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别说大熊猫不濒危

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摘　要：2015 年中国国家林业局公布数据显示中国大熊猫数量已经增加 1864 只，根据这一结果世界自然保护联盟将大熊猫由濒危物种降至易危物种。作者们指出这一结果未免过于乐观。（1）大熊猫的食物主要为竹子，CO_2 浓度升高将影响竹子的生长发育，缩短竹子的生命周期，导致竹子提前开花，提前死亡；温度升高延长了竹粘虫等灾虫的生活周期，增加粘虫等害虫数量，影响竹子的产量和品质，从而威胁熊猫生存。（2）470 km 长的龙门山地震带穿越四川亚种熊猫部分栖息地。遥感数据显示 2008 年汶川地震导致卧龙保护区进一步破碎化。（3）随着私家车的普及高速公路快速发展，生态旅游活动加剧，而人类活动影响动物荷尔蒙分泌、新陈代谢及生殖，增加疾病传播风险。（4）大熊猫栖息地环境污染日趋严重，直接威胁着大熊猫生存和健康。因此，大熊猫保护是一项长期的、艰巨的任务，世界自然保护联盟降级大熊猫保护等级为之过早，大熊猫依然是一个濒危物种，全球应该继续关注中国大熊猫保护。

关键词：大熊猫；主食竹；环境保护；生态保护；气候变化；汶川地震

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Don’t say the giant panda is not endangered

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Abstract: The number of pandas has increased to 1864 individuals, and the IUCN downgraded the conservation status of the giant pandas from endangered to vulnerable on September, 2016. However, this action was too optimistic, and it is too early to say that the giant panda is no longer endangered. (1) Atmospheric carbon dioxide concentration has increased from 280 to more 400 ppm since the industrial revolution and is projected to increase continuously. Plant growth and development are regulated by environment conditions.CO_2-enhanced warming will speed up the frequency of bamboo reproduction. Climatic change decreases the pandas’ survival by decreasing their food security. Temperature increases also are leading to increases in population sizes and cycles of herbivorous insects (such as *Leucania separata, Algedonia coclesalis, Azygophleps* sp, *Pleonomus canalitlflatus*). (2) Most of the habitat of the Sichuan subspecies of panda lies within the 470 km long active fracture zone of the Longmenshan earthquake belt. The Wenchuan earthquake in 2008 has resulted further decline of vegetation in Wolong Nature conservation zone. The potential stress still remains. (3) With the development of highways and universal access to private cars, ecotourism is becoming more and more popular in China, especially in protected areas where wildlife is concentrated and easier to observe. Ecotourism impacts hormone secretions, metabolism, productivity, and increases susceptibility to infectious disease. (4) Air pollution is more and more serious, so it stresses the giant panda’s health. These threats to panda health have not been given attention in panda conservation. Panda conservation is a long-term process, and the entire world should continue to pay close attention to issues involved in conservation of giant pandas.

Key words: giant panda; primary bamboo; environmental protection; ecological protection; climatic change; Wenchuan earthquake

In 2015, the Chinese State Forestry Administration (SFA) released data showing that the number of pandas had increased to 1864 individuals (Liu, 2015). Because of this achievement, the IUCN downgraded the conservation status of the giant pandas from endangered to vulnerable on September 5, 2016. However, this action is too optimistic, and it is too early to say that the giant panda is no longer endangered. In fact, the pandas are suffering from the fragmentation and loss of their habitat resulting from natural disasters, climatic change, and expanding human activity, etc. Wild pandas now are isolated on six mountains in Gansu, Shaanxi, and Sichuan provinces.

Climatic change decreases the pandas’ survival by decreasing their food security. Regional warming caused by global climatic change will add additional challenges to successful efforts of giant panda conservation, and may interact with natural disasters and habitation fragmentation in unexpected and understudied ways. Atmospheric carbon dioxide concentration has increased from 280 to more 400 ppm since the industrial revolution and is projected to continue to increase. This rapid increase in CO_2 is predicted to result in an increase in the global temperature of 2.6℃—4.8℃ according to IPCC reports (Intergovernmental Panel on Climate Change, 2014). The majority of the pandas’ diet is bamboo. Plant growth and development are regulated by environment conditions.CO_2-enhanced warming will speed up the frequency of bamboo reproduction. Recently there have been several reports on bamboos blooming in the Qinling and Bashan mountains, where there are relatively large panda populations. Temperature increases also are leading to increases in population sizes and cycles of herbivorous insects (such as *Leucania separata, Algedonia coclesalis, Azygophleps* sp, *Pleonomus canalitlflatus*), which may lead to further declines of bamboo. Bamboo accounts

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for most of the panda's diet, and after flowering, this monocarpic perennial takes many years to recover sufficient shoot density to support panda populations.

Habitat fragmentation stresses the giant pandas by limiting their movement. Several highways and railway cross southwest China, dividing the giant panda's habitat into 33 isolated populations, and the overall population viability of pandas is limited by this increasing fragmentation. After bamboo flowers or if diseases occur, the pandas cannot move from one isolated area to another. For example, 250 giant pandas starved to death following a widespread flowering episode that occurred between 1975 and 1983 in Pingwu and Nanping counties, Sichuan province. Subsequently, the total numbers of giant pandas in China declined rapidly, from ≈2000 individuals in 1976 to ≈1000 in eighties of last century (Zhao, 2007).

In addition, the habitat of the Sichuan subspecies of panda lies within the 470-km long active fracture zone of the Longmenshan earthquake belt. Wolong is a flagship conservation zone. Analyses of remotely-sensed data from pre-and post-establishment periods indicated that the Wolong panda conservation zones have become more fragmented and less suitable for giant pandas because of ecological degradation in protected areas that occurred before 1998 (Liu et al, 2001). Wenchuan earthquake in 2008 has resulted further decline of vegetation in Wolong Nature conservation zone (Fig.1). Further ecological fragmentation of this conservation zone is anticipated because the panda's habitat lies within the 470 km long active fracture zone of the Longmenshan earthquake belt. The 2008 Wenchuan earthquake only ruptured the 350 km northeast section of this fracture zone from Yingxiu to Qingchuan, leaving at least 120 km under continued stress, Expert forecasts of future earthquakes in this latter region suggest a M_W 6.7—7.3 earthquake that would release at least 5.6×10^{15} J energy. The Ya'an earthquake occurred near the China Conservation and Research Center for Giant Panda and in the middle of this 120 km fracture belt. This earthquake released 7.1×10^{14}—1.0×10^{15} J, or only 13%—18% of that expected from M_W 7.3 earthquake (Chen et al, 2013). This suggests that 4.6×10^{15} —4.9×10^{15} J energy remains to be released from this fracture belt, which is centrally located within panda habitat. The Qinling subspecies diverged > 50000 years ago. Fewer than 350 individuals remain in six isolated areas, where one railway, one highway and 6 traffic-ways pass through.

Ecotourism impacts hormone secretions, metabolism, productivity, and increases susceptibility to infectious disease. With the development of highways and universal access to private cars, ecotourism is becoming more and more popular in China, especially in protected areas where wildlife is concentrated and easier to observe. For example, the number of tourists increased 40-fold after 2005 when a road was opened into the Foping natural reserve area in Shaanxi province. Similarly, the number of tourists increased from about 75000 in 2011 to 110000 in 2015 at the Tangjiahe natural reserve area in Sichuan province (Ma and Cheng, 2008; Cui et al, 2009; Wang and Zhao, 2011; Liu et al, 2016).

Noise produced by tourists and cars directly impacts the health of the giant panda. For example, fecal cortisol concentration rises with increasing numbers of tourists. Indirect effects of ecological tourism include transmission of infectious diseases. For example, in 2015, there was an outbreak of canine distemper virus spread by dogs in Shaanxi wild animal research center (SWARC), and several adult female giant pandas were killed. Although the virus was contained at SWARC, if it escapes into the wild, the consequences could be severe.

Our studies also have revealed that captive pandas are exposed to high concentrations of toxic chemicals, including PCDDs (polychlorinated didenzo-p-dioxins), PCDFs (polychlorinated dibenzofurans) and PCBs (polychlorinated biphenyls), PBDE (polybrominated diphenyl ethers), and heavy metals (Chen et al, 2016, 2017). A detailed study of the Qinling subspecies demonstrated that exposure to these toxicants was associated with liver, kidney, and reproductive impairment in captive pandas (Chen et al, 2017) and that air pollution was the primary source of the elevated pollutants detected in panda blood (Chen et al, under revision). These threats to panda health have not been given sufficient attention in panda conservation.

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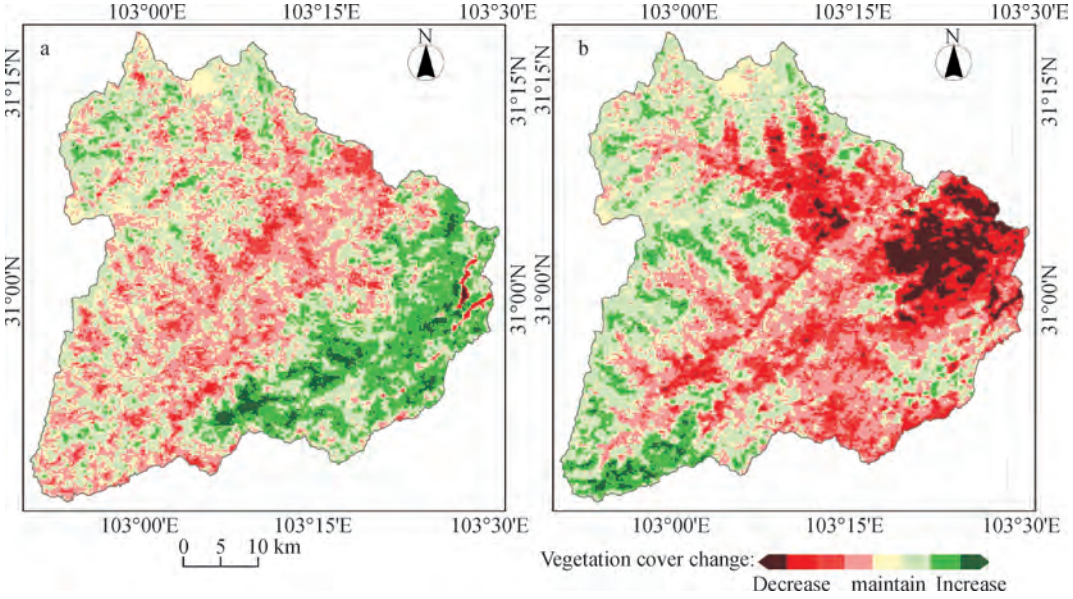

Fig.1 Change in vegetation cover at Wolong Natural Conservation Zone from 2001 to 2007 (a) and from 2001 to 2013 (b)

Method of calculative vegetation cover: Vegetation changes from 2001 to 2013 were calculated using the Moderate resolution Imaging Spectroradiometer (MODIS) TERRA MOD13Q1 Normalized Difference Vegetation Index (NDVI) dataset (250 m resolution). First, the mean-value iteration filter was used to remove the bulk of unusable pixel data from the MODIS NDVI dataset. Second, the annual Seasonally Integrated Normalized Difference Vegetation Index (SINDVI) was calculated using the reconstructed time series of the NDVI dataset. The SINDVI is defined as the sum of NDVI values $\geqslant 0.1$ for each pixel during a given year. Third, trend analysis was used to calculate the rate of change in MODIS SINDVI for each pixel from 2001 to 2008 and from 2008 to 2013, respectively. The annual rate of change in SINDVI (P) can be expressed as:

$$P = \frac{n \times \sum_{i=1}^{n} i \times N_i - \sum_{i=1}^{n} i \sum_{i=1}^{n} N_i}{n \times \sum_{i=1}^{n} i^2 - (\sum_{i=1}^{n} i)^2},$$

where i indexes the year and N_i is the SINDVI for the i^{th} year. Hence, the total change in SINDVI (E) can be expressed as: $E = P \times (n-1)$. Landscape fragmentation was calculated from Landsat TM/ETM+/OLI L1T images (30 m resolution). The images were pre-processed through radiative and atmospheric filters using Environment for Visualizing Images (ENVI). Atmospheric correction was conducted using ENVI Fast Line-of-sight Atmospheric Analysis of Hypercubes (FLAASH). The Mean Proximity Index (MPI) was calculated using the Fragstats software based on the results of supervised classification.

It is a long-term, arduous task to conserve the giant panda, and downgrading its conservation status is premature. Successful protection of this flagship species should take into account all kinds of potential threats, including habitat protection, ecological tour management, domestic animals, traffic and agriculture management, and atmospheric deposition control and climatic change. The giant panda is still an endangered species and protection effort and enthusiasm from the global conservation community should be strengthened continuously. Otherwise, “the lack of one basketful of earth spoils the entire effort to build a nine - Ren Mountain” as said in the Chinese proverb.

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