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Cats living with pandas

The status of wild felids within giant panda range, China

From 2002 - 2009, we conducted a camera-trapping survey in 11 nature reserves of the five mountain ranges within current giant panda distribution for a total sampling effort of 19,151 camera-days. Four felid species were recorded: *Panthera pardus*, *Panthera uncia*, *Catopuma temminckii*, and *Prionailurus bengalensis*. We found no significant correlation between the sampling effort and photographic rates of small felids, or medium- and large-sized felids, but a positive correlation between the photographic rates of medium- and large-sized felids and large-sized prey species. A well-designed systemic monitoring network using camera-trapping would be the best approach to obtain the critical information needed for setting felid conservation goals in China.

Nine felid species have been recorded to occur within the current giant panda *Ailuropoda melanoleuca* range and adjacent areas in southwest China. These species include the tiger *Panthera tigris*, leopard, snow leopard, clouded leopard *Neofelis nebulosa*, Eurasian lynx *Lynx lynx*, Asiatic golden cat, Pallas's cat *Otocolobus manul*, leopard cat, and Chinese mountain cat *Felis bieti* (Hu & Wang 1984, Wang 1998, Smith & Xie 2008). Giant pandas have been long considered a flagship species in wildlife conservation (Schaller 1994, Leader-Williams & Oublin 2000, Loucks et al. 2001). Immense financial and manpower resources, as well as public attention, have been devoted to the conservation of giant pandas and their habitat, which is believed to be beneficial to sympatric species, including felids (Caro & O'Doherty 1999, Lu et al. 2000). From early 1960s to 2007, 62 nature reserves were established with emphasis on giant panda protection and covered an area of 29,000 km^2 (Wang 2008). Current giant panda distribution covers one of the largest remaining forested areas in China, comprising five mountains in southern Shaanxi, western Sichuan, and a southern corner of Gansu province (Loucks et al. 2001, SFA 2006). Though a wildlife monitoring system based on sign transect has been recently established in the giant panda reserves (Gu et al. 2004, 2005, SFA 2007), our knowledge on the status of the felid species in this area is still poor due to lack of systematic survey and monitoring.

In 2002, we initiated a large mammal survey within the giant panda distribution of Sichuan and Shaanxi provinces using remote-trip cameras. We examined this dataset with respect to felids, and address three major questions: 1) what felid species are currently present in the giant panda nature reserves; 2) what is the spatial distribution pattern of these felids; and 3) what is the relative abundance of known prey for these felids.

Fig. 1. Surveyed nature reserves (NR). Label numbers and names referred in Table 1.

Methods

Camera-trapping was used to determine the presence of large mammal species within our study areas. From the five mountain ranges, we selected one to five nature reserves in each range as our study area (Fig. 1). A series of training courses on the camera-trapping technique (once a year) were held by Smithsonian National Zoological Park, Peking University, and Sichuan Forestry Department in Sichuan province from 2003 - 2008. At each course, staff from 3 – 5 reserves were trained to operate the camera units, identify common mammal species based on the photographs, manage the camera-trapping data using a database, and design the survey plan of their own reserve within a Geographic Information System (GIS). Some camera units and funds were provided to each reserve after the training to initiate a survey focusing on large mammals.

The surveyed nature reserve was divided into 1x1 km^2 sampling blocks using GIS. The major vegetation types of our sampled blocks were deciduous forest, deciduous-coniferous mixed forest, and coniferous forest. In three reserves (i.e. Wanglang, Wolong and Tangjiahe Nature Reserves), the sampling area was partly extended to alpine shrub and alpine meadow habitat above the tree-line. One or two passive infrared-triggered camera units were placed in each block for a sampling duration of one month. Adjacent camera units were set > 300 m apart. We used multiple camera models over the course of the surveys, including three passive film models (OeerCam™ DC-200, CamTrakker™ Original 35 mm, and one film model manufactured by colleagues and based on similar specifications to the CamTrakker™ Original 35 mm units), and two passive digital models (CamTrakker™ Digital Ranger, Cuddeback™ Digital). Camera units were attached to trees along active animal trails, 30-50 cm above ground and 3-5 m from the trail. All the units were set to record 24 hours per day with 0.5-2.5 minute delay between consecutive exposures, to film, memory storage or batteries being expended on a single detection. Carnivore scent lure (Montgomery Fur Company,

Table 1. Photographic rates of wild felids and their prey within surveyed nature reserves. Photographic rate was based on number of independent detections per 1000 camera-days. The survey effort is indicated in camera-days.

					Photographic rate [b]						
Mountain range	Nature reserve	Survey period	# 1km² blocks	Camera-days	Leopard cat	Asiatic golden cat	Leopard	Snow leopard	Small prey	Medium prey	Large prey
Qingling	1.Changqing	4-12/08	54	4307	5.34	0.70	0.23		16.25	17.88	177.39
Minshan	2.Tangjiahe	3/02-10/04 9/08-3/09	112	4977	0.80	0.20			8.64	62.89	45.21
	3.Laohegou [a]	7/05-4/07	33	1008	0.99				50.60	23.81	43.65
	4.Wanglang	9/04-10/05 6/08-11/08	120	4260	3.99				69.48	16.90	12.68
	5.Xiaohegou	9/08-11/08	15	587	1.70				107.33	25.55	8.52
	6.Xuebaoding	4/08-5/07	23	526	19.01				91.26	89.35	39.92
Qionglai	7.Wolong	8/05-5/07 10/08-3/09	56	2032	7.87			2.46	79.72	83.66	154.04
	8.Anzihe	4/08-1/09	5	506					65.22	41.50	23.72
Xiangling	9.Yele	6/08-12/08	26	547	1.83				7.31	89.58	14.63
Liangshan	10.Shenguozhuang	6/08-11/08	12	271	3.69				33.21	3.69	
	11.Mamize	4/08-8/08	5	130					69.23	15.38	

[a] Timber area managed by a local timber company, stopped logging in 1998 and initialized wildlife monitoring in 2004.

[b] Include the sample sites that are above tree-line.

Ogden UT) was placed in front of the camera unit to attract the animal in the focal area to ensure photographs.

The camera units were checked at the end of one-month sampling duration and moved to the next block after changing batteries, films, or memory cards if needed. The animals in each photograph were identified to species by the authors and input to a MS Access database to track the date, GPS location, elevation, and habitat information of each photographic record. Photographic rate was calculated for each felid species, as well as potential small, medium and large prey species. We defined the photographic rate as:

independent detection/1000 camera-days

where the independent detection of a species was defined as one photograph of the species taken during a 30-minute period at one camera site. Consecutive photographs of the same species within 30 minutes were considered a single detection. Small prey were those prey species with a body weight ≤ 5 kg, medium prey were those species whose body weight 5-20 kg, and large prey were considered those species whose body weight > 20 kg.

We tested the correlation between the photographic rates and the sampling effort (number of camera-days) for all felids, and the correlation between the photographic rates of felids and their prey. For this analysis, we combined the three southern nature reserves (Yele, Shenguozhuang and Mamize) due to low sampling effort in each individual reserve, and excluded the sample sites that were above tree-line. All variables were examined for normal distribution prior to analysis and no transformations were needed.

Result

From 2002-2009, 461 1x1 km² blocks in 11 nature reserves were surveyed for a total sampling effort of 19,151 camera-days (Fig. 1, Table 1), among which 6 blocks were above tree-line. The 11 surveyed reserves were not evenly sampled (sampling efforts varied from 130-4977 camera-days) due to logistic reasons. Tangjiahe, Changqing, Wanglang, and Wolong were the reserves with most sampling efforts (>2000 camera-days).

Four felid species were detected during our survey: snow leopard (n = 2 sites, ≥3 individuals, 1 reserve), leopard (n = 1 site, 1 individual, 1 reserve), Asiatic golden cat (n = 4 sites, 2 reserves), and leopard cat (n = 45 sites, 9 reserves) (Fig. 2-5). Leopard cat, the smallest but most detected species, was recorded at 9 out of the 11 reserves. The average photographic rate of leopard cat among these reserves was 5.03 (range 0.80-19.01). Large- and medium-sized felids (i.e., leopard, snow leopard, and Asiatic golden cat) were only detected in Changqing, Tangjiahe, and Wolong with rather low photographic rates. Changqing Nature Reserve detected the most felid species (i.e., leopard, Asiatic golden cat, and leopard cat), followed by Wolong Nature Reserve (i.e., snow leopard and leopard cat) and Tangjiahe Nature Reserve (i.e., Asiatic golden cat and leopard cat). The sampling effort (number of camera-days) prior to detection of felid species varied broadly among our survey reserves, from 50-1250 (average 200) camera-days for leopard cats to 600-5000 camera-days for the medium- and large-sized felids (Table 1), but there was no significant difference between small, medium- and large-sized felids (independent-samples t test, $t = 1.170$, $v = 2.037$, $p = 0.361$). No medium- or large-sized felids were detected in the three southern reserves (i.e., Yele, Shenguozhuang, and Mamize).

Small prey detected in our survey included pheasant and grouse species, pika *Ochotona* spp., wooly hare *Lepus oiostolus*, small rodents, and squirrels. Medium prey included short-tailed porcupine *Hystrix brachyura*, hog badger *Arctonyx collaris*, golden monkey *Rhinopithecus roxellana*, macaque *Macaca* spp., tufted deer *Elaphodus cephalophus*, Reeve's muntjac *Muntiacus reevesi*, and forest musk deer *Moschus berezovskii*. Large

prey detected were wild boar *Sus scrofa*, blue sheep *Pseudois nayaur*, goral *Naemorhedus goral*, Chinese serow *Capricornis milneedwardsii*, and takin *Budorcas taxicolor*. Changqing Nature Reserve had the highest photographic rate of large prey, followed by Wolong and Tangjiahe Nature Reserves (Table 1). In the two southern reserves of Liangshan mountains (i.e., Shenguozhuang and Mamize), no large prey species were detected.

We found no significant correlation between the sampling effort and photographic rates of small felid (leopard cat, Pearson test, $r = 0.409$, $p = 0.667$, $n = 9$), or medium- and large-sized felids (e.g. leopard, snow leopard and Asiatic golden cat combined, Pearson test, $r = 0.763$, $p = 0.100$, $n = 9$). We also found no significant correlation between the photographic rates of small felid (leopard cat) and small prey (Pearson test, $r = 0.767$, $p = 0.319$, $n = 9$), but a positive correlation among the photographic rates of medium- and large-sized felids and large-sized prey (Pearson test, $r = 0.821$, $p = 0.047$, $n = 9$).

Discussion

Our surveys provide current information on the status of felids and their prey within the study area. Our record of snow leopard in Wolong Nature Reserve (Fig. 2) was the first photographic evidence of this endangered species at the southeast edge of its distribution (Nowell & Jackson 1996, IUCN 2009). The photograph of an Asiatic golden cat at Tangjiahe Nature Reserve showed a rare coat pattern with rosettes and spots, which is the first field photo of this phenotype in China and only occasionally reported elsewhere (Nowell & Jackson 1996, Wang 2007, Wilson & Mittermeier 2009, Fig. 3). These preliminary results indicate extending the sampling effort of these surveys would benefit felid research and conservation in China.

There are three potential reasons underlining the spatial pattern in our survey, in which more felids were detected in northern than in southern reserves: 1) sampling effort; 2) prey abundance; and 3) poaching pressure on these felids. We found no significant correlation between sample effort and carnivore abundance but our sample effort was lowest in the south. Camera-trapping is considered the most effective methodology to detect the presence of wild felids (Cutler & Swann 1999, Karanth & Nichols 1998), but nondetection cannot be directly considered absence, especially when the sampling effort is low. Previous studies show that the number of camera-days required for detection of rare felid species varies broadly (e.g., 230-2945 camera-days for tiger and 16-4418 camera-days for clouded leopard in southeast Asia; Datta et al. 2008), so its possible our sampling effort in southern reserves (130-547 camera-days) was insufficient to detect rare large felids. However, this sampling effort was sufficient to detect large mammals in the northern reserves and in other regional studies conducted by this research team (Wang et al. 2006, Li et al., in press), but detected no large prey species in these southern reserves, a finding in agreement with informal interviews with local people. Large mammals are probably missing from these reserves because most of the nature reserves in Xiangliang and Liangshan mountains were established from 1993 to 2002 after a long history of commercial timber logging, and no control over harvest of both the felids and their prey. Of our three probable reasons for lack of detection in these southern reserves, we consider low survey effort the least likely.

All the surveyed nature reserves have an official mammal species list generated from baseline investigation and historical literature. Two to seven felid species are listed in each nature reserve's formal species list (SOM T1), though there may be no evidence for the presence of some species within the reserve in recent decades. For example, six felid species are on the baseline species list of Tangjiahe (Hu 2005), but no photographs, sightings or dead/captured animal have been reported for three species (i.e., clouded leopard, Eurasian lynx, and Pallas's cat) since the reserve was established in 1978 (Liu X., pers. comm.). Our large sampling effort (approximate 5000 camera-days), covering all possible habitat types within this 300 km^2 reserve, indicates a conspicuous gap between the felid species detected and the official list maintained by the reserve. Similar discrepancies exist in all other surveyed reserves. During the 3rd National Giant Panda Survey from 1999-2003, only three felid species (i.e., leopard, Asiatic golden cat and leopard cat) were detected with an extensive sampling effort of 11,174 sign transects throughout the giant panda distribution (SFA 2006). Among the nine felid species historically recorded within current giant panda range (SOM T1), the tiger has been probably extinct since the late 20th century (IUCN 2009), and the record of Chinese mountain cat remains doubtful (He et al. 2004). Though our camera-trapping effort didn't cover all possible felid habitat types in some reserves (e.g. above treeline), our results do highlight the need for detailed survey of felids in the major reserves rather than reliance on the reserve species lists to determine carnivore status and distribution. Studies on the distribution range of each individual felid species need to be conducted prior to setting felid conservation goals in China. We think a well-designed systemic monitoring network using camera-trapping would be the best approach to obtain such information (Li et al., in press).

Although none of our surveyed nature reserves were established for the conservation of felids, the giant panda may serve as an umbrella species for the sympatric felids and their prey (Schaller 1994, Lu et al. 2000). Nevertheless, there may be size limitations for reserves established for giant pandas that render the reserves of insufficient area for large carnivore species. Large felids normally maintain low densities due to social interactions and large home ranges for foraging requirement. For example, the home range of individual snow leopard (McCarthy et al. 2005) and leopard (Norton & Lawson 1985) can exceed 500 km^2, whereas the average size of giant panda reserve is 544 km^2 (range: 83-4069 km^2, SFA 2006). The area needed to support a viable population for these large felids may require several adjacent nature reserves. Isolated reserves, such as those in the southern mountains, may be insufficient in size for large felid conservation. For an effective conservation of felid species, adjacent giant panda reserves should be considered an integrated management unit with connectivity between reserves of primary concern.

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Supporting Online Material SOM

Table T1 at www.catsg.org

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Fig. 2. Snow leopard, Wolong NR, 2009

Fig. 3. Leopard, Changqing NR, 2008

Fig. 4. Asiatic golden cat (spotted morph), Tangjiahe NR, 2008

Fig. 5. Leopard cat, Wanglang NR, 2004