

**Budorcas taxicolor.** By John F. Neas and Robert S. Hoffmann

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***Budorcas* Hodgson, 1850**

*Budorcas* Hodgson, 1850:65. Type species *Budorcas taxicolor* Hodgson, 1850, by monotypy.

**CONTEXT AND CONTENT.** Order Artiodactyla, Suborder Ruminantia, Infraorder Pecora, Superfamily Bovoidea, Family Bovidae, Subfamily Caprinae, Tribe Ovibovini. In addition to *Budorcas* (and extinct genera), the ovibovines include *Ovibos moschatus* (Zimmermann), the tundra musk-ox (Matschie, 1898; Rüttimeyer, 1867; Thenius and Hofer, 1960). The genus *Budorcas* consists of one living and one extinct species (*B. teilhardi* Young).

***Budorcas taxicolor* Hodgson, 1850**

Takin

*Budorcas taxicolor* Hodgson, 1850:65. Type locality Mishmi Hills, Arunachal Pradesh, India; possibly from contiguous elevations of Tibet. Based on a series of cotypes at the British Museum (Natural History).

*Budorcas taxicola* Gray, 1852:45. A misspelling.

*Budorcas tibetanus* Lydekker, 1909:797. Type locality [vicinity of] Moupin (Muping; Pao-hsing, Baoxing), Sichuan Province, China.

*Budorcas bedfordi* Thomas, 1911a:27. Type locality Tai-pei Shan, 3,048 m, southern Shaanxi Province, China.

**CONTEXT AND CONTENT.** Context as in the generic summary above. *Budorcas taxicolor* includes, in addition to one extinct subspecies (*B. t. lichii* Young), four extant subspecies, as follows:

*B. t. taxicolor* Hodgson, 1850:65, see above.

*B. t. whitei* Lydekker, 1907b:887. Type locality Bhutan.

*B. t. tibetana* Milne-Edwards, 1868-74:367. Type locality Moupin (Baoxing), Sichuan Province, China. Based on a series of cotypes at the Paris Museum (*mitchelli* Lydekker, *sinensis* Lydekker, and *tibetanus* Lydekker are synonyms).

*B. t. bedfordi* Thomas, 1911a:27, see above.

**DIAGNOSIS.** Both sexes have black, lunately shaped horns that arise from the summit of an elevated frontal crest between orbits and occipital plane. The horns arise almost vertically, turn outwards and forwards horizontally, then horizontally backwards and slightly upwards (Fig. 1). The bases of the horn-cores are trigono-ovoid in cross-section and almost in contact in the midline. The horns are longitudinally striated and irregularly ringed transversely at the base. *Budorcas* is closely related to the Rupicaprini (*Capricornis*, *Nemorhaedus*, *Oreamnos*, *Rupicapra*) that also have black, transversely ringed horns that arise from the summit of the skull near the orbits. In the rupicaprines, however, the horns are shorter, posteriorly directed, and slightly decurved. The only extant bovids with horns approximating those of the takin are the musk-ox (*Ovibos*) and gnu (*Connochaetes*). The horns of the musk-ox originate from a planar skull-roof near the orbits, pass outward, downward, and forward, turning up at the tips (Fig. 2). Those in the gnu arise from near the vertex of the skull, pass strongly forward and outward, then upward and finally backward.

**GENERAL CHARACTERS.** The takin is elongate and deep in the chest, with greater height at the shoulder than at the hip; the limbs are strong and stout, especially the front legs below the knees (Fig. 1). The muzzle is attenuated and deep dorsoventrally, giving the animal a distinctly Roman-nosed appearance. Horns, hooves, and naked areas of the nostrils are shiny black. The ears are short, narrow, and pointed; the tail is short, triangular, and naked on the underside.

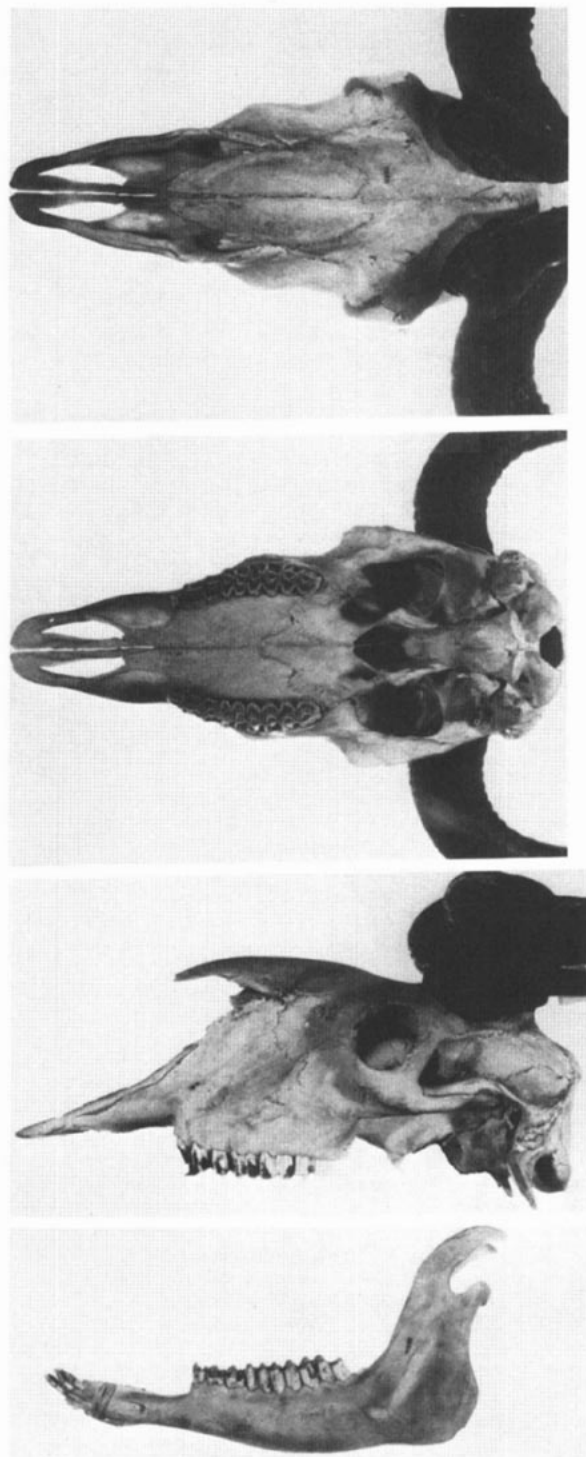


FIG. 1. Dorsal, ventral, and lateral views of skull, and lateral view of mandible of adult male *Budorcas taxicolor tibetanus* (AMNH 110476) from Chengo Creek, Sichuan, China.



FIG. 2. Captive adult male Shaanxi takin (*Budorcas taxicolor bedfordi*) Xining (Hsining) Zoo, Qinghai, China, June, 1984 (photo, R. S. Hoffmann).

The shaggy coat exhibits considerable variation in color, being dark blackish or reddish-brown suffused with grayish-yellow along the eastern Himalaya, lighter yellow-gray with black markings and a middorsal stripe in Sichuan Province, and almost entirely golden-yellow to creamy-white, with only a few black hairs on the knees, hocks, muzzle, and tail in Shaanxi Province (Allen, 1940; Blanford, 1888-91; Lydekker, 1905, 1907*b*, 1909, 1913*a*; Pocock, 1913). Eastern Himalayan takins are either regarded as a single subspecies, *B. t. taxicolor* (Ellerman and Morrison-Scott, 1951; Pocock, 1911, 1913; Schaller, 1977; Tate, 1947), or the purportedly darker, shorter-horned Bhutanese subspecies, *B. t. whitei*, is recognized as distinct from the typical Mishmi race (Lydekker 1907*b*, 1908, 1909, 1913*a*; Schäfer, 1939; Sowerby, 1928). The darker coat color of juvenile *B. t. bedfordi*, *tibetana*, and *taxicolor* more nearly resembles that of the adult pelage of *B. t. tibetana*, *taxicolor*, and *whitei*, respectively (Allen, 1930, 1940; Thomas, 1911*b*). Takins exhibit considerable sexual dimorphism in coat coloration, with females usually more darkly pigmented than males (Allen, 1940; Allen, 1909; Bailey, 1912; Benthams, 1908; Pocock, 1910*b*, 1911, 1913; Schäfer, 1939; Thomas, 1911*b*). According to Hume (1887), Lydekker (1900, 1909, 1913*a*), and Pocock (1910*b*, 1911, 1913), observed geographic color differences are probably the result of seasonal pelage changes (Lydekker [1913*b*] provided a contrary opinion).

Range of measurements (in mm) for takins (presumably adults), regardless of sex, are as follows: height at shoulder, 686 to 1,400; length, 1,041 to 2,130; length of ear, 101 to 149; length of tail, 70 to 120; weight for wild specimens, up to 302 kg (Allen, 1940; Hodgson, 1850; Lydekker, 1909; Shou, 1964; Tate, 1947; Wu and Niu, 1981). Generally, the smallest measurements presented are for *B. t. bedfordi* and *B. t. whitei* at the extreme east or west of the range for the species. According to most reports, males are larger, with slightly heavier horns than females (Allen, 1940; Bailey, 1912; Hodgson, 1850; Milton, 1959); Englemann (1938) quoting Schäfer's diary gives weights of 250 to 300 kg for cows, and 300 to 350 kg for bulls. According to Benthams (1908), however, the converse is true; indeed, the largest reported weight for a captive takin is that of a female *B. t. taxicolor* (322 kg; Haas, 1966).

The following measurements of the skull (in mm) are from Allen (1940), Benthams (1908), Lydekker (1909), Shou (1964), Smith (1939), and Wu and Niu (1981): length of horns along front curvature, 183 to 641; circumference of horn-core base, 235 to 381; distance between horn tips, 160 to 510; condylobasal length, 341 to 415; palatal length, 216 to 265; length of nasal, 98 to 162; interorbital breadth, 98 to 160; length of maxillary toothrow, 115 to 131 (postcranial skeletal elements were measured by Benthams [1908] and Milne-Edwards [1868-74]). Measurements of horns reflect the ontogenetic development and sex of the individual. Old horns are much smoother and, because of attrition at the tips, are

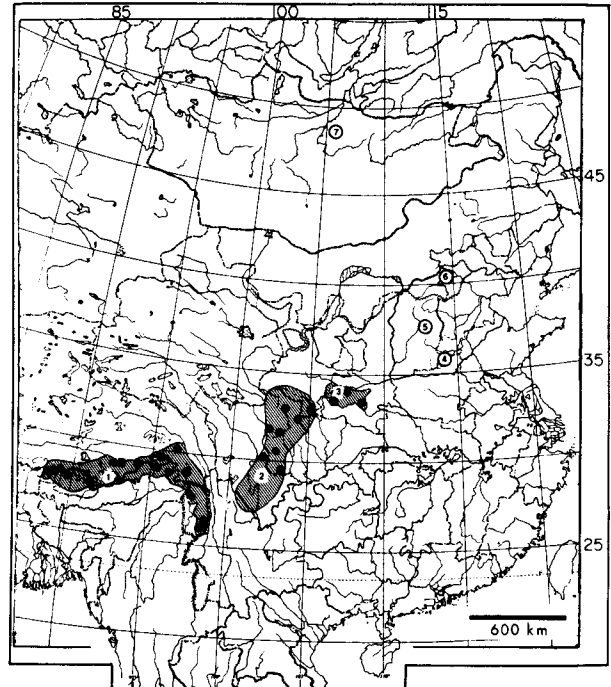


FIG. 3. Distribution of *Budorcas taxicolor*. Shaded areas denote ranges of extant subspecies: (1) *B. t. taxicolor* and *B. t. whitei*, (2) *B. t. tibetana*, and (3) *B. t. bedfordi*. Circles indicate Pliocene, Pleistocene, and Holocene localities: (4) Anyang, Henan Province (*B. t. lichii*—subRecent), (5) Yuci, Shanxi Province (*B. teilhardi*—Upper Pliocene), (6) Nihowan, Hebei Province (tentatively referred to *Budorcas*—Upper Pliocene or Lower Pleistocene), (7) Noin Ula, Mongolia (representation of *B. taxicolor*).

also shorter (Bailey, 1912; Benthams, 1908; Lydekker, 1907*b*; Smith, 1939).

According to Hume (1887), horns in females are first directed laterally then gradually curve upwards and backwards, lacking the sigmoidal flexure, or angulation, typical of males. Lydekker (1900), however, claimed that Hume's description was based on a juvenile and, like Hodgson (1850) and Milne-Edwards (1868-74), stated that horns are alike in both sexes. Horns in males tend to be longer than in females (Pocock, 1910*b*). The distance from tip to tip is also greater in males because the sides of the horns are parallel, not inclined towards each other as in females (Hodgson, 1850).

**DISTRIBUTION.** The takin has been found in three separate areas in the west central region of the People's Republic of China and along the eastern (Assam) Himalaya (Fig. 3). The exact limits of the range of each subspecies are difficult to determine because of a paucity of specimens and reliable published data.

The Bhutan takin (*B. t. whitei*) occurs in Sikkim (Bailey, 1907; Lydekker, 1906), Bhutan (Allen, 1940; Anthony, 1941; Lydekker, 1907*a*, 1907*b*, 1909, 1913*a*; Pocock, 1910*b*, 1913, 1918; Schäfer, 1939; Ward, 1966; White, 1909), and the Tibetan (Xizang Zizhiqu, Hsi-Tsang tzu-chih-ch'ü) Chumbi Valley (Ch'u-mupi Shan-ku; Lydekker, 1907*b*, 1913*a*, 1913*b*); this race recently has been reported ESE of Lhasa, Tibet (Wu and Niu, 1981). The Mishmi (Burmese) takin (*B. t. taxicolor*) occurs in the Mishmi Hills of Arunachal Pradesh, India (Bailey, 1912, 1915; Cooper, 1923; Hayman, 1961; Krumbiegel, 1968; Lydekker, 1900, 1905, 1907*a*, 1907*b*, 1909, 1913*a*; Mitchell, 1909; Ward, 1907), Kachin State, Burma (Anthony, 1941; Cuffe, 1914), and the Bomi-Zayu region of southeastern Tibet (Bailey, 1915; Feng et al., 1980; Zheng et al., 1981; Zhu, 1979). Reports of takins in Nepal (Allen, 1940; Zhang and Zheng, 1981) have not been confirmed. A few reports (Anthony, 1941; Cuffe, 1914; Ellerman and Morrison-Scott, 1951) indicate the presence of a takin population along the Irawaddy-Salween divide in Yunnan Province.

The range of the gray, or Sichuan, takin (*B. t. tibetana*) extends from the southern Daxue (Ta-hsüeh) Shan in Sichuan (Szechwan) Province to the southern Min Shan and the lower drain-

age basin of the Bailong (Pailong) Jiang in Gansu (Kansu) Province (Allen, 1912, 1940; Howell, 1929; Lydekker, 1900, 1907a, 1908, 1909, 1912, 1913a; Milne-Edwards, 1868-74; Pai, 1936; Pen 1962; Schäfer, 1939; Shou, 1964). Contrary to the distribution maps of Allen (1940) and Young (1948), it seems unlikely that the Sichuan takin is found at lower elevations in the Red Basin (Sichuan Pendi). The southern limit of this subspecies probably is determined by the Daliang (Ta-Liang) Shan lying northwest of the Jinsha (Chinsha) Jiang (Yangtze Kiang); the distribution may include areas of Yunnan Province north of the Jinsha Jiang (Lydekker, 1913a; Young, 1948). The takin does not occur in the Tibetan physiographic region with its continental Palaeartic climate (Schäfer, 1939).

The golden, or Shaanxi, takin (*B. t. bedfordi*) appears to be restricted to the Taibai (Tai-pei) Shan region of central Shaanxi (Shensi) and southeastern Gansu Province (Allen, 1930, 1940; Allen, 1909; Bubenik, 1957; David, 1873; Gee, 1930; Lydekker, 1912, 1913a; Schäfer, 1939; Thomas, 1911a, 1911b; Wang et al., 1963). As indicated by Young (1948), the distribution map by Allen (1940) erroneously included the Da-Ba (Ta-Pa) Shan regions of southern Shaanxi and northern Sichuan provinces, where there are no records of *Budorcas*. Unlike Young's (1948) map, however, the southern extent of the Shaanxi takin nearly coincides with the Han Shui (Han Chiang; Shou, 1964).

Although reported as never below 3,030 m in Burma (Cuffe, 1914) or 3,300 m in Shaanxi Province (Young, 1948), takins possibly occur between 915 and 2,744 m in the Mishmi Hills (Cooper, 1923) and at 2,000 m in the Qin Ling Mountains of Shaanxi Province (Shou, 1964). Numerous reports (Allen, 1940; Lydekker, 1900, 1906, 1907a, 1909; Sterndale, 1884; Wu and Niu, 1981) place the takin in alpine regions, near and above snowline; snowline in the Himalaya is usually between 3,600 and 4,000 m (Schaller, 1977). Seasonal vertical migrations probably are the chief reason for the reported variation in altitude. Takins most frequently are encountered between 2,500 m and 3,700 m (Sowerby, 1928) in tropical evergreen broadleaf and needleleaf forests, with dense stands of rhododendron (*Rhododendron*) and bamboo (*Bambus*, *Arundinaria*) growing along precipitous slopes (Andrews, 1932; Feng et al., 1980; Zheng et al., 1981); annual rainfall in these areas ranges from 380 to 1,020 cm (Cooper, 1923).

**FOSSIL RECORD.** The takin and the tundra musk-ox (*Ovibos*) are relicts of a formerly widespread and highly diversified group. During the Lower Pliocene a group of ovibovines with peculiarly modified horns, including *Urmitherium* Rodler, *Parurmiatherium* Sickenberg, *Criotherium* Major, and *Tsaidamotherium* Bohlin, roamed from Greece, through Moldavia (USSR) and northern Iran, to China. *Plesiadax* Schlosser, a less aberrant member of this group, probably gave rise to the musk-ox and the Middle to Late Pleistocene genera *Bootherium* Leidy (including *Symbos* Osgood) of North America and *Praeovibos* Staudinger of Eurasia and Beringia.

The common ancestor of *Budorcas* and its allies, though currently unknown, must have been similar to the Lower Pliocene Chinese forms *Tossunnoria* Bohlin and *Pachygazella* Teilhard and Young. The takin appears to be closely related to *Boopsis* Teilhard from the Upper Pliocene to Lower Pleistocene of China and to such Pleistocene forms as the Nearctic shrub-oxen (*Euceratherium* Furlong and Sinclair) and the Holarctic steppe-goat (*Soergelia* Schaub).

The earliest known takin, *Budorcas teilhardi*, is from the Upper Pliocene beds of Yuci (Yu-tz'u), near Taiyuan, in Shanxi (shansi) Province, China. This generalized takin has more rounded horn-cores than *B. taxicolor*, and the horns terminate with a supplemental curvature (Teilhard de Chardin and Trassaert, 1938; Young, 1948). A fragmentary horn-core similar to *Budorcas* has been reported from the Upper Pliocene or Lower Pleistocene at Nihowan, between Zhangjiakou (Chang-chia-k'ou, Kalgan) and Beijing (Peking) Hebei (Ho-pei, Hopeh) Province (Teilhard de Chardin and Piveteau, 1930; Young, 1948).

In the Pleistocene, mountain-valley glaciation enhanced vertical zonation in Chinese and Himalayan montane regions, and takins were found at elevations and latitudes that supported tropical and warm temperate communities (Zhu, 1979). Takins retreated from more temperate zones toward their present relict montane distribution following the close of the Pleistocene, possibly in response to climatic change, geological uplift, and human intervention

(Young, 1948; Zhang and Zheng, 1981; Zhu, 1979). *Budorcas taxicolor lichii*, from subRecent sediments at Anyang in northern Henan (Honan) Province, may represent the latest survivor of takins north of the Huang He, or Yellow River. This subspecies may be ancestral to *B. t. tibetana* and *B. t. bedfordi* but differs in having horns with greater angulation, a prominent anterior ridge, tips not as medially inflected but curving upwards, and a triangular cross-section in the upper third of the horn-core (Editorial Committee, 1979; Young, 1948).

The Pleistocene to Recent Nihowan and Anyang localities are more than 1,000 and 600 km north, respectively, of the closest present occurrence of *Budorcas*. That *Budorcas* occurred far to the north within relatively recent times is further evidenced by silver-covers depicting the takin from graves dated in the 1st century B.C., at Noin Ula in Mongolia (Brentjes, 1969).

**FORM.** Hair on the sides of the body is 3 to 5 cm long, about 7 cm long below the neck, forming a manelike fringe, and more than 12 cm long below the throat, resembling a beard (Hodgson, 1850; Schäfer, 1939). Takins lack facial tufts, vibrissae, and dorsal mane (Hodgson, 1850).

Takin woolly underfur is found on young animals and in the winter coat of older animals. Thomas (1911b) reported a midwinter pelage length of 18-24 cm along the sides of the neck and 7.5-10 cm along the back. The summer coat consists mostly of longer hair and remnants of the winter underwool; the latter is shed sporadically during warmer weather and regrows in September. The strength and ruggedness of the coat affords the takin safety while traversing thorny thickets (Schäfer, 1939); their hirsute muzzle appears associated with the need to scrape away snow from concealed vegetation in the winter (Pocock, 1910b).

Takins lack malar, intermaxillary, antorbital, postcornual, interdental, and inguinal glands (Hodgson, 1850; Pocock, 1910a, 1918); they seem to have an oily skin secretion, however, that imparts a "goat-like" aroma (Ali and Santapau, 1959a; Estes, 1959; Krumbiegel, 1968; Milton, 1959; Schäfer, 1939).

There are four teats positioned inguinally in takins (Hodgson, 1850), as there are in musk-oxen and all the rupicaprines (Lydekker, 1906). As illustrated and described by Pocock (1918), there appear to be two teats per mammary gland in the takin, with the anterior and posterior teats of each side in near contact but with left and right pairs widely separated. According to Hodgson (1850), the four teats are placed on an udder, as in the musk-ox; a fifth, or accessory, teat occurs commonly in *Ovibos* (Lönnberg 1900a; Pocock, 1918).

The eyes are set high on the skull, remote from the muzzle and close to the horns. They are projected from the sides by the saliency of the orbits, allowing more acute lateral than binocular vision (Hodgson, 1850). The upper profile of the face is nearly parallel with the virtually straight alveolar rows. The lacrimal is flat and forms part of the projecting orbit. The short nasals nearly contact the maxillae and, in turn, are widely separated from the premaxillae. The nasals are supported almost entirely by the frontals within a V-shaped receptacle (Allen, 1940; Mitchell, 1907). The frontals and parietals extend posterior to the horns; the parietal-occipital angle is obtuse.

Characters that demonstrate the affinity of takins and musk-oxen, and that serve to differentiate takins from other Asiatic members of the subfamily Caprinae, include: large size; well-developed dewclaws; extreme shortness and width of front and hind metapodials; four teats; horn-cores inserted behind orbits; base of horn cores united to the back of orbit by a ridge; frontal sinus confined to base of horns; greater width across orbits than across occipital surface; small auditory bulla; infraorbital foramen situated over back of P3; cheek teeth without well-developed accessory enamel columns at the entrance to the median valleys; paraconid and metaconid of p4 fused (Allen, 1940; Gentry, 1970; Hodgson, 1850; Lydekker, 1906; Matschie, 1898; Milne-Edwards, 1868-74; Wang et al., 1963). Lönnberg (1900b), Pilgrim (1939), Pocock (1910b, 1918), and Turner (1850) provided contrary views on takin and musk-ox relationships.

According to Lander (1919:217), *Ovibos* and *Budorcas* "differ in but few points of their soft anatomy, and in many cases they share characters which differentiate them from other ruminant Artiodactyla." The rhinarium in *Budorcas* consists of naked strips of skin above, between, and below the nostrils, and a medially grooved

extension (philtrum) to the upper lip (Pocock, 1918); in *Ovibos* the rhinarium is reduced to a naked area above and between the nostrils (Lönningberg, 1900a). The tongues of both genera have similar dimensions and distribution of fungiform and filiform papillae (Lander, 1919; Lönningberg, 1900a; Sonntag, 1922), however, in the takin a posteromedian strip is devoid of fungiform papillae (Lander, 1919). The tongues of *Ovibos* and *Budorcas* have about 14 vallate papillae, but these are arranged in four rows rather than two in *Budorcas* (Lander, 1919; Lönningberg, 1900a; Sonntag, 1922). The larynx of both genera is elongated because the thyroid cartilage is expanded; the cricoid cartilage is smaller relative to the thyroid in *Budorcas* than in *Ovibos* (Lander, 1919; Lönningberg, 1900a). The trachea of *Budorcas* is not flattened dorsoventrally as in *Ovibos* (Lander, 1919). Although it is divided in *Ovibos* (Lönningberg, 1900a) and not in *Budorcas*, both genera show remarkable simplification of the left lung among the Ruminantia (Lander, 1919). The right lung of the takin is fissured into small upper and larger lower lobes; there is a well-developed azygous lobe (Lander, 1919).

The rumen (paunch) in both genera consists of two unequal sacs lined with flattened, tongue-shaped papillae. The takin has the same number (61) of folds in the omasum (psalterium) as in *Ovibos* but fewer (17:24) in the abomasum (Lander, 1919; Lönningberg, 1900a). The lack of haustra and appendices epiploicae simplifies the colon in the takin. The small intestine of *Budorcas* is 31.4 m long, 2.7 times the length of the colon (Lander, 1919). According to Milne-Edwards (1868-74), the feces of the takin are hard and round, like those of the goat, but Cooper (1923) described them as like those of the cow; the difference may be seasonal. Three-fourths of the liver in the takin consists of the right lobe (Lander, 1919); in *Ovibos*, right and left lobes of the liver are subequal in size (Lönningberg, 1900a). The caudate (Spigelian) lobe is club shaped and projects to the right margin in both *Budorcas* and *Ovibos* (Lander, 1919; Lönningberg 1900a), but is less differentiated in the takin (Lander, 1919). The bile duct is highly valved in *Budorcas*.

The takin brain is small compared to body size. The optic lobes are completely concealed, and the occipital poles of each hemisphere rest on the anterior aspect of the cerebellum. The hemispheres are deeply fissured with sulci. There is a typical unguulate suprasylvian arch; the Sylvian fissure (lateral sulcus) is not dupliciform as in *Bos*. The brain appears much simpler than that of sheep (*Ovis*), attributable to an absence of many small isolated sulci and secondary branches of main sulci (Lander, 1919).

The penis of the takin resembles that of *Nemorhaedus*, except for a straight, moderately stout, prolongation of the urethral canal and in having a pendulous prepuce; the urethral canal extends beyond the tip of an attenuated glans in *Budorcas*, but the canal terminates at the tip of a blunt-ended penis in *Ovibos* (Lönningberg, 1900a; Pocock, 1918). Lander (1919) provided illustrations of the brain, tongue, hyoid, larynx, arytenoid cartilage, lungs, trachea, liver, and testis of the takin.

**ONTOGENY AND REPRODUCTION.** The gestation period in the takin has been reported to be either 7 to 8 months or 10 to 11 months. Sichuan takins are reported to mate in late July or early August, and by the middle of September the fetus is about the size of a squirrel. Parturition occurs in March; in May, when about 2 months old, calves stand nearly 60 cm at the shoulder and lack horn buds (Allen, 1940). It is claimed, however, that the Shaanxi takin breeds in April, at a time when there is much fighting between adult males. These takins give birth in February or March of the following year to one, occasionally two calves (Shou, 1964). Takins also have been reported to give birth in May or the beginning of June (Englemann, 1938; Schäfer, 1939). Burmese natives claim takins have two young at a time (Ali and Santapau, 1959b), but most observed births have been single.

The first mating (in January) of a pair of takins at the Rangoon Zoo resulted in an abortion after 3 months pregnancy, presumably because of the male's aggressiveness towards the female (Hla Aung, 1967). The male was secluded from the female following a subsequent September mating, and on May 1 a male calf was born (Hla Aung, 1968). This gestation period was between 200 and 220 days, only about 7 months rather than the longer periods reported by others. Throughout pregnancy the female became increasingly more sluggish and, before parturition, she walked restlessly in her enclosure and periodically laid down in a corner. At birth, the calf's forelegs appeared first, followed by the head. Immediately postpartum, the female thoroughly cleaned the calf by licking it. Within 30 min of birth the calf was standing and suckling. The calf was

darker than the mother at birth with a distinct white patch on the forehead and a dark streak from head to tail along the spine; the pelage became lighter at about 1 month of age. During the first month the calf was mostly inactive, often retiring to a cool, shady place well away from the mother. When active, the calf followed its mother and suckled; by the second month it was eating solid food and suckled less often (Hla Aung, 1968). The ability of calves to accompany the mother is acquired 3 days postpartum (Allen, 1940).

After 44 months in captivity at the Rangoon Zoo, the female of the mated pair had gained 45 kg in weight (to 145 kg), 17 cm in height at the shoulder (to 121 cm), and 107 cm in length (to 203 cm); her horns were 22 cm long. After 31 months in captivity, the male of the pair had gained 99 kg (to 189 kg), 39 cm in height (to 134 cm), and 132 cm in length (to 213 cm); his horns measured 39 cm in length (Hla Aung, 1967).

Horns are said to begin growing in September (Englemann, 1938; Schäfer, 1939). Horns begin growth widely separated at the angles of the head and grow as straight spikes upwards, with a slight outwards tendency; they later bend outwards at the base and ultimately, after loosely spiralling backwards and upwards, acquire the adult curvature (Bailey, 1912; Mohr, 1965; Pocock, 1910b; Schäfer, 1939).

**ECOLOGY.** Potential predators of takins include the Asiatic black bear (*Ursus thibetanus*), snow leopard (*Panthera uncia*), common leopard (*Panthera pardus*), and perhaps tiger (*Panthera tigris*), wolf (*Canis lupus*), and dhole (*Cuon alpinus*). Of these, only the snow leopard has been implicated as a predator of the takin (Dang, 1967). Schaller (1977), however, thought that the small size of the snow leopard precluded its killing adult takins. Takins are not common, even within their locally restricted habitats (Anthony, 1941; Estes, 1959; Sowerby, 1928); their most serious threat is posed by man, largely through habitat destruction and overhunting. The takin, though an endangered species in China and elsewhere, is not yet protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (*China Daily*, 1983).

Takins are generalists, feeding on leaves and shoots of bamboo, green grass, bean leaves, and elm (*Ulmus*) bark (Anderson, 1920; Shou, 1964; Sowerby, 1928; Thomas, 1911b). The Sichuan takin feeds on grass and a plant resembling rhubarb (*Rheum*) that grows along valley bottoms in spring (Allen, 1940). The Shaanxi takin apparently feeds on dwarf bamboo and willow (*Salix*) in the winter, and on birch (*Betula*) shoots, elm, grass, and groundsel (*Senecio*), a strong-smelling herb with a yellow flower that they are purportedly very fond of (Wallace, 1913); *Senecio*, however, is toxic to cattle, horses, and sheep (Siegmond, 1979); wolfsbane, or monkshood (*Aconitum*), is toxic to takins (Bailey, 1907; Lydekker, 1906). Like goats, takins can rear up on their hind legs to browse on leaves as high as 3 m above the ground (Milton, 1959; Schaller, 1977).

Takins have been managed in captivity on a diet of plainties, sweet and Irish potatoes, ground grain mix, rice, oats, carrots, cabbage, greens, and clover hay (Hla Aung, 1968; Milton 1959). One captive juvenile was fed about 1.6 kg of green leaves each day, though the actual consumption was not reported (Milton, 1959).

Takins apparently have a large dietary requirement for minerals in all seasons; they are known to travel great distances regularly to reach salt licks, where they congregate in large numbers and may stay for several days (Ali and Santapau, 1959b; Allen, 1940; Schäfer, 1939). Takins form trails in their passage to and from salt licks and favorite grazing areas. The trails are stamped deep (up to 20 cm) into jungle vegetation and moss. In these game trails natives set spear traps; these are tripped by passing takins, releasing a spear or knife fixed to a large beam; the force is sufficient to pass the blade nearly through the animal's body behind the shoulder (Schäfer, 1939; Wilson, 1913). Takins also are killed by crossbows fixed along a trail; the arrows are poisoned with aconite; guns, dogs, and foot snares also are used (Ali and Santapau, 1959b; Allen, 1940; Cuffe, 1914). The takin is hunted for its flesh which the natives highly esteem, though it is regarded as inferior by some Europeans (Wilson, 1913). Takins also are hunted for their hide and horns that are used for clothing and ornaments (Lydekker, 1913b; Shou, 1964; Trouessart, 1909), but hides of cattle are purportedly of better quality (Shou, 1964).

Takins apparently migrate with great regularity at certain seasons. Abbe David stated that the takin ascended in the winter to areas above forests, to slopes exposed to the sun and free of

snow (Milne-Edwards, 1868-74). Most reports claim, however, that takins migrate to higher summer ranges to feed in grassy clearings at timberline (Bailey, 1915; Fergusson, 1911) or in alpine meadows (Schäfer, 1939; Sowerby, 1936), and in the winter to mixed bamboo and rhododendron thickets at lower elevations (Anthony, 1941). Gravid females descend to jungle vegetation during the calving period (Schäfer, 1939). Through vertical migration and a concomitant shift in the biotic community, takins are known to be in potential competition with bharal (*Pseudois nayaur*) during certain seasons (Schäfer, 1939; Schaller, 1977); serow (*Capricornis*) and goral (*Nemorhaedus*) probably also compete with the takin.

Little is known regarding longevity of takins, but one captive specimen at the New York Zoological Park has lived beyond 8 years of age (Schaller, 1977).

**BEHAVIOR.** Some of the earliest accounts of takins indicate that the animals are solitary or occur in small herds, except during summer when large herds of cows and young bulls are formed (Blanford, 1888-91; Lydekker, 1906; Milne-Edwards, 1868-74; Wilson, 1913). Shou (1964) reported that takins form groups of up to three individuals in winter but 10-100 or more in the summer. A herd of more than 300 disbanded into smaller herds of 10-20 during winter (Bailey, 1912). Wallace (1913) described a herd of eight Shaanxi takins in August as consisting of three bulls, three cows, and two calves. Additional evidence for the gregarious nature of takins are reports of herds numbering 6, 8, 14, 20, 29, 40, and 80 individuals (Anderson, 1920; Andrews, 1922; Anon., 1968; Cooper, 1923; Pai, 1936; Sowerby, 1928; Thomas, 1911b; Ward, 1921; West, 1925). Some herds reportedly are led by an old bull (Allen, 1940; Cooper, 1923), but others claim old bulls are solitary, presumably driven from leadership of the herd by younger, more aggressive males (Allen, 1940; Sowerby, 1928). Because of their large size and purported aggressiveness, lone bulls have a reputation for being dangerous (Ali and Santapau, 1959b; Anderson, 1920; Bailey, 1907; Hodgson, 1850; Lydekker, 1906; Trouessart, 1909; West, 1926).

Large herds tend to congregate at favorable feeding sites, hot springs, and salt licks. A summer herd numbering nearly 300 takins was observed at an altitude of about 3,000 m north of the Mishmi Hills. The takins spent each night in the vicinity of a hot spring, drinking water and browsing on nearby trees. The herd remained in dense rhododendron and willow jungle in the daytime, emerging at 1500 h or 1600 h to descend to the hot spring and stand in the water, pushing each other in their eagerness to drink. They probably spent the night at the spring, for in the morning they were seen to browse on willows near the water (Bailey, 1912). Though takins emerge from dense cover in late evening or early morning, they may be found in the open during cloudy or foggy weather (Allen, 1940; Shou, 1964). When alarmed, takins retreat to dense vegetation; old bulls, when pursued, sometimes lie on the ground in dense thickets with their necks outstretched (Wallace, 1913). The usual sleeping posture of takins is said to resemble that of a dog, with front feet extended under an outstretched head (Milton, 1959; Schaller, 1977; Shou, 1964; Ward, 1921). In areas where they have been less disturbed, once startled, they run for a short distance then resume feeding (Wallace, 1913).

Takins are alert; when aroused, they produce a warning consisting of a hoarse cough. They utter a low bellowing sound during rut (Milne-Edwards, 1868-74; Wallace, 1913). Their vocalizations also have been described as a snorting sound (Bailey, 1912), a deep buglelike note, or a loud whistle through the nose (Pocock, 1910b).

Takins are slow and deliberate in their movements; they ascend and descend sheer, rocky areas in a ponderous manner. They can leap nimbly from rock to rock on rough slopes, but they lack the springing motion of mountain goat (*Oreamnos*); the well-developed dewclaws of takins appear to be associated with life on rough terrain. When the animal walks, its head is carried low and is swayed from side to side (Anderson, 1920; Thomas, 1911b; Ward, 1921).

Marked debarking of trees occurs where a takin herd congregates, for the animals rub the thick bases of their horns against them (Cooper, 1923). They are known to eat the bark of trees as they walk (Bailey, 1915), leaving an easy trail to follow. The trails are distinguishable from those of cervids in that smaller limbs are left undamaged (Schäfer, 1939).

Takins signal their intentions to fight by holding the neck out rigidly and horizontally, then make provocative feinting motions with their heads and hook their horns to the side (lateral display).

Finally, takins spar head to head with opponents (Estes, 1959; Schaller, 1977). Takins at the New York Zoological Park displayed by arching the neck down, retracting the ears, and adducting the tail (head down display). Moving jerkily past the opponent, they gave abbreviated grunts with their heads averted. Head-down displays are frequent in takins; lateral displays resemble those of musk-oxen and mountain goats (Schaller, 1977).

Adult male takins, and perhaps females, spray themselves with urine as a rank symbol. Males lower their heads, raise a hind leg and, with an extended penis, squirt urine against the forelegs, chest, and face. Female takins urinate with tails pressed close to the body, soaking the long tail hairs (Schaller, 1977). Male takins are known to lick the female anogenital region to elicit micturition; presumably the male can detect the phase of the estrous cycle by pheromones.

**GENETICS.** The fundamental chromosome number (FN) in ovibovines is 60, and in *Budorcas* the modal diploid number (2n) is 52. The karyotype consists of 4 submetacentric and 21 acrocentric pairs of autosomes. The X chromosome is the largest acrocentric chromosome as in most other Caprinae; the Y allosome is a tiny metacentric or submetacentric element (Bogart and Benirschke, 1975). Two additional metacentric pairs in *Ovibos* (Tietz and Teal, 1967) are possibly the result of Robertsonian fusion of four pairs of small acrocentric elements. The fourth pair (in size) of biarmed chromosomes is more metacentric in *Budorcas* than in *Ovibos*; the other three appear similar (Bogart and Benirschke, 1975).

**ETYMOLOGY.** The word *Budorcas* is from the Greek words *bous*, meaning "ox" or "cow" and *dorkas*, meaning "gazelle." The specific name *taxicolor* is from the Latin words *taxus*, meaning "badger," and *color*, meaning "hue" or "complexion," the combination referring to the yellow-grey, or "badgerlike," coloration of the takin. Numerous local vernacular names exist for the takin because of its wide range. They are called "tunu-yea" (or "ling-niu"), "niu-jiao-ling," and "jin-mao-niu-jiao-ling," by the Chinese, which mean "antelope-cow," "twisting-horn-antelope-cow," and "golden-hair-twisting-horn-antelope-cow," respectively; Chinese also refer to the takin as "bei-yang" (or "pan-yang"), a general name also applied to goat (*Capra*) or sheep (*Ovis*; Shou, 1964; Thomas, 1911b; Wang Xiaoming, personal communication). Tibetans, depending on locality, call them "ye-more," "ya-go," "shing-na," or "kin" (Bailey, 1912; Gray, 1852; Hodgson, 1850; Milne-Edwards, 1868-74). Along the Assam Himalaya, they are called "shugupan," "kyimyak," "tsimyak," and "siben-ö," by the Akhas, Po Me, Kongbo, and Abor, respectively. The Miju Mishmees call them either "kyem" or "akron." "Takin" is the name used by the Digaru Mishmees (Bailey, 1912, 1915; Hodgson, 1850).

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