I

# The giant panda as a social, biological and conservation phenomenon

SUSIE ELLIS, WENSHI PAN, ZHONG XIE, DAVID E. WILDT

## INTRODUCTION

The giant panda has captured the world's imagination. Its seemingly harmless, playful nature, velvety black and white fur, flat face, softly rounded body and soulful black eye patches combine to make it resemble an oversized and loveable teddy bear (Fig. 1.1). Its upright posture and famous 'panda's thumb' – an elongation of the wrist bone that allows it to grasp bamboo and other food much like people do – further adds to its widespread appeal. From the most prominent government authorities to young children, people are passionate about protecting the giant panda. This fervent interest has caused the panda to emerge as the most highly visible of all endangered species, even though few people have actually ever seen one in the wild. Furthermore, this single species has become a worldwide icon for the need to conserve animals, plants and habitats. Therefore, it is ironic that the giant panda, which evokes so much attention by the public, scientific and conservation communities, still remains such a mystery with so many pieces still missing from a biological jigsaw puzzle that, if solved, could improve species management, welfare and conservation. The purpose of this book is to provide, and then assemble, a few more pieces of this enormous puzzle.

*Giant Pandas: Biology, Veterinary Medicine and Management*, ed. David E. Wildt, Anju Zhang, Hemin Zhang, Donald L. Janssen and Susie Ellis. Published by Cambridge University Press. 

Figure 1.1. The giant panda (photograph by Jesse Cohen).

## WHY THE GIANT PANDA IS UNIQUE AMONG SPECIES, ESPECIALLY BEARS

Within China, the giant panda often is called *daxiongmao* by local people, literally 'large bear-cat' in Chinese (Schaller *et al.*, 1985). Its scientific name *Ailuropoda melanoleuca* actually means black and white cat-footed bear. The black and white colouration of the panda allows it to blend in with its high mountain forest surroundings, which often are blanketed with thick snow. When threatened, pandas climb the nearest tree, where this coloration renders them almost undetectable.

The giant panda is indeed a type of bear, of the subfamily Ailuropodinae in the family Ursidae. During evolution, it diverged from the main bear lineage (comprised of seven other species) 15 to 25 million years ago (Lumpkin & Seidensticker, 2002). Interestingly, the giant panda's nearest relative (genetically speaking) is the spectacled bear (*Tremarctos ornatus*) which inhabits the mountainous regions of South America. Unlike its ursid counterparts, which are principally omnivores, the giant panda is a 'grass-eating' bear with 99% of its diet as bamboo. This, in part, explains some of its unique morphology, including the skull's expanded zygomatic arches and the associated powerful muscles for mastication (Nowak & Paradiso, 1983). The giant panda's dentition is also different from, for example, a similarly sized black bear because of broad, flattened premolars and molars designed to

break and grind bamboo. As a 'hypo carnivore', the giant panda is also partial to meat, with its teeth specially suited to crush bones (Lumpkin & Seidensticker, 2002). Its forefoot, with the modified and well-described sixth toe (Gould, 1982) or wrist bone, is considered unique among species, allowing it to grasp its food more securely.

During winter, the giant panda's survival in its cold, wet mountainous habitat is enhanced by the superb insulation provided by short, thick fur. It has no tolerance for heat, in part because of its lack of capacity for passive heat loss or evaporative cooling (Lumpkin & Seidensticker, 2002). Unlike its bear counterparts, the giant panda does not hibernate, probably because of the need to forage throughout the year for its low-energy diet of bamboo. One of its most unique features is its adaptation from carnivory to herbivory while amazingly retaining the digestive system of the former. The result is the need to spend 14 hours of each day searching, selecting and consuming bamboo (Lumpkin & Seidensticker, 2002).

Perhaps most interesting (and one of the incentives for the work in this text) is the overall low reproductive rate of the giant panda. Note the use of the word 'low' and not 'poor'. There has been much embellishment by the popular press about 'poor reproduction' in this species. This misperception is derived from the well-known challenges of breeding pandas in artificial conditions in captivity. However, there has never been any systematic study of reproductive efficiency in wild giant pandas in nature. Obviously, it cannot be true that the giant panda is normally poor at reproduction or it would never have evolved or survived to modern times. Nonetheless, the species has developed some fascinating and rather illogical characteristics that are less than ideal for ensuring reproductive success. It is a seasonal breeder with the female entering oestrus (heat) in late winter/early spring. This trait in itself is nothing special, and the environmental stimulus inducing oestrus is likely to be increasing day length, although no one is sure. However, unlike other bears, the giant panda is monoestrus, displaying sexual receptivity once per year for only 2 to 3 consecutive days. In turn, the male produces prodigious numbers of motile spermatozoa, probably because of the need to ensure conception if given the chance to mate with a female, who normally is sexually 'turned off' for more than 360 days per year. Further evidence for the physiological reproductive prowess of the male giant panda includes the species' comparatively short and repeated copulations, each 1 to 8 minutes in length (Zhang *et al*., 2004), unlike in other bears. Resulting embryos are

free-floating in the uterine horns for an undetermined interval (a phenomenon called delayed implantation), which is common in bears, as is the eventual production of one or two small, comparatively immature cubs. Enigmatically, however, in the case of giant panda twins, one offspring is usually rejected by the dam and dies soon after birth. The giant panda cub is relatively slow-growing, although the species as a whole achieves sexual maturity at a time comparable to other bear species.

## STATUS IN NATURE AND THREATS

The giant panda is endemic to the mountains of Sichuan, Gansu and Shaanxi Provinces in China. The species is now found in only six mountain ranges at the eastern edge of the Tibetan plateau, distributed in as many as 30 to 40 distinctive populations (Fig. 1.2; Plate I). The Min Shan Mountains are the heart of panda numbers and activities, probably sustaining half the remaining wild individuals (Lumpkin & Seidensticker, 2002). Historically, the species was widely distributed and may have numbered 100 000 animals, but has declined to likely no more than 1500 animals in total. In reality, this number is only a broad estimate – even recent surveys have been unable to produce an absolute number of giant pandas living *in situ*. This is largely because these are extreme habitats with steeply ascending ridges that plummet into deep and narrow valleys. It is exceedingly difficult to traverse this terrain, let alone see elusive giant pandas or their signs. Historically, these rugged landscapes have protected the region's biodiversity. However, as China's human population continues to grow, human settlements are expanding into these remote areas.

As with virtually all endangered species, the giant panda has been most affected by human forces, especially overall habitat loss as a result of logging and farming operations. More than half of this habitat was destroyed from the mid 1970s through the 1980s, a time when there was enormous concern and publicity about conserving the species. The magnitude of this destructive impact has been effectively illustrated by Lumpkin and Seidensticker (2002) who have pointed out that the resulting ecospace for all giant pandas became 5000 square miles, which is *less than 25%* of the size of the Greater Yellowstone Ecosystem. Giant pandas became the ecological losers in terms of total habitat available. Compounding this problem was habitat fragmentation, the breaking apart of existing forest into small patches with no corridors for

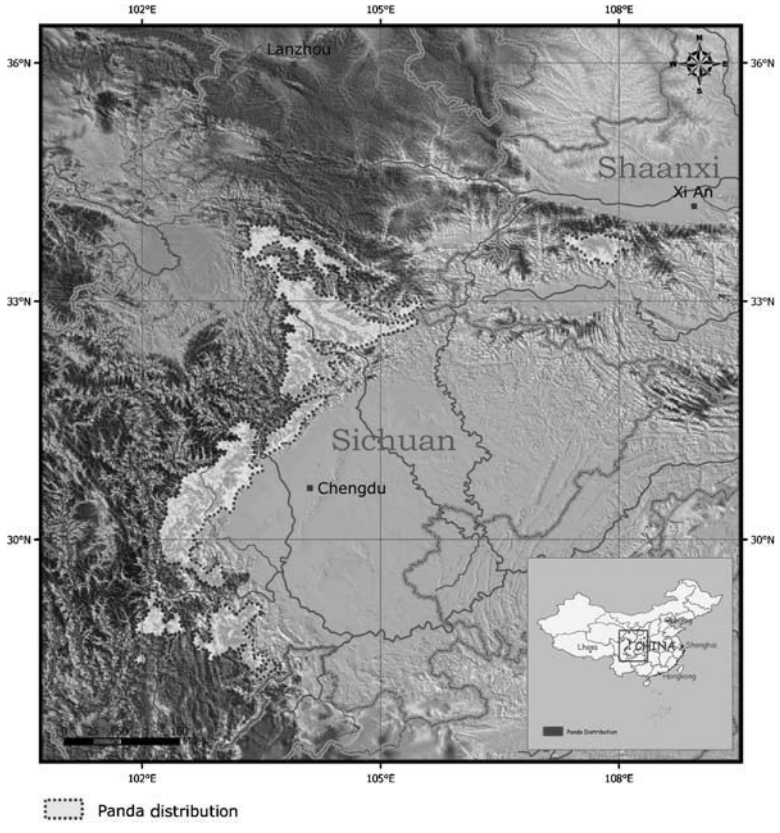


Figure 1.2. Range map for remaining fragmented populations of giant pandas living in nature. (See also Plate I.)

genetic exchange. Although no one is sure of the number of individual pandas in each of these isolated areas, it is highly probable that some populations are not self-sustaining. As human demands escalate, many nature reserves are being heavily used for economic purposes (Liu *et al.*, 1997). Furthermore, many of the official protected areas (currently more than 40 reserves) are severely under-resourced, lacking the infrastructure (roads, buildings), personnel (managers, field staff) and equipment (ranging from vehicles to binoculars) to attend properly to daily and routine activities, let alone conservation priorities. And, of course, not all giant pandas live inside protected areas.

Historic dangers for the wild giant panda included hunting as trophies (mostly by westerners), museums and zoos. Hunting was officially banned in 1963 for any purpose. Poaching still occasionally causes mortality, although most of these are probably incidental deaths in snares targeting other species rather than deliberate acts directed at giant pandas. Until recently, it was common practice to 'rescue' giant pandas from the wild to support zoo breeding programmes. As described in Chapter 2, the *ex situ* breeding community committed to abandoning the practice of taking giant pandas from nature in 1996.

Adequate supply of appropriate food sources has been debated as a potential threat, especially given the significance by the popular press to the flowering die-offs of bamboo. Lumpkin and Seidensticker (2002) indicated that this impact is probably less significant than once believed because most habitats contain at least two bamboo species that do not flower in tandem. Thus, the panda simply switches bamboo species, if necessary. Total available bamboo also is not likely a significant factor because, although quality generally is marginal, supply is usually generous and rather consistent. There is growing concern, however, about panda–human competition for wild bamboo, including shoots (a dietary favourite of both species) and stems that have many uses by people ranging from basket weaving to tools to fencing.

Certainly, a threat to giant pandas is the lack of broad-based knowledge about their biology and numbers in nature. It is impossible to manage any habitat or species without understanding its status through systematic and continuous studies. Pioneering studies that methodically monitored life history, behaviour, mating and foraging were conducted by Schaller *et al.* (1989), Reid *et al.* (1989), Pan & Lu (1993), Pan (1995), Pan *et al.* (1998) and Lu *et al.* (2000, 2001). However, given all of the unknowns about contemporary panda activities (including how many pandas are out there), a continued lack of basic information certainly hinders appropriate decision-making to best manage wild populations.

Finally, some have asserted that the *ex situ* (captive) population threatens giant pandas living *in situ*. Essentially, the argument is that if too much attention is directed at pandas living in zoos, then the wild population is 'out of sight, out of mind and out of luck' – the distraction paradigm. The concern is that because there are healthy, reproductively fit pandas in zoos, there would be no urgency, or even a real need, to protect wild counterparts or their habitats. In our opinion, this theory is not valid, especially considering the intense worldwide interest in

the species. We fully realise, however, that this theory *could* have validity, but only if we failed to clearly articulate *and* demonstrate the value of individuals managed *ex situ*, especially their potential in contributing to the conservation of the wild giant pandas. Much of this book is dedicated to this goal.

## GIANT PANDAS IN CAPTIVITY IN CHINA

Unlike other prominent species (e.g. the tiger and crane), the giant panda has never been entrenched in historical Chinese culture, including the arts and literature. The earliest recorded giant pandas in captivity were held in the Emperor's garden during the Han Dynasty (206 BC to AD 226) in the then-capital of Xian. In more modern times (mid-20th century), the species was held by more western than Chinese zoos. The first serious interest in exhibiting the species in China occurred in Chongqing in 1941, but it was 10 years later when pandas began appearing regularly in Chinese zoos.

By the early 1960s there was evidence of targeted management, largely on the basis of reproductive success, albeit with inconsistency (see Chapter 19). The first ever birth by natural mating in captivity occurred at the Beijing Zoo in 1963. This same institution produced the first cub from artificial insemination (AI) with fresh sperm in 1978. The Chengdu Zoo was the first to produce a cub by AI with frozen–thawed semen in 1980. Through 1989, giant pandas were successively bred at zoos in Kunming, Shanghai, Hangzhou, Chengdu, Chongqing, Fuzhou and Xian, and at the Wolong Nature Reserve's breeding centre. From 1990 to 2002, 179 cubs were born from 126 pregnancies, with 71% of neonates surviving (see Chapter 19). And, interestingly, dedicated captive breeding activities complemented parallel efforts at protecting giant panda habitat as the first three giant panda reserves were established in 1963, growing to 13 by 1989 and to more than 40 today.

## GIANT PANDAS IN THE WESTERN WORLD

The giant panda was virtually unknown outside China until the 1800s when the declining Qing Dynasty opened China to western trade. The species was first described in the western world by the missionary naturalist and explorer Père Armand David who described a giant

panda specimen shot by Chinese hunters in Baoxin County, Sichuan Province in 1869 (Hu & Qiu, 1990). It was not until 1916 that the first westerner, Hugo Weigold, saw a live giant panda, and then it was another 14 years until the next sighting was reported. In the years following its discovery, killing of giant pandas became a goal of western museum collectors and hunters, beginning with Kermit and Theodore Roosevelt, Jr, sons of Teddy Roosevelt, who shot a specimen on an expedition sponsored by the Chicago Field Museum (Sheldon, 1975).

The first live giant panda was exported to the USA by Ruth Harkness, widow of the wealthy adventurer William Harkness, who 'rescued' a cub in Sichuan Province. In late 1936, after trouble with customs, Mrs Harkness took the cub out of China with a customs voucher that said 'one dog, $20.00' (Sheldon, 1975; Schaller *et al.*, 1985). This animal, Su Lin, had been destined for the New York Zoological Society, but the zoo refused it because of perceived health problems (Schaller *et al.*, 1985). The National Zoological Park in Washington, DC also declined to accept it, due to a rather extraordinary asking price (Lumpkin & Seidensticker, 2002). After a whirlwind tour of San Francisco, Chicago and New York, Su Lin ended up at Chicago's Brookfield Zoo, where she died of pneumonia in April 1938. The 'panda-mania' spawned by Harkness and others' 'bring 'em back alive' approach led to the export of at least 16 giant pandas to western zoos over the next 15 years. Without readily available fresh bamboo or husbandry expertise, western zoos were ill-equipped to care for these animals, and none survived beyond 10 years of age.

The further exportation of giant pandas from China stopped with the Cultural Revolution and the formation of the People's Republic of China in 1949. A handful of animals were sent to zoos in Europe and North Korea. Then, the re-initiation of diplomatic relations between China and the USA (spearheaded by Mao Zedong and Richard Nixon) resulted in a 1972 gift of two giant pandas to the Smithsonian's National Zoological Park. This was followed by similar state gifts to Japan, France, the UK, Mexico, Spain and Germany. Only three of these pairs produced surviving young. The pairs in Japan and Mexico still have surviving offspring. The pair in Spain had two cubs; one survived for 4 years, but all offspring are now deceased.

Species charisma, relentless media coverage and parallel explosions in visitation at holding zoos in the west provoked the 'rent-a-panda' programme of the 1980s. This involved short-term loans from only weeks to a few months duration in exchange for substantial

amounts of cash. Because these activities had no clear benefits for the species, it did not take long to attract the attention of conservationists as well as the USA Government which quickly saw the programme as strictly exploitative. The giant panda was placed on the USA Endangered Species List in 1984, which was followed by an all-out importation ban in 1988. Through a loophole, the Columbus Zoo arranged a short-term loan of giant pandas in 1992. This controversial loan set the stage for the future, in that funds raised as a result of the loan were used to establish new reserves in wild panda ranges in China. To buy time, the US Fish and Wildlife Service enacted a moratorium on any further giant panda importations. The goal was to formulate a policy ensuring that any further trade in giant pandas would not be detrimental to the species in nature. In fact, the most important part of the guidelines mandated that any loan be connected to *enhancement of conservation* of giant pandas in nature and not linked to commercial gain.

The result was that zoos in the USA were forced to develop highly organised scientific and management plans before being considered as candidates for importing giant pandas from China. There were also substantial financial costs to each loan, generally about $1 million annually for the loan plus additional costs to support the home institution's research and training programmes in the USA as well as in China (see Chapter 22). Even given these challenges, to date four institutions in the USA currently maintain giant pandas, including the San Diego Zoo (beginning 1998), Zoo Atlanta (1999), the Smithsonian's National Zoological Park (2002) and Memphis Zoo (2003). The San Diego Zoo also achieved the first milestone in North America, the production of a surviving cub by AI (Hua Mei, studbook number 487, born in 1999) who was subsequently returned to China and reproduced in 2004. Most recently (July 2005), the National Zoo produced a cub (Tai Shan, SB 595) by AI which survives at the time of writing.

## CURRENT STATUS OF THE WORLD'S *EX SITU* GIANT PANDA POPULATION, INCLUDING THREATS

The notion of 'conservation breeding' of giant pandas is not new – the Chinese have long recognised this need and produced the first cub in captivity almost 40 years ago. Births in Mexico, Japan and the USA (often following complicated behavioural and reproductive monitoring as well as sophisticated assisted breeding technologies) also demonstrate

global interest and dedication to propagating the species. But throughout history, what is apparent and common to all giant panda-holding institutions is sporadic, inconsistent success at reproduction followed by survival to adulthood. Lu and colleagues (2000) correctly pointed out some of the problems that have plagued panda-breeding programmes, including the enormous amount of funds expended on captive breeding; the high failure rate of reproduction (by 1997, 74% of adults had not bred); and the lack of appropriate *ex situ* environments for this specialised species.

From our overview here, it is probably apparent that nothing is simple about giant panda conservation, biology or politics. It is a species under enormous pressure by people, and yet it relies on people to ensure its ultimate survival. Nonetheless, progress is being made. In 1996, when the activities associated with this book began, there were about 124 giant pandas living in captivity worldwide. Today, there are more than 160 living individuals (Xie & Gipps, 2003) with the majority under the management authority of the Chinese Ministry of Construction and its Chinese Association of Zoological Gardens. A counterpart Chinese agency, the State Forestry Administration, manages all pandas in the wild plus a captive population at its China Conservation and Research Centre for the Giant Panda in the Wolong Nature Reserve and a more recent collection in Ya'an (Ya'an Bifengxia Base of China Conservation and Research Centre for Giant Pandas). There now are approximately 29 pandas living in zoos in North America, Europe, Japan and Thailand.

Despite the charisma, controversies, money and politics swirling around the species, improvements in captive management are being made. This is largely for two reasons: the application of an integrative, multidisciplinary scientific approach (see Chapter 2) and the development of partnerships, including training and the emergence of trusting relationships, across often complex cultural and agency boundaries (see Chapter 22). Before 1996, the primary threats to a sustainable captive panda population were lack of knowledge and no coordinated way to address routine problems encountered in management and husbandry. In fact, the challenges had never been clearly defined, and zoo managers encountering the same health, behavioural, genetic and reproductive problems rarely cooperated scientifically. However, now (as hopefully will become clear throughout this book) there is much new information on the specific factors that limit giant panda reproduction and survival in captivity. Furthermore, there have been many positive