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On the Gazelles of the genus *Procapra* Hodgson, 1846

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Although the classification of the species of gazelles is by no means agreed upon, modern authors are unanimous in the opinion that the animals usually combined under the popular term "gazelles" represent two very distinct types. By some (SOKOLOV, 1959) these are retained, together with the Springbok of South Africa, in a single genus; by others (ALLEN, 1939; ELLERMAN & MORRISON-SCOTT, 1951) they are placed in two separate genera, the typical gazelles remaining under the designation *Gazella* Blainville, 1816, and the atypical Asiatic forms taking the generic name *Procapra* Hodgson, 1846.

The differences between the two are, in the opinion of the present author, sufficiently great to warrant the recognition of two full genera. In the genus *Procapra* no female specimen bearing horns has been recorded; in *Gazella*, on the other hand, the females commonly have horns, and even the supposedly entirely hornless-female species, *Gazella subgutturosa*, not infrequently displays horns in the female up to or exceeding 50 mm. in length.

The skulls of the two genera can at once be distinguished. In *Procapra* the skull has no preorbital depressions, as there are no face-glands; the nasals are long and pointed at their ends. In *Gazella* the face-glands are rather large, so that there are deep depressions for their reception; while the nasal bones are short and broad, and end bluntly, each of the two bones displaying a medial and a lateral point, which are short and, moreover, do not greatly project beyond the end of their suture with the bones of the upper jaw (maxilla or premaxilla, in different forms).

Externally there are also differences, mainly connected with absence or near-absence of glandular areas in *Procapra*. Thus in the latter genus the face-glands are rudimentary or absent, the carpal glands generally absent, the interdigital fossae for the reception of foot-glands are small; and the rhinarium is scarcely indicated, carrying to an extreme the tendency shown by all Antilopini to reduce the naked area on the muzzle. The typical facial markings of *Gazella* are hardly at all developed in *Procapra*, while the tail is much shorter.

Within the genus *Procapra* one species stands out in several respects and is sometimes treated as a separate genus showing intermediacy between *Procapra* and *Gazella*. This is the large species *Procapra gutturosa* (Pallas, 1777); the data of Pocock (1918) show that this species has small preorbital glands and carpal tufts, which may contain glands; the inguinal glands are large, whereas the other species have no trace. There

is also a preputial glandular sac in *P. gutturosa*, which is absent in the other species. According to the data of KLEINSCHMIDT (1961), *P. gutturosa* possesses many specialisations connected with the respiratory tract, notably a Bursa faucium (recalling the camel) and an enormously enlarged larynx, the so-called "goitre" of popular writings.

These features certainly merit taxonomic recognition. POČOCK (1918) erected a new genus, *Prodorcas*, for the reception of this aberrant species; it is felt, however, by most authors that the nearness of *P. gutturosa* to the other species of *Procapra* when compared to the genus *Gazella*, demands recognition by keeping *Prodorcas* as no more than a subgenus within *Procapra*.

The other species of *Procapra* were combined by both ALLEN (1939) and ELLERMAN & MORRISON-SCOTT (1951) into a single species, *P. picticaudata* Hodgson, 1846. However a little-known paper by STROGANOV (1949) shows that the two supposed subspecies of this species overlap in their distribution and therefore merit separate specific status; moreover one of the two is itself polytypic: *P. p. przewalskii* (Büchner, 1891).

The purpose of the present paper is to place on record some data on population variation within the genus *Procapra*, and incidentally to make known STROGANOV's important paper to English-speaking specialists in this field. The present author, in turn, cannot speak Russian, but is very greatly indebted to Dr. VRATISLAV MAZÁK, of Prague, for translating and discussing STROGANOV's paper with him. Equally, Dr. MAZÁK deserves sincere gratitude for taking the time to measure skulls of gazelles on his visits to the Academy of Sciences of the USSR, Moscow, and the Zoological Institute, Leningrad.

STROGANOV (p. 18) lists the main points of distinction between the two species, *Procapra picticaudata* and *P. przewalskii*, as follows:

1. *picticaudata* is smaller, and shows proportional differences:
The facial part of the skull is longer, the zygomata relatively broader, the braincase rather shortened: the dorsal outline of the braincase is steeper than in *przewalskii*. The nasal bones are narrower.
2. in *picticaudata* the crowns of the cheekteeth are narrower and longer; the length of the toothrow is more than 30% of the condylobasal length, being less in *przewalskii*. (This proportional difference does not appear to be valid). The crown of the first upper molar is square in *przewalskii*, rectangular in *picticaudata*.
3. the horns of *picticaudata* are much longer and more slender, and curved in only one sagittal plane.
4. in *picticaudata* the rump-patch is surrounded by a bright yellowish-red area, and is not divided by a line of darker colour as in *przewalskii*.

The distribution of the two species, according to STROGANOV, is incorrectly given by ALLEN. *Procapra picticaudata* is in fact found, rarely, in the Nan Shan, but is absent east of Kukunor. *P. przewalskii* is said by ALLEN to be found in Ordos and Alashan, south to about 38° N. In fact, south of this latitude, the species is found in the region of Kukunor, and in the valley of the Bukhain Gol. In these areas, *P. przewalskii* was observed by PRZEWAŁSKI, ROBOROWSKI, KOZLOV, and other Russian explorers. It is not present at all in Alashan; according to PRZEWAŁSKI, this area is too desert for such an animal.

In the regions of the Nan Shan and Kukunor, there is an overlap between *P. picticaudata* and *P. przewalskii*. Half of the range of the latter is in territory occupied by the former. (It may be remarked that much of the other half lies in territory occupied by *P. gutturosa*.)

In addition to this, STROGANOV describes a new subspecies of *przewalskii* which he calls *Gazella* (sic) *przewalskii diversicornis*. This is a form found along the upper course of the Huang Ho in the western regions of the southern part of Kansu, and in Ordos in Suiyan province. The original material consisted of eight adult males, one

Table 1
Means and Standard deviations for local populations of *Procapra*
Male skulls

	Horn length	Tip-to-tip	Greatest width across horns	Median length of nasals	Greatest skull length	Greatest breadth	Braincase length
1. <i>Procapra (Procapra) pincticaudata</i>							
Ladakh	271.4 ± 18.8 (9)	119.6 ± 44.6 (9)	133.5 ± 34.2 (9)	63.4 ± 3.0 (7)	187.3 ± 4.1 (7)	94.7 ± 2.5 (9)	101.0 ± 3.6 (8)
Southern Tibet	264.1 ± 14.6 (6)	136.6 ± 43.5 (6)	152.4 ± 30.6 (6)	62.8 ± 4.5 (3)	182.0 (1)	91.5 ± 2.3 (5)	102.0 ± 1.0 (2)
Szechuan	261.2 ± 19.4 (19)	96.5 ± 35.5 (19)	129.4 ± 18.8 (19)	61.7 ± 4.5 (19)	180.6 ± 4.5 (13)	92.0 ± 1.7 (19)	99.2 ± 2.0 (13)
Nan Shan	276.0 ± 26.7 (8)	110.1 ± 25.6 (8)	122.5 ± 23.3 (8)	59.2 ± 3.3 (7)	183.6 ± 5.2 (8)	91.0 ± 2.0 (8)	101.6 ± 4.1 (8)
2. <i>Procapra (Procapra) przewalskii</i>							
Kukunor	193.0 ± 17.0 (7)	78.0 ± 28.8 (7)	153.4 ± 17.1 (7)	58.1 ± 1.7 (6)	202.1 ± 4.5 (7)	95.5 ± 2.8 (7)	121.3 ± 3.7 (7)
Kansu	233.1 ± 14.2 (4)	134.8 ± 32.2 (4)	184.1 ± 23.1 (4)	64.2 ± 1.3 (3)	220.3 ± 4.7 (3)	100.7 ± 2.5 (4)	122.8 ± 2.8 (4)
3. <i>Procapra (Prodorcas) gutturosa</i>							
Altai	235.2 ± 15.1 (8)	155.0 ± 33.8 (8)	169.8 ± 31.1 (8)	90.7 ± 4.2 (7)	261.1 ± 3.6 (7)	108.3 ± 3.1 (8)	134.6 ± 3.0 (8)
Gobi	225.4 ± 15.8 (11)	128.0 ± 34.5 (11)	159.5 ± 31.5 (11)	79.8 ± 4.7 (9)	252.6 ± 4.6 (12)	103.9 ± 2.7 (12)	134.5 ± 2.7 (12)
Undur Han	205.5 ± 16.8 (5)	88.4 ± 33.0 (4)	120.4 ± 35.5 (4)	76.9 ± 4.2 (4)	257.4 ± 7.1 (5)	101.6 ± 2.7 (5)	141.5 ± 4.8 (5)
Pekin	220.0 ± 27.1 (10)	122.4 ± 31.2 (10)	145.2 ± 25.3 (10)	84.8 ± 5.6 (8)	262.3 ± 5.5 (8)	105.4 ± 4.0 (10)	143.5 ± 4.6 (9)
Gt. Kilingan Mts.	230.0 (1)	176.0 (1)	194.5 (1)	99.0 (1)	— (1)	110.0 (1)	— (1)

juvenile male. The differences consisted in the greater skull size, different (more divergent) form of horns, and darker colour, at least in winter. The horns are less massive, the tips being only a little incurved, and not at all curved up. Condylbasal length is given as 221–226 mm., Orbital breadth as 59.0–64.5 mm., Nasal length as 64.5–67.0 mm., Horn length (straight) as 227–240 mm. It is evident from these figures and a comparison with Table 1 of the present paper that either STROGANOV had larger specimens than were available to the present author or to Dr. MAZÁK, or else the standard of measurement was a little different.

The typical race was said to inhabit the regions of Chagrin steppe, Kukunor plateau, the valley of the Bukhain Gol and its tributaries, and the surroundings of Bain Nor. The paradigm consisted of eleven adult males, seven adult females, one subadult female, five juvenile males and two juvenile females. Condylbasal length was given as 187–197 mm., Orbital breadth as 53.2–61.4 mm., Nasal length as 43.2–60.7 mm., and Horn length as 175–200 mm.

Unfortunately Dr. MAZÁK could only trace eleven specimens of this species in the collections studied by STROGANOV; two more were measured by the present author in the British Museum (Natural History). The Russian collections are not alone in their depletion however; of fourteen exactly localised skulls of *picticaudata* mentioned by LYDEKKER & BLAINE (1914) as being in the British Museum, the present author could find only nine.

From the data in Table 1, it will be seen that *P. p. diversicornis* ("Kansu") is a very distinct race indeed, differing by the larger size, more spreading horns with less inturned tips, and the comparatively abbreviated braincase length, a feature not men-

Table 2
Means and Standard deviations for local populations of *Procapra*
Female skulls

	Median length of nasals		Greatest skull length		Greatest breadth		Braincase length	
1. <i>Procapra (Procapra) picticaudata</i>								
Ladakh	61.0	(1)	185.0	(1)	88.0	(1)	98.0	(1)
Southern Tibet	55.0	(1)	—		84.0	(1)	96.0	(1)
Szechuan	61.9 ± 3.8	(15)	179.3 ± 4.3	(12)	86.7 ± 1.7	(15)	95.4 ± 3.1	(12)
Nan Shan	60.8 ± 3.5	(3)	177.0 ± 1.0	(3)	88.0 ± 2.0	(3)	94.2 ± 3.1	(3)
2. <i>Procapra (Procapra) przewalskii</i>								
Kukunor	55.0	(1)	194.5	(1)	93.5	(1)	114.0	(1)
Kansu	60.0	(1)	192.5	(1)	90.4	(1)	108.0	(1)
3. <i>Procapra (Prodorcas) gutturosa</i>								
Altai	—		—		—		—	
Gobi	75.5 ± 0.7	(2)	232.0 ± 2.8	(2)	95.5 ± 2.1	(2)	123.5 ± 4.9	(2)
Undur Han	71.2 ± 1.0	(4)	234.1 ± 5.1	(4)	96.7 ± 1.2	(4)	123.3 ± 5.1	(4)
Pekin	77.7 ± 5.3	(7)	240.7 ± 6.5	(6)	97.5 ± 2.4	(6)	131.8 ± 5.7	(7)

tioned by STROGANOV. In table 2, the very scant material shows that the female of *diversicornis* is as small as the female of the nominate race. i. e. there is much more sexual dimorphism. The comparative shortness of the braincase in *diversicornis* is now seen very clearly: for two skulls of approximately the same length, the braincase in *przewalskii* is considerably longer.

Turning to *P. picticaudata*, it will be seen that local populations from different

parts of the plateau of Tibet do show minor differences, but nothing to be recognised taxonomically. In Southern Tibet (mostly the area north of Sikkim) the horns on average spread more widely, while in the Szechuan deme the tips are more inturned. The largest-sized animals come from Ladakh, the smallest from Szechuan. This comparative uniformity is in contradistinction to some other Tibetan species, notably *Equus kiang* (GROVES & MAZÁK, in preparation); according to ENGELMANN (1939) *Procapra picticaudata* occupies a variety of altitudes, from the rolling grasslands of the "Gazellensteppe" right up to the barren "Wildyaksteppe", i. e. its distribution will be continuous over the whole of Tibet, whereas that of other species, such as the Kiang and the Wild Yak, will be fragmented. The existence of two strikingly distinct subspecies within *P. przewalskii* would seem to indicate the opposite case, namely the influence of ecological factors: *diversicornis* being a lowland form, and the typical race living on the edge of the Tibetan plateau in areas occupied also by *picticaudata*, a typically montane species.

The question of the taxonomic status of *P. (Prodocarcas) gutturosa* populations is a little more difficult. The material falls quite naturally into four geographical demes, with just one specimen, from the Great Khingan range, which does not quite fit into any of them. The most spreading horns are found in the Altai deme, with the least spreading in those from Undur Han. Differences in nasal length are very striking: the nasal bones are very long in the Altai deme, less so in Pekin, still less so in the Gobi group and shortest in the Undur Han population. Of absolute skull size, Altai and Pekin are equally large, then Undur Han, with Gobi the smallest. Skull breadth follows the same pattern as nasal length. Quite by contrast, Pekin and Undur Han are almost equally long in the postorbital (braincase) part of the skull, and Altai and Gobi almost equally short. The single skull from Gt. Khingan seems, as far as can be told from the extensive damage it has suffered, to be even larger than the Altai population, while being geographically nearer to Pekin and Undur Han.

The question of the exact systematic allotment of these populations is difficult and can only be decided by a rule-of-thumb method such as that proposed by MAYR et al. (1953), who state that if the coefficient of difference (= difference between the means divided by the sum of the standard deviations) is greater than 1.28, a subspecies distinction may conveniently be made, as this level is the conventional 75% level (or 90% joint non-overlap). In the present case the following differences were at more than 1.00:

Altai: Pekin — Braincase length difference = 1.18.

Altai: Gobi — Nasal length diff. = 1.23; Skull length diff. = 1.04.

Altai: Undur Han — Nasal length diff. = 1.64; skull breadth diff. = 1.15.

Pekin: Gobi — Braincase length difference = 1.23.

Pekin: Undur Han — None.

Gobi: Undur Han — None.

Only one difference is therefore above the suggested limit (Altai: Undur Han nasal length), but several others are very near it, above the 85% joint non-overlap mark (1.04). The best course seems to be to separate the Altai form taxonomically, as it shows the greatest amount of difference from any other population. Thus HOLLISTER's race *P. g. altaica* would stand for a rather poorly-defined western race, while the eastern race, *P. g. gutturosa*, has at least three fairly wellmarked demes.

The following taxonomy of the genus *Procapra* is therefore proposed:

1. *Procapra (Procapra) picticaudata* (Hodgson, 1846).

Monotypic. Type locality said to be Hundes, but more likely the district north of Sikkim, where most of HODGSON's specimens were obtained after 1844.

Ladakh deme: Kaloch, Kulu Tunga, Rupshu, Changchenmo, Horpa Dzo (N. W. Tibet, 34° 50' N., 81° E.).

Southern Tibet deme: "North of Sikkim", Gyamtse, Kamba Dzong, Dhama valley.
Szechuan deme: Litang, Ra-ma-la, Zanzskar, Sunguan.

Nan Shan deme: Gorban-an-Gir-Gol, Khyn-Kho, Bach river, Sunan mts., Barkhan Buddha Shan.

2. *Procapra (Procapra) przewalskii* (Büchner, 1891).

P. p. przewalskii (Büchner, 1891). Type locality Chagrin steppe. Localities: Kukunor, Bukhain Gol, Nan Shan, Chagrin steppe, Bain Nor.

P. p. diversicornis (Stroganov, 1949), p. 25. Type locality, oasis of Sin-Zhin-Pu, Kansu. Localities: Southern Ordos, Sin-Zhin-Pu, Chinchiangmial (S. W. Gobi).

3. *Procapra (Prodorcas) gutturosa* (Pallas, 1777).

P. g. gutturosa (Pallas, 1777). Type locality upper river Onon, Transbaikalia.

Pekin deme: Pekin, Kalgan plateau, Tabool (N. of Kalgan), Heilunkiang, Shara Murun (Inner Mongolia), Chita (north of Abargaitui).

Undur Han deme: Undur Han (47° 20' N., 110° 35' E.), "Southeast of Ulan Bator".

Gobi deme: Loh, Tsagan Nor, Ubur-Khara-Gol, Kilga Samon (South of Ulan Bator).

P. g. altaica (Hollister, 1913). Type locality, Suok Plains, near southern end of Bain Chagan Pass, Little Altai. Localities: Suok Plain, Harum Tu, Tsagan Agzyr, Tesin Gol, Han-Höhey, Kholt.

P. gutturosa incertae sedis: Gt. Khingan range.

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