had to painstakingly rebuild that nat-

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Plants under attack can turn hungry caterpillars into cannibals

A series of experiments shows plants that defend themselves chemically can taste so bad that herbivores like the beet armyworm will eat each other instead.

When does a (typically) vegetarian caterpillar become a cannibalistic caterpillar, even when there is still plenty of plant left to eat?

When the tomato plant it's feeding on makes cannibalism the best option.

"It often starts with one caterpillar biting another one in the rear, which then oozes. And it goes downhill from there," says University of Wisconsin–Madison Integrated Biology Professor John Orrock, author of a new study published July 10 in *Nature Ecology & Evolution* that examines how plants, in defending themselves from insect predation, can encourage insects to become cannibals.

"At the end of the day, somebody gets eaten," he says.

It started when Orrock wondered whether a tomato plant could ever taste so horrible that an herbivore that would typically munch on its green leaves would instead turn to its buddy and begin to consume him or her instead.

"Many insects are known to become cannibalistic when the going gets tough," says Orrock.

So Orrock, his postdoctoral researcher Brian Connolly, and Anthony Kitchen, an undergraduate student in the lab, devised a set of experiments to test their idea using tomato plants and a species of caterpillar called the beet armyworm.

"Beet armyworms are important agricultural pests, in part because they can feed on a variety of plants," Connolly says. "And early, influential work describing plant responses to herbivore attacks used tomato and beet armyworm. We build on that work here."

Unlike animals that can flee from hungry predators, plants are rooted in place. However, plants aren't defenseless. When danger looms, many plants can produce chemicals like methyl jasmonate that act like a chemical scream. Other plants can detect this scream and begin to invest in their own defenses, producing chemicals that deter herbivores, in case they are next on the menu.

To test the effect of plant defenses on herbivore behavior, the researchers sprayed tomato plants in plastic containers with either a control solution or a range of concentrations of methyl jasmonate—low, medium and high—and then added eight caterpillar larvae to each container. They counted the number of caterpillars remaining each day to determine how many had been eaten, and after eight days they weighed how much plant material each treatment group had managed to preserve.

If a tomato plant has made its leaves too nasty-tasting for a caterpillar to eat, the fellow traveler in the background might be next on the menu.

In the control and lower-concentration treatment groups, the caterpillars ate the entire plant before turning to cannibalism, but the plants sprayed with the highest levels of methyl jasmonate stayed mostly intact. Caterpillars living with the well-defended plants became cannibalistic much sooner than their leaf-eating counterparts with access to the less-well-defended plants.

"Not only do these guys become predators, which is a victory for the plant, they are getting a lot of food by eating one another," says Orrock. "We struck upon a way that plants defend themselves that nobody had really appreciated before."

"It's grisly and macabre," Connolly adds, "but it's energy transfer."

In a second experiment Orrock conducted while on sabbatical at Virginia Commonwealth University, he added a single caterpillar larva to containers holding leaves from plants that were not sprayed with methyl jasmonate or containing leaves from plants sprayed with a moderate level of the chemical. To some containers he also added freshly frozen-and-thawed caterpillars that appeared alive. It was important to ensure the flash-frozen caterpillars looked enticing enough to serve as a potential meal for a living caterpillar, but were not actually alive to consume plant material.

Once again, caterpillars with access only to well-defended plant leaves and lifelike dead caterpillars turned to cannibalism sooner than caterpillars for whom less-nasty plant leaves were available, and they ate far less leaf material.

"From the plant's perspective, this is a pretty sweet outcome, turning herbivores on each other," Orrock says. "Cannibals not only benefit the plant by eating herbivores, but cannibals also don't have as much appetite for plant material, presumably because they're already full from eating other caterpillars."

The cannibalistic caterpillars on defended plants grew at similar rates to caterpillars given access to undefended plants, which consumed the plant material available to them before turning to cannibalism. Meanwhile, caterpillars housed with well-defended plants and no fresh caterpillar carcasses ate less plant material and had very low rates of growth.

"The next step in this work is to figure out whether accelerated cannibalism would slow, or increase, the rate of spread of insect pathogens," says Orrock, who says the researchers also hope to better understand whether caterpillars are as quick to turn to cannibalism when they are not trapped with a single plant, as they were in the lab.

Regardless, Orrock says, "the research suggests that we may need to give plants a little more credit. Instead of being wallflowers who sit and wait for life to happen, plants respond to their environment with potent defenses, and these defenses make caterpillars more likely to eat other caterpillars."

Hello, Integrative Biology

(continued from page 3)

ural history collection after it was destroyed in the Science Hall fire of 1884. Many items are still housed within the Zoological Museum in Lowell E. Noland Hall.

It was Zoology professor Birge, along with his biology colleague Chancey Juday, who pioneered the study of freshwater lakes, known as limnology, here at UW–Madison. It's now one of best-known programs in the world, thanks in large part to the long-term research that was begun by Birge and his colleagues on Lake Mendota.

UW's medical school had a large influence on shaping the former Department of Zoology, and vice versa. In fact, Zoology's Dr. William Snow Miller, who researched the anatomy of vertebrates' lungs, is credited with laying the first foundation for a medical school by introducing courses in human anatomy and histology at the close of the nineteenth century.

Today, nearly 2,500 students enroll in the department's introductory biology courses. Another 1,000 students enroll in a variety of courses in the field of biology. Researchers delve into all levels of biological organization (from the molecular level to whole ecosystems and regions) and consider a diverse range of taxa (microbes, plants, animals) and systems (terrestrial, aquatic). They also address a wide array of basic and applied research questions. Some of the research being done in Integrative Biology can shed light on diseases like Alzheimer's, schizophrenia, and Parkinson's, birth defects, how cells repair wounds, and how tissues can regenerate. Other research provides insights into mechanisms of biological evolution, invasive species, the functions of whole ecosystems, and the effects of climate change.

"It's the same department, but hopefully the new name better reflects the way biology—in all its richness—is taught and studied here at UW–Madison," says Hardin.

Faculty & Staff Updates

Riters recognized with Kellett Mid-Career Award

Professor Lauren Riters is one of the UW–Madison Kellett Mid-Career Award winners. The award recognizes outstanding faculty 7–20 years past their first promotion to a tenured position. Lauren directs the Zoology Graduate Program and specializes in teaching endocrinology. She studies the neural mechanisms underlying what motivates and rewards vertebrate social communication in different contexts, with the goal of providing insights into mental health disorders characterized by deficits in communication and social reward.

Hardin selected for WARF Named Professorship

Professor Jeff Hardin has been appointed a Wisconsin Alumni Research Foundation (WARF) named professorship in 2017. The awards are intended to honor faculty who have made major contributions to the advancement of knowledge, primarily through their research endeavors, but also as a result of their teaching and service activities. Jeff Hardin, Raymond E. Keller Professor of Integrative Biology, is chair of the Department of Integrative Biology and Director of Biocore. His research focuses on the genetic regulation of morphogenesis—the changes in cell movements, cell adhesion, and cellular forces that shape embryos during development.

First Wayland Noland Distinguished Chair Awarded

The inaugural Wayland Noland Distinguished Chair in Integrative Biology was awarded to Professor Tony Stretton. Tony has made multiple, significant contributions to the University in terms of research, teaching, and service. His own research focuses on how tiny but abundant bits of protein, called neuropeptides, work in the nervous system to drive behavior. This award was made possible through the generosity of Dr. Wayland E. Noland, Professor Emeritus of Chemistry at the University of Minnesota, and son of Lowell E. Noland.

Steve Carpenter Retires from Center for Limnology

Steve Carpenter, Director of the Center for Limnology and Stephen Alfred Forbes Professor of Zoology, is retiring after 28 years at the University of Wisconsin–Madison. Carpenter is widely recognized as one of the world's most renowned and influential leaders in the fields of limnology and ecosystem science.

His contributions to ecology result from decades spent combining theoretical modeling, long-term studies, and whole-ecosystem experiments to help inform our understanding and management of freshwater resources. His research topics include trophic cascades and their effects on production and nutrient cycling, the dynamics of freshwater fisheries, and resilience of ecosystems and social-ecological systems.

Among many other awards and recognitions, Carpenter is the co-founder and co-editor-in-chief of the scientific journal *Ecosystems*, former President of the Ecological Society of America, a member of the National Academy of Sciences, recipient of the 2011 Stockholm Water Prize, and recipient of the G.E. Hutchinson Medal from the American Society of Limnology and Oceanography.

He looks forward to spending part of his retirement continuing his research on Wisconsin's lakes, as well as getting to spend more time fighting invasive species and restoring native prairie plants on his land in Wisconsin's driftless area west of Madison.

Student Stories

Rachel Mikolas

During spring 2017, Zoology junior Rachel Mikolas studied abroad in Tanzania at the School for Field Studies research camp. While taking classes and learning about the local culture, she participated in field research consisting of dung and grass analyses, environmental policy interviews and mapping techniques, animal counts in national parks and protected areas, and baboon behavior research. As part of her directed research project, Rachel studied elephant demography across multiple national parks including how elephant group size varies throughout different elephant social structures and protected area protection status. "Studying abroad in Tanzania allowed me to learn valuable research skills that aided my academic and personal experience, which highlight my major and will help me throughout graduate school and even my personal life," said Rachel. During her field research, Rachel captured a photo of simba ("lion" in Swahili) napping next to the road in the Ngorongoro crater, where lions have many choices of prey and were frequently seen eating or sleeping.

Lindsi London

Molecular Biology junior Lindsi London has been awarded a 2017–18 Wisconsin Idea Fellowship (WIF), sponsored by the Morgridge Center for Public Service. With guidance from faculty advisor Dolly Ledin, Lindsi's project promotes equity, diversity, and success in science learning among underrepresented teens in the City of Madison. This project has received the Michael Thornton and Nora Medina Social Innovation Award, a special honor made possible by a generous endowment fund for WIF projects targeting the opportunity gap in Madison. "I am excited for the opportunity to provide local teens with personal assistance in Advanced Placement science courses, and I hope to inspire students to pursue higher education."

Jeremy Spool

Long-lived animals have multiple opportunities to breed but rarely succeed in raising offspring 100% of the time. Some animals appear to learn lessons from their recent successes and failures, such as where and when it is optimal to raise offspring. However, we don't know how social behaviors important for reproductive success might also change in light of animals' recent breeding attempts. In collaboration with Dr. Walter Piper of the Loon Project, Zoology PhD student Jeremy Spool had the opportunity to ask whether previous breeding success changed how common loons defended their lake territories, which they need in order to reproduce successfully, from intruders (in this species, intrusions range from harmless to deadly!). Jeremy predicted that loons with previous breeding success would defend their territory with more persistence than loons without previous breeding success. After all, why should a bird risk its life for a territory that may be no good? But instead, he found the opposite result. This raises many new questions, and adds to our knowledge of how wild animals contend with success or failure in their attempts to raise offspring. Jeremy's research was possible thanks to generous contributions from John and Virginia Emlen Fund as well as Lowell E. and Ruth Chase Noland Memorial Fund.

SUPPORT INTEGRATIVE BIOLOGY

The generosity of our donors allows the Department of Integrative Biology to help our students, faculty, and staff reach their full potential. Please consider making a gift to the Integrative Biology Department Fund (#132860093) through the UW Foundation.

allwaysforward.org/giveto/integrativebiology

Check donations can be made out to the University of Wisconsin Foundation. Please include the fund number on the check.

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EXTINCT SPECIES AT UW ZOOLOGICAL MUSEUM

The thylacine (*Thylacinus cynocephalus*), aka Tasmanian tiger or Tasmanian wolf, is one of the several extinct species in the UW Zoological Museum collection. Although the skull of thethylacine closely resembles a wolf-like canid, it is actually a carnivorous marsupial. The last known thylacine, "Benjamin," died in Hobart Zoo, Tasmania, on September 7, 1936. Despite reported sightings, no specimen of this species has been found after this date. Image by Nazan Gillie.