Many amphibian species, such as frog and salamander species, are in trouble. Recent estimates place the percentage of threatened species worldwide at between 33 and 50 percent. These figures are staggering and indeed much has been written on the amphibian extinction crisis. There are some selfish reasons why losing so many species matter to us humans. For example, amphibian skin secretions of some species contain potent anti-HIV chemicals. Amphibians can control insect species in some areas and are generally important members of the food web. When frogs die out, tadpoles are not present to control algae in streams and ponds, altering the ecosystem.

Yet, even if we were content to live with 50 percent fewer amphibian species, we might want to consider what such a massive loss is telling us about the condition of the environment in which we all live.

My laboratory in the Department of biology is focusing on a perplexing problem in wildlife ecology: why are species of frogs and salamanders disappearing in seemingly pristine areas around the world? Amphibian species, like many other species, are imperiled by habitat destruction and fragmentation. However, in the western United States, Central and South America, and Australia, amphibians are dying in areas that seem untouched by habitat destruction, such as national parks and forests.

One agent of mortality is a lethal skin fungus, *Batrachochytrium dendrobatidis*, which only attacks amphibians, and attacks many amphibian species. For example, this pathogen has caused losses of up to 70 percent of amphibian species in Panama. Perhaps no other pathogen in history has caused so much mortality to so many species. The fungus has a swimming spore stage that spreads the pathogen from one individual to the next. In Panama, the western United States, and perhaps other areas, the pathogen spreads in a wave-like fashion from one population to the next.

Why this disease is emerging now is not fully understood, but recent evidence from Costa Rica links climate change to disease outbreaks. Importantly, not all species, populations or individuals are susceptible to the pathogen. This observation allows us to study the causes of variation in susceptibility.

Amphibians have chemical defenses, such as antimicrobial peptides, that can kill the fungal pathogen. These are the same chemicals that can kill the virus that...
Dr. Alex Bannigan is teaching Organisms and a course on genetics and society. She earned her B.A. in biology from JMU in 1998. Cresawn has studied the basic biology of kidney cancer cells, and how new kidney cell proteins are directed to their final destination at the cell membrane using both recombinant and biochem- ical techniques. Cresawn also has strong interest in genetics and genetic technol- ogy. He is a leader in the study of capybaras, and sex-biased sex-determination in mammals. He has studied the alert and alarm signals, and the sex hormone testosterone in various species in the tropics. Cresawn has added a G.I.S. requirement for the student who wishes to enter one of the environmental science programs at JMU. Students who are interested in these programs are very important in the fields of conservation biology, natural history and the study of rare species (for example, nitrate, phosphorus). The models will then use these met- erials to predict which watersheds will have high levels of nutrient pollution. Based on this model, we can then try to deter- mine which factors are the most important in determining whether a watershed is polluted.

Dr. María Caro was born in Bolívar in Venezuela, and her Ph.D. in biology from Universidad Simón Bolívar in Caracas. She received her B.S. in biology from Universidad Simón Bolívar in Venezuela, and her Ph.D. in biology from Purdue University. She worked as visiting professor at Pennsylvania State University in Farm- ington, Va., before coming to JMU. She has studied the alert and alarm system of capybaras, and sex-biased sex-determination in various species in the tropics. Cresawn has added a G.I.S. requirement for the student who wishes to enter one of the environmental science programs at JMU. Students who are interested in these programs are very important in the fields of conservation biology, natural history and the study of rare species.

From the department head

GREETINGS to you all! As the recently appointed interim head of biology, I want to take this opportunity to tell you a little about myself. I came to JMU from William Jewell College in October 2004 as associate dean of the College of Science and Mathematics. I am a geneticist/microbiologist and had been at Jewell for 29 years. At JMU, I saw a vibrant faculty community in the sciences focused on student learning, having the same values as the small liberal arts college where I worked. I am serving as chair of biol- ogy for 18 years.

I have not been disappointed — the commitment to student learn- ing, to the sciences for majors and nonmajors, and to undergraduate research is strong at JMU and the Department of Biology exemplifies those commitments. The faculty work hard to create an environment that supports and enhances student learning. They provide an excellent education for majors and nonmajors, and a number of opportunities and support for undergraduate research.

They also are involved in the sort of peer-reviewed work that is impor- tant for maintaining an excellent biology department. In addition to publica- tions in peer-reviewed jour- nals, they have received grants to support their research and teach- ing, and from the National Science Foundation for a confci- ential microscope and for a summer undergraduate research program. The department is also involved in a successful NSF biometar- inst proposal, which supports under- graduate research and curriculum innovation. The university, in large part because of the good work of the sciences faculty, was asked by the Howard Hughes Medical Institute to submit a proposal for funding to support any of all of the follow- ing: student research, broader access to science, faculty development, curriculum, equipment, labora- tory development, and precollege and outreach. The proposal writing is directed by a biology facu- member with several mem- bers of the department on the core team. The 226 institutions invited by HHMI were chosen because they excel in preparing students for careers in science and medicine. I am happy to announce that this effort will understand the excitement and commitment that I can both see and feel.

I hope that you will find the opportunity to come and visit at Homecoming, Oct. 22–27, or any other time — we’d love to see you. You can also visit us at our Web site, http://www.jmu.edu/biology. — Judith Dilis, interim head

New faces in biology

Dr. Alex Bannigan is teaching Organisms and a course on genetics and society. He is a Nikon confessed micro- scopist. Bannigan studies symbi- ont, mitosis and cell-to-cell communica- tion in plant cells, and has been using confocal microscopy in her research for over 10 years. She earned a B.S. and Ph.D. at the University of Sydney, Australia, where she also worked as an associate lecturer briefly before coming to the United States to do a three-year postdoc at the University of Pittsburgh. She is returning to JMU following his post-doctoral work in micro- biology and Molecular lab and a Scientific Perspectives course on genetics and society.

Dr. Lisa Rilfa is an animal ecologist and geneti- cist, comes to JMU from the University of Flor- ida where she most recently studied the basic biology of kidney cancer cells, and how new kidney cell proteins are directed to their final destination at the cell membrane using both recombinant and biochem- ical techniques. Cresawn also has strong interest in genetics and genetic technol- ogy. He is a leader in the study of capybaras, and sex-biased sex-determination in mammals. He has studied the alert and alarm signals, and the sex hormone testosterone in various species in the tropics. Cresawn has added a G.I.S. requirement for the student who wishes to enter one of the environmental science programs at JMU. Students who are interested in these programs are very important in the fields of conservation biology, natural history and the study of rare species.

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Environmental biologist Dr. Bruce Wiggins began teaching two new biology courses in 2006: “Environmental Toxicology” and “Biological Applications of GIS (Geographic Information Sys- tems).” Along with the change in focus of his research focus to using GIS to analyze landscape variables that affect eutrophication, the increase in chemical nutrients in an ecosystem resulting in excess- plant growth, which inter- feres with the health and diversity of fish, plant and animal popula- tions. The Living Connection recently interviewed Dr. Wiggins to learn more about his research, what prompted the changes, and where he envisions it taking him.

LC: Most of our alumni who know you probably remember that you were a microbiologist who worked on bacte- ria in human and animal wastes. Using GIS to analyze landscape vari- ables, how will you depart from a previous career? Why change?

BW: Well, in some ways it is a big change, but in other ways it is a nat- ural extension. There is some overlap in water quality and in reducing water pollution. I have always tried to focus my research on practical meth- ods that can be used to reduce pollution from streams. I started out as a microbiol- ogist and developed a methodology for tracking the sources of fecal pollution from streams. This was an important tool in helping to deter- mine what steps to take to pre- vent the pollution in the first place. Gradually, though, I became more interested in the larger picture, in examining the effect of factors in the landscape on water quality. LC: Can you describe the model? How does it work, and what can it do?

BW: I plan to try several types of models, including discriminate func- tion analysis and classification tree methods. The input to these models will be the watershed metrics, such as vegetation cover around streams, the amount of impervious (paved) surface in a watershed, the amount and type of agriculture present, etc. The models will then be used to predict which watershed levels (for example, nitrate, phos- phorus, ammoni- a) will be found in a given stream. The results will be very complete — the actual measured pollution levels.

LC: What will you do with your model? Who might be able to use it?

BW: The model that does the best job will then be used to ana- lyze other water- sheds and to pre- dict whether (and how much) they are polluted. The model will also be able to determine which of the metrics are the most important in determining the pollution levels and this could be useful to state and local regulatory officials and to con- servation and land use planners.

LC: You are also teaching two new courses. What are they about?

BW: The environmental toxicology course covers the biological effects of a wide range of pollutants, from acid rain to global warming to pesticides and environmental estrogens. A major emphasis of the course is on data analy- sis. Because of the complexity of eco- logical systems, there is a great deal of variability in the environmental effects of most pollutants, and thus statistical analyses are necessary to determine the extent of the effect. The GIS course is an introduction to geographic information sys- tems with a focus on using GIS to answer biological questions. GIS is an extremely powerful tool that is increasingly being used by ecolog- ists, environmental biologists and natural resource managers. Expe- rience in GIS is essential for any student who wishes to enter one of these fields, which is why we have added a GIS requirement for the department’s new concentration in environmental science.

BW: We created the concentration in ecology and environmental biology for several reasons. First, it is an advis- ing guide for students to let them know about geography, G.I.S and remote sen- sor experience in G.I.S is essential for any student who wishes to enter one of these fields, which is why we have added a GIS requirement for the department’s new concentration in ecology and environmental biology.

LC: Why start a new concentration?

BW: The models that does the best job will then be used to ana- lyze other water- sheds and to pre- dict whether (and how much) they are polluted. The model will also be able to determine which of the metrics are the most important in determining the pollution levels and this could be useful to state and local regulatory officials and to con- servation and land use planners.

LC: What are your future interests?

BW: I will use GIS to develop a set of landscape metrics for the water- sheds in the Shenandoah River basin. For the most part, these metrics will be created from exist- ing geographic data, such as digital elevation models, satellite images, hydrographic data and others. I will also use the extensive database of water quality parameters that have been collected by the Friends of the Shenandoah River over the last 10 years. My goal is to create a model that will simulate the various landscape metrics to predict which watersheds will have high levels of nutrient pollution. Based on this model, we can then try to deter- mine which factors are the most important in determining whether a watershed is polluted.
causes AIDS and that show promise as pain-relief drugs for humans. Research by Dr. Doug Wood at Vanderbilt University, and now at JMU in my laboratory, has shown that amphibian species that co-exist with the fungal pathogen have different chemical secretions from those species that decline or go extinct once the pathogen arrives in their location. The chemical secretions of the persisting species show strong antifungal activity in laboratory assays. In addition to helping to explain why species do not go extinct when faced with this lethal fungal pathogen, many new antimicrobial chemicals have been discovered, some of which may be useful in human medicine. The amphibians' defensive secretions are important, but they may not be the whole story.

Plants and animals, including humans, harbor a vast diversity and quantity of bacteria. Within and between our bodies, we are outnumbered by bacterial cells 10 to 1. It is increasingly recognized that these bacteria play an often beneficial role in maintaining health. For example, bacteria in our digestive tracts are helpful in digestion and in preventing pathogenic bacteria from successfully colonizing or multiplying to high numbers. It turns out that amphibians may also host a diverse group of bacteria, many of which cannot even be cultured by current techniques. When a fungal pathogen arrives on an amphibian, it does not find a "blank slate" of skin. Rather, the pathogen has to compete with existing skin bacteria of the species that does not succumb to the pathogen. In fact, we found that when we exposed species of skin bacteria to the fungal pathogen, we obtained results that suggest that the addition of beneficial bacteria may prevent death from the fungal pathogen. However, our main interest was in comparing individuals exposed to the pathogen with individuals inoculated with beneficial bacteria before being exposed to the pathogen. We found that we were successful in getting the beneficial bacteria to colonize the skin, at least in the short term. We also found that this common salamander species did not die when exposed to the pathogen, indicating that it is one of the species that does not succumb to the fungus. However, we found that when individuals exposed to the pathogen died, loss of 30 percent of their body mass over a month-and-a-half, which is a symptom of the fungal disease. Those individuals inoculated first with beneficial bacteria before exposure to the fungus lost much less weight, which means that the bacteria helped to prevent a symptom of the disease. This result is the first indication that we might be able to manage the disease, although certainly much more testing is necessary before field trials are conducted. Given the encouraging results from this experiment, we are soon going to repeat the experiment with the mountain yellow-legged frog from the high Sierra Nevada Mountains in California. This species can be strongly affected by the disease and does die from the disease in laboratory trials. If we obtain results that suggest that the addition of beneficial bacteria prevents death from the fungal pathogen, then field trials would be a logical next step. The fungal pathogen in California moves in predictable directions, so we might be able to inoculate the frogs in the path of the disease and halt it. The beneficial bacteria already occur on the skins of some individuals in the populations, so we would not be adding new species to the ecosystem. Government officials would have the final say on how and when to proceed. We are cautiously optimistic that our ecological study of the interaction between skin bacteria of amphibians and their lethal fungal skin pathogens will give us a workable tool to manage and halt this horrible epidemic.

The Cow Knob salamander, Plethodon punctatus (above), is native to Augusta, Rockingham and Shenandoah counties of Virginia that surmount the campus of JMU.
Mark Dertouzos (’82), mark.dertouzos@army.mil, is the chief of business plan and programs at the U.S. Army Medical Research Institute of Infectious Disease. He is responsible for planning and management of the institute’s $95 million research program including strategic planning, program and portfolio management, business development, and financial transfer. Dertouzos serves as the institute’s chair of organizational transformation, and he is also secretary of the USAMRIID’s board of management and information technology governance committees. Before taking his current position he served in various capacities for USAMRIID on projects to develop vaccines, therapeutics, and diagnostics for infectious diseases including plague and anthrax. (posted 9/15/06)

Aimee Kearns (’93), akearns@acsol.com, is an attorney with the firm Higgs, Fletcher & Mack in San Diego. “After graduating from JMU, I moved out to San Diego and worked a bit in a few labs,” says Kearns. “I completed a master’s in public health, health services administration in 1998. That same year, I moved to Chapel Hill, N.C. to work on my Ph.D. in health policy and administration. I ended up completing my coursework and taking a long break before working on my dissertation in order to get closer to home. I graduated from University of North Carolina-Chapel Hill School of Law in 2003.” (posted 12/12/06)

JAMES MADISON UNIVERSITY

Career tracks

Current biology students are encouraged to use the alumni news section of the Department of Biology’s website, www.jmu.edu/biology/, to see what our alumni have done with their JMU degrees.

During the past year, we received the following news from our alumni about their current endeavors. If you don’t see your name or would like to update, please complete the Web submission form and stay in touch!

Karen Avery Geertsz (’80), director of development

Discussion on Endowments and Scholarships

Endowed gifts provide for the JMU gift program.

Endowed gifts are gifts to JMU because they give in perpetuity. Endowments that fund scholarships can be merit or need based. Most scholarships endow the university to recruit and retain students of the highest academic caliber. Deserving students who qualify for scholarships and need financial assistance to attend college due to financial constraints are helped through need-based scholarships, which help cover the cost of tuition.

While JMU’s endowed gifts primarily fund the student scholarship programs, endowed gifts also support faculty. During their careers, professors often face challenges in the areas of faculty recruitment and retention. Faculty. During their careers, professors often face challenges in the areas of faculty recruitment and retention. While JMU’s endowment gifts provide support for scholarships and attracting and retaining both top students and faculty members, endowed funds can be structured to provide support for scholarships and attracting and retaining both top students and faculty members.

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Please consider making a gift to JMU. Your gift enhances support for scholarships and attracts and retains both top students and faculty members.

Prefer: Mr. Mrs. Miss Dr. Other Name

Signature

Endowed gifts can be structured over a period of five years or so, with an amount, for example, $5,000, can be given each year until the endowment level is reached. Support is needed at all levels, so any gift is greatly appreciated.

Contact Gunther by calling (540) 568-6605 or e-mailing her gift card information to help expand these programs when state appropriations are simply unavailable. And, a donor’s gift can be enhanced significantly with employer match programs where applicable. Endowed gifts can be structured over a period of five years or so, with an amount, for example, $5,000, can be given each year until the endowment level is reached. Support is needed at all levels, so any gift is greatly appreciated.

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Dr. Louise Wilkins-Haug (’76)
Division Director for Maternal Fetal Medicine
Brigham and Women’s Hospital

DR. LOUISE WILKINS-HAUG performs some of medicine’s most complex surgeries — operating in utero to correct abnormalities of the fetus or to prolong the development of the fetus prior to delivery. As the medical director of the Center for Fetal Medicine and Prenatal Genetics at Brigham and Women’s Hospital in Boston, she boasts one of the most preeminent medical careers in her field. She is the director of maternal fetal medicine, a high-risk obstetrician and a faculty member associated with Harvard Medical School. Over the past 13 years, she has done extensive work on placental genetics and has been involved in groundbreaking fetal surgeries, providing hope for unborn infants whose medical conditions would, without intervention, lead to irreversible, fatal damage. She was listed in Boston magazine as one of the top 100 doctors in Boston — an area that has one of the highest concentrations of highly skilled doctors, as well as the acclaimed Mayo Clinic.

I appreciate how much Madison has developed in the past 30 years. I’m very impressed by the expansion and diversity of biology and other sciences at JMU, particularly the research areas being undertaken by faculty and students in biology.

–Dr. Louise Wilkins-Haug