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GIANT PANDA BEAR

Saving Pandas from Extinction: Why Captive Breeding Matters

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On the Precipice

The giant panda (Ailuropoda melanoleuca) is one of the most beloved species in the world, garnering the attention of schoolchildren and researchers alike. Who can deny the appeal of this fuzzy, black-and-white bear, with its large ears, dramatic color pattern and its clumsy antics so often shared in video clips on the internet? For many “panda fanatics” the unique physical characteristics of the panda, along with its perceived docile temperament (pandas typically eat bamboo, after all, not meat), are the epitome of “cuteness”. But for scientists across the globe, the panda represents a more serious concern, as it is the only living bear species that has been classified as endangered.

Giant pandas are currently range-limited to a few high-mountain areas of China, where they typically live in dense bamboo thickets covering steep slopes not easily accessible by humans. Their historic range was much broader. Two million years ago, ancestral pandas ranged as far north as modern Beijing and as far south as Vietnam. Two thousand years ago, when there were about 250 million humans living across the globe, pandas could also be found in the lowland areas of China near where large cities currently
exist: Chengdu, Chongqing, Guilin, and Guangzhou. Today, these cities alone are home to more than 50 million people. The expansion of the human population over the last few millennia directly corresponds to the decline in the panda’s range, and now the species clings to a few protected areas where the density of people is still low.


As an artifact of their declining range, modern pandas have also most certainly declined in numbers. However, the extent to which they have declined is not well known, because good estimates of their population sizes don’t exist before 1970. Since that time, four range-wide surveys have been conducted. The first three, completed between 1970 and 2002, all concluded that the total population numbers for pandas did not exceed about 2500 (the
fourth survey has recently been completed, but the data is not yet fully analyzed). Using the criteria for assessing populations, the result of these surveys was that giant pandas have been classified as RARE (before 1990) or ENDANGERED (since 1990), indicating that their situation in the wild is precarious. Given the continued onslaught of habitat pressure from humans, will the panda survive into the future?

In response to the concern that pandas might be on their way from rare to endangered to extinct, biologists from around the world began to take a sincere interest in this species in the 1980s. But hurdles to effective conservation of the panda were immediate. To ensure the survival of a species, you need to secure its habitat. To secure the right habitat for the panda, you need to know something about what the species needs to survive. Things like: how much bamboo does a panda eat on a daily basis? Does the pattern of bamboo consumption change by season? How much space does one panda occupy as it goes about its daily activities? Does that space differ for males and females? What types of den sites are best for ensuring successful rearing of panda cubs? What habitat contains those optimal dens? How long do panda cubs stay with their mothers? What other resources are critical for young panda survival? Even if large tracts of habitat were set aside for this species, were there enough pandas left in the wild to ensure that they could persist into the future?

Right from the start, it was apparent that researchers knew very little about the panda and its basic biology; all of the above questions were in need of answering. In order to facilitate the conservation of this species, scientists would need to undertake a comprehensive approach to research with the giant panda, a process that would take many years. In the meantime, the panda teetered on the precipice of extinction.

Fortunately, there is one tried and true way to guard against the demise of an endangered species: develop a self-sustaining, captive-breeding
population. By bringing some representatives of the species into a zoo or breeding center, biologists could hold as a reservoir a large group of animals, hedging against the possibility that their wild counterparts declined to the point of no return. If breeding in these facilities was successful, the captive population could even be used to restock individual bears to wild populations, supplementing the numbers of wild bears or even developing new groups of pandas in areas where they currently do not exist. In addition, developing a captive panda population allows biologists an up-close opportunity to study many elements of the basic biology of the species that might otherwise remain elusive.

The first significant attempt to create a captive population of giant pandas began in the 1980s. A joint effort of the Chinese government and WWF developed a panda breeding base in Wolong, China, where a few rescued pandas were housed.
These animals were typically refugees from a crisis created by the simultaneous flowering and die off of mountainous bamboo species, which left several wild pandas short of food. Starving, these animals descended from the mountains and entered human dwellings and farms to find sustenance. Once captured by government officials, they were relocated to the new Wolong breeding base.

Although the placement of pandas at the Wolong breeding base allowed biologists to begin to learn about this species, the development of a self-sustaining captive population of pandas remained elusive. The bears were unable to reproduce successfully. Some bears, particularly males, did not demonstrate appropriate breeding behavior, and were thus unable to mate. Even if mating occurred, pregnancy detection was difficult in females who demonstrated similar behavior whether or not they gave birth to cubs. For those females who did give birth, their cubs did not survive for more than a few weeks. These were all significant problems to address in order for the captive population to be successful. No good conservation plan could rely on continuously removing wild animals from their homes to supplement a captive group of the species! The ultimate objective was to move pandas in the other direction, from captivity to the wild. This could not be accomplished unless the captive population reliably produced cubs that grew to adulthood.

Into this mire of uncertainty and expectation, San Diego Zoo Global (SDZG) stepped forward to participate in the conservation of the giant panda. Our goal was to shed light on the basic biology of this species, in the hopes that our research results could help panda conservation efforts. We would work with the captive population both in China and back home in San Diego to elucidate aspects of panda reproduction, maternal care, infant development, husbandry, veterinary science and nutrition that would improve the health and success of the captive-breeding population. Though we had little experience
with pandas before 1996, SDZG staff were competent professionals with a wealth of experience from efforts to secure other rare and endangered species, and we had much to bring to the panda conservation table.

Welcome, Bai Yun

In 1991, Wolong breeding center welcomed its first female panda cub to survive beyond infancy. She was one of a pair of twins, though her sibling died within a few days of birth. The young female, reared by her wild-caught mother Dong Dong, grew old enough to be given a name of her own: Bai Yun, or “White Cloud”. Little did the world know, but Bai Yun would make a habit of collecting “firsts” in her lifetime, and she is today still contributing much to our knowledge of giant pandas.
In the fall of 1996, Bai Yun was transferred to the San Diego Zoo, along with a wild-caught male, Shi Shi. These two bears could not be more different from each other. Bai Yun was a spunky 5 year-old: energetic, curious and smart. She weighed about 90 kilos (198 pounds) when she arrived, a bit light for her tall frame. Shi Shi, on the other hand, was a wild-caught male of unknown age. Based on the condition of his teeth and physique, we believed he was born in the mid 1970’s, making him roughly 20 years old when he arrived in San Diego. His temperament reflected his age: Shi Shi was no-nonsense, always looking for his next bamboo feed. The older male liked routine, peace and quiet. We hoped that he might be able to overcome his preference for the bachelor life when Bai Yun experienced estrus, the physical changes associated with her readiness to breed. As panda estrus usually occurs in the spring, both bears had several months to settle in before their mating compatibility would be put to the test.

Limited observations of wild pandas had been done before that time. These observation had indicated that adults of this species prefer a solitary existence, interacting rarely with other adult bears. The only social groups that had been seen were mothers with dependent cubs, or an occasional cluster of males with a female during a breeding opportunity. To mimic the wild situation as much as possible, Bai Yun and Shi Shi were housed separately. They each had their own bedrooms and exhibit spaces, though they occasionally had access to each other’s scent as they traversed the animal passageways at the panda building. Thus, the bears were solitary, with occasional access to chemical information about one another, much as wild pandas appeared to live.

In order to begin to understand the complex lives of pandas, an intensive research program was built around the pandas at SDZG. One of the linchpins of this effort was the behavioral research component. We developed an ethogram, a list of all behaviors we thought might be part of a panda’s
repertoire and that we wanted to study. Our first ethogram was 32 pages long and included topics such as daily maintenance activities (feeding, resting, etc.), chemical communication behaviors (scent marking in various postures, olfactory investigation), manipulation activities (digging, scratching, chewing) and vocalizations (bleat, honk, huff). We trained a large corps of volunteers to identify these behaviors, which allowed us to collect behavioral data in two-hour blocks, twice each day for each bear. At times, we ran 24-hour observations, watching the bears round-the-clock to ascertain how their behavior might be influenced by time of day. Under this intense regime, we began to acquire massive amounts of detailed information about the behavior of our giant pandas.

Behavior wasn’t our only research focus. Simultaneously, our pandas participated in studies representing numerous scientific disciplines. Our endocrinologists regularly analyzed the urine of our pandas to develop hormone profiles, investigating reproductive components, like estrogen, and byproducts of stress, like cortisol. Veterinarians examined the physical and chemical indices of the health of the pandas, examining teeth for bamboo-specific wear patterns and palpating the condition of the pandas in different seasons. Nutritionists explored the amount of bamboo the pandas could consume, and how this changed with the selection of bamboo we could offer. And our husbandry staff, the keepers who saw the bears daily, kept detailed notes about how the bears responded to all of the above, and how their weight fluctuated with seasons. They constantly strived to optimize their husbandry efforts to ensure the well-being of their charges.

All of these research efforts combined to form a more complete picture of panda biology. Imagine the amount of resources necessary to carry out this enterprise! In those early days, it took a small army to accomplish all of these objectives, and the panda facility was always buzzing with paid staff and volunteers who contributed to our work. We had a pricey camera system
that covered all animal areas, and allowed us to follow the bears unobtrusively. Hormone assays and medical supplies and computer equipment all require a capital outlay. But in our quest to help pull the panda from the precipice of extinction, these expenditures and resources were deemed necessary to our efforts. As we neared the first estrus for Bai Yun in the spring of 1997, we would need to pull out all the stops to try to ensure a breeding, pregnancy and birth of a panda cub in San Diego.

**Understanding Estrus**

Although researchers had seen snippets of wild panda behavior during the breeding season, Bai Yun provided us with the first opportunity to document an estrus cycle from beginning to end. In early April 1997, she began to scent mark at a high rate, leaving regular deposits from the gland under her tail as she traveled about her enclosures. On a typical, non-estrus day, she marked at a rate of less than 1 bout per hour; as she moved through estrus, however, her rate of marking climbed to dozens of bouts per hour. At its peak, she left scent deposits as often as 50 times per hour! Along with scent marking, Bai Yun’s activity level increased as she wandered more purposefully through her space, resting less than was typical. Taken together, these behaviors would serve to ensure that she regularly communicated her presence via scent across the greatest distance available to her.

After about 10 days of increased scent marking, this behavior began to wane. In its place, Bai Yun began to vocalize at a high rate. She started “bleating” regularly, emitting a twittering sound reminiscent of a horse’s neigh, and thought to be a friendly call to others of her species. Her restlessness continued. In parallel with these behavioral changes, our physiologists were reporting a noticeable increase of metabolites of the hormone estrogen in Bai Yun’s urine. A week later, the hormones continued to increase, and her vocal repertoire now included a new vocalization, the
so-called “chirp”, a high-pitched sound not typically heard from her. New behaviors were now on display: she began backing up into walls and shrubs, raising her tail and lowering her torso to the ground into what is known in the lordosis posture, the position for mating.

![Graph of estrogen levels and behaviors](image)


What of our male, Shi Shi? He was less than charmed by Bai Yun’s behavioral and hormonal changes. He responded not with interest, but with aggression. SDZG staff tried various means by which to increase his motivation to interact with his assigned mate: we swapped the bears in and out of each others’ enclosures regularly, to facilitate his access to her changing chemical messages; we played audio recordings the vocalizations of a female known to be in estrus, to ensure he was getting the right auditory cues; and we provided the bears with access to a “howdy door,” where they could get close to one another and see and sniff each other, without risk of injury to either bear. Shi Shi did not respond favorably. Finally, when we ascertained that Bai Yun was at the peak of her estrus and most primed to breed, we allowed the two bears to be in the same enclosure. Despite her strong interest in him, Shi Shi responded by fighting with our female, and mating did not occur. Our first breeding season ended with a whimper.
The following spring, we experienced the same pattern from both bears: Bai Yun experienced significant behavioral and hormonal changes, and Shi Shi rebuffed her advances. But on April 8th and 9th, 1998, our reproductive physiologist stepped in. Shi Shi was sedated long enough to collect semen from him, and Bai Yun was sedated for an artificial insemination. While we hoped this might result in a pregnancy for her, we were aware that predicting the proper time for insemination in this species was one of the elements of panda biology that was still uncertain. However, even if we had succeeded in getting the timing exactly right, there were many more uncertainties ahead of us as we awaited the possible arrival of a panda cub.

**Panda Pregnancy**

Many people are familiar with the denning behavior of some of the most abundant bears species. Brown bear, North American black bear and polar bear females typically dig out a den when food becomes less plentiful. While in the den, they slow their basal metabolic rate to allow them to rest without food or water intake for months. Within the den confines, these females also give birth to their young, caring for their helpless newborns while in this sluggish state. Giant pandas do not suffer the same seasonal loss of food abundance that other bears do, but they do experience the same behavioral changes around denning seen in hibernating species: increased sluggishness and decline in appetite. But female pandas that do not give birth to cubs also experience these changes, even if they do not breed. Females of this type are said to experience a “pseudopregnancy.”

Our physiologists have determined that there is a change in progestin hormones associated with both pregnancy and pseudopregnancy, and that drives denning behaviors. As spring turned to summer in 1998, we had no way to determine if Bai Yun’s behavioral and hormonal changes were indicators that she would soon give birth, or if she was instead experiencing a
pseudopregnancy. We knew only that we had better be prepared for either case.

First we created a data check sheet to monitor daily changes to behavioral and physiological parameters we thought might be informative of pregnancy. This system allowed the keepers, who spend the most time each day monitoring Bai Yun, to assess these changes on a scale of 0 to 3, where 0 was baseline and meant no change, and 3 represented the greatest magnitude of change from baseline. Changes were noted for behavioral factors such as appetite for bamboo, seeking seclusion, nest building, and rates of urination, as well as for physiological indicators such as swelling of the mammary glands. Additionally, we began watching her progestin hormone profile to determine if and when an increase occurred.

In early June, her progestins did just that. We knew that if Bai Yun was pregnant, she was now beginning a countdown to a possible birth window. But we didn’t know when that would occur. We immediately placed the area around the panda facility into a quiet zone, limiting any loud equipment use and rerouting vehicles like trash trucks and street sweepers away from the panda facility. A pair of staffers – one behavioral researcher and one keeper – were assigned to keep watch over Bai Yun 24 hours a day, looking for signs of impending birth. Closed-circuit video of Bai Yun was recorded on VHS tape around the clock. Veterinarians attempted to locate a fetus regularly via ultrasound, as keepers had trained Bai Yun to sit still while they ran the ultrasonic wand across her belly. An enormous amount of resources were poured into ensuring that we would not miss the smallest indicator changes to her condition.

In July, our check sheet monitoring system recorded a number of significant changes in Bai Yun. Her loss of appetite peaked near the end of the month, and she engaged in some nest building behavior inside the den. Her progestins reached their peak 130 days after the artificial insemination,
as her appetite was waning. The staff was on pins and needles, wondering what might happen next. But as summer waxed into fall, we began to lose hope. Bai Yun’s hormones and behavior steadily returned to baseline, and her interest in the den disappeared. In October, after six months of intense observation, we finally called off our birth watch efforts. Although we were disappointed that there was no panda cub to celebrate, we were pleased to now be sitting on piles of data for the first fully documented panda pseudopregnancy known to the species.

The following year, the breeding season followed much the same pattern as before. Bai Yun displayed strong estrus behavior, and Shi Shi remained uninterested and aggressive. On April 9th, 10th and 11th, 1999, we artificially inseminated Bai Yun, and set ourselves to watching for changes to her hormone and behavior profiles. In June, Bai Yun’s progestins began to rise, and we again instituted the quiet zone. Researcher-keeper observation teams began round-the-clock monitoring in July, when we first noted her decline in appetite. Regular ultrasounds were performed, but nothing definitive was discovered during those sessions. We had no clues to enable us to discern whether Bai Yun was experiencing a pregnancy or a pseudopregnancy. Until 18 August.

That day, veterinarians performed a regular ultrasound and snapped the first-ever ultrasonic picture of a panda fetus in utero! It was an amazing day of jubilation over what was to come, and apprehension that we had a new challenge looming on the horizon. Would the birth go smoothly? Would the cub be born healthy? Would Bai Yun be a capable mother? What if she wasn’t, and we needed to hand rear the cub? What if she gave birth to twins? Having cleared one hurdle, it was obvious that we needed to gird ourselves for the ones to come.
Postpartum Challenges

As with the rest of panda biology, 1999 found us with very little understanding of what birth and the postpartum window looked like in pandas. We knew that a panda cub would be born small and helpless, without hair to keep it warm and with its eyes sealed shut. We knew mother pandas in captivity had struggled to rear their young successfully, and tiny cubs had been crushed in the den. Some mothers showed fear responses when their cubs cried loudly. When pandas gave birth to more than one cub, invariably one cub didn’t survive. Could we overcome these challenges of successful rearing of a panda cub?
Some field researchers had noted that, like other bears species, wild pandas mothers would seek the solitude of a den at the time of birth, enveloping themselves in a quiet, warm space where they would be undisturbed by any outside influences. In some captive environments, females had given birth to cubs and this had stimulated a flurry of human activity: people wanting to glimpse the cub, assess its health, photograph it and generally be closely observant of the mother-cub pair. The well-meaning folks had unknowingly impeded the mother’s ability to rest properly. In those cases, the mother panda became so fatigued that when she did rest she slept very deeply, enough that she rolled over her newborn, crushing it to death. By implementing a quiet zone around our panda facility, we hoped to avoid that mistake. We sought to mimic the wild state and reduce any potential stressors that might come along with life in captivity. As Bai Yun approached her birthing window, keepers minimized their activity in her bedroom areas, staff got used to keeping their voices low, and non-essential work was put off to a later date. Our mother panda would not be disturbed by nearby sounds of people, and we would not interfere with her den.

On August 21\textsuperscript{st}, Bai Yun gave birth to a healthy single cub. Our first glimpse of the youngster was at the moment of birth, as Bai Yun’s contractions ejected it from the birth canal to the floor. After a momentary fumble, our first time mother picked the tiny creature up in her sizable jaws and began to cradle it in her forearms. We didn’t see much of the cub after that. Bai Yun was doing a great job nurturing her little one and keeping its hairless body warm with her own. But how could we assess the health of this new panda life if we couldn’t see it?

Fortunately, we had planned ahead and installed a microphone in the den. Though we could not see the cub, we \textit{could} hear it, and it was vocalizing regularly. The cub emitted frequent loud cries and squawks when it was in need of immediate comfort, and croaks when Bai Yun had apparently taken
care to relieve its concerns. We watched - and listened- as the initial burst of activity around the birth subsided, and a rhythm set in between mother and cub: both bears rested quietly for an hour or more; then cub vocalizations woke Bai Yun, who appeared to nurse; she would then groom the cub with her pink tongue. Finally the pair would settle down to rest again. All the while, Bai Yun held her tiny neonate in her paws, never setting it down. The effort required her to maintain constant contact with a creature less than 1 percent of her own size, highlighting for us how important it was that mother bear remain undisturbed. She needed to get the most out of every rest period to ensure that she made no mistakes when caring for this cub.

Bai Yun rests with young cub in the birthing den. Image via closed circuit TV. Photo S Hall.
Like the brown and polar bears, Bai Yun maintained a fast after the birth. She did not eat or drink for several days, maintaining that constant nurturing of her cub inside the den. However, unlike the brown or polar bear that are able to acquire a thick layer of fat by eating animal flesh and other highly nutritious foods before denning, pandas do not have the luxury of building up a calorie reservoir on a diet of bamboo. They cannot forgo feeding for months on end, because their primary food source does not afford them the same thick fatty reserves as cold weather bears obtain. As a result, Bai Yun did begin making short trips out of the den to feed herself about 10 days after birth. Starting with about 10 minutes of feeding a few times each day, she slowly built up to her regular feeding regime. It was several months before she was consuming pre-birth amounts of bamboo in a day.

Initially, the cub was not very tolerant of Bai Yun’s need to feed. Almost as soon as she set it on the den floor, it began to squawk for her, and she would rush back and comfort it. With each den departure, we could see the gears tuning in her head as she planned her exit: she waited for the cub to be deeply asleep before she quietly crept away to eat. As the cub adapted to her departures and started sleeping through them, Bai Yun was able to eat for longer periods of time. It was fascinating to watch her balance the intensity of caring for a helpless cub with the need for her to maintain her own health and well-being. It’s a compromise that mothers of many mammalian species must make in some way.

As Bai Yun’s feeding forays progressed to greater length and regularity, we were able to make better assessments of the cub itself. For the first time, as Bai Yun munched bamboo in an adjacent room, we had an unobstructed view of the cub laying on the den floor. We could get a good look at the round belly, which indicated to us that mother’s milk was sufficiently filing the cub’s belly. We could count toes and claws and inspect the tail, all of which revealed no defect or disease. With repeated viewing opportunities we
were able to chart the increasing thickness of its coat, the change in skin pigment from white-pink to black-and-white, and the lengthening of its body relative to unchanging landmarks in the den. But our veterinarians awaited the chance to pull the cub from the den for a quick examination.

Once Bai Yun had gotten comfortable with a regular routine of den departures, staff gathered one morning about three weeks after the birth and waited for her to come out of the den for a feed. Once outside, one of Bai Yun’s favorite keepers began hand feeding her biscuits and apples through a slot in the door. Another keeper gently closed the door to the entrance to the den area, putting a safety barrier between mother bear and the den. A staff member went into the den with a soft warm blanket to wrap the cub in, and brought the cub out to the waiting veterinarians and their examination table, only feet away from the panda bedrooms.

A panda cub undergoes a veterinary exam. San Diego Zoo photo.
A brief five-minute exam ensued, in which they determined the cub’s gender (it’s a girl!), its weight and length, and they listened to her heart and lungs. Weekly health exams like these enabled us to chart the physiological development of the cub as it grew. After placing the cub back into the den and opening the door, Bai Yun returned and inspected the cub, and, finding everything satisfactory, returned to her nurturing duties.

As with the cub exams, we waited a few weeks before slowly returning the panda facility to normal operating procedures. As Bai Yun spent increasingly longer periods outside of the den feeding, staff began increasing its maintenance workload and allowing louder vehicles, like garbage trucks and street sweepers, to pass on the road outside the facility. We watched her closely with each change in procedure to assess her response. As long as she did not appear to react to any increase in activity, we continued to slowly progress returning things to normal. Balancing the needs of an endangered species with the needs of a functioning zoo takes some creative teamwork, but we managed to make Bai Yun feel secure and continue our daily operations throughout the postpartum window. One major factor in that is that we made the decision to ensure that her den was left undisturbed. Even as things on the outside might change, and people and noise would return to typical levels, we allowed Bai Yun to be the only one to manipulate her nest. We didn’t clean the den, or bother her while she was inside it. This way, when she was with her cub, she could be ensconced in a private, protective world where she could focus her energies on the task at hand. At the end of the day, to ensure the development of a healthy captive breeding population, the efforts of our panda mother in her den were paramount to the fulfillment of our objective. What Bai Yun was doing in that den was more than just simply caring for her cub: she was participating in the recovery of her species.
The Value of Captive Work

Over the years, Bai Yun has given birth to six cubs. At age 22, she may well be done with cub rearing, or she might have another breeding cycle left in her. Only time will tell. But Bai Yun’s legacy goes beyond her many offspring to the wealth of data and information she has provided panda conservation over the years. The details of her life from her time as a young, first-time mother in 1999 to her role as a seasoned matron of a certain age, we have charted her behavioral and physiological changes scientifically in an effort to better understand panda biology.

Bai Yun and Zhen Zhen, her fourth cub. San Diego Zoo photo.

Much of the work we have completed over the years highlights the importance of captive breeding populations to the conservation efforts for an endangered species. Our ability to get daily data from our bears, to peer into their dens without disturbing them, get frequent samples of their hormones,
and make regular assessments of their health enables us to understand parts of panda biology that have not been successfully documented in wild populations yet. We have improved the state of knowledge about the giant panda, and by sharing our work with other captive breeding facilities, we have contributed to changing the outlook for this species in captivity. When Bai Yun arrived in San Diego all those years ago, there was no self-sustaining captive breeding population of pandas. Today, there is. Captive facilities now produce enough cubs each year to sustain themselves. In fact, in 2012 the worldwide captive population of pandas reached a milestone: it exceeded 300 individuals. Further, there are enough cubs born each year that the Chinese have begun the process of introducing some of those youngsters to wild habitat, supplementing wild populations with new individuals. With this, panda conservation has reversed the equation of the early days in which we took more bears from the wild than what we put back. Today, the captive population is bolstering the wild one with new bears. That narrative alone is a major conservation success story.

But there is more to our success. Over time, we have developed such an in-depth, detailed understanding of panda pregnancy and postpartum behavior that we can now tailor our facility’s approach to managing this significant event in such a way as to maximize our resources and minimize wasted time and money. Our check sheet, behavioral data, and hormonal data provide a highly predictive tool to determine when birth will occur; we can now determine the birth date, plus or minus about a week. Ultrasounds have become routinely used diagnostic tools that can narrow that window to a few days. This means that the thousands of staff hours and dollars poured into the 1998 pseudopregnancy watch can today be saved for some other purpose, while we focus instead on a week or so of intense pregnancy monitoring.
Over the years, San Diego Zoo Global has contributed much to panda conservation. Not only have we gathered valuable data on the mother-cub relationships of Bai Yun and her six offspring, but we have collected similar data on mother-cub pairs in the breeding center in Wolong, China. Pregnancy detection via ultrasound has become more routine at other facilities. We have studied other aspects of panda biology, ranging from chemical communication, to stress and well-being, to the effect of enrichment. We have shared the results of our work in innumerable published papers and presentations. We have worked hard to build support for panda conservation through intensive outreach efforts, writing blogs, visiting schools, and meeting with zoo patrons over the years. We have taken the task of panda conservation seriously, and it shows, as SDZG has become internationally recognized for its expertise in this field.

Despite the accolades and the work output, perhaps the most satisfying legacy of our efforts comes back to Bai Yun. Several of her cubs have returned to China to participate in the breeding program themselves. That first little girl born here in 1999 – later named Hua Mei – has gone on to give birth to 10 cubs of her own. Some of Bai Yun’s descendants have participated in the “reintroduction training” process that could eventually result in their release to the wild. To know that someday, Bai Yun’s great grandbaby might be climbing the slopes of a bamboo-laden mountainside in China, on the hunt for her own perfect denning place, is most satisfying, indeed.