A NEW SUBSPECIES OF GIANT PANDA (*AILUROPODA MELANOLEUCA*) FROM SHAANXI, CHINA

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Multivariate statistical analyses of cranial and dental morphology and comparison of pelage coloration were used to describe a new subspecies of giant panda from the Qinling Mountain range of Shaanxi Province in China. Based on 2 components that were highly related to skull and molar sizes, respectively, principal components analysis grouped all samples into 2 clusters corresponding to the Qinling and Sichuan samples. The Qinling cluster was characterized by significantly smaller skulls and larger molars compared to the Sichuan cluster. Based on skull and molar sizes, discriminant function analysis also correctly identified all samples from Qinling and Sichuan populations. Comparison of pelage coloration indicated that Sichuan individuals had black chest patches and white ventral pelages, whereas Qinling pandas had dark brown chest patches and brown ventral pelages. These results reveal that the diagnostic characteristics of the new Qinling subspecies are a small skull, large molars, dark brown chest patch, and brown ventral pelage.

Key words: giant panda, new subspecies, Qinling

The giant panda (*Ailuropoda melanoleuca*) was 1st identified as a distinct species in 1869 by the French missionary Pere Armand David based on a skin he collected from Baoxing County in the Qionglai Mountains. Fossil records indicate that the giant panda was once distributed throughout southern and eastern China, extending into northern Burma and northern Vietnam (Hu 2001). However, recent human activity has resulted in giant pandas being restricted to 6 isolated mountain ranges in Sichuan, Gansu, and Shaanxi provinces, China, specifically the Qinling, Minshan, Qionglai, Daxiangling, Xiaoxiangling, and Liangshan mountain ranges (Fig. 1). The giant panda is recognized as one of the most endangered animal species in the world and much effort has been devoted toward its conservation. The current global population of giant pandas is estimated to be ~1,000, with 85% of them occurring in Sichuan Province, 5% in Gansu Province, and 10% in Shaanxi Province (Hu 2001).

The separation of populations of a species by geographical features such as glaciers, deserts, or oceans over long periods can lead to compensatory adaptation and genetic isolation. If separated populations of a species show significant adaptive differentiation to different habitats (ecological niches), or

significant genetic differentiation, then they are potentially subspecies on the path to speciation (Wan et al. 2004). Conversely, human activity and introduction of feral species may lead to fragmentation of populations. Therefore, it is difficult for geneticists and ecologists to discern whether populations became isolated due to historical factors or more recent human activity.

Generally it is thought that panda habitat was fragmented on 6 completely isolated mountain ranges in the past 100 years. Contrary to this popular belief, a recent study by our group revealed highly significant differences between the DNA fingerprints and morphological characteristics of Qinling pandas and those from the other 5 populations, indicating that the Qinling population became separated from the other populations approximately 10,000 years ago (Wan et al. 2003). Based on the genetic data and analysis of variance from 7 cranial measurements, the Qinling population was recognized as a new subspecies (Wan et al. 2003). Herein the new Qinling subspecies is described formally based on multivariate analyses of 16 cranial and dental measurements and qualitative comparison of pelage coloration.

MATERIALS AND METHODS

Specimens examined.—We examined 37 skulls, 45 skins, and 45 live animals (Appendix I). The research on live animals was performed in a humane manner, and followed guidelines of the American Society of Mammalogists (http://www.mammalogy.org/committees/index.asp). Only 11 skulls had museum numbers and none of the skin samples
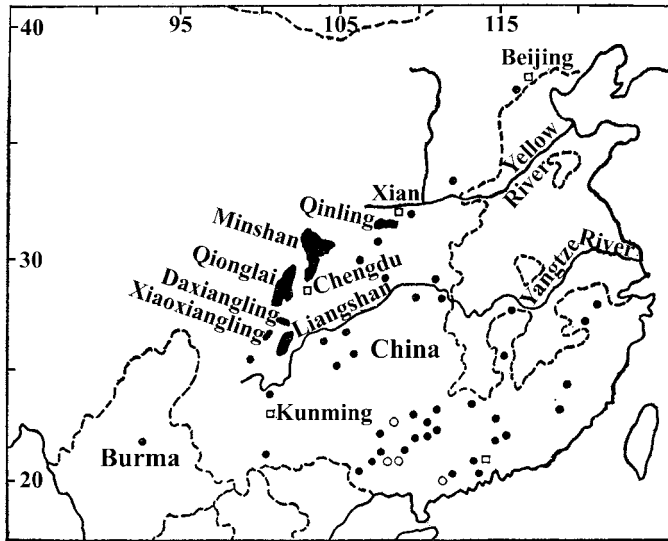
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FIG. 1.—Current and historical distribution of the giant panda. Black areas, present distribution; open circles, fossil records in the Early Pleistocene; closed circles, fossil records in the Mid and Late Pleistocene; dashed line, border of Yellow River–Yangtze River lowlands.

had museum numbers. All live animals observed for pelage coloration had studbook numbers (Appendix I). Because only 36 giant pandas reside in the Daxiangling and Xiaoxiangling mountains (Hu 2001), we were unable to collect samples from these 2 populations. A considerable number of samples were not sexed, therefore, samples from males and females were combined in analyses. The Qinling population is restricted to Shaanxi Province and nearly all individuals in the other 5 populations were from Sichuan Province (only about 50 pandas live in Gansu Province). Therefore, we referred to the Minshan, Qionglai, and Liangshan samples from the nominate subspecies as Sichuan populations.

Age determination.—We used the criteria of Wei et al. (1990) to determine the relative age of giant pandas. Only adult skulls showing closed basal suture and clear wear of molars were included in the analyses. Live animals included in the pelage coloration analyses were required to be at least 5 years of age, as determined from birth-date data recorded in studbooks, for our analysis. Age data were unavailable for museum skins but museum records indicate that skins were collected from adult individuals. Therefore, fur colors of adult museum skins were used as controls in the comparison of Qinling and Sichuan populations.

Morphometric measurements.—Dimensions of skulls and molars are the best characteristics for distinguishing taxonomic status between species and subspecies (Carrasco 2000; Deng et al. 2000; González et al. 2002; Luna and Pacheco 2002). Therefore, 16 cranial and dental measurements were taken from 37 adult skulls to the nearest 0.01 mm by using Vernier calipers. Measurements and their acronyms were as follows: greatest length of skull (GLS), occipitonasal length (ONL), condylobasal length (CBL), basal length (BL), palatal length (PL), zygomatic breadth (ZB), occiput breadth (OB), length of rostrum (LR), breadth of rostrum (BR), cranial height (CH), mandibular length (ML), mandibular breadth (MB), length of lower 1st molar (Lm1), width of lower 1st molar (Wm1), length of lower 2nd molar (Lm2) and width of lower 2nd molar (Wm2).

Phenotypic characters examined.—Pelage coloration patterns often differ between species and subspecies (Díaz et al. 2002; Sutton and Patterson 2000). Hence, to determine if the coloration of the Qinling giant pandas differed from that of Sichuan pandas, hair color on different parts of giant pandas from the 2 regions was examined, including ears, eye patches, shoulder band, legs, tail, chest, and venter. (The same researcher performed all assessments.) Ninety samples (45 live pandas and 45 skins) were divided into 2 groups according to whether the panda originated from Qinling ($n = 21$) or Sichuan ($n = 69$), and pelage coloration patterns were compared between these groups.

Morphological analyses.—Statistical analyses were performed by using SPSS Version 10.0 for Windows (SPSS, Inc. 1999). Descriptive statistics (mean, standard deviation, and observed range) were calculated for each population. Factorial analysis was used to obtain a general view of variation, both within and among populations. Factors were extracted by principal components analysis by using a correlation matrix. Projection of individuals over the most informative factors was analyzed to detect possible clusters of specimens belonging to the same population. Another multivariate analysis, discriminant analysis, was performed to classify individuals by population location.

RESULTS

Cranial and dental measurements for samples from 3 Sichuan populations (Qionglai, Minshan, and Liangshan) and the Qinling population indicate that the Qinling population was characterized by a smaller skull size and larger molar size than the Sichuan populations (Table 1; $P < 0.05$ for all comparisons except zygomatic breadth and breadth of rostrum). Panda size varied among the 3 Sichuan populations, with the Qionglai population having the largest and the Minshan population the smallest sizes. The Liangshan population exhibited variable morphology, with both large and small pandas (Table 1).

A principal components analysis was conducted on 16 cranial and dental measurements from 37 adult pandas. The first 5 components extracted explained >88% of the total variation (Table 2). High positive relations with most variables on the 1st factor indicate that this component is related principally to skull length, breadth, and height. The 2nd factor shows high positive relations with molar length and width, whereas breadth of rostrum had a high positive relation with the 3rd factor ($r > 0.8$). When individuals were discriminated by population over the first 2 factors, an obvious differentiation emerged between the Qinling and Sichuan populations (Fig. 2A). The differentiation along the 1st factor revealed that the Qinling population had a smaller skull size than the Sichuan populations. The 2nd factor, which is highly related to dental characteristics, was a good discriminator, reflecting larger molar size in the Qinling population; it assigned only 1 Qinling individual to the Sichuan populations (Fig. 2A). In contrast, the distribution of individuals along the 3rd factor indicated that the range of rostrum breadths was similar across all the populations examined (Fig. 2B). The results of the principal components analysis indicated that, compared to the Sichuan populations, the animals in the Qinling population have smaller skulls and larger molars but similar rostrum breadth. In contrast to the separation between the Qinling samples and the Sichuan samples in the plots of the 1st and 2nd factors, the 3 populations comprising the Sichuan samples (Minshan, Qionglai, and Liangshan populations) showed a much greater degree of overlap (Fig. 2).

TABLE 1.—Morphometric measurements (mm) of adult pandas from the nominal subspecies (3 localities) and the new subspecies. See "Materials and Methods" for explanation of abbreviations.

| | *Ailuropoda melanoleuca melanoleuca* (Sichuan subspecies) | | | | | | | | | New subspecies | | |
| | Minshan | | | Qionglai | | | Liangshan | | | Qinling | | |
Measurement	Mean $\pm$ SD	Range	n	Mean $\pm$ SD	Range	n	Mean $\pm$ SD	Range	n	Mean $\pm$ SD	Range	n
GLS	287.2 ± 10.3	275.4−309.8	14	307.5 ± 14.2	290.1−326.8	7	299.7 ± 18.4	274.7−326.5	5	276.8 ± 11.6	256.8−291.1	11
ONL	254.9 ± 9.0	242.5−274.2	14	282.5 ± 13.9	260.7−298.3	7	269.8 ± 18.3	241.3−286.9	5	246.5 ± 12.6	224.3−263.3	11
CBL	254.6 ± 10.2	241.8−280.9	14	275.0 ± 10.4	263.8−288.0	7	267.4 ± 13.0	248.0−284.0	5	250.5 ± 9.1	234.5−263.7	11
BL	236.6 ± 9.1	224.1−260.1	14	255.0 ± 9.6	242.2−266.4	7	247.7 ± 10.4	232.9−260.4	5	231.6 ± 9.9	213.1−247.3	11
PL	133.2 ± 4.8	128.3−146.0	14	144.6 ± 7.7	132.8−154.2	7	141.2 ± 4.0	137.2−145.5	4	126.0 ± 5.5	117.0−134.6	11
ZB	208.0 ± 10.8	190.3−222.3	14	221.5 ± 7.5	209.9−233.4	7	207.5 ± 18.5	182.2−232.4	5	203.6 ± 10.9	184.2−221.2	11
OB	150.8 ± 10.0	132.8−165.7	14	156.0 ± 9.3	143.2−170.7	7	170.8 ± 12.3	157.9−187.1	5	161.1 ± 16.9	144.5−187.2	11
LR	95.5 ± 3.8	90.1−102.3	14	99.7 ± 5.7	91.5−108.7	7	98.9 ± 6.2	88.8−105.9	5	91.8 ± 4.0	85.5−96.7	11
BR	43.5 ± 2.3	39.1−47.5	14	44.4 ± 4.6	40.3−54.1	7	48.3 ± 3.5	44.6−52.2	5	44.5 ± 2.0	41.8−48.0	11
CH	88.6 ± 5.0	81.0−101.1	14	93.1 ± 4.3	87.0−98.0	7	90.5 ± 8.7	81.1−103.0	5	83.2 ± 5.0	71.0−90.1	11
ML	205.1 ± 6.0	195.8−213.1	12	221.1 ± 7.3	212.0−229.1	7	211.4 ± 11.8	197.7−228.4	5	205.0 ± 6.3	190.4−214.3	11
MB	191.3 ± 10.1	176.6−209.2	12	203.8 ± 9.8	194.2−221.1	7	193.6 ± 12.2	177.2−210.0	5	187.0 ± 9.9	166.4−199.6	11
Lm1	30.1 ± 1.2	27.4−31.4	12	30.9 ± 0.7	29.8−31.8	7	31.3 ± 1.3	30.3−33.0	5	33.2 ± 0.7	32.1−34.0	11
Wm1	18.4 ± 1.4	16.3−20.8	12	19.3 ± 1.3	17.0−20.5	7	20.7 ± 1.1	19.5−22.4	5	20.3 ± 1.3	18.8−23.3	11
Lm2	24.1 ± 1.0	22.1−25.5	12	25.1 ± 1.0	23.6−26.3	7	24.8 ± 1.1	23.3−26.4	5	26.4 ± 0.8	24.6−27.2	11
Wm2	20.7 ± 1.1	19.3−22.7	12	20.9 ± 1.2	18.6−22.3	7	21.5 ± 0.8	20.3−22.1	5	22.2 ± 1.6	18.2−24.6	11

To further confirm the distinct morphologies of the Qinling and Sichuan populations, a discriminant function analysis using the stepwise model was performed to classify samples from the Qinling, Minshan, Qionglai, and Liangshan populations. The step-by-step model evaluated 16 variables and selected palatal length, length of lower 1st molar, and width of lower 1st molar to discriminate among the populations. Based on these 3 variables, highly significant differences were detected between the Qinling and Sichuan populations ($F = 74.047$, $P < 0.001$). The first 3 canonical discriminant functions had, respectively, eigenvalues of 4.542, 1.010, and 0.105; canonical correlations of 0.905, 0.709, and 0.308; and accounted for 80.3%, 17.9%, and 1.9% of the total variance.

In the plot of the 1st and 2nd functions, samples from the 4 populations were grouped into 2 distinct clusters (Fig. 3) corresponding to the specimens from the Qinling and Sichuan populations. In the projection of the Sichuan specimens onto the first 2 functions, 1 specimen from the Minshan population was mistakenly classified with the Qionglai population; 4 specimens from the Qionglai population were identified correctly but 2 and 1 samples were mistakenly classified as being from the Minshan and Liangshan populations, respectively; and 1 specimen of the Liangshan population was mistakenly identified as being from the Minshan population. As a result, the Minshan, Qionglai, and Liangshan populations had misclassification rates of 7.1%, 42.9%, and 20%, respectively. Samples from the Liangshan population, which exhibited a variable morphology that ranges across the Minshan and Qionglai populations (Table 1), lie in the middle of the Sichuan populations (Fig. 3), and would probably overlap the Minshan and Qionglai populations to an even greater extent if more Liangshan specimens were collected.

Pelage coloration was examined in all 90 available skins and live animals. Pelage was black on the ears, eye patches, shoulder band, and legs, and white on the dorsum, tail, and remainder of the head in all individuals. In the Sichuan populations, all specimens had black patches on the chest (Fig. 4A). Sixty-four (94.2%) of 69 individuals were white on the venter (Fig. 4B), but 5 (5.8%) had bicolored ventral hairs with black tips and white bases (Fig. 4C). In contrast to the Sichuan individuals, the Qinling population had dark brown patches on the chest (Fig. 4D). Nineteen (90.5%) of 21 individuals were brown on the venter (Fig. 4E), but 2 (9.5%) had bicolored ventral hairs with brown tips and white bases (Fig. 4F). It is worth noting that it is easy to confuse the 2 kinds of bicolored

TABLE 2.—Five factors extracted by using the principal components method for 16 variables measured on 37 adult skulls of giant pandas. Values correspond to correlation coefficients between variables and each factor. "Percentage explained" refers to percentage of variance accounted for by each factor. Asterisks indicate variables that have a strong positive association ($r > 0.7$) with the factor. See "Materials and Methods" for explanation of abbreviations.

| Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
GLS	0.933*	−0.067	−0.033	0.104	−0.008
ONL	0.932*	−0.064	−0.103	0.189	−0.069
CBL	0.950*	0.042	−0.061	0.140	−0.123
BL	0.958*	−0.022	−0.040	0.154	−0.100
PL	0.905*	−0.235	0.060	0.189	−0.030
ZB	0.889*	0.175	−0.093	−0.270	0.010
OB	0.872*	0.087	−0.073	−0.271	0.051
LR	0.817*	−0.167	−0.077	0.275	−0.142
BR	0.315	0.232	0.898*	0.094	0.033
CH	0.813*	−0.134	0.254	−0.117	0.274
ML	0.885*	0.118	−0.134	−0.123	0.039
MB	0.855*	0.168	−0.023	−0.310	0.190
Lm1	−0.081	0.894*	0.056	−0.116	−0.317
Wm1	0.056	0.848*	0.015	0.170	0.118
Lm2	0.152	0.893*	−0.019	−0.075	−0.208
Wm2	−0.135	0.766*	−0.240	0.304	0.421
Percentage explained	55.77	19.69	6.19	3.89	3.14

A

B
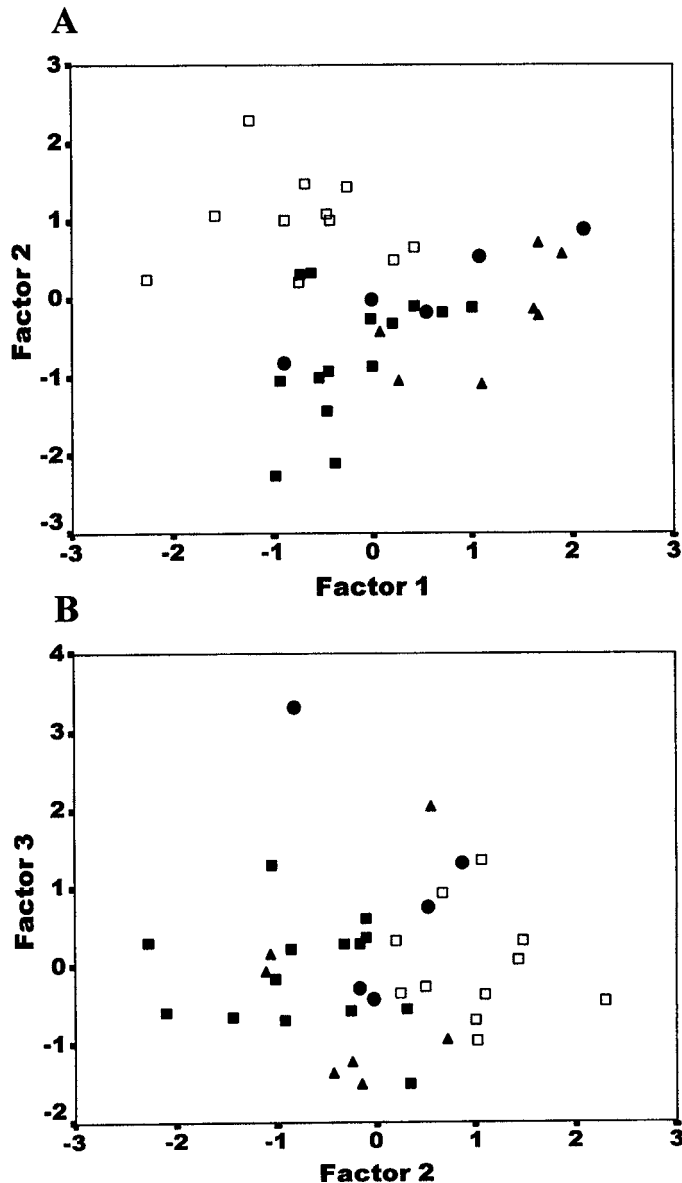
FIG. 2.—Multivariate relationships among 4 populations of the giant panda. Projections of individual specimen scores from principal components analysis on A) the 1st and 2nd factors, and B) the 2nd and 3rd factors. Specimens are indicated by open squares (Qinling, new subspecies), filled squares (Minshan), filled triangles (Qionglai), and filled circles (Liangshan).

hairs. To distinguish these samples, it was necessary to pull hairs out and perform the comparison. These results indicated that the Qinling population is a new subspecies of *Ailuropoda melanoleuca*, as summarized in the following accounts.

SUBSPECIES DESCRIPTION

Ailuropoda melanoleuca qinlingensis, new subspecies

Holotype.—An adult female skull, specimen number SFNRMB 2000-03 deposited at Shaanxi Foping National Reserve Management Bureau, Shaanxi Province, China. Collected 16 March 2000, from Foping National Reserve by Y. G. Yong.
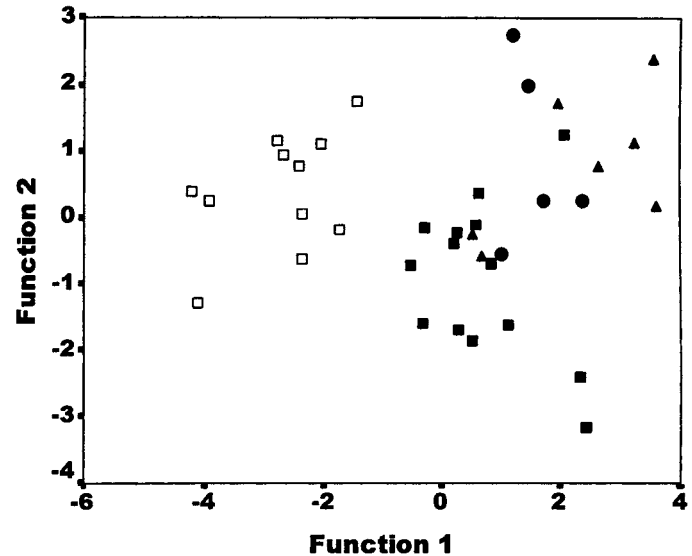

FIG. 3.—Plots of discriminant function scores on first 2 canonical variates. Specimens are indicated by squares (Qinling, new subspecies), filled squares (Minshan), filled triangles (Qionglai), and filled circles (Liangshan).

Distribution.—Currently at an elevation of 1,300–3,000 m on the southern slopes of the Qinling Mountains of Shaanxi Province, China.

Etymology.—Named after the Qinling Mountain range, where the only population remains.

Diagnosis.—*Ailuropoda m. qinlingensis* has a smaller skull size and larger molar size than *Ailuropoda m. melanoleuca* (Table 1). In addition to cranial and dental size, *Ailuropoda m. qinlingensis* differs from the nominate subspecies in pelage coloration (Fig. 4). The Qinling subspecies is dark brown on chest and brown on venter. In a few specimens, ventral hairs are distally brown, fading to whitish bases.

Skull measurements for the holotype (mm).—Greatest length of skull, 263.16; occipitonasal length, 230.18; condylobasal length, 238.76; basal length, 222.34; palatal length, 120.58; zygomatic breadth, 204.64; occiput breadth, 147.46; length of rostrum, 88.48; breadth of rostrum, 43.74; cranial height, 81.58; mandibular length, 203.38; mandibular breadth, 190.68; length of upper 2nd premolar, 12.20; width of upper 2nd premolar, 6.14; length of upper 3rd premolar, 18.42; width of upper 3rd premolar, 10.36; length of upper 4th premolar, 22.96; width of upper 4th premolar, 16.36; length of upper 1st molar, 22.66; width of upper 1st molar, 25.68; length of upper 2nd molar, 31.50; width of upper 2nd molar, 24.96; crown length of upper molar row, 137.74; length of lower 2nd premolar, 11.94; width of lower 2nd premolar, 6.84; length of lower 3rd premolar, 17.24; width of lower 3rd premolar, 9.48; width of lower 4th premolar, 23.68; width of lower 4th premolar, 14.18; length of lower 1st molar, 33.44; width of lower 1st molar, 23.28; length of lower 2nd molar, 27.16; width of lower 2nd molar, 24.60; length of lower 3rd molar, 21.66; width of lower 3rd molar, 22.66; crown length of lower molar row, 151.60. These measurements of this skull are given in Table 1.

DISCUSSION

The principal components analysis revealed 2 distinct clusters, separating specimens from Qinling and those from Sichuan, and the discriminant function analysis had no classification errors between the Qinling and Sichuan populations (Figs. 2 and 3). However, the coat coloration of Qinling individuals differed from that of the Sichuan populations (Fig. 4). All morphological characteristics are consistent with previous genetic data, indicating that the Qinling population and the Sichuan population genetically are distinct units (Wan et al. 2003), and thus support the hypothesis that the Qinling population has differentiated into a new subspecies. The Qinling Mountain range, located in the middle of China, is an important physical barrier to the movement of animals between northern and southern China. This mountain range has unique geomorphic and climate characteristics that are favorable to a wide variety of wildlife including large mammals (Yue and Chen 1998). Several animal subspecies endemic to the Qinling Mountains have been distinguished from other subspecies based on their pelage coloration (e.g., the golden takin [*Budorcas taxicolor bedfordi*]—Yue and Chen 1998). Hence, it is not surprising that Qinling pandas represent a new subspecies.

In multivariate analyses, the Minshan and Qionglai samples were separated into 2 relatively independent areas within the scatter plots (Figs. 2 and 3), suggesting morphological differences between these 2 populations. However, the Liangshan population appeared in the middle of the Sichuan plots, forming a link between the Minshan and Qionglai samples (Fig. 3). Furthermore, examination of genetic data reveals no significant genetic differences between the Minshan and Qionglai populations (Wan et al. 2003). Consequently, morphometric differences in the Sichuan populations are most likely the result of intrasubspecies variation resulting from environmental factors.

Examination of the DNA fingerprint data (Wan et al. 2003) suggests that the Qinling and Sichuan populations diverged around 10,000 years ago. As large mammals, giant pandas have differentiated into 2 subspecies in as little as 10,000 years (Wan et al. 2003), which is a relatively small amount of time in comparison to other animals (Frankham et al. 2002). However, it is worth noting that a glaciation event occurred around 10,000 years ago that divided giant pandas into a large Qinling population and a relatively small Sichuan population, resulting in independent evolutionary histories (Wan et al. 2003). The more rapid genetic drift that occurs in small populations may therefore have quickened the Sichuan subspeciation of the giant panda such that it occurred within 10,000 years.

Faced with the growing challenge of deriving strategies for salvaging diminishing flora and fauna, conservation biologists continue to search for methods that can distinguish unambiguous units for conservation, and this has resulted in the reevaluation of the taxonomy of poorly studied groups (González et al. 2002). We have used the subspecies concept proposed by Avise and Ball (1990) and O'Brien and Mayr (1991) as our working definition. These authors agree that concordance of morphologic and genetic data is fundamental to subspecies definition; members of a subspecies would share
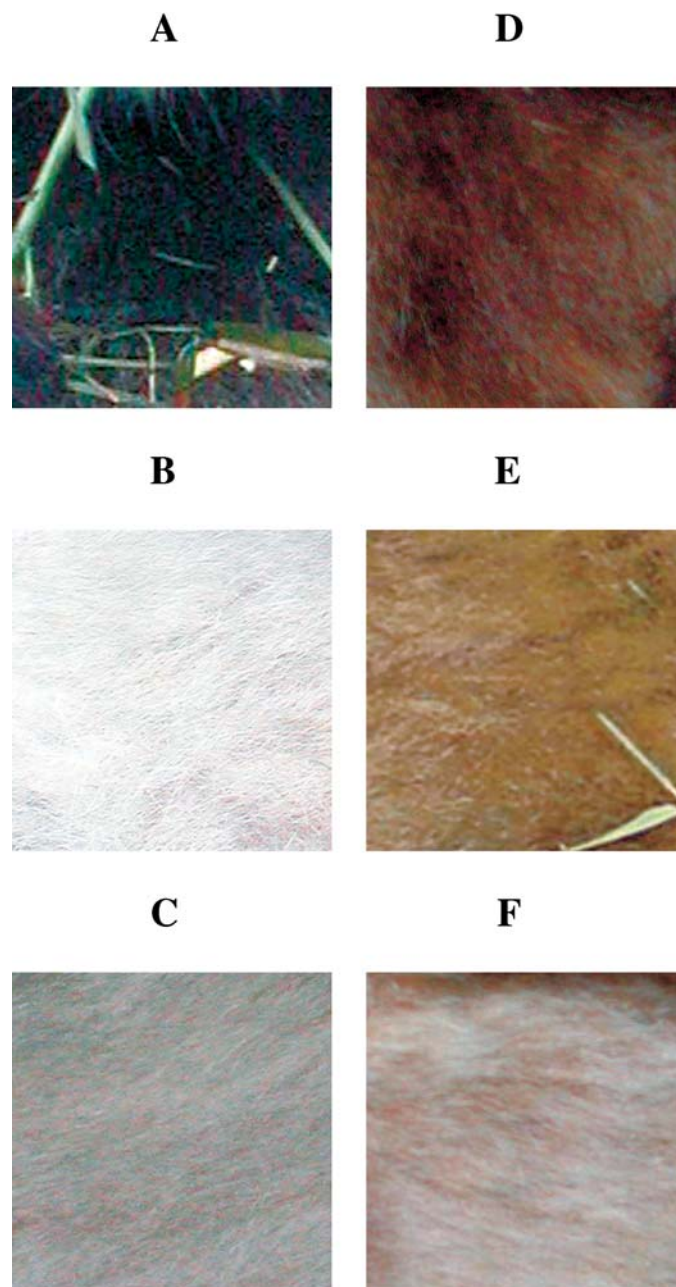

FIG. 4.—Color characteristics of the Qinling and Sichuan populations. A, B, and C) Sichuan individuals; D, E, and F) Qinling individuals; A and D) chest; B and E) most common venter color; and C and F) rare venter color.

a unique geographic range or habitat, and a group of phylogenetically concordant phenotypic characters; and members of a subspecies would have an evolutionary history distinct from those of other subdivisions of the species. Consequently, the evidence presented here and in our previous study (Wan et al. 2003) support the hypothesis that the Qinling population is a distinct subspecies.

Approximately 100 giant pandas of the Qinling subspecies survive (Hu 2001), making this population the most endangered giant panda subspecies. However, all giant pandas currently are managed as a single metapopulation. Only 1 breeding center has

been built (Wolong Reserve in the Qionglai Mountain range) to carry out the reintroduction strategies for all giant pandas in China. Moreover, captive-bred giant pandas from the Qinling subspecies have been mated with animals from the Sichuan subspecies and have produced hybrid offspring. Taking into account the fact that there are fewer than 15 Qinling pandas in captivity, we recommend that a breeding center be built exclusively for the Qinling subspecies. We also highly recommend that giant pandas from each of the subspecies be managed as unique stocks. Because hybrids may be at a disadvantage, sometimes even displaying partial reproductive isolation and differences in adapting to different conditions (Frankham et al. 2002), hybrid descendants should be excluded from the breeding population and subspecies hybridization should be avoided in the future. The Qinling population traditionally has been regarded as 1 group of the Sichuan subspecies. Therefore, there is no doubt that financial resources allocated to the Qinling subspecies are less than those available for the Sichuan subspecies. In view of the fact that the Qinling Mountains contain 10% of the giant panda population, it is essential to allocate more resources to the Qinling subspecies at this time.

ACKNOWLEDGMENTS

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APPENDIX I

Specimens examined.—Acronyms for institutions: Shaanxi Foping National Reserve Management Bureau (SFNRMB); Shaanxi Institute of Zoology (SIZ), Xian; Shaanxi Changqing National Reserve Management Bureau (SCNRMB); Shaanxi Rare Wild Animal Rescue and Breeding Center (SRWARBC), Zhouzhi; the Specimen Museum of China West Normal University (SMCWNU), Nanchong; Chengdu Breeding and Research Center of the Giant Panda (CBRCGP); Sichuan Wolong National Reserve Management Bureau (SWNRMB). All museums are in China.

For morphometric measurements, 37 skulls from different mountain ranges were collected as follows: SFNRMB (Qinling, 9); SIZ (Qinling, 1); SCNRMB (Qinling, 1); SMCWNU (Minshan, 13; Qionglai, 6; Liangshan, 1); CBRCGP (Minshan, 1; Qionglai, 1; Liangshan, 4). Only 11 skulls had museum numbers: SFNRMB 01, SFNRMB 07, SFNRMB 08, SFNRMB 1991-10, SFNRMB Geng-01, SFNRMB 2000-03, SMCWNU Wolong-III, SMCWNU Ping-84001, SMCWNU Qing-001, SMCWNU Wolong-GP3001, and SMCWNU 93001. For comparisons of pelage coloration both museum skins and live animals were examined. The museum skins from the Sichuan populations were not labeled with their specific mountain origins, but it is certain that they came from within Sichuan Province. The live animals had the following studbook numbers for each locality. SRWARBC: 377, 444, 460, 497; CBRCGP: 278, 287, 297, 312, 314, 342, 362, 373, 386, 387, 401, 407, 425, 453, 454, 467, 480, 490, 491, 494; SWNRMB: 308, 329, 357, 374, 382, 394, 399, 404, 413, 414, 432, 437, 439, 446, 474, 476, 477, 495, 502, 503, 504. The studbook records indicate that captive pandas sampled from Sichuan Province were descendants of founders captured from Minshan, Qionglai, and Liangshan mountain ranges, but the source population of each individual is not known. Therefore, the 45 skins and 45 live animals used in the pelage comparisons were divided into 2 groups based on whether they originated from the Qinling population or the Sichuan populations. The 45 skin samples had the following geographic origins: SFNRMB (Qinling = 18); SMCWNU (Sichuan = 3); SWNRMB (Sichuan = 24). The geographic origins of the 45 live animals were as follows: SRWARBC (Qinling = 3; Sichuan = 1); CBRCGP (Sichuan = 20); SWNRMB (Sichuan = 21).