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THE SCIENCE OF Saving Species

SAN DIEGO ZOO GLOBAL

INSTITUTE FOR CONSERVATION RESEARCH



GIANT PANDAS: A Story of Hope

Two decades of challenges, discoveries, and successes—no longer endangered!



Both of our experiences exemplified an essential lesson learned for international collaboration: if you make friends first, science and teamwork will follow.

—RON SWAISGOOD, PH.D., AND MEGAN OWEN, PH.D.

Still Saving Giant Pandas

Outside of China, San Diego Zoo’s giant panda breeding program is second to none. Our lovely matriarch, Bai Yun, has given birth to six healthy cubs at the Zoo and now has 14 grandcubs back in China, including one great-grandcub! Adding to that accomplishment is the tremendous body of knowledge we have gained from this iconic species, resulting in more than 70 scientific publications. While we are delighted that the panda was downlisted from Endangered to Vulnerable last year on the IUCN Red List of Threatened Species, we know this beloved animal still needs our help—the goal is nothing less than a sustainable population and successful reintroduction to China’s forests.

How You Can Help

Our field research teams all over the world rely on the generosity of donors like you to help achieve San Diego Zoo Global’s vision to lead the fight against extinction. To learn ways you can help, please call Maggie Aleksic at 760-747-8702, option 2, ext. 5762, or email maleksic@sandiegozoo.org.

More than two decades of experience with panda behavior, diet, breeding, and reproduction in partnership with our Chinese colleagues has led to new discoveries that have made the future much brighter for the giant panda.



GIANT PANDAS: The Road to Recovery

BY RON SWAISGOOD, PH.D., DIRECTOR OF RECOVERY ECOLOGY,
AND MEGAN OWEN, PH.D., ASSOCIATE DIRECTOR OF RECOVERY ECOLOGY

Two decades ago, we could hardly imagine that the giant panda would one day be downlisted from Endangered to Vulnerable. San Diego Zoo Global is proud to have played an important role in setting the giant panda on the road to recovery, as we reflect on some of the most poignant and personal moments that have marked this journey.

Ron remembers his beginning as if it were yesterday. He began working at the breeding center at China’s Wolong National Nature Reserve in 1995. In those days we didn’t get the red carpet treatment, and Ron spent the first few weeks as the only foreigner there, feeling isolated, cold, and lonely . . . and making little progress with his research. This was aimed at getting pandas to do what is supposed to come naturally—mate! After weeks of rain, snow, and sleet, the sun came out and the “Wolong guys” got out a basketball. Ron decided to join the daily game and almost immediately everything changed. Poor cooperation turned into good friendships, and two decades of camaraderie and collaboration followed.

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A FEW YEARS LATER, MEGAN ARRIVED AT WOLONG on a cold winter evening with her family in tow—husband, toddler, and baby—ready to embark on four months of research in the heart of the giant panda’s home. Children are beloved there, so Megan and her family were quickly integrated into the social fabric of Wolong. Being part of this extended family not only made the tea warmer and the food tastier, it also meant that the Wolong staff was keen to work with Megan toward our collective research goals. Most importantly, long-term trust was established that also helped us make progress toward common goals. Both of our experiences exemplified an essential lesson learned for international collaboration: if you make friends first, science and teamwork will follow.

Over the years, many San Diego Zoo Global teams pitched in, tackling groundbreaking research in behavior, husbandry, reproductive physiology, genetics, nutrition, disease, and more. All this helped lead to a dramatic turnaround, and now the panda population is growing exponentially, with two or three dozen cubs born each year.

With the managed population growing, our attention turned next to saving giant pandas in the wild. Working with the Chinese Academy of Sciences and others, we placed GPS tracking devices on pandas so we could monitor their movements as well as learn from studying their

“signs”: feeding sites, scent marks, and especially their droppings, which provide a treasure trove of information. These include diet, DNA, gender, and hormones. And, since they leave about 50 of these nuggets a day, they leave a perfect record of where they’ve been and their habitat preferences.

We now understand that female pandas need access to old-growth trees large enough to contain a cavity suitable for rearing their cubs. We are working with our partners on a trial using artificial maternity dens, creating denning habitat while waiting for some of the old-growth forests to grow back. We’ve also learned that younger forests provide good habitat where pandas can forage. As this forest matures and recovers, they are using it more and more—and that’s a good thing for the future of pandas. We now understand how solitary pandas find one another, how they use scent and vocal signals to stimulate sexual motivation, and how they compete for and choose their mates. Recently, using DNA from droppings, we determined that pandas have a modest amount of inbreeding. This is nothing to be alarmed about but something to pay attention to as habitat fragmentation may make it more difficult for them to find suitable, unrelated mates.

These scientific findings have been invaluable for guiding management and policy for giant pandas. Panda habitat is increasing as forests recover, the panda’s range is expanding, and panda numbers in the wild are up: they are on the road to recovery. We celebrate this accomplishment, a testimony to how hard work and persistent collaborative efforts can rescue endangered species from the brink of extinction. ●

Leading the Way for Panda Conservation

Today, the San Diego Zoo holds the only foreign position on the China State Forestry Administration’s Reintroduction Advisory Panel. We chair the Giant Panda Expert Team of the International Union for Conservation of Nature (IUCN), the leading international conservation organization for evaluating endangered species and setting priorities, as well as the Giant Panda Species Survival Plan of the Association of Zoos and Aquariums (AZA). The Zoo was the recent co-recipient of the AZA International Conservation Award for our scientific approaches to conservation of giant pandas and their habitat.

GIANT PANDA CONSERVATION PROGRAM TIMELINE



1995-2005

San Diego Zoo research on breeding begins in Wolong



1996-2006

Sensory ecology studies at Wolong



Bai Yun
Shi Shi

SEPT. 10, 1996

Bai Yun and Shi Shi arrive in San Diego



SPRING 1997

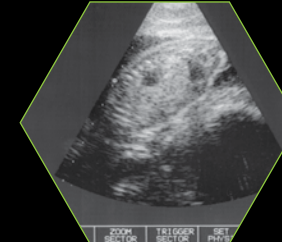
Bai Yun’s first estrus in San Diego

SPRING 1998

Bai Yun’s first artificial insemination

APRIL 8-9, 1999

Bai Yun’s next artificial insemination



AUGUST 1999

First ultrasound confirmation of pregnancy



AUGUST 21, 1999

Hua Mei is born!

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A CALL TO ACTION

By Meghan Martin-Wintle, Ph.D.,
Postdoctoral Associate,
Megan Owen, Ph.D.,
Associate Director of Recovery Ecology,
and Ron Swaisgood, Ph.D.,
Director of Recovery Ecology



In an exciting new collaborative program, we are preparing pandas born at the breeding centers for life in the wild. —Megan Martin-Wintle, Ph.D.

WITH MORE THAN 35 CUBS BORN in 2016, and a worldwide population of more than 400 giant pandas in breeding centers and zoos, many of the challenges faced in the early days of the panda breeding program have been overcome. However, the ultimate goal of this effort is to sustain a healthy population to support recovery of the species in the wild, dependent on natural mating and cub survival.

Our research is focused on individual giant pandas that are genetically poorly represented in the population. Conservation breeding programs have to work with very small populations, and often enticing the pair that will promote the most genetic variability in the entire population to actually mate with each other can be one of the trickiest parts! In collaboration with our colleagues at the China Conservation and Research Center for the Giant Panda, we are working on getting

male pandas in the program to breed more reliably. Building on recent research where we demonstrated that pandas produce many more cubs if they are allowed to mate with a partner they have chosen, we are investigating how infusing a little male-male competition prior to breeding increases testosterone levels and a male giant panda's motivation to mate.

In an exciting new collaborative program, we are preparing pandas born at the breeding centers for life in the wild. We are the only foreign entity invited to work on the reintroduction program, a tangible acknowledgement of the trust we have built over two decades in this close partnership. Although the panda population is recovering in the wild, there are still many small populations living in reserves and forest fragments that would benefit from new pandas with a different set of genes.

WE ALSO HELP DEVELOP TRAINING PROGRAMS DESIGNED TO TEACH PANDAS SPECIFIC SURVIVAL SKILLS FOR THRIVING IN THE WILD, SUCH AS AVOIDING PREDATORS, FORAGING, NAVIGATION, AND MAINTAINING PROPER SOCIAL RELATIONSHIPS WITH OTHER PANDAS.

To prepare for reintroduction, we screen individual pandas and evaluate their behavioral competence compared to their wild counterparts. In the near future, we will be working with China West Normal University to track released pandas and learn from our successes and challenges. With a little luck and a lot of effort and teamwork, our goal is to establish new and improved populations of pandas in the wild. ●

Panda Family Tree



GIANT PANDA CONSERVATION PROGRAM TIMELINE

Gao Gao

FEBRUARY 2003

Gao Gao arrives in San Diego

APRIL 2003

First natural mating in San Diego with Gao Gao

Mei Sheng

AUGUST 2003

Mei Sheng is born!

JULY 2003

First voluntary ultrasound with giant panda and confirmation of pregnancy

APRIL 2005

Natural mating between Gao Gao and Bai Yun

2003

First scouting trip to Foping, met with Chinese Academy of Sciences (CAS)

AUGUST 2005

Su Lin is born

2006

Research in Foping begins with CAS on habitat needs

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MANY ROADS TO THE Giant Panda's Recovery

Karyl Carmignani, Publications, Staff Writer

WHEN THE FIRST GIANT PANDAS, Basi and Yuan Yuan, arrived at the Zoo in 1987 on a 6-month loan from China, little was known of the panda's reproductive physiology, behavior, and ecology. When a 12-year panda loan was negotiated in 1996, Bai Yun and Shi Shi debuted at the San Diego Zoo, and a new era in panda conservation was launched. The Moores Family Giant Panda Research Station was built as a home base and work space for researchers and panda keepers. Our horticulture staff developed a browse program to satisfy the bears' bamboo diet. Then our Institute scientists pooled their expertise to understand giant pandas, and before long, history was made.

FIRST STEPS

While Shi Shi was not able to breed Bai Yun, researchers carefully documented her ovulation cycle and collected Shi Shi's sperm. Led by Dr. Barbara Durrant, head of the Reproductive Sciences team, these efforts resulted in a carefully timed artificial insemination procedure, which she performed in 1999. Over the next several weeks the 15-member panda team waited to hear if Bai Yun was pregnant. Then Barbara and Dr. Pat Morris, Director of Veterinary Services, decided to do an ultrasound, the first ever on a panda. The two stood breathless, looked up, and silently mouthed, "Oh, my God!—there is a fetus!" A few days later, Hua Mei was born—on Barbara's birthday—the first panda cub to survive in the U.S. and the first successful artificial insemination of a panda. Barbara still calls it "the most exhilarating moment of my career."



Frequent health checks ensured that Hua Mei was thriving.

GAO GAO SAVES THE DAY

In 2003, breeding male Gao Gao arrived with much fanfare. Although on the petit side, he was keenly motivated when Bai Yun was ready to mate, changing our program dramatically and maximizing breeding success. Five cubs later, Bai Yun and Gao Gao have both made vast contributions to our breeding program.

HEALTHY PANDAS

Managing giant pandas so they are thriving and able to engage in natural behaviors like breeding is a major collaborative effort. Dr. Meg Sutherland-Smith (pictured), Director of Veterinary Services, focuses on the complexities of giant panda care, from disease prevention to geriatric care. Training pandas for health exams, such as letting veterinarians examine their teeth or take their blood pressure, is something we can share with our Chinese colleagues and other facilities. Also, our Disease Investigations experts have led a series of workshops in China on giant panda health and disease management.

A CALL TO ACTION

After 20 years on the panda team here, Dr. Megan Owen explains, "This is a story of hope, moving the panda one step further from extinction, and a reminder that when we work together, we can recover species from the brink of extinction. 'Hope' is fundamentally a call to action, and the panda's story is one I believe will serve to inspire increased collaborative efforts to save many, many more species." ●

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—Megan Owen, Ph.D.



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—KARYL CARMIGNANI



DAY 1
Held high in Bai Yun's arms, the newborn panda was hard to see with video cameras.



DAY 20
Bai Yun was a great mom from the beginning. This was a typical pose as she cradles the cub against her chest. Fans could also watch daily on Panda Cam.



DAY 22
An early exam of Hua Mei, when her mother left the den to get a drink of water. Our team took a quick look for just a few minutes.

Boosting Panda Survival

What we learned from pandas in zoos and breeding centers is benefiting wild pandas today. Working with Chinese colleagues to develop a conservation strategy and create protected panda reserves, San Diego Zoo Global played a significant role in bringing this beloved species back from the brink of extinction. It has been a productive 20 years!

- Our teams developed a **panda milk formula** and a hand-rearing technique, raising survival rates of nursery-reared cubs from zero to 95 percent.
- Institute researchers developed **thermal imaging** for early pregnancy diagnosis.
- **A goal of 300 pandas was reached** in zoos and breeding centers in 2010, needed to sustain the species.
- **Historic collaboration with Chinese scientists:** the teams track wild pandas at Foping using GPS technology.
- **China increased its panda reserves from 4 to 67**, to provide habitat for this national treasure to thrive.

GIANT PANDA CONSERVATION PROGRAM TIMELINE

AUGUST 2007

Zhen Zhen is born



AUGUST 2009

Yun Zi is born



MAY 2008

Sichuan earthquake devastates Wolong breeding center, killing people and pandas.

JULY 2012

Xiao Liwu is born



2013-PRESENT

Courtship studies on mate choice



2015

Research collaboration with China West Normal University



OCTOBER 2016

San Diego Zoo is invited to first reintroduction conference hosted by China



SEPTEMBER 2016

Pandas downlisted from Endangered to Vulnerable by the IUCN. San Diego Zoo participated in the assessment process.

Conservation Achievements

HONORS AND AWARDS

Dr. Jenny Glikman (Community Engagement) was selected as an At-Large Board Representative for the Society for Conservation Biology's Social Science Working Group.

David O'Connor (Global Partnerships) has been invited to join the IUCN Bear Specialist Group, serving on the Asiatic Black Bear and Sun Bear Expert Teams.

Dr. Megan Owen (Recovery Ecology) was appointed to the role of research advisor for the Association of Zoos and Aquariums Bear Taxon Advisory Group.

Dr. Oliver Ryder (Conservation Genetics) was named a trustee of the Genome 10K initiative.

HIGHLIGHTED PUBLICATIONS

Davis, E. O., D. O'Connor, B. Crudge, A. Carignan, J. A. Glikman, C. Browne-Nuñez, and M. Hunt. 2016. Understanding public perceptions and motivations around bear part use: A study in northern Laos of attitudes of Chinese tourists and Lao PDR nationals. *Biological Conservation* 203: 282-289.

This collaborative study revealed differences between Chinese tourists and Lao nationals in their attitudes toward bears and the use of bear products, as well as their consumer preferences. We are using these data to inform the design of demand reduction campaigns that better resonate with Laotians.

Miller, L. J., C. B. Pisacane, and G. A. Vicino. 2016. Relationship between behavioral diversity and faecal glucocorticoid metabolites: A case study with cheetahs *Acinonyx jubatus*. *Animal Welfare* 25: 325-329.

In this study, we showed that lower glucocorticoid levels correlate with higher levels of behavioral diversity in 18 cheetahs at the San Diego Zoo Safari Park. Discovering noninvasive methods for monitoring physiological stress is critical to optimizing animal welfare in zoos.

Steiner, C. C., S. J. Charter, N. Goddard, H. Davis, M. Brandt, M. L. Houck, and O. A. Ryder. 2015. Chromosomal variation and perinatal mortality in San Diego Zoo Soemmerring's gazelles. *Zoo Biology* 34: 374-384.

Summarizing 35 years of data, we analyzed the effect of chromosomal and genetic variation on early life mortality in Soemmerring's gazelles. Low levels of genetic diversity and high relatedness values among founders suggest that outbreeding depression is less of a concern than inbreeding for maintaining a sustainable zoo population.

Tubbs, C. W., L. A. Moley, J. A. Ivy, L. C. Metrione, S. LaClaire, R. G. Felton, B. S. Durrant, and M. R. Milnes. 2016. Estrogenicity of captive southern white rhinoceros diets and their association with fertility. *General and Comparative Endocrinology* 238: 32-38.

We investigated the role of phytoestrogens in reproductive failure of captive-born female southern white rhinos. We found that high phytoestrogen levels in the diet negatively impact reproductive success and recommend that zoos breeding this species reduce the levels of these chemicals in their rhino diets.

Gifts & Grants

A few years after the San Diego Zoo Institute for Conservation Research was founded in 1975, Dr. Donald G. Lindburg brought his considerable knowledge and expertise to San Diego Zoo's conservation program as its first dedicated behaviorist. Over his decades-long career with us, Dr. Lindburg achieved significant conservation milestones, helping numerous species, but he is perhaps best known in the zoo world for his contributions to giant panda, lion-tailed macaque, and cheetah breeding efforts.

Linda, Don's wife, was equally passionate about animals and dedicated her talents as the managing editor of the journal *Zoo Biology*. Sadly, we lost Linda far too soon, but her name lives on at the

Institute through the **Donald & Linda Lindburg Conservation Legacy Fund**, which Dr. Lindburg established in 2014. This endowment is Dr. Lindburg's way of ensuring that the scientists who carry on his work will always have the resources they need. The endowment is also a very personal tribute: "One of the things that inspired me in all of this is that my dear wife, Linda, was a zoo nut," Dr. Lindburg notes, along with "the great pleasure I derived from managing the panda program."

On the birth of Hua Mei in 1999, Don said, "if there is one word that summarizes this unique event for our team, it is the word hope. We have renewed hope that this birth is only the first in a successful breeding program, . . . and we hope that this magnificent species will escape extinction in its native land." This year, the Lindburg Conservation Legacy Fund will support giant panda reintroduction efforts in China. As Dr. Lindburg led the panda team when our first panda was born here, it is only fitting that he has a hand in helping return pandas to the wild. ●

When our second panda, Mei Sheng, was born in August 2003, it was not a surprise to the Zoo's scientists. It confirmed that by monitoring panda behavior during the mating season, we could reasonably predict another pregnancy.



At 54 days of age, Hua Mei's eyes were starting to open and she could crawl a bit. For Don Lindburg, the young cub "continued to add mystery and wonder to our lives by just being a panda."



After Bai Yun arrived at the Zoo in 1996, Don and a team of volunteer behaviorists spent hours each day at the panda exhibit, observing and recording her behaviors as well as those for Shi Shi and Gao Gao. This led to a better understanding of natural mating behaviors and the successful births of six cubs in San Diego.



RECOVERY ECOLOGY

Together with our partners, we developed a novel geofence system that uses virtual boundaries placed around wind farms to provide early warning alerts whenever telemetered California condors fly too close to wind turbines.



POPULATION SUSTAINABILITY

During the koala breeding season, we participated in field research that included deploying GPS collars, tracking wild koalas, and ecological data collection in Australia's Greater Blue Mountains World Heritage Area.



COMMUNITY ENGAGEMENT

We extended our Teacher Workshops in Conservation Science to key range country partners, including Save the Elephants, Free the Bears, The Giraffe Centre, Lewa Wildlife Conservancy, Saiga Conservation Alliance, CEDO Intercultural, and Pronatura Noroeste.



GLOBAL PARTNERSHIPS

Together with the U.S. State Department, we hosted the inaugural Zoohackathon. Teams of programmers and designers joined us to address wildlife trafficking, including the national winning app, WildTrack, that allows the public to notify authorities of poaching.



WHAT'S New



CONSERVATION GENETICS

We received the body of the last known Rabb's fringe-limbed tree frog and processed the samples under multiple conditions in an effort to preserve the genetic material in the Frozen Zoo® of this now extinct Panamanian species.



PLANT CONSERVATION

As part of the California Rare Plant Rescue Initiative, we successfully collected seeds from the imperiled Dunn's mariposa lily, a showy herbaceous perennial bulb with bell-shaped white to pinkish flowers.



REPRODUCTIVE SCIENCES

Using ultrasound, we visualized ovaries of the female southern white rhinos housed at the Safari Park's Nikita Kahn Rhino Rescue Center throughout the reproductive cycle and used this information to induce ovulation with hormone treatments.



DISEASE INVESTIGATIONS

We are investigating the relationship between polar bear habitat change and exposure to pathogens over time in order to gain a better understanding of disease threats and contribute to improved management decisions.

THE SCIENCE OF
SavingSpecies

EDITOR: Mary Sekulovich | GRAPHIC DESIGN: Studio 318 | PHOTOGRAPHER: Ken Bohn

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