

Narrative

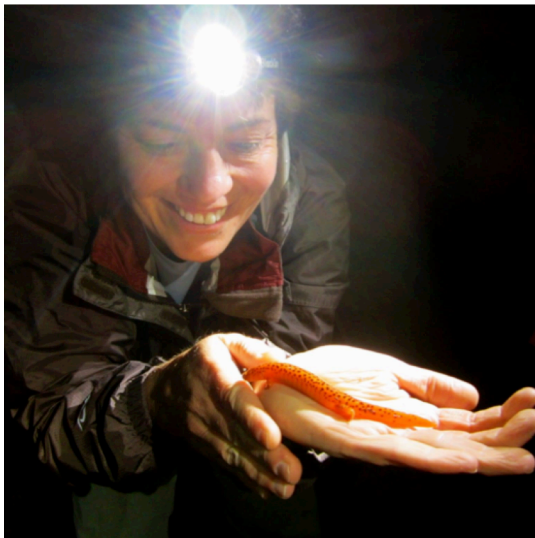
Stopping a Wildlife Disease from Becoming a Crisis A Collaborative Leadership Success Story

Part I: The Crash

“Fortuna, Panama. Friday 10 January 1997 – We ran a transect on Quebrada Chorro and netted a bunch of tadpoles. The surprising thing was that we heard no Colostethus calling, although the habitat looks excellent, and saw no frogs. Next we ran a transect on Quebrada Arena and found a bunch more dead frogs (27 total now), but also a bunch of live ones. We even found two dying Rana tadpoles, one with a bloody lesion. It looks really bad for Fortuna.”

Karen Lips paused as she wrote these words in her journal. She thought back to April 1993 and the field work in southern Costa Rica that had inspired her journey to Fortuna. Still a graduate student then, she had returned to her field site after winter break to find that nearly all the amphibians, including the frog species she was studying, had mysteriously disappeared. Not to be deterred from her life’s dream of advancing knowledge about the animals she loved, she had quickly turned her attention to finding a new field site. She chose Fortuna because it shared the key characteristics of her former site in Costa Rica. The moist, verdant cloud forest supported an almost unimaginable diversity of life, including a wide range of amphibian species. The human population was sparse and produced few impacts. Now, the silence and emptiness added a new, eerie dimension of similarity between the two places.

But her observations from the day taking measurements on Quebrada Chorro and Quebrada Arena were not the primary thing on her mind. Instead, her thoughts turned to the many talks she had heard and journal articles she had read in recent years on sudden declines of amphibian populations in Central America, Australia, and the western United States. One of the casualties that had deeply affected her was the Golden toad. Her adviser, Jay Savage, had discovered the small, brilliantly colored species in 1964 in the cloud forest north of the city of Monteverde, Costa Rica. Abundant in the 4-square-kilometer area that was its range, the toad was the subject of many studies over the course of more than two decades. Then, without warning, researchers reported a sharp decline of the population in 1987. By 1989 there were no Golden toads left: the last known sighting, of a lone male, was recorded in May.



Karen Lips

Between the late 1980s and Karen’s trip to Fortuna, researchers had been reporting similar declines of other amphibian species around the world. What made the situation puzzling was that abnormally large numbers of amphibians were disappearing from protected areas – areas removed from known stressors, such as habitat destruction and pollution. This was a theme first articulated during the First World Congress of Herpetology in Canterbury, England, in 1989. Initially, some scientists suggested that the disappearances were merely natural fluctuations in population. Others objected that the historical data were too slim to support any firm conclusion about population trends. However, the conference generated enough concern to capture the attention of the National Research Council, which convened a workshop in 1990 to explore the issue further. After a systematic review of new data, the workshop participants concluded that there were too many reports too widely distributed for the declines to be coincidence. There was something larger going on.

Nonetheless, in 1997 scientists remained mystified as to what that something might be. A host of theories had emerged, ranging from known threats (habitat fragmentation, pollution, pesticides, the introduction of new predators) to climate change, ultraviolet exposure, and disease, or perhaps some combination. Meanwhile, amphibians continued to disappear at an astonishing rate.

Karen had come to Fortuna, a forest reserve, in search of abundant amphibian communities for research. It was an easily accessible, protected site just east of her former site in Costa Rica. The many carcasses and dying frogs she saw prompted a bittersweet observation. *Here I am, watching frogs die before my very eyes,*

she thought. *Exactly the right place, at the right moment, to collect evidence that will help identify whatever is causing this.*

In the months that followed, a group of researchers including Karen, based at several universities, zoos, and wildlife agencies in Australia, Canada, the U.K., and the U.S., discovered that frogs collected in rainforests in Queensland and Panama and at the National Zoo in Washington, D.C. had died of the same fungal infection of their skin. In 1998 the group published a paper that identified the infection as the cause of global amphibian population declines. Known as chytridiomycosis, it was caused by the fungus *Batrachochytrium dendrobatidis*, or *Bd*. As the scientific community discussed and vetted these results, the next phase of work seemed obvious. The race was on to learn how *Bd* was spread and how to stop it.

This goal proved elusive. In many areas known for amphibian biodiversity, there were few historical records about weather, land use, and the distributions of species to help scientists figure out how to track and forestall the spread. As they scrambled to learn how to predict where the disease would strike next, frogs continued to die. In September 2005 representatives from organizations concerned about amphibian declines, including the International Union for Conservation of Nature (IUCN), the Declining Amphibian Task Force, the Species Survival Commission, and Conservation International, held the Amphibian Conservation Summit to map out a plan of action. They issued a declaration that it was “morally irresponsible to document amphibian declines and extinctions without also designing and promoting a response to this global crisis.”¹ The outcome was the Amphibian Conservation Action Plan, published in 2006. It laid out an ambitious agenda for researching and conserving amphibians. However, because it focused on science alone and had no policy component, it lacked a call to action to galvanize broad support. Recognizing that there were no other means to prevent mass extinction, a small group of scientists including Joe Mendelson, who was a colleague of Karen’s and the curator of herpetology at Zoo Atlanta, undertook emergency airlifts of frogs to museums and zoos.² Time was running out for the world’s amphibians, and there was no clear path forward for saving them in the wild.

Part 2: How Do You Do Policy?

In 2008 Karen accepted a faculty position in the biology department at the University of Maryland. Location alone made it an easy decision: the campus lay a few hours’ drive from the Appalachian Mountains, a hotspot of amphibian biodiversity. From her base there, Karen would have a unique opportunity to advance understanding of how *Bd* spread and what factors made species more or less susceptible to infection. Another draw was the opportunity to shape an innovative, interdisciplinary graduate program called the Program in Sustainable Development and Conservation Biology, known on campus as the “CONS program.”³ It existed to prepare students in policy, biology, and economics to work with policy-makers and government officials. Since her Leopold training, Karen had remained deeply committed to helping other scientists share their research beyond academe. The University of Maryland was seeking to update the CONS program and had asked Karen to be the new director. Karen looked forward to this role and hoped to incorporate elements of the Leopold Leadership Program in the revised curriculum.⁴

In the months after her move in January 2009, Karen dived into research of woodland salamanders, one of the most species-rich and ecologically important amphibian groups in Appalachia. She quickly launched a project to look for evidence of disease and population declines. As she settled in, she could not help thinking how different her new situation was from what she was used to in Central America. For more than a decade, she had had scant historical records about weather, land use, and the distributions of species to inform her work on the *Bd* epidemic in frogs. By contrast, in Appalachia she had a wealth of data from generations of ecologists and collectors to draw on. She could now ask different kinds of research questions than had been possible before. By 2012 she and her colleagues confirmed that many species of salamanders had declined across the Appalachian Mountains, that losses were not specific to particular species or areas, and that while *Bd* was present, it was not very common. Their findings contained some very good news: many populations were still large, and no species were lost. In addition, fewer than 1% of salamanders were infected with *Bd*, suggesting that the salamanders might be evolving and developing defenses to coexist with the fungus.

A New Beginning for Policy

There was also reason for optimism on the policy front. Now living inside the D.C. beltway, Karen was in regular touch with friends and colleagues working for federal agencies and professional societies concerned about the spread of *Bd*.⁵ She was often asked to give presentations and participate in panel discussions on a range of topics related to her research.⁶ At one of these events, she met Peter Jenkins, the director of international programs for the conservation organization Defenders of Wildlife.⁷ A veteran of policy work in Washington, Peter was an expert in environmental law and knew the complex network of congressional and agency staff responsible for executing policy.⁸ He was familiar with the gaps in federal regulation of animal imports, a known source of wildlife diseases: he had just completed a groundbreaking report on this topic, “Broken

Screens: The Regulation of Live Animal Imports in the United States,” for the Defenders of Wildlife, the Consortium for Conservation Medicine (CCM), and the IUCN Invasive Species Specialist Group. The report described the enormous size of the animal import trade to the U.S.; the patchwork of regulation by three agencies (the Departments of Interior, Agriculture, and Health and Human Services); the environmental and health risks posed by hundreds of nonnative species; and recommendations for reforms. It gave *Bd* as an example of a disease that wrought havoc in the absence of comprehensive risk analysis.⁹ As they got into conversation, Peter and Karen discovered shared interests in the role of the animal trade in the spread of wildlife disease.¹⁰



Peter Jenkins

In 2009 Peter called Karen to ask if she would review and consult on a petition he was writing. Peter Daszak, the CEO of CCM and an expert on impacts of emerging diseases, had convinced him of the need to do something about the amphibian trade in response to *Bd*. Peter Jenkins was drafting a petition from the Defenders of Wildlife to submit to the secretary of the Interior and the secretary of Agriculture. The petition asked the secretaries, under their respective authorities, to prohibit importation of all amphibians into the U.S. unless they were certified to be free of *Bd*¹¹. For the U.S. Fish and Wildlife Service (USFWS), an agency within the Department of the Interior, that authority existed under the Lacey Act, the only major federal law on wildlife importation. Peter knew that Lacey Act listings were intended for wild animals and did not include the authority to list pathogens as injurious. He requested that USFWS list the amphibian hosts of the pathogen, because the pathogen makes the host amphibians injurious. In doing so, Peter asked that USFWS adopt a new international standard, developed and adopted by the World Organization for Animal Health in 2008, for handling imported wildlife and certifying their health. Veterinary experts from the U.S. Department of Agriculture had helped craft the standard¹². It contained provisions for pathogens, specifically *Bd*, that could provide scientific guidance to USFWS for preparing a regulation more quickly. In a world of rapid global travel, anything that could hasten a listing under the Lacey Act could make a difference in saving animals' lives. As it stands, the listing process can take several years and is often the only mechanism available for stopping the spread of wildlife invasions and diseases.

In addition to Karen, Peter reached out to a scientist at the U.S. Forest Service and Joe Mendelson, the director of herpetological research at Zoo Atlanta, to review the petition for scientific integrity.¹³ In the weeks that followed, Karen wrote an op-ed for the *Baltimore Sun* that ran in September, just as the Defenders of Wildlife submitted the petition. Her op-ed called for a strong federal conservation policy to protect amphibians, which were under threat and played important roles in regulating ecosystems and benefitting people in ways that were just being discovered.¹⁴ Seeing the op-ed in print and the petition submitted brought Karen a sense of satisfaction, even relief. Having a concrete proposal on the table seemed almost too good to be true.

Lessons for the Classroom from the Policy Front

Karen's experiences with *Bd* influenced her in updating the CONS program during her first years in Maryland. As she thought about the future of the program, Karen realized that teaching students to communicate their science, as she had learned to do as a Leopold fellow, was only a first step: they also needed tools and practice for working with people in other disciplines and sectors. It was not only master's students in biology clamoring for this kind of training. She heard from professors at the Robert H. Smith School of Business that MBA students wanted a deeper understanding of scientific data needed to evaluate proposals for ecotourism, life-cycle analyses of electronics, private-public partnerships for land protection, and other sustainable business enterprises.¹⁵

Taking these factors into account, Karen focused on updating CONS 680, the existing semester-long problem-solving course, which she renamed the “Multidisciplinary Environmental Sustainability Problem-Solving Course.” It paired teams of four to six students from the master's program in biology (and sometimes the MBA program) with a real-world client to address a sustainability challenge. The client posed a question related to an aspect of the business that required expert analysis of scientific, economic, marketing, or other data, which the students worked through together.

The course drew an A-list of clients, including PricewaterhouseCoopers, the International Finance Corporation, the Maryland Department of Agriculture, The Nature Conservancy, and the U.S. Fish and Wildlife Service Refuge System. Clients valued the high quality of the students' work and the outside-the-box approaches that the interdisciplinary teams devised. For their part, the students gained insights from working with others who had very different skill sets, values, and perspectives. In 2009 CONS 680 students in the biology master's

program helped Peter Jenkins with questions about the science of *Bd* as he wrote the petition for the Defenders of Wildlife.

Doing Policy: A Federal Agency Takes on a Novel Proposal

The staff person who received the Defenders of Wildlife petition at USFWS was Susan “Su” Jewell, the injurious wildlife listing coordinator. Having worked for a number of years on endangered species listings at USFWS, Su had seen many petitions, and she was immediately impressed by this one. Peter’s argument – that a health certification system was needed for imported amphibians – was well-written and clearly reasoned. It cited as its model a USFWS regulation on salmonid fish from the 1960s. At the time, several pathogens carried by imported salmonids threatened fish stocks in the U.S. To prevent the spread of disease, USFWS listed imported salmonids as injurious wildlife unless they were accompanied by a health certificate verifying that they were free of certain pathogens. The action, taken under the authority of the Lacey Act, had been effective in protecting salmonid fisheries in the U.S.

Wow, Peter Jenkins has done a lot of the work, Su thought to herself as she began outlining steps for drafting a rule on amphibians as injurious wildlife. But she quickly realized that it would be no simple task to craft a regulation that would meet all the necessary administrative requirements. From USFWS’s standpoint, a major obstacle was that *Bd* was already widespread in the U.S. For the agency, this fact meant that a listing, which prohibits importation and interstate transport of designated wildlife (but not pathogens), had limited value: new strains might be stopped from coming in on amphibians, but it was unclear how much benefit such an action would generate, given the extensive harm already done by *Bd*. Another problem was that many countries that exported amphibians to the U.S. lacked reliable, well-documented animal health certification procedures. This was not the case for imported salmonids in the 1960s. They came primarily from such countries as Canada and Norway with reliable certification procedures. Moreover, in the *Bd* petition the Defenders of Wildlife were asking that *all* amphibians be listed as injurious. This promised to be a difficult task, given that many species are native to the U.S. and part of the national economy. Finally, to make such a regulation, USFWS would have to know, or be reasonably sure, that all 7,500 known species could carry *Bd*. Listing an entire class of animals as injurious was unprecedented, and making a regulation so broad would be infeasible.¹⁶



Su Jewell

Su undertook the immense task of sifting through source materials to determine how an amphibian regulation might be prepared. With her input, USFWS decided to seek the public’s help with unanswered questions through a notice of inquiry, a mechanism by which USFWS seeks information in order to decide whether to prepare a proposed rule and asks anyone with relevant information to help.¹⁷ In September 2010 Su drafted a notice that USFWS published in the *Federal Register* seeking “biological, economic, or other data” to help answer 14 questions related to the petition.¹⁸ Some were legal (“What Federal, State, or tribal regulations exist to prevent the spread of chytrid fungus?”); others were scientific (“What species of amphibians, fish, or other class of animal have been affected by chytrid fungus in the United States and how were they infected?”). About half addressed economic questions, such as: “How many businesses import live

amphibians or their eggs into the United States? What are the annual sales of these imported live amphibians and their eggs? What are the potential costs of recovering threatened or endangered species affected by chytrid fungus? What is the potential for the industries that conduct trade in amphibians to self-police through voluntary best practices; for example, how successful is the ‘Bd-Free ‘Phibs Campaign’ sponsored by the Pet Industry Joint Advisory Council?” The deadline for comments was December 16.

The three-month comment period showed yet again that an amphibian rule was no ordinary undertaking. Approximately 5,000 comments rolled in, and the contents were somewhat unusual. Su found it striking that the notice produced more questions than answers, usually to ask how USFWS would handle a certain aspect of a regulation or whether the agency had considered a certain issue. In other cases, respondents simply wrote to express anger that USFWS was considering listing such a large number of species; some thought that the rule had already been made. The notice of inquiry became a hot topic in the blogosphere and produced a wave of emails to USFWS. As the staff lead for the notice of inquiry, Su wrote back with a careful explanation that USFWS had no proposed rule in place and was merely calling for help with information to evaluate the petition from the Defenders of Wildlife. After one blogger posted her reply verbatim online, the emails stopped.¹⁹

With help from Dr. Angela Picco, an expert in pathogens in the amphibian trade at a USFWS office in California, Su reviewed all the comments submitted. Despite the many hours they spent, no clear path forward emerged. Their progress came to a halt when Su was diverted to a more pressing project: a proposed listing of nine large constrictor snakes as injurious wildlife, which the then secretary of the interior Ken Salazar had declared his priority.²⁰ For the next two years, Su and her colleagues focused on the snake listing, which met with opposition from some parts of the pet trade. It was finally completed and announced by Salazar in January 2012.²¹

In August 2012 Karen invited Su to give a presentation at the Seventh World Congress of Herpetology about how the USFWS makes injurious wildlife listings. Su talked about both the final rule on large constrictor snakes and the progress to date on the amphibian petition. She ended with a call for help with the big questions that remained on the amphibian petition. “This is too big a problem for Fish and Wildlife to solve on its own,” she said. “If there’s anyone here today who can help us, please come talk to me.”²²

At the end of Su’s talk, Karen Lips went up to the podium. “Maybe we can help,” she said, and described how her CONS 680 students worked with clients to address real-world conservation problems.²³ Su was intrigued and expressed her interest in participating.²⁴

Two Steps Forward: A Scientific Advance

On the research front, Karen and her colleagues had learned how and why *Bd* affected some amphibian populations more severely than others, and why some populations persisted after exposure, while others disappeared within a few months. Karen was part of a scientific collaboration that began mapping the path of the epidemic in Latin America going back several decades. They used museum collections and geospatial data to show the likely timing of historic losses and routes of spread. They realized that while populations were in sharp decline in Central American and California, the disease had already affected many of the upland areas of South America. Over time, they learned that *Bd* is not one fungus; instead, it has at least six distinct genetic lineages. Only some have spread globally, probably through shipping and travel. The greatest amphibian losses occurred when strains traveled and encountered new populations for the first time.²⁵

These breakthroughs were bittersweet for Karen. At last, after the hope and dread of the past fifteen years, scientists had a more detailed picture of what *Bd* was, where and how it had traveled over time, and why it proved so devastating in some places and not others. But it left her and other scientists in a terrible position: able to predict what would happen next and unable to stop it.²⁶ On the one front where there was even a chance of doing so, progress was stalled: the months continued to pass without a proposed rule from USFWS.

Part 3: Stopping a Wildlife Disease from Becoming a Crisis

In early 2013 alarming news arrived from Karen’s colleagues in Europe. There had been massive die-offs of fire salamanders in Belgium: 96% of the population had disappeared in a few months. On August 1, 2013 An Martel, a researcher at Ghent University, and several of her colleagues published a paper confirming a suspicion that was swirling through the herpetology community: the cause was a new, virulent strain of chytrid. The researchers named it *Batrachochytrium salamandrivorans*, or *Bsal*, from Greek and Latin for “eater of salamanders.”²⁷

Finding a Navigator

Two weeks after the Martel paper came out, Karen got an email from the Leopold Leadership Program announcing a new workshop on engaging in policy issues. “Do you want help understanding how to engage in and shape policy conversations?” the message began. “Stuck on where to start, and how to find the bandwidth and support to engage efficiently on topics such as renewable energy, climate adaptation, water conservation, and land-sea interactions?” The lead facilitator would be Chad English, the director of science policy outreach for COMPASS, a nonprofit that helps scientists connect with decision-makers and share their knowledge about natural resource issues.

This was the workshop that Karen had been looking for in her search for ways to stop *Bd*. She and some of her colleagues considered wildlife import regulation to be a promising mechanism, based on the emerging science about how *Bd* spreads. She had dived into learning all she could about the laws and entities related to testing live animals arriving through trade. However, her research turned up more questions than answers. She was surprised to find that there were no regulations giving USFWS the power to screen wildlife imports for disease or prevent the importation of wildlife. *How would a policy like this get made?* she wondered. *Who would be in charge of writing a bill or implementing it? What information would they need? Where would I as an ecologist fit into the process? What exactly does a scientist have to offer that’s helpful?* She wished there were a

guidebook somewhere describing how to do policy. She looked online for guidance, instructions, or examples. There was nothing.²⁸

Seizing the chance to get expert advice on how to engage, Karen registered for the workshop. She prepared for it by working with Chad to refine her questions and identify policy experts to talk with about trade and wildlife. One of the first on her list was Peter Jenkins, who remained deeply involved in issues related to invasive species policy.²⁹ Chad told her about two bills on regulating animal trade, one in the Senate (S. 1153) and its companion bill in the House (H.R. 996), that were stalled, and suggested congressional staff members for her to meet with. Given her history working on *Bd* and her familiarity with the D.C. herpetology scene, Chad wondered if she knew of other efforts underway. “Aren’t there any boundary organizations working on this?” he asked. Karen said that although there had been several amphibian organizations twenty years earlier, they had faded away as they proved ineffective in fighting *Bd*.³⁰ She also knew of interest among federal agencies to minimize threats from live animal imports. In 2010 the Government Accountability Office published a report, commissioned by the Department of Homeland Security, that called for better coordination among the agencies responsible for controlling animal diseases coming into the country: the Customs and Border Protection office within Homeland Security; the Centers for Disease Control and Prevention; USFWS; and the Animal and Plant Health Inspection Service within the Department of Agriculture.³¹ Karen followed up on the report and found that no progress had been made on its recommendations. Her initial research complete, she created a map showing everyone she knew to be working on trade and wildlife and consolidated her thoughts about where productive conversations might begin.

Her efforts got an additional boost when she announced the request for proposals for CONS 680 projects for spring 2014. One of the submissions came from Su Jewell, who wanted a student team to revisit the *Bd* petition and determine whether there was a way to proceed with it. Karen assigned a team of three graduate students to the project. With a way forward on both the science and the policy elements, she was off to a strong start.

Working the Landscape: Seeding Conversations for Action

In January 2014 Karen talked with Peter Jenkins.³² No longer on the staff at Defenders of Wildlife, he had his own small nonprofit, the Center for Invasive Species Prevention, where he consulted for the National Wildlife Federation and other clients on wildlife diseases and invasive species. (In the years after submitting the petition, the Defenders of Wildlife had narrowed their strategic focus, and no one had replaced Peter in pushing USFWS to make a regulation on the amphibian petition.³³) With a five-year grant from the Turner Foundation, he was now working to reform the Lacey Act with the National Environmental Coalition on Invasive Species (NECIS), a partnership of action-oriented organizations that included The Nature Conservancy, the Wildlife Society, the Ecological Society of America, the Society for Conservation Biology, the Environmental Law Institute, and the National Wildlife Federation³⁴. Peter suggested additional people for Karen to interview and asked if she would be willing to take part in briefings on the Hill later that year as part of the annual NECIS legislative fly-in. Karen agreed; it seemed that this would be the perfect opportunity to share information with policy-makers.

At the Leopold workshop Karen prepared to interview two congressional staff recommended by Chad. Chris Tomassi staffed the Senate Committee on Environment and Public Works, where S. 1153 was languishing. Harry Burroughs was his counterpart on the House committee, which had responsibility for the companion bill, H.R. 996. Karen’s main goal in meeting with Tomassi and Burroughs was to find out what information they needed and let them know what was available.

The two conversations took very different courses. Tomassi was unfamiliar with the amphibian die-offs, so Karen provided a high-level overview and explained why she as a scientist was concerned. By contrast, Burroughs knew everything Karen knew, had the data at his fingertips, and understood the implications for wildlife, human health, and the economy. He grilled Karen for information and outlined reasons why the bill would not advance through the legislative process. He noted that injurious wildlife was a low priority for USFWS, as evidenced by the paltry allocation of staff and congressional funds. He brought up the pet trade, where prominent industry organizations had expressed opposition to regulating amphibian importation. Karen outlined the risk to the industry’s bottom line from chytrid disease. Burroughs talked at length about the need to calculate and consider the short-term costs of regulation versus the long-term viability of the business. What was the probability of infection and escape? How did this compare with the cost of regulation? How did these factors vary by species, approach, and different levels and types of regulation? As part of his regular duties, Burroughs told Karen that he would submit questions to USFWS about its priorities and resources for addressing injurious wildlife issues. This was the one action that resulted from the meeting.

Throughout the spring, Karen remained in regular contact with Peter, with whom she discussed new angles, meetings, and avenues to increase the visibility of the issue.³⁵ The two had complementary roles: she was the locally based academic amphibian expert³⁶, and he was the policy navigator, using his networks and knowledge of the issues and policy process to plan for action and engage others when and where they were needed. Karen continued to reach out, giving talks in the D.C. area and media interviews about her salamander research.³⁷ In March she gave a presentation at the Reptile and Amphibian Law Symposium and Workshop, an event sponsored in part by the Pet Industry Joint Advisory Council and attended heavily by pet traders and in smaller number by herpetologists, hobbyists, zoo and aquarium personnel, state and federal wildlife agency staff, veterinarians, pet traders, and legal experts.³⁸ Karen talked about new findings on *Bsal* and climate change and outlined the likely effects on the pet trade.³⁹ The student team assigned to the project talked with many of the pet traders and USFWS staff who attended. From the industry representatives they heard loudly and clearly that opposing “big government” was a primary motivation for them in defining their position.

Karen took stock of what she had learned and where things were heading. She sat down to reflect and articulate her goals for contributing to policy. There were two things she wanted to accomplish: raise awareness in the policy community about the threats of introduced wildlife diseases to human and environmental health; and convince USFWS that it is important to regulate the import of wildlife diseases.⁴⁰

A Role for Students: Filling the Data Analysis Gap

At the start of the semester in spring 2014, Su gave a presentation to the CONS 680 students describing how injurious wildlife listings are made and providing background about the amphibian petition. She explained that USFWS needed to be able to defend any action it took down to the last detail. Her goal in working with the students was to analyze the original *Bd* petition, identify ways to narrow the scope, and arrive at a rule that would provide reasonable protection to biodiversity for amphibians, fall within USFWS’s authority under the Lacey Act, and be feasible to implement.⁴¹

With Su’s guidance and Karen’s oversight, the students scoped the assessment to determine the risk that amphibian importation posed to amphibian biodiversity in the U.S. and the extent to which various regulatory options would mitigate this risk. They focused on risks posed by importation through five industries: the pet industry, the live food industry, zoos and aquaria, research, and education.⁴² At one point, Su asked Karen and the students whether to focus on *Bd* alone or on *Bd*, *Bsal*, and ranavirus, another pathogen known to be killing frogs. In the end, they decided to focus on *Bsal* and *Bd*, because similarities in biology allowed for simple changes in the model to explore the effects of both organisms on biodiversity.⁴³ Su provided the students with 10 years of amphibian importation data gathered by USFWS,⁴⁴ and the students got to work. In addition to running the models with the USFWS data, they interviewed a few dozen key stakeholders from the five industries of interest. Among them were Peter Jenkins, key staff at the USFWS, policy liaisons for the pet trade, and Fred Kraus, an expert on introduced species who had published a book on attempted and successful amphibian introductions through the pet trade, food trade, research, and transport over time. To make sure their work remained aligned with USFWS’s goals, the students provided periodic updates to Su throughout the spring.⁴⁵

At the end of the semester in May, the CONS 680 students presented their final report to a small group of USFWS staff including Su and the assistant director to whom she reported. The students’ risk assessment model evaluated the biological impact of *Bd* and *Bsal* on native amphibians under the scenarios of creating a full ban, doing business as usual, and restricting some imports. The model estimated the financial burden of the same scenarios to the trade groups and to USFWS in testing imports for disease and conducting recovery or adding listings if new species were affected by disease invasions. Backed by the USFWS data, it reflected the high numbers of amphibians imported into the U.S. The students’ command of the material and the depth of their work on the model impressed the USFWS team. It was clear that the students had gathered data that the USFWS staff considered useful to future work and that the staff would not have had resources to gather themselves.⁴⁶

Pounding the Pavement and Tailoring the Message

Meanwhile, Karen continued her efforts to raise awareness within the policy community. In June she took part in the annual legislative fly-in organized by Peter and NECIS. She presented research related to H.R. 996 at a congressional briefing and met with legislative assistants from several offices. Although she had given talks on the topic dozens of times, she rethought her approach and tailored it for each meeting. She used an iPhone app called “Congress” and other resources to familiarize herself with each legislator’s district, priority issues, committee history, and voting record. In addition to identifying a risk from an invasive species in each district, she also prepared comments on the financial burdens of passing or not passing the bill, which she knew were

the arguments at the forefront of the legislators' minds. She made sure that her comments were clear, concise, and effective for the time slots she was given, which ranged from 10 minutes for the briefing to about 30 minutes for legislative meetings.

Karen's most productive meeting was one that Peter arranged with the chief of staff for Ben Cardin, a Democratic senator from Maryland and the chair of the Committee on Environment and Public Works. The chief of staff let them know that a hearing on S. 1153 was scheduled for July. The main purpose for holding it was to get testimony on several environmental issues entered into the *Federal Register*. No action was expected, given that summer recess for Congress was a few weeks away. Karen and Peter attended and listened as one of Peter's colleagues from the National Wildlife Federation gave testimony.

Another Chance to Act: Pulling Strategic Opportunity from a Mortal Threat

In fall 2014 Karen was involved in a study that would become a game changer for the policy effort.⁴⁷ The source was a paper on *Bsal* by Martel and a collaboration of international scientists, including Karen, which was to be published in *Science* in October. It gave evidence that *Bsal* likely originated in Asia and had been transported through the pet trade to Europe, where it had escaped into the environment and was killing wild salamanders. Based on screenings and experiments done on four continents, the authors warned that many species of salamanders from other parts of the world were highly susceptible. Furthermore, although the fungus was not present in North America yet, it could easily arrive there via the pet trade, which imported hundreds of thousands of salamanders from Asia every year.⁴⁸

Reading Martel's paper, Karen felt as if it were 1998 all over again. Her thoughts turned to the well-intentioned but ill-fated recommendations that had come out of the Amphibian Conservation Summit in 2007⁴⁹. The Amphibian Conservation Action Plan had provided a detailed roadmap for research, conservation, and funding, but the authors had still been thinking in a mode of "conservation as usual." Leadership of the kind needed to develop a policy solution had been lacking. There was no centralized mission, vision or goal; no centralized funding mechanism; little stakeholder engagement; and no champions to effect change at the highest levels. The plan, which carried a large price tag, offered no specific solutions to address most of the threats it described.⁵⁰

Even as she grasped the enormous threat that *Bsal* posed to North American salamanders, Karen saw an opportunity for action in Martel's findings. *If Bsal hasn't arrived in North America, we still have the chance to stop it*, she thought to herself. And who was better placed than she to apply the lessons from the *Bd* experience? If there was one thing that Karen had learned, it was that action was needed, and quickly. This time, it would not be conservation as usual. This time, action would be the priority; there would be no decade lost to the assertion that more research was needed before anything could be done.

Once the paper was in press, Karen called Chad and Liz Neeley for advice on how to proceed and what to say. "This seems like an opportunity, but what do I do?" she asked. They urged her to meet with her contacts at the USFWS to let them know about the paper and to do the same with Peter Jenkins and NGOs with a potential interest.⁵¹

On October 5 Karen emailed Su to let her know that the Martel paper would be published soon and asked if Su could help her set up a meeting at USFWS. Su arranged for Karen to meet with a group that included Dr. Angela Picco of USFWS and experts in international trade. What they heard that day convinced them of the need to drop everything and address the *Bsal* threat. As Karen briefed them on the Martel paper, they quickly grasped the magnitude of the danger it posed to the unique salamander biodiversity of the U.S. They also recognized the need to act immediately, because the fungus had not yet been detected on U.S. shores. Fighting *Bsal* was named a priority by the USFWS director, and the way was cleared to begin work. Thanks to the CONS 680 team, USFWS staff also had the economic and trade data to provide the necessary context.

Karen then called Peter. "You've got to see this paper," she said. "Let's get together and talk about it."⁵² She met with him and the leaders of several NGOs the next day.

As he listened, Peter found himself becoming increasingly interested in the *Bsal* issue, which presented almost exactly the same problem as *Bd* but with an emerging disease.⁵³ He saw in it a unique opportunity for action. Like Karen and the USFWS staff, he understood that the key factor was timing: because *Bsal* had not yet arrived in the U.S., it was still feasible to keep it out.⁵⁴ If decision-makers felt they could do something to make a difference, they were more likely to act. This being the case, *Bsal* might also create an opening to rekindle interest in the *Bd* petition. In a world of rapid travel, *Bsal* provided a concrete example of the need for an overarching policy for regulating wildlife diseases, rather than the piecemeal approach that resulted from the

Lacey Act. This time, there was also the possibility of funding to get the process moving. Some of his Turner Foundation grant could be used for work on amphibians, allowing him to devote time in the coming months to helping Karen.⁵⁵

The Grassroots Campaign

When it appeared on October 31, Martel's paper created a sensation in the popular press that began with coverage in the *New York Times*. Carl Zimmer, a science reporter for the paper, wrote an article. Andy Revkin, a columnist for *Times* and a keen newt enthusiast, tweeted about Martel's findings and wrote a piece for his blog, *DotEarth*. Karen had met Revkin through her Leopold training as a new fellow in 2005, and they had been in touch over the years about amphibian issues. Richard Conniff, another *Times* reporter, wrote about what would happen if salamanders disappeared from the forest. Karen and Joe Mendelson then wrote an op-ed, which Revkin helped to get published in the *Times*.⁵⁶ Entitled "Stopping the Next Amphibian Apocalypse," it called for an immediate halt to the importation of salamanders and the passage of the Invasive Fish and Wildlife Prevention Act, the two bills still pending in the House and Senate (H.R. 996 and S. 1153). It also spoke poignantly to the lessons from *Bd*. "Watching those die-offs has left biologists like ourselves feeling at times more like paleontologists," Karen and Joe wrote. "This time, we have ample warning to prevent the arrival of *Batrachochytrium salamandrivorans* into the United States. We know what kind of killer we're dealing with.... Let's get it right this time."

The op-ed generated a wave of interest and news stories across the globe.⁵⁷ Seizing the moment, Peter quickly called together the NGOs that work on invasive species. They decided to launch a letter-writing campaign to Dan Ashe, the director of the USFWS, making the same requests outlined by Karen and Joe in their op-ed. Peter coordinated with the NGOs, and Karen coordinated with the scientific societies, including the Ecological Society of America, the Society for Conservation Biology, and the three most prominent herpetological societies. They also briefed Ashe's staff well in advance about the campaign so that no one at the agency would be caught by surprise.⁵⁸

One group caught by surprise when the Martel paper came out was the Amphibian Survival Alliance. Members called Karen and asked what they could do. "We've got this letter-writing campaign, if you want to write a letter," she told them. They agreed to do so and asked what else was needed. "We should be doing more," they said. Karen was struck by the irony of the situation: the established international organization, with a mission to guide policy, was looking for a role, while she and Peter, two individuals with no official role, were leading the effort. She went to talk with one of her longtime mentors, George Rabb. A member of the Defenders of Wildlife board and the Global Council of the Amphibian Survival Alliance, George had played an essential role behind the scenes in protecting amphibians and addressing *Bd* since its identification in 1997. Karen told him that Peter could get things done. "I think you should hire him as a part-time consultant," she said. "Look what he's been able to do with minimal resources; he knows the ropes and has the connections."⁵⁹ Peter met with the leadership of the Amphibian Survival Alliance, including George, and said that he wanted to continue working on the issue but needed financial support to do so. With George's help, private funds were identified and given to the alliance, which awarded Peter a five-month contract to keep the effort moving forward.⁶⁰

After Martel's paper came out, Su and her colleagues at USFWS began work on a ban of salamander imports. But even with a mandate to focus resources on the issue, a solution remained elusive. How could USFWS list a whole class of animals? The policy context put the agency in a difficult position. Even though it is required to make listings on the science alone, it operates in a world where industries' bottom lines are at stake and health documentation for imported animals is highly variable. The CONS 680 students' work, which was based on both biological and economic data, proved newly valuable as USFWS grappled with the question of what to do.

For Karen, the publication of the Martel paper provided a catalyst for another round of visits to policy-makers. Using data from Martel and the CONS 680 students for context, she created a storyline that related her research to the loss of native biodiversity, highlighted gaps in animal importation policy, and referenced the legislation awaiting action in both houses. She opened with a more personal story than she normally used in science talks to get her audience's attention and communicate her concern. Wherever possible, she referred to past outreach and academic work she had done in a policy context related to the issues at hand, a strategy that underscored her experience and credibility. She turned to colleagues to help her prepare for topics that she did not know as well.⁶¹ She became adept at quickly honing in on her audiences' questions, interests, and familiarity with the issues and adjusting her remarks on the fly.⁶²

In December Karen got the chance to talk with staff from Senator Kirsten Gillibrand's office, the sponsor of S. 1153. One of Karen's colleagues from herpetology, Priya Nanjappa, was a policy staff person for the

Association of Fish and Wildlife Agencies, a national organization representing the interests of state agencies in federal policy-making. She got a meeting with Gillibrand's staff for herself and Karen over the December recess for Congress. The staffers had seen the Martel paper and Karen and Joe's op-ed in the *New York Times* and were interested in reintroducing the bill. Priya provided information to support their effort.⁶³

Meanwhile, in his consulting role with the Amphibian Survival Alliance, Peter had time and resources to identify a path forward in pushing for the USFWS ban and coordinating action among the many groups that were getting involved. He recruited cosigners to the letter campaign, and for organizations and societies that wanted to take independent action, he urged writing separate letters that supported the most important outcomes for salamanders' survival: a temporary ban on salamander importation and the adoption of a screening system to certify the health of incoming salamanders.⁶⁴

The month and a half following the publication of Martel's paper had been very busy for Karen. She gave talks and media interviews, cowrote the op-ed, coordinated the letter-writing campaign, consulted with Peter, set up meeting after meeting, and followed up on resulting requests for information.⁶⁵ In the relative calm of the end of the year, she reflected on the concern and desire to help that she had encountered everywhere she went. She also took heart in the grassroots efforts that were springing up in response to the threat.⁶⁶ The Amphibian Survival Alliance offered free kits to salamander owners to test their pets for *Bsal* and gave advice about how to minimize the spread of the disease. The Association of Zoos and Aquariums urged its members to test salamanders in their collections. All the organizations were communicating with the state wildlife agencies, which supported the call for immediate federal action.⁶⁷ For the first time, everybody was on the same page, pulling in the same direction, and pressing for a coordinated response.

Addressing New Questions

The year 2015 marked the start of a new round of meetings with agencies, congressional offices, and other stakeholders. Working closely with NGO participants including James Lewis, the director of operations for the Amphibian Survival Alliance, Karen and Peter met in January with Dan Ashe's staff at USFWS to make the same requests that had formed the basis of the letter-writing campaign in November.⁶⁸ Karen provided a technical briefing. George Rabb attended by phone and made an impassioned plea for action by the USFWS before it was too late.⁶⁹ The staff listened and explained why the agency had not yet acted: they had eight additional questions about the science. From the tone of the conversation, it was clear that they were deeply concerned about the implications of *Bsal* for the fate of the continent's salamanders, and also that they needed to remove uncertainties in order to move ahead with a new regulation. The NGOs agreed to draft a letter addressing USFWS's remaining scientific questions and articulating additional reasons why it was crucial to list all families of salamander, rather than just the half that had been tested and found to be mortally susceptible to *Bsal*.

In the months that followed, Peter coordinated a campaign to keep the salamander listing moving forward. He organized several other meetings with USFWS to address ongoing questions. Many people attended them: agency staff, Peter, Karen, James Lewis, Priya Nanjappa from the Association of Fish and Wildlife Agencies, and often George Rabb by phone. By March, five months after the publication of Martel's paper, they had not seen any action by USFWS. Karen, Peter, and leaders from the member organizations of NECIS wrote a second letter to Dan Ashe and Sally Jewell (no relation to Su), the secretary of the Department of the Interior, with the same requests outlined in the first. Andy Revkin wrote an opinion piece for the *New York Times* urging readers to write to their representatives.⁷⁰ Peter met regularly with David Hoskins, the assistant director for fish and aquatic conservation at USFWS, and had additional meetings with other senior and junior staff. Karen sometimes attended as well, giving her six-minute talk to new groups of people. She was one of 12 experts who submitted a letter outlining why USFWS should be very broadly inclusive of species in the regulation, rather than tailoring it to a certain few. She also took part in a meeting with the National Invasive Species Council, the body responsible for coordinating action on invasive species issues among the secretaries of Interior, Agriculture, Commerce, State, Defense, Homeland Security, Treasury, Transportation, and Health and Human Services; the U.S. Trade Representative; and the administrators of the U.S. Environmental Protection Agency, NASA, and the U.S. Agency for International Development.⁷¹ At the end of April she presented a poster on *Bsal* at the Coalition for National Science Funding Exhibition, which nine members of Congress attended. In May she received comments back from Su on the draft report submitted by the CONS 680 students the previous year and began preparing a paper and presentation for the annual meeting of the Ecological Society of America in August.⁷² In June she gave a presentation on the threat posed by *Bsal* at the NECIS legislative fly-in.⁷³ With each interaction, Karen and her colleagues identified additional audiences to engage in moving the policy effort forward.

Other groups took their own routes to action. The U.S. Geological Survey convened a meeting of all the stakeholders to develop a national monitoring plan for detecting *Bsal* and an emergency response plan in case it appeared. A meeting in Fort Collins in June led to the formation of the National *Bsal* Task Force, overseen by a committee with representation from state wildlife associations, federal agencies, zoos, the pet trade, NGOs, and research institutions. Its purpose was to examine the policy, management, and research implications of *Bsal* and develop a process for responding to the threat.⁷⁴

A Rule at Last

As these new efforts took shape, Karen, Peter, and James Lewis turned their attention to the pet trade. They realized that for USFWS to act, it needed confirmation that there would be no major opposition. Having rerun the risk assessment developed by the CONS 680 class using data for salamanders, Karen knew that the impact to the pet industry would be minimal. Peter met with pet industry trade groups, including the Pet Industry Joint Advisory Council and the U.S. Association of Reptile Keepers, which historically opposed regulation of the reptile trade. However, once their leaders understood that the projected economic losses amounted to a few hundred thousand dollars at most, they agreed not to oppose the suspension of salamander imports while a clean trade system of health certification was developed.⁷⁵ In November, the Pet Industry Joint Advisory Council called for a voluntary ban on two species of newts.⁷⁶

Karen, Peter, and James went back to the USFWS with these commitments in hand. Peter had seen that the agency staff were still dealing with questions from the legal staff about what they could do and how they could carry out the kind of broad regulation needed to keep *Bsal* at bay. The reports from the pet industry helped to allay their concerns.⁷⁷

Meanwhile, a team of experts from USFWS was diligently working on a rule. Their efforts came to fruition on January 13, 2016, when USFWS published an interim rule making it illegal to import 201 species of salamanders or move them across state lines without a permit from the agency.⁷⁸ The staff was relieved to have an import ban in place. Of the nearly 700 known salamander species, they had identified and listed the 201 that they determined could carry *Bsal*, based on the available data. This measure prohibited 95 percent of amphibian imports. Moreover, they had accomplished the task barely 15 months after Karen's briefing on the salamander die-offs in Europe, a short timeline for taking such an extensive action using the agency's current procedures.

For Karen, Peter, and many of their colleagues, the regulation represented a helpful start in addressing *Bsal*. They had been unable to convince the USFWS to list all salamander species as injurious, and about 400 species had been excluded from the ban because of a lack of evidence that they could carry the fungus. While far smaller in scope than their original vision, the regulation nonetheless provided an important safeguard for slowing the spread of *Bsal*. It also bought time for doing the research needed to prove which of the remaining 400 species should be added to the listing. Everyone agreed that the outcome was far better than that for *Bd* and provided a direction for future policy-making.

Afterword

With the USFWS announcement in January 2016, the informal coalition that had worked together for so many months dispersed but continued to pursue their efforts separately. Peter Jenkins began work on a grant with Priya Nanjappa and others to address the deficiencies of the Lacey Act and institute a strong, broadly supported federal system for screening the disease risks of imported wildlife. Karen accepted a Jefferson Fellowship and began the 2016-17 academic year working at the Department of State to learn more about the transnational policy world. She also stayed in touch with the *Bsal* Task Force, which began creating a holistic, action-oriented strategic plan for dealing with *Bsal*. She and Peter planned to keep working together on invasive species and amphibian biodiversity, almost certainly with Priya, Joe Mendelson, and George Rabb.

As she contemplates the future, Karen returns to the vision of a "CDC for wildlife" that informed her application to the Leopold workshop on doing policy. "In a chytrid world, the kinds of questions that need to be asked are different from those of a previous era," she says. "These are just the first waves of invasion, and the more surveillance and things we can do to slow or stop the impact, the more we can prevent other invasions. You have to be thinking about the next thing and the thing after that."⁷⁹

Karen's time at the State Department has given her new tools in science diplomacy, the chance to build relationships with environmental leaders from around the world, and exposure to programs that promote the international collaborations needed to protect humans and wildlife from emerging disease. She is preparing to pursue this work for the rest of her career, knowing that the path will be uncertain, and hoping that she will live to see the next amphibian apocalypse averted.⁸⁰

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