The hectic around-the-clock effort to save an endangered, orphaned bat

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Early one Wednesday morning in January, in an exhibit at the San Diego Zoo Safari Park, a fruit bat named Patty went into labor.

This should have been good news. Patty belongs to a colony of critically endangered Rodrigues bats, a species that almost went extinct in the 1970s. The bats exist in the wild in only one place - a small island in the Western Indian Ocean - and the colonies at the Safari Park and more than a dozen other zoos around the world form a kind of Noah's Ark for the future.

Bats are creepy to a lot of people, but they play important roles in ecosystems across the globe as pollinators, seed-dispersers and mosquito-eaters. Take away bats and the world would be a lot less lush and a lot more itchy.

So Patty's pregnancy represented another brick in the bridge of survival at a time when scientists say the planet is experiencing a "sixth wave" of extinction, with dozens of plant and animal species disappearing every day. Except Patty was in trouble.

A keeper found her on the ground of the exhibit, writhing in apparent pain. Her amniotic sac was visibly protruding.

The bat was rushed to the Safari Park's hospital. The staff there put her in a plexiglass box to keep her still and took an X-ray. Dr. Jeff Zuba could see that the pup was in the wrong position. The head was tucked

against the body instead of pointing down into the birth canal.

With large animals, the veterinarian can reach inside and manipulate the fetus. But Rodrigues fruit bats are small, about 14 inches long as adults. They weigh less than a pound.

Zuba tried massaging the outside of the abdomen. The pup was stuck. They did an ultrasound and the fetal heartbeat was faster than normal, a sign of distress.

"It was time," Zuba recalled later. "These pups are important. We had to get this one out."

He'd never done a C-section on a bat. He was going to do one now.

In the operating room, the anesthesiologist put Patty under. She was placed on the table face up, her wings, feet and head strapped down. Zuba, wearing a headpiece with magnifying lenses, leaned in and made the incision. He took care to avoid nicking anything that would cause excessive bleeding. There are no blood banks for bats.

He pulled the pup out, and it started breathing right away. The umbilical cord was cut. Patty's incision was closed with the same kind of tiny sutures used on human eyes. The whole procedure took about 15 minutes.

While Zuba finished his work, the pup was handed to Lissa McCaffree, a keeper at the Safari Park's animal care center. She wrapped the bat in a blanket and drove in a pickup truck to the nursery a few minutes away.

At any given time, the staff there is helping to raise by hand a couple dozen different animals. But they didn't have much experience with bats. Only once before had they been asked to step in as substitute mom - four

years earlier, when Patty was born and her mother abandoned her.

The new pup was male. They named him Lucas.

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It's easy to see why zoos would take great pains to save animals like pandas, which are cute and appear cuddly and draw large crowds. But bats?

Few animals have been as reviled and feared over the years, thanks to Dracula and other blood-sucking lore. Our language is littered with phrases - blind as a bat, batty - that aren't complimentary. People walk into the Safari Park Bat House and cringe at the brown, eggplant-sized creatures hanging upside down, their bodies wrapped in leathery wings.

But zoos around the world are increasingly focused on conservation as their core mission, everything from butterflies to rhinoceroses. This comes amid shifting public attitudes about whether the captivity and display of animals is ethical, a debate that has roiled organizations like SeaWorld, which ended its captive breeding of orcas, and Ringling Bros., which stopped using elephants in its circuses.

The 1,800-acre Safari Park in Escondido and its sister facility, the 100-acre zoo in Balboa Park, are considered leaders in conservation. The organization supports more than 140 projects in 80 countries on six continents to help threatened or endangered species. It runs the Institute for Conservation Research, with specialists in behavioral ecology, reproductive physiology and wildlife disease, and it has a Frozen Zoo, where the genetic material from more than 10,000 animals is stored.

It's also active in international Species Survival Plans, which move animals among various zoos for breeding to improve genetic diversity

and long-term sustainability. That's what brought Rodrigues fruit bats to the Safari Park.

In the mid-1970s, fewer than 80 of the thickly furred, fox-faced bats existed on Rodrigues, an island 11 miles long and five miles wide that is part of the Republic of Mauritius and is located about 1,000 miles east of Madagascar. Although the population has rebounded today to about 20,000, it remains critically endangered, vulnerable especially to cyclones that historically have swept the island.

To guard against extinction, an emergency captive breeding program was started in 1976 in Jersey, England, with 25 bats, and it spread to other zoos. In 2011, 13 bats arrived at the Safari Park from the Bronx Zoo in New York and the Brookfield Zoo near Chicago.

While they were in quarantine, mammal keeper Todd Ryan got his first peek. "Those are cool," he told himself. "I want those." He asked to be put in charge of their day-to-day care.

A lot of what he did was trial and error. In the beginning, the bats wouldn't let the keepers get close enough to weigh them, a key indicator of their health. Ryan rigged up a scale to a food tray and put it in the exhibit. When a bat landed on the tray, keepers used binoculars to read the scale.

The goal was to create a breeding colony at the Safari Park, and that had its complications, too. Because the bats are small, and their fetuses even smaller, it isn't easy to tell when one is pregnant. Sometimes the keepers learn of a birth when a visitor at the exhibit points to a pup clinging to its mom and asks how old it is.

Fatherhood can be a mystery, too. The keepers realized how prolific one of the males had been only after he was moved to another zoo and

pregnancies in the colony decreased.

"There's always something going on in there," Ryan said of the Bat House. "It's always some kind of drama."

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Patty's operation went well - so well that after the C-section, the animal care staff opted not to put an Elizabethan collar on her. Designed to prevent animals from nibbling their stitches, collars have side effects. Some animals won't eat with one on. Some lose their balance and break limbs.

The bat seemed to be resting comfortably. She was eating. At about midnight, the staff went home. When they returned in the morning, Patty had opened up the incision. Part of her intestines had come out. She was rushed back into surgery, and her condition deteriorated over the next day. The doctors decided to euthanize her.

"Should we have been watching her 24 hours?" Zuba asked. "Maybe, but we thought she was OK. Animals are unpredictable and sometimes they surprise us."

Lucas was an orphan now. If he was going to have a chance at a life, he would need help from humans. Eventually, more than a dozen would be involved in raising him.

In the nursery, keepers placed him in a temperature- and humidity-controlled incubator tucked into a medical supply closet. There wasn't room anywhere else. Someone printed out a sign and put it on the door: "You Are Entering the Bat Closet." The sign included the Batman logo familiar to comic-book and movie fans.

For the first couple of weeks, the pup required round-the-clock attention. He was given a sock to cling to that's approximately the size of an adult bat and filled with stuffing. He was wrapped in a blanket, simulating a mother's wings.

Feedings occurred every two hours. A keeper would reach in through openings in the incubator, holding the "sock mom" in one hand and a nipple-tipped syringe filled with bat formula in the other. Feedings lasted 60 minutes because Lucas would nod off, just as a pup does in nature attached to its mom's chest. That meant the keeper had to stand in place, bent over. Backs would ache. Legs would cramp.

There was stress along with the discomfort. Giving Lucas too little formula might cause starvation. Pushing too much down his throat might cause asphyxiation.

"You are taking something that is so delicate, and you know that it's endangered," McCaffree said. "The last thing you want to do is kill it."

They had to clean him by hand, too, using cotton balls dipped in water. In the wild, a mother would lick the pup clean. They rubbed lotion on his wings to prevent dryness. To make sure Lucas was urinating enough, they stimulated him with cotton balls dipped in warm water. "The glamorous part of our job as keepers," McCaffree deadpanned.

A few weeks after his delivery, Lucas was moved to a bigger enclosure in a bigger room, where a pair of cheetah cub sisters had been. Feedings came less frequently, and the keepers didn't have to stay overnight any more. To supplement the formula, they gave him pieces of fruit - banana, grape, watermelon, mango - on a skewer.

Rodrigues bats aren't blind. They have acute vision similar to that of cats, plus sharp hearing and smell. As Lucas grew, he became

increasingly curious about his surroundings. When the keepers took him out of the cage for a formula feeding or a bath, he grabbed for their hair with his wings, which have a small claw at the top. He would scoot into the pockets of their shirts and sit there, watching and listening and smelling, while they walked around the office.

"We want to expose him to different things," McCaffree said one day in mid-March. "That will help with his transition when he joins the colony. He's being raised in a bubble here."

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It was hard to know how much to push him. He started flapping his wings while he hung upside down, a precursor to flight. In nature, young bats drop from one tree branch to another, getting the feel of air time. But the nursery wasn't set up for that kind of activity. Twice Lucas had to go to the hospital for repairs to his left wing, torn apparently when he flapped against something.

Doctors also discovered a defect to his left foot, probably developmental, which meant Lucas mostly just used his right foot while hanging upside down to sleep. There was a problem with a joint on his right wing, too. It wouldn't extend all the way. That would impair full flight in the wild, but the keepers were optimistic he could manage the short bursts necessary to maneuver around in the colony.

They set out to show him how.

In early May, McCaffree and keeper Jules Anderson loaded Lucas into a carrier and took him by golf cart from the nursery to the Bat House, located in the Safari Park's Nairobi Village. Adjacent to the colony is a catch pen, where bats can be isolated for an exam or for other reasons. Lucas went into the catch pen. The carrier door was opened, and out he

crawled.

The keepers were bringing him over almost every day now for a few hours, letting him smell and hear the other bats, catch a glimpse of them through the catch pen door. A couple of the bats would usually fly over to the door to check out the newcomer.

Lucas was nervous and clung to the keepers. They scratched him between his ears, called him a "good boy." Gradually he got more comfortable, and it was time for flight training.

McCaffree and Anderson stood a few feet apart, a large dog bed on the cement floor between them for crash landings. Holding Lucas by his feet, Anderson swung him back and forth, counted to three, and let him go toward McCaffree. He flapped a few times and landed in her arms. She tossed him back to Anderson. They did this about 20 times.

"He's growing up," McCaffree said.

Keepers learn not to get attached to the animals because eventually they move on. That's the whole point of caring for them. But there was something about Lucas, maybe the way his wings felt like a hug when he clung to them. "This one will be hard to let go of," keeper Eileen Neff said.

But they did, a couple of weeks later.

They moved Lucas from the nursery to the catch pen and left him. This would be his home now while he was gradually introduced into the colony. "It's like seeing your child go off to college," McCaffree said. "A little scary, but rewarding, too. If he grows up to be a breeding bat, it will have all been worth it."

Nobody talked about the alternative. What if he didn't fit in?

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Ryan, the bat keeper, hung stuffed animals, a mirror and other attractions around the catch pen to keep Lucas occupied while he settled into his new surroundings.

After a few weeks, Ryan started taking the bat out into the exhibit while he cleaned it at night. Other bats came over to sniff Lucas or to chase him from their food. He didn't like it. He screeched and sometimes dropped to the ground to get away.

"He doesn't know how to behave around other bats yet," Ryan said.

The keeper figured Lucas would be able to stand his ground more as he got bigger, but he was also concerned about the bat's poor flight skills. "The other young ones in here, they get chased away, too, but they can flit like butterflies to another tree," Ryan said. "Lucas goes down and he has to crawl back up. If he was flying normally, he would catch on real quick."

Weeks went by, then a month, then another. Ryan put out the word for volunteers who could come to the exhibit and watch Lucas. Leaving the bat with the colony for an hour or two at night, and maybe an hour in the morning while he prepared the food, wasn't enough, he said. He wanted to leave him out there for the whole day, while he took care of the other mammals on his rounds.

He put yellow beads on one of Lucas' feet so the volunteers could pick him out in the colony. If Lucas got into trouble, Ryan figured, the volunteer on duty could call for help on the radio.

Which is what happened one day in early August. Lucas flew into the vertically strung piano wire that separates the bats from the viewing public. He got his head stuck and couldn't wriggle out. Ryan came and freed him.

"If he'd grown up with his mother, she would have kept him away from that," the keeper said. "But he didn't, so he doesn't know any better. He has to learn how to be a bat."

The learning was slow, but it came. Lucas groomed himself after seeing other bats do it. He figured out where to go in the colony without upsetting the four dominant males, figured out how to get his share of the food. He made friends with Lucy and Fenriz, two bats close to him in age who are starting to separate from their mothers.

As August turned to September, Ryan still felt it necessary to bring Lucas into the catch pen at night for his own safety, but in the mornings the bat eagerly went back out with the colony. Soon, the keeper expects to leave the back door to the pen open, letting Lucas decide when and where he wants to interact with the other bats. And they with him.

"All our questions have been answered," Ryan said. "He's ready."

He put Lucas on a tree branch next to Lucy. They sniffed each other, then settled in for a nap hanging side by side from the branch.

Eight months ago, a newborn bat's world was turned upside down when his mother didn't survive the birth. Now he was upside down again - on purpose this time, among winged friends instead of two-legged ones. Lucas was home.