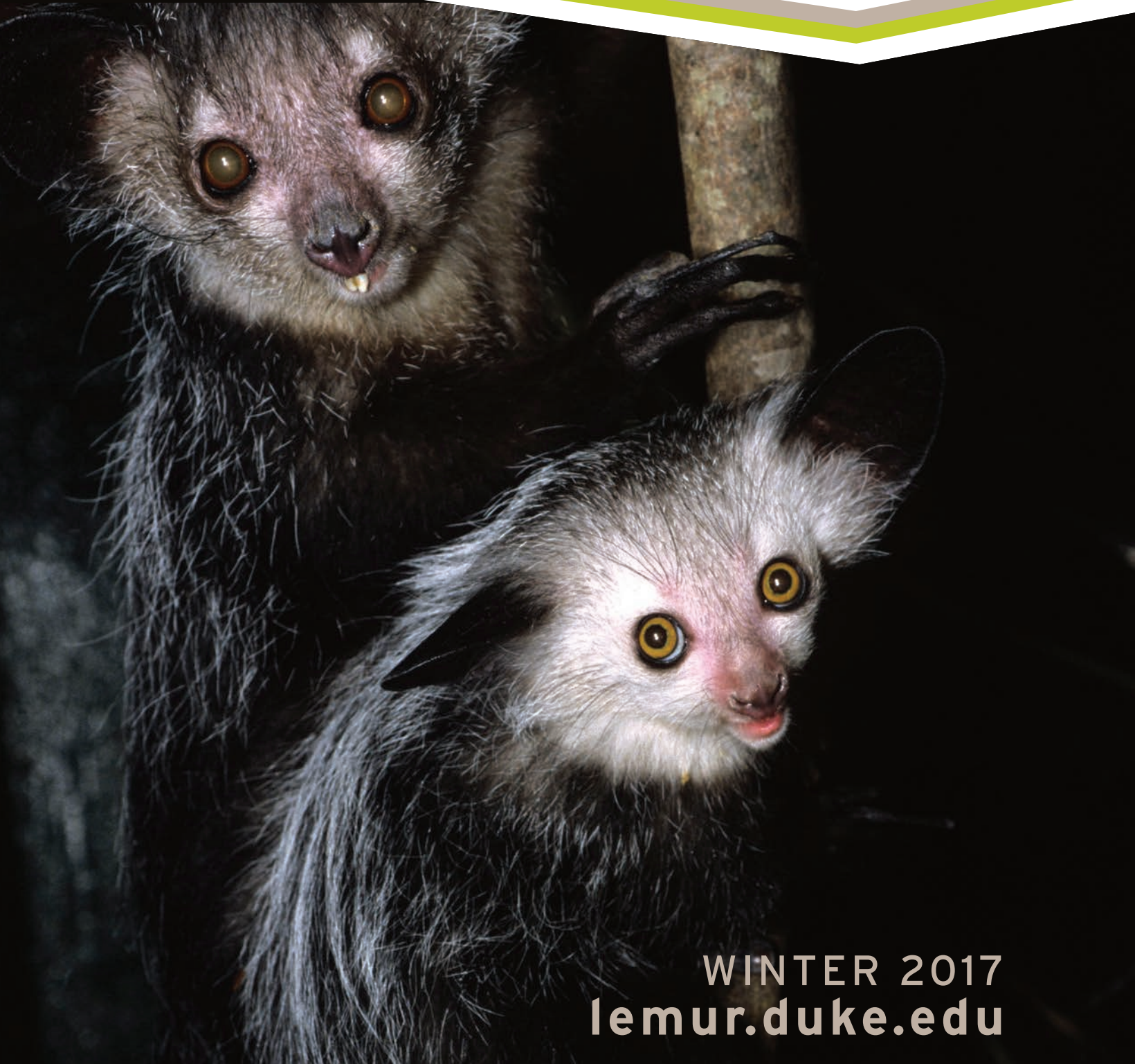




DUKE

LEMUR CENTER



WINTER 2017
lemur.duke.edu

DISCOVER | PROTECT | ENGAGE

LETTER FROM THE DIRECTOR

BY ANNE D. YODER, PH.D.



Caring for more than 200 fragile and endangered primates is never easy. When we began this adventure 50 years ago, no guidelines for lemur care existed. To determine the best foods to feed them, to diagnose their ailments, to encourage them to reproduce and to flourish --- initially, all of it had to be learned on the fly. But, over the years, we have gained vast knowledge about these remarkable animals and have come ever closer to perfecting our skills as their caretakers. And even though missteps sometimes occur, and occasional mysteries continue to perplex, keeping an unflinching eye on the lemur conservation prize has made it worth all the effort. It has been an honor and a privilege to be caretakers to the world's largest collection of lemurs outside of their native Madagascar.

This sense of a larger purpose, and our joy in that mission, faced a nearly crushing challenge on October 25th and 26th. In a matter of only 13 hours, we lost four of our most precious animals: Morticia, Norman Bates, Merlin, and Angelique. These four aye-eyes, ranging from young to old, were suddenly and inexplicably stricken, and not even the most strenuous efforts on the part of our animal-care and veterinary staff could save them. For all of us, that Wednesday, October 26th, is a day that we can barely bring ourselves to recall. The grief and the shock were overwhelming, made even worse --- if that is possible --- by what was at the time a completely mysterious cause of death. It was as if we had been hit by an asteroid, random and deadly, from the clear blue sky.

But we didn't have the luxury of giving into grief and despair, even for a moment. Hundreds of mouths needed to be fed, other animals' maladies and routine health needs had to be tended to, scheduled tours must be given, student projects had to be supervised, and so on. The essential daily functions of the Duke Lemur Center are matters of necessity. The staff came together, working through their grief, to assure that all necessary tasks were completed with the same skill and excellence as any other day. Wednesdays were my teaching days, so I had to

walk into the classroom just hours after the tragedy had happened and teach a room full of eager undergraduates, as if all was well. For me personally, and for every member of the DLC staff, I can tell you that October 26th was the most painful day of our professional lives.

Now, more than three months later, the pain is still fresh, and the wound is far from mended. This newsletter, dedicated entirely to our aye-eyes --- the fallen and those that remain --- is one step toward healing. In the pages to follow, you will read about the incredible intelligence and charisma of our aye-eyes from the people who know them best. You will also read about the intensive forensic analysis that has led us to the unavoidable conclusion that it was avocado toxicity that was the ultimate cause of death. Given that avocados have been a staple of the aye-eyes' diet for years, both at the DLC and elsewhere, and was in fact their favorite food, this finding has been a hard truth to accept. But the evidence is overwhelming, and we must and do accept it. The one glimmer of light to which we all hold is the knowledge that what we have learned from this tragedy can inform the care of aye-eyes now and forever, here at the DLC and at animal collections around the world. We will do all in our power to assure that not a single aye-eye will ever again succumb to avocado toxicity.

Aye-eyes are the vestige of an evolutionary lineage that has persisted for more than 50 million years, since the time that they last shared a common ancestor with other lemurs. They have so much to teach us, and they enrich our lives daily with their distinctive personalities and keen intelligence. We will rebuild our aye-eye colony, and our commitment to this species and to their survival is unwavering. Please join us in our pledge to continually improve their lives, and to insure their future for the next 50 million years.

ANNE D. YODER, Ph.D.

2016: THE SUMMER OF THE AYE-AYE

BY MEG H. DYE, BEHAVIORAL MANAGEMENT COORDINATOR & STUDENT PROJECT COORDINATOR

Sometimes, challenges become opportunities. The news that we would need to house four of our aye-ayes outside during the summer, in order to replace the HVAC in their indoor housing, was a significant challenge. However, having three months to observe aye-aye behavior in an outside environment was a remarkable opportunity to learn more about them.

Unlike many of our indoor aye-ayes, who are kept on a reverse light cycle to assist with research and observation, these aye-ayes would be on the North Carolina photoperiod. This meant the lemurs would emerge from their nests around 8:00 p.m. and go to sleep around 6:00 a.m. To assist with observations, night vision cameras were installed to record the animals' overnight behavior. In addition, I and four summer interns worked evenings to observe and interact with the animals during the first few hours they were awake, as well as to review video footage from the previous night.

Outside observations

After countless hours spent observing the aye-ayes, both in person and through the recorded footage, here are some of the highlights of each of the animals:

- Merlin was the early riser. He often was the first of the four aye-ayes up and active prior to sunset.
- Morticia could get an aye-aye “conversation” going! Generally the aye-ayes were quiet and did not vocalize with each other. However, we had a string of nights where Morticia would start with a deliberate, loud and coarse “eeekkk” which would be responded to by her neighbor, Merlin, and the two would continue back and forth for some time.
- We knew Angelique was an amazing nest builder – and now we had her skills on video! Angelique would chew off a piece of bamboo that was longer than she was, then manipulate its length, using only her mouth, to carry it back to her nest box. The magical part was watching her push



and pull the bamboo into her box. On the nights she was making a fresh nest, she could be observed working on the nest even as the sun was coming up – getting it just right before using it for the first time.

- Norman was the master of making nests on the ground. He would spend hours on their construction, chewing off pieces of bamboo or pine to haul to his nest spot. He particularly favored the “pie wedge” corner of his yard. These ground nests would start small and grow in size and complexity during each successive night.

Summer training sessions

Between May and September, training sessions occurred at either 8:30 p.m. or 5:00 a.m., and all four animals eagerly participated in them. Each aye-aye would often greet me at the door in anticipation of the session. Our main objective during these sessions was to have a basic visual check of each animal. However, given this rare opportunity to work with aye-ayes outside in the dark, an additional training goal was to condition each one for a voluntary weight on a hanging scale.



NORMAN TAPPING THE DOMES COVERING THE OUTDOOR CAMERAS.



- Merlin was the first to navigate down the scale and have his weight taken. By the end of the summer, he had become a master at descending the scale head first, turning around, and patiently waiting for his reward.
- Angelique would often climb down the scale but, once there, was reluctant to remove the foot she was using to hang from the branch that supported it. But, she finally did!
- Morticia would descend down the scale to her mid-point, then return to the branch supporting the scale. This was amazing progress for her as she, historically, had not taken to participating in training sessions.
- Norman thought the idea of chewing on the casing of the hanging scale was much more appealing than climbing down it. Whereas scale training went slowly, Norman

was superior to all at entering a kennel during a training session. We all have our strengths.

Similarly, Norman explored, tapped, and chewed on the domes that protected the outdoor cameras. By the end of the summer, he'd created a challenge for us to observe him through the indentations of teeth marks on the dome.

To say that I miss each of these individuals would be a huge understatement. Daily, I reflect on how thankful I am that the challenge of housing four nocturnal lemurs outside provided us the opportunity to work with and learn about these truly amazing lemurs. To experience the joy of watching some of our favorite video footage from last summer, please visit the DLC's YouTube channel.



MERLIN, NEARLY 19 YEARS OLD IN THIS PHOTO, GREETES VISITORS TO HIS ENCLOSURE.

VETERINARY SUMMARY

BY CATHY WILLIAMS, D.V.M., STAFF VETERINARIAN

When animals die at the Lemur Center it is always difficult and emotional for the animal care staff as well as the veterinary staff. In a situation such as the recent loss of the four aye-ayes, understanding and coming to grips with the loss is even harder as answers are often elusive and slow in coming. Despite the sense of grief we all feel, the veterinary department and senior management have focused intently on doing everything possible to determine what happened to these rare and unique animals.

The sudden death of four animals of the same species all within hours of each other is an extremely rare event in any animal colony and has never occurred before in the history of the Lemur Center. As such, the Center immediately reached out to specialists in the fields of disease investigation, a CSI team of forensic experts if you will. Specialists at Duke University, North Carolina State University College of Veterinary Medicine and the Centers for Disease Control all actively assisted the Center with the investigation. What follows is a summary of findings to date.

As in deaths due to unknown causes in humans, the first step is to perform a detailed post-mortem examination. Necropsies, the animal equivalent of autopsies on humans, were performed on all four animals immediately following death in hopes of finding clues to their demise. The only abnormal finding in all animals was the presence of fluid around the heart, or pericardial effusion, indicating that heart failure likely contributed to death. But why would heart failure occur in four otherwise healthy animals within hours of each other? In search of an answer to that question, the hearts and samples of all other organs were sent to several veterinary pathologists for further evaluation. Results confirmed injury to the heart muscle in all four animals but, unfortunately, could not determine the cause of the injury.

Given that the deaths occurred so suddenly and in such a short period of time, the highest probability was ex-



posure to a toxin, either in food or in the environment. Within hours of the first deaths, air and water samples as well as bacterial cultures were taken from the rooms in which the animals lived and from rooms housing unaffected animals. Thankfully, results from all these tests did not identify any toxins or chemicals in the environment that could have caused the animals' deaths.

This led us to consider the possibility that the animals may have consumed a toxin or chemical in their food. To rule this out, samples of the primate biscuit or "chow" fed to aye-ayes were tested for common toxins and heavy metals known to affect animals and humans. Here too, the tests did not identify the presence of any likely suspects.

To further explore the possibility that the animals consumed something toxic, stomach contents from the deceased animals were tested for an extended panel of known toxins in domestic animals. Results of those tests identified the presence of a toxin called persin, a chemical present in avocados.



MORTICIA WITH HITCHCOCK

We knew from the post-mortem exam and the microscopic evaluation of tissues from the deceased animals that a heart-related problem was likely the cause of death, and avocado toxicity was on our list of possible culprits early on. All 13 aye-ayes at the DLC had received avocado in their diets the previous day. But conclusively proving avocado toxicity is extremely difficult. Because humans aren't affected by avocado toxicity, there are no standard tests available to measure levels of the toxin in animals. The test that identified persin in the stomach contents of the aye-ayes confirmed the presence of the chemical, but not the amount present.

So where does that leave us? By pulling all the evidence together, many potential causes have been ruled out; for example, there is no evidence that the deaths were caused by bacteria, fungi, or a contagious disease. Several pieces of information point strongly to avocado as the culprit. These include the fact that 1) persin was present in the stomach of three of the aye-ayes that died (the fourth could not be tested); 2) the time of death in all four animals 24-30 hours after being fed avocados is common for avocado toxicity in those species known to be sensitive (e.g., domestic cattle, horses, goats, and several species of birds); and 3) persin toxicity predominately affects heart muscle and causes cell death identical to that seen in the 4 animals that died. Hence, avo-

cado toxicity has emerged as the most likely cause of this very tragic event.

How could this have happened you may be asking yourself? My best response is "It's complicated." Avocado toxicity has not been previously recognized as a threat to lemurs or, indeed, to any species of primate. Avocados have routinely been fed to captive aye-ayes around the world for years as a high-fat supplement, and it's one of the aye-ayes' favorite foods. The mystery that may never be solved is why these animals suddenly died on this particular day. Duke's aye-ayes have eaten the fruit about once a week without incident for the last few years. We are still combing through every bit of information available in attempts to understand what was different the day the avocados were fed that contributed to the death of four of our thirteen amazing aye-ayes.

Of course, it is frustrating not having answers to all of our questions. But I remind myself continually that this is a process and that it will take time. If there is a silver lining here, it is that avocado toxicity is preventable. Removing avocados from the diet of aye-ayes from now on will prevent such a devastating event from ever occurring again. And that is considerable consolation to all of us who care so deeply about the future of this remarkable species.

MERLIN'S MAGIC:

REACHING THE WORLD THROUGH RESEARCH

ERIN EHMKE, PH.D., RESEARCH MANAGER, DUKE LEMUR CENTER

There was one aye-aye who contributed more to science than any other aye-aye in the history of the Duke Lemur Center. There was one aye-aye who won the hearts of everyone he met, enticing giggles of delight as he fished for a mealworm in their closed fist. This aye-aye was Merlin.

Since 2007, 31 aye-ayes have contributed to our research program but Merlin solely accounted for nearly 15% of all aye-aye research. He participated in 27 different projects, totaling 247 trials. Merlin chewed, solved puzzles, and reacted to novel objects. He walked mazes, listened to music, and reacted (or rather, didn't react) to a fake fossa... all in the name of science.

Some of my favorite memories of Merlin involve research that allowed us to experience and appreciate the nuances of his personality:

- Two recent studies examined cortisol (i.e., stress) levels in the aye-ayes, and for this we needed to collect voluntary saliva samples. How do you get aye-ayes to willingly donate spit? Well, you encourage them to do what they do best... chew! And we encouraged them to chew by soaking the collection swabs in a dilute honey or blueberry concoction. Many of the aye-ayes would give a cursory chew or two and then lose interest. Some stole off with the swab (even though we tried to hold onto it via a fleece tie). But Merlin, well he so calmly rested on a branch and chewed until there was no flavor left to chew! He made our jobs easy, and it was nice to have those moments to simply observe and appreciate his beautiful oddities (i.e., those that come with being an aye-aye).

- Do aye-ayes see color, and if so, do they behaviorally express this ability? It was a challenging project, to say the least, and one that required dedicated, long-term training so that the aye-ayes understood the goal of the vision trials. Merlin was chosen to participate because of his motivation to engage with training. He would immediately station himself at the designated location at the start of the trial,

and he always maintained focus. He carefully studied the colored cards before making his selection rather than randomly swiping at a card like some aye-ayes did. As the DLC's behavioral trainer, Meg Dye, said, "He took his work very seriously and had fun with it!"

- And talk about having fun...Merlin even got to drink on the job! And I do mean an afternoon cocktail! Aye-ayes have a gene mutation (like humans) that enables them to more efficiently metabolize alcohol. It makes adaptive sense, then, that they would seek out this calorie-rich "treat" (in the form of fermented nectar or fruit), especially given harsh and unpredictable resource availability in Madagascar. Merlin was given a choice of several different solutions meant to mimic nectar, some that contained varying concentrations of alcohol and some that were simply sugar water. There was no mistaking the results... Merlin went straight to the two highest concentrations and systematically drained the cups one drop at a time using his tapping finger. While risking sounding anthropomorphic, Merlin thoroughly enjoyed this project. As soon as we entered his enclosure with the cups, he ran over and would try to start the trial before we were even set up for data collection. I will forever hold onto those memories.

But Merlin was so much more than a patient and curious study subject. Researcher Lydia Greene put it best: "Merlin was that animal. The one who could convince even the biggest skeptics that aye-ayes can be gentle, kind, curious, safe, and decidedly not evil. I saw many people fall in love with aye-ayes because Merlin tap-foraged with incredible precision in their fists, extracting mealworms with utter care. He was a true ambassador for his species."

Merlin is greatly missed. His death is an immense loss to research and of all the potential he had to contribute. Even more importantly, the DLC and lemur supporters around the world lost one of our greatest connections to the bizarre and fascinating world of the aye-aye. Thank you for letting us in, Merlin.

ANGELIQUE THE AYE-AYE, A PRIMATE CENTER TRIUMPH

BY DENNIS MEREDITH



ANGELIQUE BEING WEIGHED AT
3 MONTHS, 1 WEEK OLD

This story originally appeared in Duke Today on January 26, 2006. Reprinted with permission.

At only a couple of pounds, the gangly creature named Angelique hardly seems like the centerpiece of an historic event in the preservation of her highly endangered species. But the little aye-aye is, indeed, just that. She is the first of her species ever born to parents who were themselves born in captivity.

Angelique's successful birth last September [2005] was a signal event, because the ancient primates known as aye-ayes are notoriously complex social creatures. And the achievement of the Duke Primate Center [as the Lemur Center was then named] -- more specifically Assistant Director Dean Gibson -- in coaxing Angelique's inexperienced father to mate yielded important insights into the requirements for breeding aye-ayes in captivity.

The strange primates are fascinating both in themselves and as examples of the ingenuity of evolution. Their evolution began some 60 million years ago, when their line split off from their fellow lemurs on the island of Madagascar. Since

then, they have adapted magnificently to occupy the ecological niche that elsewhere is the province of woodpeckers. The difference is that aye-ayes use batlike ears and finger-tapping to detect grubs hidden beneath tree bark; beaver-like teeth to gnaw into the wood to expose them; and the dexterous fingers with hooked nails to fish them out.

Today, aye-ayes are extremely rare on Madagascar, both because of deforestation and because local superstition holds that if an aye-aye points a finger at a person, that person is doomed. Thus, the gentle animals are killed on sight.

Since the Primate Center first brought aye-ayes into captivity some two decades ago, they have been successful in maintaining the animals. In fact, the center was the site of the first captive aye-aye birth -- Blue Devil, born in 1993. However, all aye-ayes at the center have, until Angelique, been born of fathers socialized in the wild -- apparently where they learned the art of mating.

So, when it came time for these first-generation offspring to mate, the center was faced with teaching naive male aye-ayes the arts of lemur love.

"Even though the wild-caught animals reproduced well, the males from that first generation were not showing any signs of interest in breeding, well beyond the years that the first-generation females had already started cycling and breeding," said Gibson. "The males at four to five years of age were clueless and knew nothing about breeding."

One of these males was Merlin. Despite having been on a "honeymoon" at the San Francisco Zoo for two years with another female, Caliban, Merlin showed no ability to breed. Determined to ensure the continuation of the species, Gibson paired Merlin with the captive-born female Ardrey who had breeding experience with a wild male. The result was sparks, but not of love.

"Merlin was scared to death of her, didn't know what to do," said Gibson. Instead of performing the requisite be-



ANGELIQUE, NEST BUILDING

haviors of sniffing and mating, said Gibson, Merlin would sniff and run away, apparently unsure what to do next. And Ardrey would take annoyed swipes at the reluctant suitor.

"It took two years of catching her in her breeding cycle, putting Merlin with her every day during her cycle, coaching him along and stopping her from being aggressive towards him," recalled Gibson. "I'd stand there with a net, and defend him, and when he was doing well, give him nuts.

"Also, I'd give her treats to calm her down, so she'd sit there and eat, rather than attack him," she said. Eventually, Gibson's coaching was successful, and the animals bred. Gibson's reward from the animals was by no means their gratitude. "Ardrey was hateful afterwards; she even smacked me in the head." Nevertheless, Gibson did receive an ultimate gratification for her efforts, in the form of Angelique.

The experience with the aye-ayes has taught the center's primatologists an invaluable lesson -- that the complex creatures need socialization to mate. Thus, said Gibson, "We've introduced Tolkien, a younger male, with Merlin to maybe get some competition going; because in the wild, when a female starts to cycle, she'll call and present herself, and males will come in and compete." Gibson reports that the young Tolkien appeared to learn mating skills from Ardrey as well as the now-experienced Merlin.

According to center Director Anne Yoder, the animals' need for natural socialization is also driving design of

planned new housing at the center. "We need to build facilities so that these animals can live in the social structure required for their natural reproductive behaviors to emerge and continue," said Yoder. "Otherwise, we might find ourselves housing the last aye-aye, or the last examples of other of these endangered lemurs.

"Dean showed us through her amazing coaching efforts to promote the aye-ayes' mating how important this socialization is -- that their behaviors are so much more sophisticated than one would ever suppose, given the traditional belief that lemurs are merely hard-wired for behavior," said Yoder. Thus, she said, the center plans include "aye-aye atriums," spacious facilities that will allow a full range of socialization among the animals.

And for other lemurs, the new facilities will feature indoor housing amidst outdoor fenced enclosures. Thus, during the winter, the animals can be released on warm days, but brought into the buildings when temperatures drop.

Not only will such flexible arrangements relieve the animals' social stress from being housed indoors all winter -- as is now the case. They also will enable researchers to continue lemur behavior studies year-round, said Yoder.

Such studies, she said, will yield scientific surprises about the primates that, isolated on Madagascar, evolved into a rich array of species in parallel with anthropoids in the rest of the world. Also critically, said Yoder, the studies will yield knowledge that will enable preservation of the exotic, endangered primates.

Duke's Aye-Ayes : Worldwide Impact

THE DUKE LEMUR CENTER'S "FOUNDING EIGHT" have produced descendants enough to populate domestic zoos in six states, and also sufficient to provide individuals to zoos overseas in London, Frankfurt, Tokyo, Bristol, and Jersey Channel Islands.

1987 IMPORTS



1986-LIVING



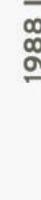
POE



1985-LIVING



NOSFERATU



1988-1989



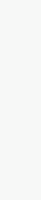
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1978-1995



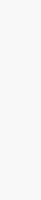
SAMANTHA



1988-2016



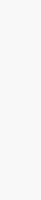
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1983-LIVING



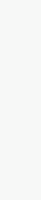
ENDORA



1985-LIVING



OZMA



1981-2014



MEPHISTOPHELES

1988 IMPORTS



1988-1989



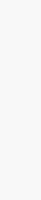
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1978-1995



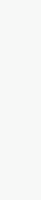
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1988-2016



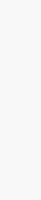
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1983-LIVING



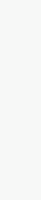
ENDORA



1985-LIVING



OZMA

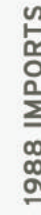


1981-2014



MEPHISTOPHELES

1991 IMPORTS



1988-1989



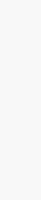
ANNABEL



1978-1995



SAMANTHA



1988-2016



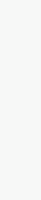
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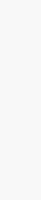
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1985-LIVING



OZMA



1981-2014



MEPHISTOPHELES

1992-1998



1992-1998



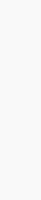
UNKNOWN WILD MALE



1994-2016



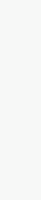
MERLIN



1998-LIVING



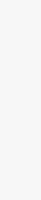
KALI



2001-LIVING



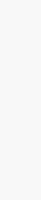
LUCREZIA



2005-LIVING



CLAUDIA

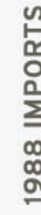


2010-LIVING



GRENDDEL

1993-1998



1993-1998



CRUELLA



1996-LIVING



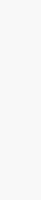
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1998-2008



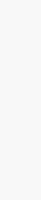
MARVIN



2001-LIVING



TOLKEIN

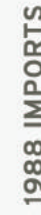


2003-2016



SABRINA

1998-LIVING



1998-LIVING



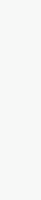
WARLOCK



2001-2015



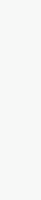
OZONY AVELO



2003-LIVING



MEDUSA



2010-LIVING



STYX

1992-1998



1992-1998



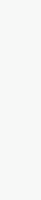
BLUE DEVIL



1998-LIVING



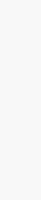
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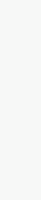
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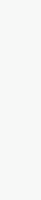
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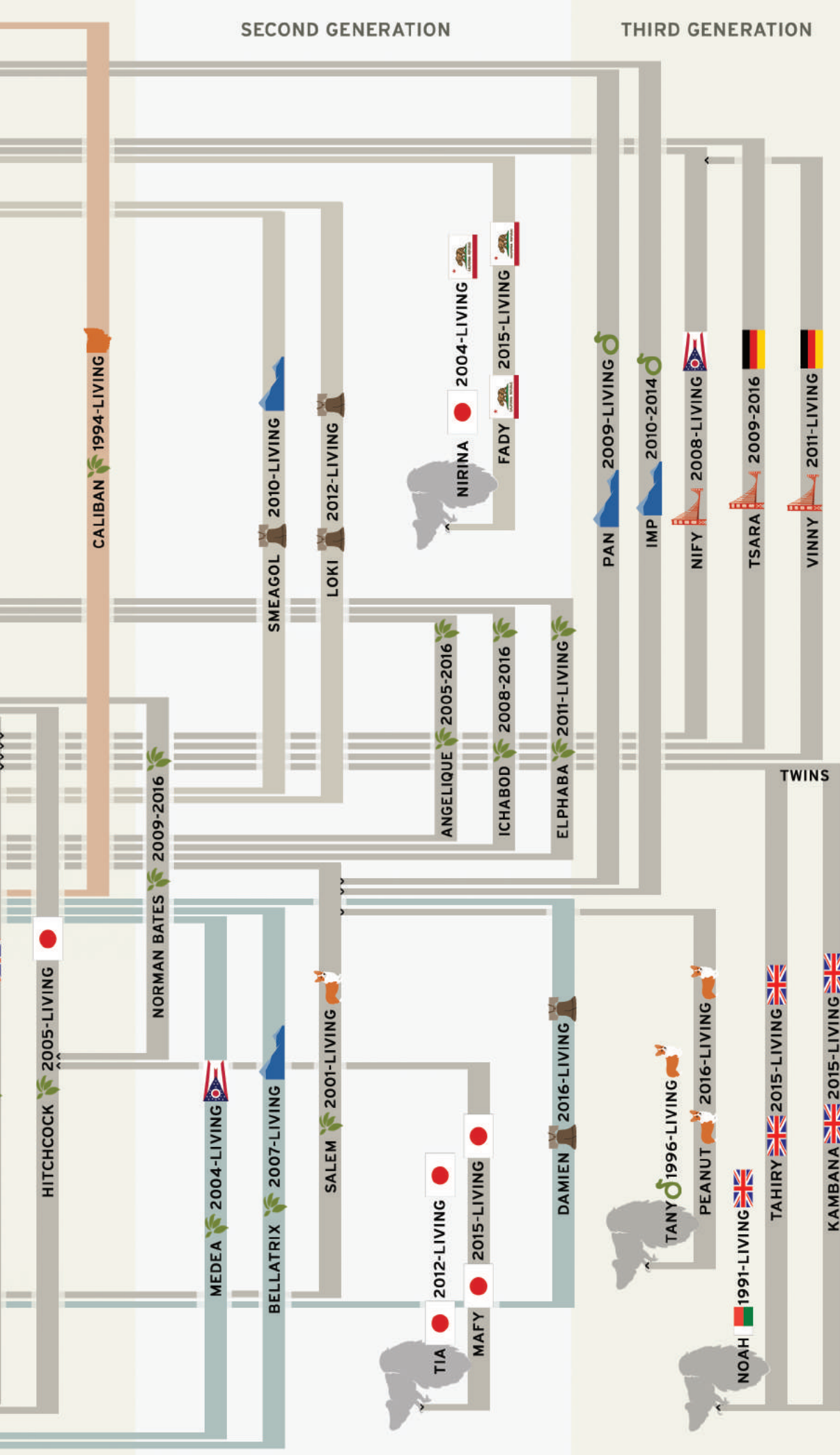
MEDUSA



2010-LIVING



STYX



SYMBOLS INDICATE EACH AYE-AYE'S PLACE OF BIRTH (LEFT) AS WELL AS PLACE OF DEATH OR CURRENT LOCATION (RIGHT). The animals' years of birth and death (if appropriate) are provided. Birth dates of wild caught aye-eyes are estimates.

A left-facing gray aye-aye symbol denotes animals not related to the DLC's original eight aye-eyes. All other symbols are defined below.

	DUKE LEMUR CENTER (USA)		CINCINNATI ZOO (USA)		UENO ZOO (JAPAN)		WILD CAUGHT (MADAGASCAR)
	DENVER ZOO (USA)		CLEVELAND ZOO (USA)		BRISTOL ZOO (UK)		FRANKFURT ZOO (GERMANY)
	SAN FRANCISCO ZOO (USA)		HENRY DOORLY ZOO (USA)		LONDON ZOO (UK)		DURRELL WILDLIFE PARK (JERSEY)

THE DLC'S FOUNDING AYE-AYE FATHERS (AND MOTHERS)

BY DAVID HARING, REGISTRAR AND PHOTOGRAPHER

The Duke Lemur Center was one of the first modern-day captive breeding centers to house the mysterious and, at the time, little studied aye-aye. (The Paris Zoo and Jersey Wildlife Preservation Trust were other pioneers.) Three complicated and arduous DLC capture missions to Madagascar succeeded in the importation of two males (Poe and Nosferatu) in 1987, two females in 1988 (Annabel Lee and Samantha), and one male and three females in 1991 (Mephistopheles, Morticia, Endora, and Ozma). All of the wild caught aye-aye were captured in threatened, unprotected areas containing fragmented forests in diverse locations across Madagascar. Besides Mephistopheles, who died in 2014 at the ripe old age of 33, and Morticia, one of the four deaths this newsletter mourns, the remaining four aye-aye wild caught during the 1987 and 1991 imports remain alive and well to this day. With an average age of 31 years old, they are all remarkably healthy: their current medical woes consist only of dental problems and the inevitable cataracts of the aged lemur.

As of December 1st, there were 23 captive aye-ayes in the United States: 10 males and 13 females. Of these, nine reside at the DLC and 14 are held at six additional AZA¹ institutions. All but one of these 23 are descendants of our original eight wild caught founder animals. The original eight (only one of which did not produce offspring) have not only produced descendants enough to send to the six domestic zoos, but sufficient aye-aye have bred successfully to ship animals overseas to zoos in London, Frankfurt, Tokyo, Bristol, and the Jersey Channel Islands.

The arrival of the first aye-ayes

1987 was a long time ago, but I clearly remember the arrival of the first aye-ayes ever imported into the U.S., Poe and Nosferatu ("Nosy"), at Raleigh-Durham International Airport late one December evening. I drove to the airport in my tiny Toyota hatchback where I met DLC Director Elwyn Simons who, thankfully, had driven in his more Director-worthy larger vehicle. We had only a short wait

until the plane carrying Dr. Patricia Wright, accompanied by kennels containing Poe and Nosferatu, arrived. Dr. Wright was triumphantly returning from the capture mission in Madagascar where she and field assistant Patrick Daniels, after nearly a month of fruitless searching through empty aye-aye nests, had finally located and captured the two males a few days before they were scheduled to leave the country. (Dr. Wright's return might have been even more triumphant if she had managed to capture a male/female pair!) For an interesting and amusing account of the rigors of this capture mission as well as the trials and tribulations of air travel with two aye-aye from Madagascar to NC, check out a YouTube video of Dr. Wright's talk from the Lemur Center's 50th-anniversary symposium. This and all the other talks from the symposium are available for viewing at lemur.duke.edu/discover/50th-anniversary-scientific-symposium.

A surprisingly short time after the plane's arrival, the aye-ayes were made available to us. I loaded one into my Tercel and off we drove to the Lemur Center! 1987 was a radically different time. Today, any incoming shipment of a non-human primate (NHP) of any species into the U.S. is strictly monitored and controlled by the CDC. Special precautions must be taken to assure that any crate containing such a critter be segregated from the general public at all times. Any human coming in direct contact with crates or carriers must be outfitted in a full hazmat suit, and when a shipment of imported NHPs arrives at an airport, the plane must be met by the hazmat-suited officials, who are the only ones authorized to unload the animals. I always thought it must be unnerving to be waiting to deplane, and look out the window only to see a pair of workers, garbed head to toe in full hazmat gear, unloading your plane's cargo! Regulations also state that after unloading, special vehicles must be used to transport the NHPs from the airport to a CDC-approved quarantine facility (for 31 days) ensuring, again, that the newly imported primates do not pose a risk to human health. The days of grab-



bing your newly imported primate at the airport baggage claim, then casually schlepping the kennel through the terminal to your personal vehicle parked out front, are gone for good!

Unraveling the secrets of aye-aye husbandry

When I began working at the Center in the early 1980s it was thought that aye-ayes might actually be extinct in Madagascar, as it had been years since anyone of any scientific authority had seen one in the wild (perhaps due to the fact that most foreign scientists had been banned for years from Madagascar). But just a few years later, by the time the Lemur Center had launched its first aye-aye capture mission in 1987, it was apparent that aye-aye were actually widely distributed throughout the island, although nowhere in high density. Still, virtually nothing was known about their social structure or dietary needs.

Since details of the animal's natural history were unknown to biologists, how did we know how to feed and take care of the animals when they arrived at the DLC in 1987? Good question! In fact, until Yale University student Eleanor Sterling's dissertation work was completed in 1994, in which she identified four main types of food favored by the aye-aye (insect larvae, seeds, nectar, and fungi), little was known about wild diets. However, even in 1987, we knew that wild aye-aye ate a variety of insect larvae like those found in trees and rotten logs; hence larvae (available commercially as mealworms) became an important component of our original captive diets. Initially we presented the mealworms in stainless steel bowls but, not surprisingly, neither Poe nor Nosy was familiar with the function of bowls and failed to recognize a writhing mass of squirming mealworms so presented as food.

We quickly figured out that if we delivered the grubs in a more naturalistic manner – inside a hollow stalk of

bamboo, for instance – we might have more success. Sure enough, the aye-aye approached these bamboo stalks exactly as they would any potentially edible item. With their enormous ears perked forward and their noses nearly touching the stalks, the aye-aye would move slowly up the bamboo, all the while rhythmically tapping it with their third fingers. Their tapping would clue the animals to the fact that the bamboo was hollow and therefore a potential source of burrowing insects. Then they would immediately rip into the tough stalk using their powerful jaw muscles and sharpened incisors, until an opening was made. At that point, using their third fingers, the aye-aye would explore every inch of the inside of the bamboo until a grub was found, at which point it would be hooked with the finger and pulled directly into the mouth.

Poe and Nosy also enjoyed foods supporting the fact that they were omnivorous lemurs: coconuts, cucumbers, chicken eggs, corn on the cob, and melons among them. In a matter of months, we had arrived at what we thought was a suitable captive diet, basically consisting of portions of everything the animals liked plus a variety of novel fruits and vegetables, as well as some primate chow. There were some problems with this diet: the aye-aye would leisurely pick through the large platters presented to them daily, selectively eating only their favorite food items. Often they consumed only about 15-20% of the total amount of food given to them, leading to an enormous amount of waste and making it difficult to document exactly how much food the animals were consuming (not to mention the fact that it is never a good idea to give primates a diet consisting mainly of their favorite foods!).

Nonetheless all went smoothly for the colony in the years following the last importation in 1991, with the eight founders all doing well (except for a juvenile female, Anabel Lee, who arrived with her ancient mother Samantha in 1988 and died a little over a year later). Then, the



celebrations started as the founders began to produce infants! Blue Devil, the first aye-aye to be born in captivity in North America, was discovered unexpectedly in his mother's nest in April 1992. (Apparently, Endora had been pregnant when she arrived from the wild in 1991.) Next, the first infant conceived from a captive breeding, Goblin, was born in October 1992, to Ozma and Mephistopheles. Cruella was born in October 1993 to Morticia and Poe. In June of 1994, Endora produced another infant, Merlin, this time from a captive breeding with Nosferatu.

Then, just before his first birthday, Goblin's technician noticed that he was looking lethargic and dragging one of his legs. Radiographs revealed that he had undergone a stress fracture due to poor bone density, in turn caused by a vitamin deficiency. Our precious infant had developed rickets! It was at this point that we realized that our aye-aye diets were flawed and nutrition experts were called in for consultations. An extensive diet survey was undertaken in 1993 by Sue Crissey, a nutritionist from the Chicago Zoological Society.

The survey, which carefully documented each food item given the animals and whether it was consumed or rejected, revealed that we needed to introduce a nutritionally complete, commercially available primate chow. Of course we had been providing chow all along, but in the midst of their full trays of choice food items, the aye-aye were simply not consuming the most nutritious food, the chow—because, let's face it, chow is dry and somewhat tasteless and what self-respecting primate would turn down coconut, mango, egg, and corn on the cob for a monkey chow which probably tasted like cardboard? It became clear that in order to entice the aye-aye to eat chow we had to reduce the amount of their favorite food items, so the animals would feed on the less appealing but essential chow.

The animals were less than enthusiastic about this new diet plan, until one of our technicians had a brilliant idea: concoct a chow gruel, flavor it with something tasty and then present it to the animals in a more naturalistic container: namely a hollow stem of bamboo from which the animals could dig it out with their fingers much as they would grubs. After much trial and error and with a variety of flavorings (vanilla extract turned out to be the initial favorite), the aye-ayes began to feed on this gruel, and since that day, neither the colony's infants nor our adults ever suffered again from any sort of nutritional deficiency.

In the years that followed, additional surveys were undertaken, with the aye-aye diets over time becoming more and more refined and sophisticated. Our general husbandry techniques have also evolved greatly since the early days, as there has been a push to provide more and more enrichment to the animals: food puzzle boxes, the construction of complex arboreal pathways, and provision of a wide variety of nesting material and natural logs for foraging. These refined husbandry techniques were what allowed our population to thrive and captive aye-aye numbers to grow to the extent that we could send healthy captive born animals across the country and even across the globe.

October's tragedy, and a remembrance of Morticia's life at the DLC

A few short months ago, I would have reported that things could not possibly be better in the aye-ayes' sheltered corner of the universe at the Lemur Center, until the fateful evening of October 25th. Then, in one absolutely horrific 13-hour period, four DLC aye-ayes ranging in age from 7 (Norman, Morticia's last born) to 28 (Morticia), all in excellent health, suddenly became extremely ill only to inexplicably perish in a matter of hours. To bring

the unlikelihood of that stunningly swift tragedy into perspective, just consider Morticia's 25-year DLC history:

In 1991, Morticia, then a strapping young aye-aye, was taken from her nest 30 feet up a tree in a remote forest in western Madagascar near the village of Anjimangirina by a Malagasy guide. The guide deposited her into a cloth bag, descended the tree, and transferred her to a kennel where she was driven over hundreds of kilometers of bumpy roads to Madagascar's capital city Antananarivo. A few days later, she was transported to an international flight, and more than 24 hours later landed in Raleigh, NC. Then followed a six-hour drive to a CDC quarantine facility in coastal South Carolina, and 31 days later she found herself in a large room at the Duke Lemur Center (next door to her eventual mate, the handsome Poe), a caring and conscientious facility, but one that was just beginning to unravel the secrets of aye-aye husbandry.

Morticia lived for 25 years at the Lemur Center. Whether she was happy during that time, we cannot say, but she was certainly healthy, reliably producing an infant every two to three years, with a final total of seven offspring², more than any other captive female aye-aye has ever produced, and all of which survived to adulthood. Recent years have seen her gradually settling into a comfortable "retirement" in which no curator or species manager would ever again ask her to produce yet one more infant. And her personal caregivers, the DLC's dedicated staff of Primate Technicians, were all beginning to dote on her, eager to respond to her every need because everyone knows that animal caretakers adore their geriatric animals.

In short, Morticia, based on her 25-year-long stay with us, was one tough cookie of an aye-aye. What, then,



could have been the cause of her (and the other three animals') sudden passing? That was the question that everyone at the Lemur Center, and indeed aye-aye lovers everywhere, were thinking about for months during the DLC's exhaustive investigation into their deaths. You can be sure that avocado is forever off the menu for every lemur at the DLC.

I feel confident that the captive aye-aye population will successfully rebound from the tragic loss of the four, and that once again in the not too distant future, the DLC's now empty 07 core rooms will bustle with the activity of technicians dragging in huge bundles of nesting bamboo, new branches, diets and other enrichment items for the aye-ayes housed within. But only the passing of many years will ease the pain and emptiness now felt by all those who knew and loved the fallen four.

1 Association of Zoos and Aquariums. The AZA is a non-profit, independent accrediting organization dedicated to the advancement of zoos and aquariums in the areas of conservation, education, science, and recreation. To learn more, visit AZA.org.

2 Cruella, Hitchcock, Tolkein, Sabrina, Marvin, Ardrey, Norman Bates.

50TH ANNIVERSARY SCIENTIFIC SYMPOSIUM

A heartfelt THANK YOU to everyone who helped make the DLC's 50th Anniversary Scientific Symposium & Gala such a success! Held in Durham on September 21-23, the symposium brought together leading scholars engaged with research at the Duke Lemur Center. Their

talks spanned a vast array of disciplines, from behavior and genomics to brain sciences and paleontology. Videos of the talks are archived online at lemur.duke.edu/discover/50th-anniversary-scientific-symposium. Please enjoy!

OUR FOUR LOST AYE-AYES

BY JULIE MCKINNEY, LEAD TECHNICIAN



JULIE MCKINNEY WITH
INFANT ELPHABA

Three months ago, we lost four amazing, beautiful and rare animals that I'd had the privilege of caring for over the years. Reflecting on my ten-year career working with the aye-ayes at the DLC, I've realized that each of these four, in their own unique ways, taught me valuable life lessons. I'd like to share them with you, in the hopes that these aye-ayes will not be forgotten.

Morticia

A stunning aye-aye with a fantastic white stripe on her tail, Morticia was wild caught in November 1991. Named after Morticia Addams, matriarch of the Addams Family in the 1960s tv series, Morticia the aye-aye was a matriarch herself. She was mother to seven offspring, grandmother to 20, and great-grandmother to seven.

Morticia was one of the most amazing nest builders, fashioning beautiful tightly woven creations with only the smallest hole to enter and exit. She passed that trait on to her offspring, who became excellent nest builders themselves. Morticia was also a very selfless mother. Seven years ago, she had her last offspring, Norman Bates, whom I

had the pleasure of watching her raise. She let him steal all her food, and she taught him to build beautiful nests. He was as stunning as she was.

During my time as her technician, Morticia taught me patience as she was one of the aye-ayes I trained on a daily basis. I would love to tell you that I trained her to do all kinds of amazing husbandry things, but I didn't. I taught her very little and instead she taught me patience! In the training world, it is all about finding the animal's motivation, and I never did. I tried new treats and new behaviors, but day after day, she would just take the treat and leave me standing there. I learned that each aye-aye has its own unique personality, likes and dislikes. I learned that no matter what I did, Morticia ruled the house and I was just a visitor.

Norman Bates

Holy aye-aye Norman was a character! He was the last son of Morticia, born on April 3, 2009. He was named after the main character in Alfred Hitchcock's Psycho, a name that at times seemed to fit him like a glove. Like other aye-ayes, Norman went through a difficult "terrible twos" phase of development, but for him it lasted most of his life. For a typical aye-aye, the terrible twos consist primarily of a youngster slapping his technicians on the head and charging at them, which as you can imagine can be a bit scary. But really, the youngster is just testing its boundaries, and I have to say it's one of my favorite ages! I can't begin to guess how many technicians were chased out of Norman's room.

While he was best known for this behavior, the handful of technicians who regularly cared for and trained Norman got to see his softer side. It took nerve to train Norman Bates – but he was always a perfect gentleman and would take the smallest pieces of nut right out from between your fingers with his teeth. Norman taught me to look past his blustery cover. If I had run away from him the first



JULIE MCKINNEY TRAINING ARDREY

time he chased me, I would never have discovered his gentler side which I came to love. You couldn't judge what Norman was really like, without him first testing you to see if you would play by his rules.

Merlin

Merlin was born at Duke on June 5, 1994, to wild caught parents Nosferatu and Endora. He and his mate Ardrey produced three infants: Angelique, Ichabod, and Elphaba. All were notable births, since Ardrey and Merlin were the first captive born aye-aye pair to successfully produce infants! Merlin himself was the gentlest aye-aye I've ever worked with, and he was always incredibly polite and easygoing.

When I started training Merlin, I realized how smart and motivated he was. His training provided us with many insights on how a well-trained aye-aye could assist in DLC husbandry needs. One of his trained behaviors was to hang by his feet and let us palpate his abdomen. At first, I was unsure how this would prove useful, but as with everything I learned from Merlin, I was able to transfer the training of this particular skill to Ardrey, his mate. When Ardrey learned to dangle by her feet, we could then gradually get her accustomed to having her abdomen gently palpated, first by hand and then by an ultrasound wand. Using this technique, we were able to confirm that she was pregnant with Elphaba.

Merlin taught me a lot about aye-ayes, but most importantly he gave me confidence. While I was beating my

head on the wall training Morticia, Merlin was rewarding my patience and allowing me to grow by giving me the confidence that training aye-ayes was indeed possible and well worth it.

Angelique

Named after Angelique Bouchard from Dark Shadows, Angelique was born at the DLC on September 5, 2005 to Ardrey and Merlin. A pioneer in our first experimental attempts to house aye-aye outdoors, Angelique proved that aye-ayes could live active, enriched lives in outdoor housing. She was also the first aye-aye at the Lemur Center to make a nest out in the open, not in the box we provided for sleeping, and it was lovely.

Angelique was a thinker and would work hard for all of her enrichment. She made her technicians work hard, too. We had to constantly develop new enrichment, as well as find new handling techniques for her – she wasn't afraid to show you her beautiful pearly whites when you tried to hand-grab her out of her box for a visit to the vet! Angelique taught me to think on my feet and go with the flow. She made me a better technician because I had to trust my instincts with her.

These last few months have been far from easy on any of the staff, but thinking about what these beautiful and irreplaceable creatures taught me has given me the chance to grieve them and remember and appreciate them. These aye-ayes have made me the technician I am today, and for that I am truly grateful!

TAKING CARE OF NORMAN BATES

BY KATE BYRNES, PRIMATE TECHNICIAN

For eight years, I've cared for animals at sanctuaries, rehabilitation centers, zoos, and most recently, the DLC. In doing so, I've tended several hundred individual animals of more than 100 different species. As a professional, I strive to provide the best possible care to any and all animals under my responsibility. That said, I don't think I'm alone in admitting that a few special individuals have made an outsize impact on my life and career – a fancy way of saying, yes, I do have favorites.

Enter Norman Bates.

When I arrived at the DLC two years ago, Norman Bates had a reputation and the nickname "Stormin' Norman." While the Center was working to educate the public on the gentleness and uniqueness of aye-ayes, who have traditionally been viewed as "scary" or "ugly," Norman was happily charging and slapping at anyone who dared enter his enclosure if he didn't feel they needed to be there. Even seasoned researchers had to be closely supervised around him. And I was to be his primary keeper!

Yet while Norman had a reputation that he certainly deserved, he was still a favorite of several technicians and other staff. Some people's favorite animals are always the cutest or cuddliest. But for me and many others in this field, our favorites are the animals that challenge us daily to earn their trust; the ones that make us work harder to provide them with the proper diet, an abundance of enrichment, challenging training, suitable housing, and so much more. It's these animals that not only give me new appreciation for them as individuals as well as for their species, but also make me a better caregiver.

It didn't take long for me to share the same fondness for Norman that many others had developed since his birth at the Center in 2009. And that affection seemed to grow over the two years I worked with him. I'm not saying he never scared me right out of his room, particularly when he decided to imitate a huge flying squirrel and leap across



KATE BYRNES WITH AYE-AYES
ARDREY AND ELPHABA

the enclosure at me because I was too loud bringing in his bamboo! But that was only one side of Norman. If I respected him by moving quietly and slowly around him, he allowed me to be in his presence. That was when I truly discovered his personality and intelligence.

Eventually I started training with him, and once I discovered his fondness of pecans, he was eager to work with me on any behavior I tried. We were able to make tasks that were once stressful, such as kenneling and getting monthly weights, fun and easy activities. Norman would voluntarily walk onto the scale any time I asked, even during daylight hours. I could call him out of his nest box and he would calmly crawl down, walk to the scale, station himself on top of it while enjoying his pecan reward just long enough for me to record his weight, then turn around and head right back to his nest.

He motivated me to work harder on training and enrichment because his positive reaction to my efforts was positive reinforcement for me. Giving him rotten logs and nesting material was always a favorite. Give him any size box, and he would find a way to make a nest in it! (Seri-



NORMAN BATES, ADULT

ously, any size box!) Hide his worms in anything and he would find them. Even if an item didn't have worms inside, he'd still check just to make sure. His intelligence also showed in his participation in research, and as he aged and matured he became a lot easier to work with and captivated even more people. He was also one of the best-looking aye-eyes, but if you can't tell by now, I'm a little biased.

Norman was and will always be a favorite, and I'm only one of many who have worked with and loved him. All of the aye-eyes at the DLC are valued, and many technicians have dedicated years of their lives caring for them. Even after this devastating event, we all continue to work hard to save this species and all of the species we care for, because we will never forget those that are no longer with us and everything they have taught us.

SEND AN AYE-AYE A PRESENT!

Did you know you can send special treats like fleece, coconuts, and sugar cane to the DLC's aye-eyes? Select an item from our online wishlist, and your gift will be sent directly to the DLC! To see the wishlist, please visit lemur.duke.edu/donate/wishlist. Great gifts for aye-eyes are specially marked!



ANGELIQUE



The DLC's oldest aye-aye, Endora, celebrated her 33rd birthday in December! (Since she was wild caught as an adult in 1991, her age and birthdate are estimated.) Her technician, Jodi, made a healthy cake of raisins, frozen banana, honey, and chow to help mark the occasion. Endora lives with our second oldest aye-aye, Ozma (31), so of course Jodi made a cake for Ozma too! The two old ladies celebrated close together, but separately, in style: Endora on the floor of the enclosure, where she spends a lot of her time, and Ozma on the green shelf. Besides the fact that both old gals have cataracts, are losing some pigmentation in their extremities (check out Endora's tapping finger), and are a bit slow getting around, the ladies are in excellent shape for their ages!

Cover photo: Ozma, one of the Lemur Center's original eight wild caught aye-ayes, was imported with Morticia in 1991. See "The DLC's Founding Aye-Aye Fathers (and Mothers)" on page 10.



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