Missing link in species conservation: Pharmacists, chemists could turn tide on plant, animal extinction

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`Akikiki or Kaua`i Creeper (Oreomystis bairdi), a Hawaiian honeycreeper.
Credit: Carter Atkinson, USGS, Public domain, via Wikimedia Commons

As the world faces the loss of a staggering number of species of animals

and plants to endangerment and extinction, one University of Michigan scientist has an urgent message: Chemists and pharmacists should be key players in species conservation efforts.

"Medicinal chemistry expertise is desperately needed on the frontlines of extinction," said Timothy Cernak, assistant professor of medicinal chemistry at the U-M College of Pharmacy. "Animals are dying at staggering rates, but they don't have to. Modern bioscience has achieved enormous breakthroughs in treating disease in humans, and the same medications, and the science behind them, can be applied in the wild."

Local and global efforts to reduce environmental damage are underway, but they are too slow to save the many ailing populations in the wild, he said.

"We are in the middle of a mass extinction. We are chasing mass die-offs around the world. Lowland gorillas, Argentinian penguins, the akikiki bird in Hawaii, loggerhead turtles in Florida. The list goes on, and many precious plants are also hanging by a thread," he said. "So it's critical to bring the power of modern pharmaceuticals and the dosing expertise of medicinal chemistry into conservation efforts."

Cernak and a team of young scientists, including a local high school student, make the case for establishing and nurturing the emerging field of conservation medicine in a research article published in the *Journal of Medicinal Chemistry.*

"It's hard-core science. It's bringing the lens of medicinal chemistry and modern pharmaceuticals into the conversation to save other species," Cernak said. "Drivers of the current mass extinction include habitat loss, global warming and overharvesting, but one specific root cause—wildlife disease—seems ripe for intervention. Medicinal

chemistry is that intervention."

Cernak, in one of many roles and research projects, receives samples of dead and ailing species from around the world. Using the same methods and models used to find compounds that work against human disease, his lab at U-M, which recently brought a veterinarian on board, tests chemical compounds on samples to see which ones respond to disease-causing organisms. A major focus is fungus, the single-largest killer of amphibians.

In their paper, the authors propose a new role for chemistry and pharmacy on the frontlines of preventing extinction. "A long-term solution to mass extinction is to fix climate change and habitat loss using new technologies and new policies. As a bandage for the short term, chemistry in service of endangered species is needed.

"Medicinal chemists interested in preventing extinction are encouraged to talk to zookeepers, foresters, veterinarians, entomologists, wildlife rehabilitators and conservationists to learn about the challenges and solutions where conservation medicine could make an impact, and to share their wisdom from the frontlines of drug discovery."

Cernak is pushing for a new, impactful field of science.

"At the higher level, my mission is to have pharmaceutical companies be involved in this space and young scientists view this as the field they want to go into—a field that doesn't really exist at this point," he said. "A more immediate goal is fundraising and more research as the field and the value of the field is established."

From deadly fungus decimating Panamanian golden frogs, cancerous tumors killing loggerhead turtles and the numerous pests and illnesses sickening plants such as the hemlock tree, there is no shortage of

challenges for conservation medicine to tackle.

One of those challenges may be preventing a disease from threatening public health.

"In January, 96% of sea lion pups in Argentina died in January from avian flu. If it reaches humans, what are we going to do?" Cernak said. "There may be just five akikiki songbirds left in the wild. They are dying from malaria and pox, diseases that can be treated in humans."

Studying wildlife diseases could also provide critical insights to medicinal chemists focused on human health, he said, and possibly a new paradigm where drug development and dosing prediction models, which are currently trained heavily on pharmacokinetics in rodents, could be diversified.

"The problem is that too often, conservationists who are trying desperately to treat and save dwindling populations aren't equipped with the latest pharmaceutical science and tools," he said. "Given current knowledge gaps, they may not know which drug will work best or what the right dosage might be for an endangered species."

Bringing chemists and pharmacists into the conservation fold isn't meant to diminish veterinarians and conservation groups, but to blend their experience and expertise and achieve the same goals of saving lives—and the ecosystem, Cernak said.

"Modern medicine could prevent the extinction of endangered species. Wildlife disease is a major driver of the current mass extinction yet therapeutic intervention in nonhuman species remains poorly understood," he said. "In zoos, botanical gardens and animal rehabilitation centers, many diseases are treatable, but the understanding of medicine for endangered species lags far behind our current

understanding of human medicine."

At this moment, Cernak's lab is not only researching faster, safer pharmaceutical development for humans but also testing the Panamanian golden frogs afflicted with a fungus that threatens their existence.

Cernak supports the Centers for Disease Control and Prevention's concept of One Health, which recognizes the connection between the health of people, animals and the environment.

"We look at plants and animals the same," he said. "The concept of One Health Pharmacy—plants, humans and animals—is we treat any that are sick or in need."

Cernak's lab has advanced the use of artificial intelligence and other technology in speeding up the process of drug discovery. He said that only increases the opportunities to help animals and plants sooner than later.

"Streamlining drug and agrochemical discovery with automation and artificial intelligence is likely to usher in a future era of accelerated medicinal invention tailored to specific patient populations," Cernak and team wrote in their paper.

"While it may still be decades away, one can imagine a future where it is possible to feed a chatbot prompts like, 'Invent a single-dose antiviral for elephant endotheliotropic herpesvirus with optimal pharmacokinetic properties for Asian elephants.' Exciting applications of medicinal chemistry on threatened and endangered species are beginning to offer hope."

More information: Tesko Chaganti et al, Medicinal Chemistry Gone Wild, *Journal of Medicinal Chemistry* (2024). DOI: 10.1021/acs.jmedchem.3c02334

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