TRANSCRIPT

Key Conversations with Phi Beta Kappa

Why Professor Kay E. Holekamp's Research into Animal Behavior is Beneficial to Humans

The Michigan State University Professor of Integrative Biology shares how her early fascination for animals led to an extensive career in researching mammalian behavioral development, and the importance of studying the social, ecological, and endocrine variables of a species. As a leading behavioral ecologist, Professor Holekamp's initial field studies as a Ph.D. candidate transpired into decades of research on the spotted hyena including their reproductive success, their survival, and the forces shaping the species and its evolution.

Fred Lawrence: This podcast episode was generously funded by two anonymous donors. If you would like to support the podcast in similar ways, please contact Hadley Kelly at hkelly@pbk.org. Thanks for listening.

Hello and welcome to Key Conversations with Phi Beta Kappa. I'm Fred Lawrence, Secretary and CEO of the Phi Beta Kappa Society. Since 2018, we have welcomed leading thinkers, visionaries, and artists to our podcast. These individuals have shaped our collective understanding of some of today's most pressing and consequential matters, in addition to sharing stories with us about their scholarly and personal journeys. Many of our guests are Phi Beta Kappa Visiting Scholars who travel the country to our Phi Beta Kappa chapters, where they spend two days on campus and present free public lectures. We invite you to attend. For more information about Visiting Scholars' lectures, please visit pbk.org.

Today, I'm delighted to welcome Professor Kay E. Holekamp, University Distinguished Professor in the Department of Integrative Biology at Michigan State University. Professor Holekamp earned her PhD from the University of California at Berkeley, where she studied dispersal behavior in mammals. After spending three years as a postdoctoral fellow in behavioral endocrinology at the University of California at Santa Cruz, she

joined the research staff at the California Academy of Sciences and began her ongoing study of the behavioral ecology of free living spotted hyenas in Kenya in 1988.

In 1992, she joined the faculty at Michigan State University. Her research interests focus on the autogenic development, physiological mediation, and evolution of mammalian behavior. Much of her recent work focuses on the selective pressures favoring the evolution of intelligence. Welcome, professor.

Kay Holekamp: Thanks very much, Fred. It's wonderful to be here.

Fred Lawrence: Tell us a little bit about where you grew up and if you think there's something in your childhood that led you to go along the path you did to the research interests that you have taken on with such distinction.

Kay Holekamp: Sure. I grew up in St. Louis, Missouri where my parents are both animal lovers. We always had loads of animals, including lots of box turtles and whatever else we could find in the yard, and then when I was a senior in high school, I started working as a volunteer at the St. Louis Zoo, and that's when I decided that animal behavior was really the thing I loved most. I imagined I might go on to a career as a zoo curator or whatever, but then I actually tried fieldwork studying mammals in their natural habitats, and that is just the most wonderful thing ever.

Fred Lawrence: Did that work in the field with studying animals take place in college or before college?

Kay Holekamp: Actually, it was after college. I had done an honors thesis in college on these little murina possums that come into the United States on bunches of bananas from the Neotropics, but then I actually turned my attention full blast to fieldwork when I was studying dispersal as a PhD candidate at UC Berkeley. There I lived in the Sierra Nevada of California every summer for three years studying these little ground squirrels and their dispersal behavior.

Fred Lawrence: To what extent did you study these topics in college and to what extent did the topics find you?

Kay Holekamp: Actually, I studied animal behavior in college just having taken a couple of courses in it, but that was as far as I got other than doing this honors thesis on the murina possums. But then in graduate school, I got very interested in dispersal behavior because it was very poorly understood, honestly. People could look around the animal kingdom and see that typically members of one sex or the other dispersed in specific taxonomic groups. For example, in birds, it's usually the females who dispersed to new habitats to breed. In mammals, it's typically males.

But the hypotheses that had been put forward to explain why these animals were leaving home were, oh, they're getting aggressively chased out, or they're leaving in

search of resources, or the population density is too high. I was able to test all those hypotheses with these free living squirrels in nature and rule out the idea that they're chased out and the idea that they're leaving because population density is too high. They go of their own volition, and that seems to be because females don't like to mate with you if you're too closely related to them in your natal area.

Fred Lawrence: From an evolutionary point of view, do we think there are reasons that behavior would be selected for or is it just a preference?

Kay Holekamp: No, I think they're very important selective reasons insofar as dispersal by one sex, but not the other allows avoidance of inbreeding. Typically, male mammals will move to a nearby habitat and try and find unrelated females, females with whom they did not grow up, to mate with. The females are much more receptive to them. It turns out that's true in many mammals actually.

Fred Lawrence: Their version of going away from home to go to college.

Kay Holekamp: That's right.

Fred Lawrence: How did you become interested in, of all things, studying hyenas?

Kay Holekamp: Does sound unlikely, doesn't it? I actually was on safari in East Africa with my husband in 1976, and we saw a group of hyenas run down from quite a distance away, run down a wildebeest. It finally killed this wildebeest and consumed it right next to our vehicle. I turned to Rick and I said, "I thought those things were supposed to be skulking carrion-eaters," and he said, "Yeah, I did too." That piqued my curiosity. I went home and read about them, still never imagining I'd have an opportunity to actually study their behavior.

Turns out that one of my PhD mentors at UC Berkeley, right as I was finishing my PhD on ground squirrels, he got multiple millions of dollars from the National Institute of Health to set up a big captive colony of hyenas at UC Berkeley. He's the one who actually ultimately got me an opportunity to go study them in nature.

Fred Lawrence: The field work in the Amazonian jungle, what led to that?

Kay Holekamp: Oh, that was an adventure. After I graduated from college, I had done very little traveling internationally. In fact, I'd only ever been outside of the United States to go to Montreal. I had an opportunity to go work at a little tiny hotel in the Amazon basin. I was mainly functioning as an interpreter there between the Spanish-speaking motoristas and either the scientists or tourists that we were guiding around in the Amazon. That was a real eye-opener for me.

I went there having done this undergraduate honors thesis on these murina possums that come from that area of the world. I went there naively thinking I could study them in nature, but they're secretive, nocturnal tiny little things that unless you're very, very well-equipped, very unlikely to see in nature. I was there for a year and I never saw one.

Fred Lawrence: The happenstance in the planning of our careers is always so interesting. That is after college, before graduate school.

Kay Holekamp: That's right.

Fred Lawrence: And then how does it affect the academic agenda or the scholarly agenda when you reach graduate school?

Kay Holekamp: Well, I had actually applied to graduate school before I even left the States to go to the Amazon, and I had applied to work specifically with a fellow at Berkeley who had done a lot of work on zoo animals. He studied curiosity in zoo animals, and he understood that zoos can be important laboratories for understanding animal behavior. You have exposure to a lot of species that you otherwise would never get exposure to. I had applied specifically to work with him, and he fortunately admitted me. I did my PhD with him as one of my two co-mentors at Berkeley.

Fred Lawrence: You and your students are currently investigating how social, ecological, and endocrine variables interact during the individual's early development to influence its subsequent behavior, survival, and reproductive success as an adult. Can you translate that for the general listening audience, and then tell us a little bit about the methods that you and your students use in doing those studies?

Kay Holekamp: To translate, we look at endocrine and social and ecological variables. Ecological variables are things like how much food is available, how much rainfall is happening, what kind of habitat do the animals live in. Social variables are the types of interactions it has with its group mates and its parents. The endocrinological variables are concentrations of hormones in the animal at the time it's behaving so that one can inquire about the relative importance of these things in shaping subsequent behaviors, both in later during development and in adulthood.

Some of the methods that we use to get at these things are we collect biological samples from the hyenas insofar as we take blood from them, we collect fecal samples. We have a lot of them able to come up and chew on a rope, and that gives us saliva samples and we can measure hormone in saliva. There are a lot of different ways you can measure hormone concentrations. But our main methods are sitting in a car six or seven hours a day, mainly around dawn and dusk, just watching the animals behave. That's to me the most fun thing of all. I love that.

Fred Lawrence: Put us in the car with you sitting there for six or seven hours. What are we looking for when we see how the animals behave?

Kay Holekamp: Well, we went out there originally just trying to... I knew very little about hyenas biology, and I just had read a single book about them at that point because there was only one book available, nd that was a Scotsman named Hans Kruuk who went... He was actually Scandinavian, but he came from Scotland. He was the fellow who was able to name hyena social groups clans because that's the prerogative of the first person to go study them, I suppose. He had been surprised to find that they weren't skulking carrion-eaters either, that they are actually very good hunters and have no trouble whatsoever bringing down adult wildebeest and even zebra when they're hunting in a group.

We actually use a variety of different observational techniques. One of the most important ones is that we record all occurrences of particular types of behaviors that we see. For example, we've been recording ever since we first started watching the animals every single kind of agonistic interaction that's taken place in our presence gets recorded. What that allows us to do later on is to basically generate a very clear picture of the social structure of each animal group.

In addition to these all current sampling, we sometimes follow individuals for hours or days at a time and focal animal follows, and that allows us to get even more subtle behavioral records and record exactly what's happening to the animal, who it's interacting with, and so forth. It's really fun.

Fred Lawrence: In 2021, you published this very interesting cover story in *Science Magazine* titled Mother's Clan. Tell us a little bit about this female dominated structure and what theories you've developed over decades now of studying this.

Kay Holekamp: Spotted hyenas are very unusual amongst mammals, insofar as females are socially dominant to males. They're also larger and more aggressive than males. In most mammals, as in the human species and other primates, for example, it's almost always the case that males are bigger and more aggressive and better armed than females are. But in spotted hyena society, the reverse is true. One of the questions that we've been trying to address from the beginning is, why should that be? Why don't you see this kind of female dominance in other large mammalian carnivores?

We've actually looked at patterns of morphological and behavioral development, and what we can see is that female dominance is something that will be selected if there is intense selection pressure on mothers to protect their offspring and allow them to feed. In hyena society, your priority of access to food is very strictly determined by your social rank, which in turn is determined by your mother and her allies. The paper that we had in *Science* talked about how young hyenas inherit not only their mothers and the rest of

their kin, but they actually inherit their mother's entire social networks, which turns out to be tremendously valuable to animals with larger social networks than smaller ones.

They are large mammalian carnivores, but they live in monkey-like societies. Their societies are structured nothing like a lion pride or a wolf pack or a mongoose band. Instead, the hyena societies much more closely resembled baboon troops or macaques troops than the societies of any other mammalian carnivore. Evidently, the reasons for that were over the course of evolutionary time that these animals descended within the last million years from carrion-feeding ancestors and they still have the residual morphology of carrion-feeders. Their heads are just these monstrous, heavy, bony, very thick bone structures that fossilize very well, and we know a lot about the fossil record of members of the hyena family.

The fact is that there are multiple species of hyena that were clearly adapted for cracking open bones and feeding on carrion. In fact, there are two other extant hyena species that still do feed almost exclusively on carrion, and those are striped hyenas and brown hyenas. But spotted hyenas just appeared very recently in the fossil record, literally within the last few hundred thousand years, and they have done extraordinarily well. That's despite the fact that these animals are catching and killing their own prey and then having to compete for animals as in a monkey troop who are not only their kin, as you would find in a lion pride or a wolf pack, but animals that are not related to them at all.

You have these very strong selection pressures favoring individuals who can win in competitions in these competitive feeding situations. Because the hyena's adult skull is specialized for being able to break open large bones, as are the skulls of brown and striped hyenas, the skull takes a long time to develop during the course of antagony. In fact, we found that the skull doesn't finish developing until the animals are over three years old. That's very long. They're wildly handicapped for a very long time in these competitive feeding situations.

It looks like mothers have been favored over the course of evolutionary time who are big enough and strong enough and aggressive enough to let their babies have access to food rather than letting them starve to death, not able to get at the carcass while their skulls are still developing.

Fred Lawrence: Hyenas, in fact, don't have such a great reputation in the cultural imaginary, do they? They're the laughing hyenas, but laughing hyenas in popular culture are rarely thought of in a pleasant or comical sense, but more in a cynical or sarcastic sense as we anthropomorphize these animals. They're skulking around on the perimeter waiting to be able to pounce on somebody. That's the modern cultural imaginary view of hyenas. Why do they get such a bad rap?

Kay Holekamp: Well, that's a good question, Fred, and I think this is historically due to a couple of different things. First, hyenas used to be robbers of graves. Even in medieval beast eras, you can actually see there's drawings of hyenas opening graves and taking out human remains to consume them. In fact, that even happens in Africa. When people are just buried under earth, the hyenas can dig you up.

But more importantly, I think, both the Indigenous African peoples that occupy the continent and the colonial people who came and took over control of those countries for at least a while, everybody recognizes that the African bush is a dangerous place to be wandering around at night because there are all these large carnivores out there trying to make a living. They all lock themselves into their villages and their houses at sundown and go out again at dawn. When you go out at dawn, it's very typical to see big, handsome, glamorous male lion feeding on a carcass surrounded by a bunch of bloody hyenas who do appear to be skulking around.

Certainly that's the image that has been pushed on the public by Walt Disney, for example, and even Ernest Hemingway, for that matter, in *Green Hills of Africa*. But if you're the hyena biologist and you're out there a little bit earlier, you see it's the hyenas who killed the thing and then the lions steal the food, and the hyenas have to wait for the lion to move off before they can have access to the remains again.

Fred Lawrence: The lion is the interloper. The lion is the skulker, in spite of that big beautiful mane.

Kay Holekamp: Exactly.

Fred Lawrence: It's hyenas who are getting the blame for it. It depends what time you start the camera rolling, doesn't it?

Kay Holekamp: Exactly. Hyenas eat very, very fast. They can put away an adult human in a few minutes, honestly. We've seen them actually strip a 300 pound antelope from a living, running, breathing creature to a little bloody place on the ground where there's not even a remaining bone because they've just literally consumed everything and taken the rest of the bony materials away. It's very impressive how fast they can eat.

Fred Lawrence: I was thinking when you were talking about the relatively long time from birth to full physical maturation, that's one of the standard explanations of the difference of how humans evolve. That in order to have our brains evolve, there's no way that you're going to be self-sufficient at the moment of birth, as opposed to some animals that are actually shockingly self-sufficient literally from the moment of birth and certainly shortly thereafter, whereas human infants are wholly dependent on others for some considerable length of time.

It's longer than hyenas, but hyenas seem to be, speaking generally here, in between. Somewhere what I think of as the general animal kingdom's response on this and the human context on this. Have I got that right?

Kay Holekamp: Yeah, I think you do actually. We've been using hyenas to study the evolution of brains and the evolution of intelligence in mammals more generally, because there are a couple of hypotheses that have been put forward in the literature to try and help us all understand, well, what are the selective forces that shape the evolution of big brains and great intelligence? Because neural tissue is very expensive, of course, because your neurons are constantly pushing ions around and trying to maintain equilibrium and they're using tons of energy.

There must be some benefit that accrues from having all this expensive neural tissue massed in your head, and you should theoretically have as little of that in your head as you can possibly need to survive and reproduce. But hyenas, they seem to have developed convergently the same kind of elaboration of at least social cognitive skills as we see in primates, presumably because they live in primate-like societies.

Fred Lawrence: Let me shift gears for a second from the ecosystems we've been talking about to a different ecosystem. I mean, the human ecosystem and the higher education and research ecosystem where there are many challenges these days to funding in different fields and the question of applicability of research to very practical solutions, the idea that general research sometimes has a harder time getting funded than that which will lead to the pill or the cure that will do lead to some disease.

I wonder in your area, and particularly now that you've been at it long enough, what you've seen over time in terms of the funding for this kind of research that obviously has applications to the human condition, but not anything immediate.

Kay Holekamp: No, that's true, but there are a lot of other potential applications to improve human welfare. I mean, my general feeling is that the more humans know about the animals and the plants and the other organisms in their natural environment, the better off we'll all be because we can potentially learn to coexist better, but also understand how we can help each other and benefit. Hyenas, for example, here's a species that can eat anthrax and not die, and they have just an extraordinary immune system. We've seen them be bitten in the face by big cobras and big rattlesnakes and they get sick for a day or two, but they're fine.

You see them exposed to canine distemper and rabies, and we can sample their blood and we know they have antibodies to these diseases. They've seen them, but they don't express symptoms or die. What is going on there? That's a really interesting thing. In fact, the US Army's given us some support over the years to investigate those kinds of questions because they felt it would be useful to them. But yeah, I think you're right. In

general, basic science is harder to get funded than biomedical or other aspects of applied science. We often try to have some applied elements in our grant proposals, even when the main focus would be basic science.

The funding rate at the National Science Foundation, for example, for basic research in behavioral biology is typically one or two percent of proposals submitted will get funded as opposed to more like 15 or 20% at the National Institutes of Health.

Fred Lawrence: What's next? What are the upcoming projects you're working on that you're excited about?

Kay Holekamp: I've got actually one going on right now where we are trying to understand the role of communication in collective behavior in mammalian societies. We have put radio collars on every single member of one hyena clan in our study area in Kenya. This is 30 hyenas basically. The collars are really unusual, because not only do they give you information on where the animal is in space via VHF and GPS transmitters in the collars, but they're also fitted with accelerometers and magnetometers. Once you get the collar back and can get the data, you can see how the animal was moving, but the coolest thing of all is that there's a microphone and a soundboard on every collar.

For the entire life of the collar, you hear every sound the hyena utters or hears. If the hyena hears a call for help, for example, you can see from the other instrument onboard whether or not it responded to what it heard. Did it go help that animal or not? And if not, why not? Were they just too far away? Were they full already and they didn't go help because they weren't hungry? There's a lot of different hypotheses that we can test here.

Fred Lawrence: One of the things I like to ask my guests on Key Conversations is to help our readers fill out their bookshelves or their Kindle with suggested readings. I wonder if you have a thought of a work or two for someone who actually has some background in the field, maybe not a specialist like you, but somebody with some background in animal behavior, and then as well, for someone who is interested in this conversation, wants to learn more, but really is at a pretty basic level of entry into the field of animal behavior.

Kay Holekamp: I would recommend two books for people who have some exposure already to scientific process and so forth. One was by Hans Kruuk. He's the guy who first studied hyenas systematically and had a lot of really interesting revelations. I swear I've read his book 500 times, and each time I've read it, I've learned new stuff. There's another one by a guy named Gus Mills on Kalahari hyenas, comparing brown and spotted hyenas that live sympathetically there.

For people who are just interested in this but don't have particular training, I would suggest a book by Sy Montgomery called *The Hyena Scientist*, where she actually came

to our field site and spent quite a while with us and did a great job, I think, of explaining to the lay public in general why hyenas are actually much more interesting than Walt Disney would lead you to believe.

Fred Lawrence: I think human beings are drawn to animals in so many ways, probably for evolutionary reasons as well. We have shared our planet, our communities, our ecosystem with them the entire time our species has been around. Trying to understand them better is clearly an important part of broadening our own knowledge about how we fit into the planet. Thanks so much for the work that you do in this and for sitting down with us on Key Conversations today to share these insights. Good luck with the continued work. We look forward to hearing results of future work, and thanks for being with us today on Key Conversations.

Kay Holekamp: Thanks, Fred.

Fred Lawrence: This podcast was produced by LWC. Kojin Tashiro is lead producer. Paulina Velasco is managing producer. This episode was mixed by Trim LightBurn. Hadley Kelly is the Phi Beta Kappa producer on our show. Our theme song is Back to Back by Jan Perching. To learn more about the work of the Phi Beta Kappa Society and our visiting scholar program, please visit pbk.org. Thanks for listening. I'm Fred Lawrence. Until next time.

CITATION:

Lawrence, Fred, host. "Kay Holekamp" *Key Conversations with Phi Beta Kappa,* The Phi Beta Kappa Society, February 27, 2023. www.pbk.org.

Produced by: