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Capra cylindricornis.

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Capra cylindricornis (Blyth, 1841)

Daghestan Tur

Ovis cylindricornis Blyth, 1841:68. Type locality "Caucasus."
Aegoceros pallasii Rouillier, 1841:910. Type locality "Caucasus" (not Schinz, 1838).
Capra cylindricornis Büchner, 1887:21. First use of current name combination.

CONTEXT AND CONTENT. Order Artiodactyla, suborder Ruminantia, infraorder Pecora, family Bovidae, subfamily Caprinae, tribe Caprini (Simpson 1945). The genus *Capra* has 9 extant wild species (Grubb 1993): *C. caucasica*, *C. cylindricornis*, *C. falconeri*, *C. hircus* (= *C. aegagrus*—Heptner et al. 1961; Lydekker 1913; Schaller 1977), *C. ibex*, *C. nubiana*, *C. pyrenaica*, *C. sibirica*, and *C. walia*. *C. cylindricornis* is monotypic.

DIAGNOSIS. Adult *C. cylindricornis* males >6 years of age (Fig. 1) can be differentiated from other *Capra* by a unique combination of cross-sectional shape and curvature of horns. Horn cores and sheaths are subtriangular in cross section; at the base, horn sheaths are usually cylindrical. Sheaths are twisted in heteronymous open spirals (Dinnik 1910; Heptner et al. 1961; Sokolov 1959; Veinberg 1993). Rounded horns of females also display a faint spiraling twist.

Skulls of adult Daghestan tur males have no bulging on forehead below horn cores, as is noticeable in most other *Capra* (Heptner et al. 1961). Skulls of male *C. cylindricornis* resemble most those of neighboring west Caucasian or Kuban tur *C. caucasica* (Heptner et al. 1961; Tsalkin 1955), but skulls of adult males of these 2 species differ as follows. First, coronal suture projects forward at an angle in *C. cylindricornis* but is almost straight in *C. caucasica*. Second, highest point of skull between horn cores is situated closer to back of cores in *C. cylindricornis*, whereas in *C. caucasica* it lies near line connecting front of cores. Third, parietal has a depression in *C. cylindricornis* that is lacking in *C. caucasica* (Tsalkin 1955).

Beard of adult male Daghestan tur is ≤12 cm in winter coat (Abdurakhmanov 1977) and, when stretched forward, never extends beyond chin (Heptner et al. 1961). Being short, coarse, and pointed somewhat forward, it differs from the long and drooping beards of most *Capra*, including *C. caucasica* (Heptner et al. 1961; Sokolov 1959).

Daghestan tur lack dark stripes on the coat that are typical of Siberian or Asiatic ibex (*C. sibirica*), Nubian ibex (*C. nubiana*), and wild goat (*C. aegagrus*—Heptner et al. 1961; Schaller 1977; Veinberg 1993), except those along frontal surfaces of legs, but even the latter disappear in the uniformly dark winter coat of adult males (Dinnik 1910; Veinberg 1993). Winter color of adult male *C. cylindricornis* differs from that of the neighboring *C. caucasica*, which is grayish yellow (Tsalkin 1955). Only the alpine ibex (*C. ibex*) has an almost similar color combined with a short beard (Nievergelt 1967), but the horns are absolutely different.

GENERAL CHARACTERS. *Capra cylindricornis* displays pronounced sexual dimorphism in body size and mass, pelage color, and development of horns (Figs. 1 and 2—Dinnik 1910; Heptner et al. 1961; Sokolov 1959; Veinberg 1984, 1993). Summer coat is short and coarse. Upperparts of all animals, irrespective of age and sex, are sandy yellow, whereas underparts and inner surfaces of legs are dirty white. Dark-brown stripes run along frontal surfaces of legs, becoming wider above hooves and dewclaws. Upper side of tail is also dark brown. Color of winter coat of juveniles, females, and yearlings is essentially the same as in summer, except for being more grayish. Coat of males is homogenously dark brown from the 3rd year on; only 2- to 4-year-old males still display barely visible stripes on legs. The grayish or dirty yellow rump patch in all age and sex classes is very small and is covered by tail (Abdurakhmanov 1977; Veinberg 1984, 1993). Beard is rare in females, minute in yearling males, quite conspicuous in 2-year-old males, and fully developed in 4- to 5-year-old males in winter pelage. In summer coat the beard is hardly noticeable (Veinberg 1993).

Hooves are large. In adult males length of hooves is 80–92 mm on forefeet and 70–76 mm on hind feet, and height is 34–54 mm on both (Sokolov 1959).

Horns of adult females usually grow to 20–22 cm in length, whereas in males they reach 70–90 cm in length and ca. 30 cm in base circumference by 10–15 years of age (Abdurakhmanov 1973; Tsalkin 1955; Veinberg 1984). *C. cylindricornis*, *C. caucasica*, and *C. ibex* are short- and massive-horned due to slower growth rates compared with *C. aegagrus* or *C. sibirica* (Schaller 1977; Veinberg 1984). Horn tips of male Daghestan tur >8 to 9 years old are usually broomed or broken off (Veinberg 1984) and, thus, lose considerable length. Horns of juveniles are straight or slightly curved in 1 plane and oval in cross section. In yearling males horns are triangular in cross section at base, have small transverse wrinkles, and curve up, out, and then back. From the 3rd year, transverse wavelike ridges (usually 2–3 on each annual segment) are prominent on frontal surface, and the small wrinkles disappear gradually. The spiraling curve develops with age, and tips of horns become distinctly pointed upward by 6–7 years. This curve usually does not depend upon an individual's rate of growth; horns of 7-year-old males can be below average size and significantly shorter than those

FIG. 1. Adult male Daghestan tur *Capra cylindricornis* in North Ossetia. Photograph by the author.

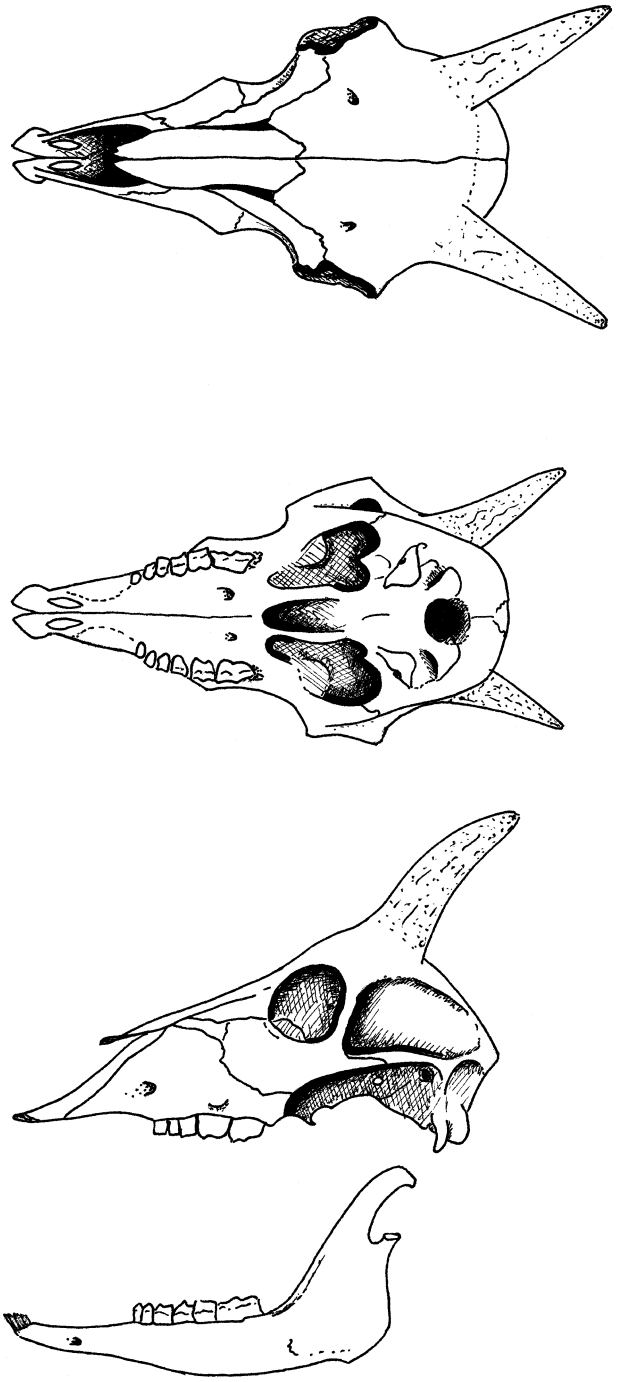

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of a 12-year-old female *Capra cylindricornis* from North Ossetian Nature Reserve, North Ossetia, Russia. Greatest length of cranium is 258 mm. Drawings by the author.

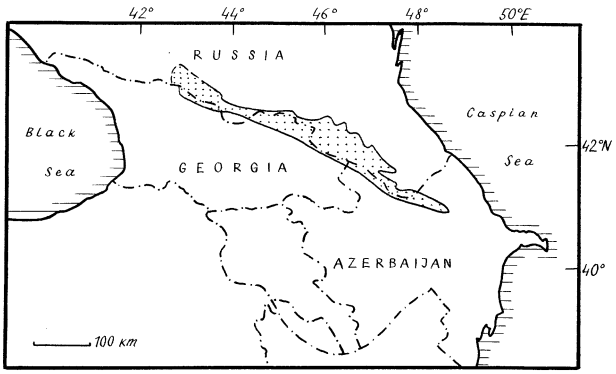

FIG. 3. Present distribution of the Daghestan tur *Capra cylindricornis* (after Heptner et al. 1961; Magomedov and Akhmedov 1994; Veinberg 1984; Zalikhanov 1967). Drawing by the author.

of 5-year-olds but have adult shape nevertheless (Veinberg 1993). Horns diverge widely, being ≥60° in males and ca. 45° in females (Sokolov 1959). Average mass (±*SE*) of horn sheath of a 14-year-old male was 2.45 ± 0.05 kg (Abdurakhmanov 1973).

Male and female juveniles in their 1st winter do not differ in size. In North Ossetia, juveniles (n = 8) measure (in cm, with parenthetical range): length of head and body, 95 (87–100); length of ear, 9.5 (8.0–10.5); length of tail, 7.5 (6.0–9.5); length of hind foot, 25.5 (24.0–28.0); height at shoulder, 57 (51–59—in litt.). Adult females measure (in cm, ±*SE*): length of head and body, 138.0 ± 2.7; height at shoulder, 85.2 ± 0.9. Corresponding figures for adult 12- to 16-year-old males are: length of head and body, 189.8 ± 1.8; height at shoulder, 104.8 ± 0.7 (Abdurakhmanov 1973). Adult females weigh (in kg, ±*SE*) 56.4 ± 8.5, and 12- to 16-year-old males weigh 139.7 ± 3.0, gaining maximal mass of 72.0 and 148.6, respectively (Abdurakhmanov 1973).

Greatest cranial lengths (in mm, ±*SE*, n in parentheses) of *C. cylindricornis* males >7 years old and females >2 years old are 299 ± 2 (17) and 250 ± 2 (13—Tsalkin 1955), respectively. Other cranial dimensions (in mm) of 12- to 15-year-old males and 6- to 9-year-old females, respectively, are: basilar length, 267 ± 1, 243 ± 2; mastoidal width, 126 ± 1, 85 ± 9; alveolar length, 84 ± 1, 74 ± 8. Length (±*SE*) of horn cores of 14-year-old males is 421 ± 2 mm (Abdurakhmanov 1973).

DISTRIBUTION. The Daghestan tur are distributed along the Greater Caucasus chain (Fig. 3). The eastern limit is quite distinct, being situated in the Babadagh Mountain massif (41°N, 48°31′E) in Azerbaijan (Kuliev 1981; Vereshchagin 1938), but the western boundary is less definite. On the southern slope it occurs in the headwaters of the Inguri River (Dinnik 1910; Vereshchagin 1959), whereas on the northern slope it reaches the Bezengi Cherek River (Sokolov and Tembotov 1993) or even the headwaters of the Malka River (43°20′N, 42°40′E) in the Elbrus Mountain massif (Vereshchagin 1959). The area between Balkarian Cherek River and Malka River, on the northern slope, and the Rioni River headwaters and Inguri River, on the southern slope, which is up to 60 km long, also harbors *C. caucasica* (Heptner et al. 1961; Vereshchagin 1959). Total length of the range of the Daghestan tur is about 500 km, if measured to Bezengi Cherek River (Heptner et al. 1961). The distribution reaches its maximal width (up to 70 km) in Daghestan, in the basins of the Avar Koisu and Andi Koisu rivers (Magomedov and Akhmedov 1994), and is most narrow (ca. 12 km) in North Ossetia (Veinberg 2000). The distribution has changed little since the 19th century, when it was slightly wider, encompassing peripheral mountain ranges, more distant from the Main Watershed Range and the Side Range (Veinberg 2000; Vereshchagin 1959). Daghestan tur inhabit Georgia, Azerbaijan, and several territories within the Russian Federation: Kabardin-Balkaria, North Ossetia-Alania, Ingushetia, Chechnya, and Daghestan (Weinberg et al. 1997).

Twenty *C. caucasica* and *C. cylindricornis* were introduced into a 300-ha enclosure in Borzhomi valley in central Georgia (Caucasus Minor—Pfitzenmayer 1915). This exotic population reached about 500 free-ranging tur by 1917 (Heptner et al. 1961; Vereshchagin 1938) but was extirpated during the Russian Revolution and the Civil War in 1917–1921 (Heptner et al. 1961; Sokolov and Syroechkovski 1990). In 1934 and 1941 several Daghestan tur were bred in an enclosure in Borzhomi, but this project was stopped because of the Second World War (Sokolov and Syroechkovski 1990).

FOSSIL RECORD. Fossil remains of *C. cylindricornis* have been mentioned, but not described, from Late Pleistocene deposits from the Caucasus Minor: Dashsalakhly and Damdzhily sites in western Azerbaijan (Aliev 1969) and Tsopi Cave in eastern Georgia (Vekua 1967). These identifications seem unconvincing because Daghestan tur are believed to have originated in the Greater Caucasus, and their occurrence in the Caucasus Minor is considered most unlikely (Baryshnikov 1987; Vereshchagin 1959). The poor

fossil record may indicate that the original range of Daghestan tur included only the East Caucasus, which has very few excavation sites, none of which contain definite *Capra* (Baryshnikov 1987; Vereshchagin 1959). Alternatively, all fossils of tur from the Central Caucasus may have been identified as *C. caucasica*, following the widespread opinion of Sokolov (1959).

FORM AND FUNCTION. In adult males the skin is 3.33–5.24 mm thick at nape of neck. In summer animals practically lack underwool and have 2 kinds of guard hairs. The 1st are about 20 mm long and are evenly scattered, at a density >500 hairs/cm^2 of skin surface. The 2nd are very short, 1.3 mm long, and grow in clumps at a density of 1,750 hairs/cm^2. Winter pelage has 55- to 97-mm-long guard hairs and much underwool, 50 mm long and ca. 20 μm thick (Sokolov and Tembotov 1993).

A single molt takes place in spring and summer (Veinberg 1984). In North Ossetia, in warm years, females, yearlings, and juveniles finish shedding their winter coat by the beginning of May; in cold years they molt a month later, before the parturition period. Males 2–4 years of age shed their winter coat ca. 1 month later and older males 2 months later. Older individuals of both sexes molt later than mature individuals (Veinberg 1984). In North Ossetia growth of winter hairs occurs by the beginning of October (Veinberg 1993).

Females have 2 mammae, which enlarge visibly during lactation. Daghestan tur have a subcaudal skin gland (Pocock 1910; Sokolov 1959; Sokolov and Tembotov 1993).

Horns grow throughout life, with cessations in the cold period of each year. Annual increments are much bigger in males than in females. Maximal annual increment (≤16.5 cm) occurs in the 2nd year in males but is ca. 4 cm by 10 years of age (Veinberg 1984). Dental formula is i 0/3, c 0/1, p 3/3, m 3/3, total 32 (Heptner et al. 1961).

Mass of the axial skeleton in females is slightly less (48.7%) than that of the appendicular part (51.3%), and bones of the hind limbs are heavier than those of the forelimbs. Peculiarities of the appendicular skeleton characterize tur as a climber, which is well adapted to broken, precipitous terrain, compared with Armenian mouflon (*Ovis gmelinii*), which runs on open ground (Kuliev 1981).

Total length of intestines is 24.9 m in females (Kuliev 1981). Daghestan tur have a heart index (mass of the organ/body mass) of 5.7%, a lung index of 2.0%, and a liver index of 2.2% (Abdurakhmanov 1973). The indices are usually smaller in Daghestan tur males than in females. Females may be less adapted to higher altitudes (Abdurakhmanov 1973) and generally live at lower elevations when compared with adult males (Veinberg 1984). Heart and lung indices are smaller in Kuban tur (4.8% and 1.3%, respectively—Abdurakhmanov 1973), but both tur have a considerably bigger heart index than such lowland bovids as goitered gazelle (*Gazella subgutturosa*; 9.2%—Vereshchagin 1938). Larger horn cores may be advantageous to males if they are additional blood-generating organs (Korzhuyev et al. 1978). Daghestan tur have a high oxygenic capacity of blood: 14.34 million erythrocytes/10^{-6} l (1 mm^3) and 12.4 g% of hemoglobin (Bulatova 1962).

Raw contents of the stomach weigh up to 15 kg. Summer forage of females contains 1.3 times more nutrients than that of males because females prefer the shady slopes of northern exposures, where vegetation is richer in nutrients than on sunny slopes (Magomedov and Yarovenko 1998). In summer, relative food intake (compared with body mass) of young animals exceeds 1.5 times that of adults; this difference increases in winter because juveniles do not lower the intensity of their feeding but older animals do. Loss of body mass over winter in adult Daghestan tur is 25–30% (Magomedov et al. 2001; Yarovenko 1997).

ONTOGENY AND REPRODUCTION. *Capra cylindricornis* females reach sexual maturity when 2 years old (Abdurakhmanov 1977; Veinberg 1984; Vereshchagin 1938). In *C. caucasica*, females usually give birth for the 1st time at 4 years (Kotov 1968). Yearling females of Daghestan tur mate in captivity (Heptner et al. 1961) but rarely do so in the wild (Veinberg 1984). However, ca. 40% of yearling females bred in Kabardin-Balkaria (Zalikhanov 1967). Males reach sexual maturity by 4 (Abdurakhmanov 1977) or 6 years (Akhmedov and Magomedov 1995). The latter age is considered the peak of sexual maturity (Vereshchagin 1938).

On the southern slope of the Greater Caucasus, in Azerbaijan, mating takes place in December (Vereshchagin 1938). In North Ossetia, prerut begins in mid-November (Veinberg 1984). The rut begins the end of November or the beginning of December and usually lasts until the beginning of January in North Ossetia and Daghestan but may extend to the end of January in cold and snowy winters (Abdurakhmanov 1977; Veinberg 1984). Animals from the lower and less snowy Rocky Range in Kabardin-Balkaria rut ca. 15 days earlier than do conspecifics on the Watershed and Side Ranges (Zalikhanov 1967). Gestation is 160–165 days (Vereshchagin 1938). As with the rutting season, parturition is earlier on the southern slope of the Watershed Range (Kuliev 1981; Vereshchagin 1938) and in the Rocky Range (Zalikhanov 1967). In Daghestan, parturition begins the end of May and lasts until the end of July, with a peak in the 2nd half of June (Abdurakhmanov 1973; Magomedov et al. 2001). In North Ossetia births occur later, extending from early June until August (Veinberg 1984).

Generally, 1 young is born (Abdurakhmanov 1973; Veinberg 1984). In Azerbaijan, only 3.3–3.7% of all females (Vereshchagin 1938) have twins. The proportion of barren females varies throughout the range, from 6% in Kabardin-Balkaria (Zalikhanov 1967) to 40% in North Ossetia and Azerbaijan (Veinberg 1984; Vereshchagin 1938).

Average mass (±*SE*) of 4 neonates in Daghestan was 3.35 ± 0.19 kg (Yarovenko 1997), whereas a newborn kid in Kabardin-Balkaria weighed 4.1 kg (Zalikhanov 1967). In North Ossetia a pregnant female died on 20 July, most probably just before parturition. The fetus had the following measurements (in cm): length of head and body, 58; length of ear, 7; length of hind foot, 19; height at shoulder, 36; height at rump, 38 (in litt.).

Growth is slow. Two-year-old females usually can be distinguished from older ones (Akhmedov and Magomedov 1995; Veinberg 1984), but in Daghestan sizes of body and skull do not change significantly in females after the age of 3–4 years and in males after 6–8 years (Abdurakhmanov 1973; Magomedov et al. 2001). Body mass does not increase after 5 years in females and 10–11 years in males (Magomedov et al. 2001). Cranial sutures fuse by 6–7 years in males (Vereshchagin 1938). Complete dentition is achieved at 5 years. Teeth are heavily worn by 12 years (Vereshchagin 1938).

Weaning starts in September, but kids suckle until December, although they begin grazing in July. A female found dead in January had milk in her udder (Veinberg 1984). Sometimes a yearling may suckle, supposedly when the female has lost her neonate (Zalikhanov 1967).

ECOLOGY. Daghestan tur dwell at elevations from 1,000 to 4,000 m, in forest, subalpine, alpine, and subnival habitats (Abdurakhmanov 1977; Ekvtimishvili 1952; Veinberg 1984; Vereshchagin 1938). However, areas >3,500 m are visited only in summer and rarely even then (Veinberg 1984). Within the species distribution at the foot of the Watershed Range at 1,500–1,750 m, mean annual temperature ranges from 4.5 to 6.0°C. Annual precipitation is 644–688 mm in North Ossetia and Daghestan and 1,394 mm in Azerbaijan and occurs mostly in the 2nd half of spring and in summer (Malikova 1960; Sokolov and Syroechkovski 1990). The forest zone is dominated by pine *Pinus kochiana* and birch *Betula litwinovii* on the northern slope and by beech *Fagus orientalis*, hornbeam *Carpinus caucasica*, and oak *Quercus macranthera* on the southern slopes. Subalpine vegetation is mainly grasses: *Bromus*, *Festuca*, and *Poa* (Sokolov and Syroechkovski 1990; Veinberg 1984; Vereshchagin 1938).

Animals avoid thick forests on gentle slopes but readily stay in open forests growing on steep, precipitous slopes, which they use not only in winter but also during snow-free periods, especially females with kids and young males. In some areas these age and sex classes stay in the forest the year-round (Veinberg 1984). Some forest-dwelling populations in Azerbaijan are completely isolated from the subalpine zone (Vereshchagin 1938). On average, 34% of Daghestan tur live in the forest throughout the year in Georgia (Ekvtimishvili 1952). Nevertheless, most animals inhabit subalpine and alpine zones in summer. In North Ossetia the proportion of animals below timberline (ca. 2,500 m) increases significantly in winter, but mild winters allow most Daghestan tur to remain above timberline, primarily on south-facing slopes. At the end of February and in March, animals move upward following the retreating snow but descend again in April to the 1st patches of green grass. By July, Daghestan tur gradually increase in numbers in subalpine and alpine zones that are finally snow free. However, even in summer,

long periods of cold and rainy weather cause females with kids to shelter in forests (Veinberg 1984). Above timberline in Daghestan, animals favor northern slopes in summer (53.5% of sightings) and, more distinctly, southern slopes in winter (93.0%—Yarovenko 1997). The latter regularity is well pronounced all over the species range (Aiunts and Kolomyts 1986; Veinberg 1984; Zalikhanov 1967).

Male and female Daghestan tur favor different habitats. In North Ossetia, females use the forest zone more intensively than adult males >6 years old. The altitudinal distribution of females and adult males coincides only during the rut. From February to April, over 80% of females, kids, yearlings, and young males (n = 1,245) dwell in the forest, while over 50% of adult males (n = 264) stay in the subalpine and alpine zones (Veinberg 1984). In summer, above timberline, 82.3% of adult males (n = 544) feed on gentle slopes, while 63.0% of females with yearlings and kids (n = 459) graze on cliffs (Veinberg 1984). In Daghestan, adult males are more numerous on medium steep (26–46°) slopes. Females are opportunistic with respect to steepness but avoid southern slopes (Akhmedov and Magomedov 1995, 1996). The latter behavior, as well as higher activity during daylight, may be caused by greater nutritional demands in lactating females (Akhmedov and Magomedov 1996). In general, females usually live in closed habitat, and adult males live in open habitat (Veinberg 1984). The habitat differences described above, combined with differences in diurnal activity, create ecological and, often, spatial segregations of females with offspring from adult males outside the rut (Magomedov et al. 2001; Veinberg 1984).

Daghestan tur both graze and browse. They consume 256 plant species in Daghestan (Abdurakhmanov 1977), ≥80 in Georgia (Ekvtimishvili 1953), and 78 in Azerbaijan (Kuliev 1981). Practically all plant species in the habitat are eaten, but ca. 60 are the basic forage, and ca. 20 of these are preferred (Magomedov and Yarovenko 1998). Grasses dominate the diet and constitute on average ≥30% of rumen contents in all seasons in Daghestan. They are eaten most in autumn and the beginning of winter (65%) and least in spring (30%) and summer when forbs prevail (Magomedov and Yarovenko 1998), especially in alpine and subnival zones where grasses and sedges are less frequent (Veinberg 1984). Low shrubs such as *Vaccinium myrtillus* and *V. vitisidaea* are essential in winter (Kuliev 1981). In Georgia, trees, shrubs, and low shrubs make up 60% of the plant species consumed in winter but only 15% of those consumed in summer (Ekvtimishvili 1953). *Euonymus*, *Pinus*, *Rosa*, and *Salix* are preferred browse all over the range (Abdurakhmanov 1973; Veinberg 1984). In snowy winters, particularly in February and March, animals may subsist on pine needles (Veinberg 1984). Less frequent food items include mushrooms and lichens (Zalikhanov 1967). Daghestan tur can have a considerable impact because they use 29.0–51.3% of the phytomass in different types of plant communities above timberline. They change the floral composition and diminish the productivity of their feeding areas (Magomedov and Yarovenko 1998).

Mineral licks are used mostly in spring and the beginning of summer (Zalikhanov 1967). Daghestan tur eat soil impregnated with natural minerals. Animals lick minerals on the surface of cliffs and drink at mineral springs (Vereshchagin 1938). Otherwise, they seldom drink (Zalikhanov 1967).

Average population density of Daghestan tur varies from 0.15 to 17 animals/km² (Kuliev 1981; Magomedov and Akhmedov 1994; Tembotov 1972; Veinberg 1984). Highest densities were for Zakataly (Kuliev 1981) and North Ossetian Nature Reserves from the 1970s to the 1980s, and in the latter reached 66 animals/km² in the wintering areas, which was abnormally high (Veinberg 1984).

Sex ratio (male : female) varies throughout the range and across years. Generally, yearling sex ratio is close to even (Akhmedov and Magomedov 1995, 2000). Males prevail among animals >2 years in Azerbaijan (Kuliev 1981; Vereshchagin 1938), whereas in Daghestan (on the other slope of the Watershed Range) the ratio in June–September strongly favors females (62–63:100—Abdurakhmanov 1973; Akhmedov and Magomedov 1995). The skewed ratio is due to increased hunting of adult males with trophy-class horns in Daghestan (Abdurakhmanov 1973). However, because males and females prefer different habitats, the sex ratio can be estimated adequately only during the rut, and in protected populations it favors males (130:100 in North Ossetian Nature Reserve—Veinberg 1984). In summer, kids are 22.2% of the animals encountered in Daghestan (Akhmedov and Magomedov 1995) and 21.4% of those in Azerbaijan (Kuliev 1981). In North Ossetia the proportion of kids is 16.5% and of yearlings 7.6% in August and September, but both figures may be slightly higher because summer counts usually do not include forest-dwelling females and their offspring (Veinberg 1984). The proportion of kids in North Ossetia corresponds to a kid : female ratio of 60:100 ($n_{females}$ = 239—Veinberg 1984, 1989). In Daghestan, this ratio correlates inversely with population density: from 73:100 at a density of 1.8 animals/km² to 48:100 at a density of 7.3 animals/km² (Akhmedov and Magomedov 1995).

Four social groups of Daghestan tur are distinguished: adult male groups composed of males over 6 years, usually including younger males; young male groups; female groups that may include young males; and mixed groups having at least 1 adult male and 1 adult female. Adult male groups are largest outside the rut: mean group size is 12.2 (n_{groups} = 224). They disintegrate in November just before the rut, when adult males join females, forming mixed groups, and reunite in January or February. Consequently, mixed groups are rare outside the rut. In North Ossetia, in years of high density, average size of mixed groups is 10.0 animals (n_{groups} = 125). Female groups are the most stable and contain at least half of the population throughout the year. Their size fluctuates little throughout the year, averaging 6.8 (n_{groups} = 577). Because most young males are members of adult male or female groups, young male groups are less common and are the smallest (mean, 2.6; n_{groups} = 94). Overall mean group size is 7.4 (n_{groups} = 1,020) and changes from 5.8 (n_{groups} = 353) in November–January to 9.5 (n_{groups} = 201) in May–July. Yearly changes of overall average group size depend on changes in group type over the reproductive cycle. Group size is also influenced by topography. In the North Ossetian Nature Reserve, average group size was 9.7 in precipitous areas and 24.0 in more rolling and gentle valleys, despite a twice lower population density in the latter area (Veinberg 1983, 1984). In Azerbaijan, with its less precipitous relief, mean group size was ca. 78 (Kuliev 1981), and herds of 300 animals were sometimes observed in Zakataly Reserve in the 1950s (Heptner et al. 1961). Mean group size also correlates with population density: from 11–15 animals at 1.8 animals/km² to ca. 30 animals at 7.3 animals/km² (Akhmedov and Magomedov 1995).

Seasonal migrations rarely exceed 5 km in North Ossetia (Veinberg 1984), Daghestan (Abdurakhmanov 1977), and Kabardin-Balkaria (Zalikhanov 1967). In particularly snowy winters, migrations may reach 15 km in Kabardin-Balkaria (Zalikhanov 1967). About 2 regular migrations from Azerbaijan to Daghestan occur across the Watershed Range: 1 in winter, when snow is more abundant on the southern slope, and the other in summer, to escape biting insects (Vereshchagin 1938). In North Ossetia and Kabardin-Balkaria, animals generally move north in autumn, away from the snowy Watershed Range (Aiunts and Kolomyts 1986; Veinberg 1984). Seasonal migrations of adult Daghestan tur males usually exceed those of other age and sex classes (Veinberg 1984).

Daghestan tur are sympatric with red deer (*Cervus elaphus*) in the eastern part of the Watershed Range, but because red deer usually avoid precipitous areas and are much less numerous, competition is minimal (Popkova 1968; Veinberg 1984). *C. aegagrus* is restricted to Daghestan, Chechnya, and northeastern Georgia (Heptner et al. 1961). It outnumbers Daghestan tur in forested habitats by 6–7 times, but *C. aegagrus* rarely occurs above timberline (Weinberg 1999). Chamois (*Rupicapra rupicapra*), more common on southern slopes of the Watershed Range (Heptner et al. 1961; Popkova 1968), often share habitat with Daghestan tur and competes for food, but Daghestan tur may have a less selective diet (Popkova 1968). Therefore, the occurrence and altitudinal distribution of the chamois may depend upon the presence of Daghestan tur (Popkova 1968; Veinberg 1984). Livestock, sheep (*Ovis aries*) in particular, are the principal competitors of Daghestan tur. Winter densities of *C. cylindricornis* decrease from ca. 3.1–3.5 animals/km² in areas without intensive shepherding to 1.2–1.5 animals/km² in areas where >80% of wintering pastures of Daghestan tur are used by sheep in summers (Magomedov and Akhmedov 1994).

The helminth fauna of Daghestan tur is limited due to the severe environment of the highlands (Asadov 1959; Zakariyev 1980). Fifteen animals from Azerbaijan had no worms (Vereshchagin 1938). Nevertheless, Daghestan tur parasites include tapeworms, *Coenurus cerebralis* and *Cysticercus tennuicollis*; flukes, *Dicrocelium lanceatum* and *Fasciola hepatica*; 29 species of nematods; lice, *Mallophaga*; ticks, *Haemaphysalis sulcata*, *H. warburtoni*, and *Rhinocephalus turanicus*; and larvae of gadfly, *Oes-*

trus turanicus (Abdurakhmanov 1973; Asadov 1959; Rukhlyadev 1964; Vereshchagin 1938; Zakariyev 1980). Mange, caused by the tick *Acarus siro*, occurred in Azerbaijan (Vereshchagin 1938), Daghestan (Akhmedov and Magomedov 2000), and Kabardin-Balkaria (Zalikhanov 1967). Daghestan tur suffered from foot-and-mouth disease in Kabardin-Balkaria and, perhaps, Daghestan (Zalikhanov 1967). Some unknown plague reduced Daghestan tur numbers in Central and Eastern Caucasus by the late 19th century (Zalikhanov 1967).

Most natural (excluding human hunting) mortality is caused by avalanches and predators. In North Ossetia, avalanches account for 60% of natural mortality (n = 136—Veinberg 2000) and mainly kill adult males (Naniyev 1962; Veinberg 1984). In Kabardin-Balkaria, where *C. caucasica* and *C. cylindricornis* ranges partly overlap, avalanches kill annually ca. 370 Daghestan tur (4% of the population—Zalikhanov 1967). In Daghestan, avalanches account for ca. 35% of the annual natural mortality of Daghestan tur (n = 367—Abdurakhmanov 1973). Wolves (*Canis lupus*) are a greater threat in less precipitous terrain. In 1 valley of Kabardin-Balkaria a pack of 5 wolves killed 31 Daghestan tur (9 adult males, 2 young males, 16 females, and 4 yearlings and kids) in 1 winter (Zalikhanov 1967). Wolves account for 20% of the natural mortality in Daghestan (Abdurakhmanov 1973). In contrast, only 2 successful wolf hunts are known in the precipitous North Ossetian Reserve, and wolf tracks are rarely seen within the Daghestan tur habitat, whereas lynx (*Lynx lynx*) are a consistent predator of Daghestan tur, killing mostly kids (58%, n = 36) year-round (Veinberg 2000). Large birds of prey, such as lammergeiers (*Gypaetus barbatus*) and golden eagles (*Aquila chrysaetos*) hunt neonatal Daghestan tur (Abdurakhmanov 1977; Veinberg 1984; Zalikhanov 1967), causing 5–7% of their mortality (Abdurakhmanov 1973). All 4 lammergeier nests examined in the North Ossetian Reserve contained many hooves and fragments of skulls of newborn Daghestan tur (Veinberg et al. 1983). Mortality is very high during the 1st year of life, and in Daghestan it reaches ca. 40% (Abdurakhmanov 1977; Akhmedov and Magomedov 2000). In Daghestan, annual mortality is gender specific: at the age of 3 it is 9.5% for both males and females, whereas by the age of 14 it is 32% and 14%, respectively (Akhmedov and Magomedov 2000). Longevity is 15–16 years (Akhmedov and Magomedov 2000; Heptner et al. 1961), but some animals live 22–23 years (Vereshchagin 1938; Zalikhanov 1967).

Status of Daghestan tur depends totally on intensity of anthropogenic pressures, including poaching, competition with livestock, industrial activities (e.g., mining, road construction), and recreation such as mountaineering and tourism. From the 1940s to the 1980s, land-use for livestock and industry was the greatest threat to Daghestan tur via habitat destruction, but by the late 1980s, numbers of livestock decreased drastically, and industrial projects were stopped or postponed. In contrast, poaching intensified because of political instability and the large numbers of illegal modern firearms obtained by civilians as a result of military conflicts in the Caucasus. Legal hunting was always very limited, and Daghestan tur will probably remain subjected to low-level sport hunting (Veinberg 1984, 1997).

Traditional use of hide and wool was abandoned long ago. Only horns still have considerable and widely acclaimed value. They are used for home decoration and, when mounted in silver, as traditional cups for wine and beer (Veinberg 1984).

Daghestan tur are bred mainly in the following zoos: Tallinn (Estonia), Liberec (Czech Republic), Augsburg (Germany), and San Diego (United States—Olney and Fisken 1998). *C. cylindricornis* neonates can be caught on foot within the 1st days after birth (Yarovenko 1997; Zalikhanov 1967). In North Ossetia, animals were captured in nets stretched across trails (in litt.).

Census methods are based on direct counts of animals along transects or from fixed observation points, usually during the snowless period of the year. Either animals are counted over the whole territory or certain plots are chosen and the data extrapolated (Abdurakhmanov 1973; Magomedov and Akhmedov 1994; Zalikhanov 1967).

BEHAVIOR. Generally courtship occurs only during the rut, although young 3- to 4-year-old males may court females in spring and summer. Rutting males keep their tails up and folded over the back. Those older than 5 years do so constantly; 3-year-olds raise their tails only when older males are absent and then only for short periods. Courtship generally looks like guarding and includes low-stretch, twist, broadside, kick, tongue-flick, lip-curl, sniffing of female genitalia or urine, sniffing and touching of muzzle, touching of lying female with the forefoot, and urinating on own muzzle (or mouthing of penis). Low-stretch forms the basis of guarding, and most other courtship patterns are performed by the male while low-stretching (Veinberg 1984). Frequent use of the low-stretch and the rarity of kick and twist results in cautious courting, characteristic of protected and healthy populations with natural age and sex structure (e.g., Siberian ibex *C. sibirica*—Fedosenko et al. 1992). However, Daghestan tur court persistently in captivity (Ernits 1982). The intensity of courtship is much higher in adults (3.2 displays/h) than in 3- to 6-year-old males (2.1 displays/h). Courtship by young males is exaggerated, often grotesque, and even aggressive. Unlike adult males, young males may attack a female if she tries to drive them off. Females escape from 27.2% of the courtship attempts of adult males (n = 362) and 44.8% of those of young males (n = 316) and respond aggressively to 9.5% of the attempts of adult and 15.5% of those of young males. Young males court yearlings and kids (23 observations) much more often than adult males do (5 observations). Young males can breed only after the main rutting period, when adult males are exhausted, but some females are still not pregnant. In stable and sunny weather, courtship intensity is higher, and the rutting period is shorter (Veinberg 1984).

Agonistic behavior of adult males occurs almost exclusively during the rut. The aggressive repertoire includes low-stretch (with tongue-flicking), broadside, weapon-threat, rush, jump, clash (with or without rearing on the hindlegs), kick, jerk, and block. The last 3 patterns are used by older males toward younger ones to prevent their approach to females. These elements, together with the low-stretch and broadside, are common to courtship and aggression, but their frequency is either low (kick and jerk) or different (low-stretch) in both situations. Head-low (or facing away), sniffing of side (genitalia or muzzle), licking and rubbing of side and muzzle (often mutual), and horning are submissive behaviors. Aggressive interactions take place mainly between animals of different age classes. Young males receive 0.75 aggressive actions per hour from adult males, whereas adult males receive only 0.2 actions per hour from other adult males (Veinberg 1984). Adult dominant *C. cylindricornis* males never expel other males from rutting groups. Adult males usually exchange indirect threats. The only exceptions are fights that are rare in North Ossetia (Veinberg 1984), contrary to statements by Abdurakhmanov (1977) and Vereshchagin (1938).

Fights take place between equally sized males and are preceded by aggressive displays; they are extremely fierce and not ritualized. Clashing from a bipedal position is followed by horn wrestling. Animals lock horns and sometimes roll down the slope together. Blows are delivered to the head and body. Males may fight in the head-to-tail position and butt each other on the belly from below. Tail is kept down during a fight. The loser leaves the group, followed, but not chased, by the winner, who then rejoins the group (Veinberg 1984).

During the rut, females display aggression only as a response to courtship. They avoid adult males outside the rut and are dominated even by 2- to 3-year-old males (8 aggressive actions from young males to females and 1 aggressive action in return). Female aggression is primarily intrasexual (66%, n = 32) and mainly overt. It is probably connected with late pregnancy because it is usually observed in April and May (Veinberg 1984).

Daghestan tur have 2 hierarchical orders. First, adult males dominate young males during the rut. Second, young males dominate females, which dominate yearlings and juveniles the year-round. No dominant–submissive relationships occur between adult males and females (Veinberg 1984).

Just before parturition, a female will isolate herself in rugged terrain and later sometimes hide her neonate, leaving it alone for 2–3 days and periodically visiting to nurse (Abdurakhmanov 1977). After this hiding phase, females with young may avoid other conspecifics for ca. 3–7 days (Zalikhanov 1967).

Kids suckle in the head-to-tail position. Weaning begins in September, and females not only step forward but also kick and, rarely, even butt their kids to prevent them from suckling (Veinberg 1984).

In summer, in fine weather, Daghestan tur feed at night, even if undisturbed, and by dawn, animals begin moving their resting sites. Adult males are practically inactive from 0800 until 1600 h, whereas females may forage in daylight, and their activity never

ceases completely at midday. During the rest of the year, animals are active in daylight (Veinberg 1984).

Diurnal movements are most evident in summer and above timberline (Abdurakhmanov 1973; Veinberg 1984). Because Daghestan tur rest in cliffs above their subalpine, foraging meadows, they descend in the evenings and ascend in the mornings (Veinberg 1984). However, in Daghestan and Kabardin-Balkaria, animals may spend the day below their feeding sites, so the direction of diurnal movements is opposite (Aiunts and Kolomyts 1986; Vereshchagin 1938). Typically, males move daily 1,500 m horizontally and 1,000 m vertically, whereas females move ca. 500 m horizontally and ca. 300 m vertically (Magomedov et al. 2001; Veinberg 1984).

Feeding behavior is diverse. Animals paw through snow (up to 30 cm deep) to dig out the underground parts of plants, and they also bend branches with their forelegs, rear up on their hind legs to reach leaves, twigs, or pine needles, and even climb slanting trees (Veinberg 1984).

Animals often play in spring and summer during the day. They mostly use elements of courtship and agonistic behavior, e.g., mounting is performed by juveniles as young as 1.5–2 months (Veinberg 1984).

Vocalization is poor. The alarm signal is a sharp and hissing whistle (Abdurakhmanov 1977; Veinberg 1984; Vereshchagin 1938). Females and kids bleat to each other (Dinnik 1910; Zalikhanov 1967).

Marking is rare (n = 32 observations) and is performed by all age and sex classes, albeit mostly by adult males (63%), which mark only during the rut (0.1 markings/h for each male, n = 360 male-hours). Males debark trunks or bigger branches using their horns and then rub against the bare places with the postcornual area, sniffing periodically at the mark that may be up to 70 cm long. Numerous old and new marks characterize wintering areas and most often occur on pines. Marks of adult males have durable scent (Veinberg 1984), although postcornual glands are not known in Daghestan tur (Sokolov 1973; Sokolov and Tembotov 1993). Young males mark during the rut and outside it; females do so only outside the rut. They mark twigs and do not debark them. On the whole, marking evidently belongs to agonistic behavior. It is not connected with territoriality because Daghestan tur are not territorial (Veinberg 1984).

Females form groups whose composition is not constant. Perennial home ranges of female groups cover ca. 4–6 km^2. Home ranges of adult males are considerably larger because of their active roaming during the prerut and rut, and their seasonal ranges may be quite separate. Adult male groups display fidelity in space use (perennial trails, resting sites, and feeding areas—Veinberg 1984).

GENETICS. *Capra cylindricornis* has 2n = 60 (FN = 60) chromosomes (Kuliev and Mamedov 1974). Daghestan tur readily interbreed with domestic goats in captivity (Heptner et al. 1961) and do so in the wild (Zalikhanov 1967). In the 1930s, crossbreeding occurred in Tbilisi Zoo, and fertile hybrids were obtained. Daily milk yield from hybrid dams was 1–2 l, and the milk contained 5.5–6% fat (Heptner et al. 1961). First-generation hybrids reached sexual maturity by 16 months and second-generation hybrids (25% tur) by 8 months. Hybrids grew fast and large: a 3-year-old male weighed 107 kg (Heptner et al., 1961).

Researchers who consider *C. caucasica* and *C. cylindricornis* as separate species described hybrid specimens in the wild (e.g., Heptner et al. 1961). *C. cylindricornis* and *C. aegagrus* crossbreed in captivity and produce fertile offspring (Pfitzenmayer 1915; Sarkisov 1953). Hybridization between these species in the wild is not well documented (Pfitzenmayr 1915) and has not been confirmed (Heptner et al. 1961; Weinberg 1999).

CONSERVATION STATUS. Daghestan tur numbers have increased since the early 20th century (Heptner et al. 1961) and reached 30,000 in the 1970s (Veinberg 1984). This increase was followed by a decrease that was not simultaneous throughout the species' range. In Georgia it began in the mid-1970s (Eriashvili 1990). The total number of Daghestan tur had declined to ca. 20,000 by the end of the 1980s, 10,000 of these being in Daghestan (Weinberg et al. 1997). However, a different census technique indicated ca. 20,000 *C. cylindricornis* in Daghestan alone (Magomedov and Akhmedov 1994).

Caucasian tur, treated as a single species (*C. caucasica*), were regarded as rare in the USSR (Sokolov et al. 1977) but were not included in Red Data Books of the USSR (Borodin et al. 1984) and the Russian Federation (Eliseev et al. 1983). Nevertheless, Daghestan tur were listed as Vulnerable by Shackleton et al. (1997). They occur in several nature reserves: Zakataly, Ilisu, Ismailly (Azerbaijan), Lagodekhi, Tushetian, Kazbegi (Georgia), North Ossetian, Kabardin-Balkarian (Russia—Weinberg et al. 1997). In the Soviet period, these reserves harbored ca. one-third of the total population, and, counting sanctuaries of different ranking, the largest part of the *C. cylindricornis* population was concentrated in comparatively small protected areas (Veinberg 1984). The situation is essentially the same today, though these areas, in practice, offer no more actual protection than the unprotected ones.

REMARKS. E. Blyth (1841) named Daghestan tur on the basis of a sketch and a vague description of horn sheaths contained in a letter from Col. H. Smith. Blyth noticed that the horn sheaths resembled those of bharal (*Pseudois nayaur*). Because Blyth considered bharal as true sheep, he regarded the new species as a sheep too, hence the Latin name *O. cylindricornis*. A year later, Rouillier (1841) had a mounted specimen at his disposal and determined that Daghestan tur are not sheep but a link between *Ovis* and *Capra*. Lydekker originally accepted *O. cylindricornis* as valid (Lydekker 1898) but later (Lydekker 1913) considered *C. caucasica* Güldenstaedt et Pallas (Pallas 1783) and *C. cylindricornis* as synonyms and used the early name, *C. caucasica*, for Daghestan tur. Specimens described by Pallas as *C. caucasica* came from the area "between Malka and Baksan Rivers north-east of Mnt. Elbrus in the North Caucasus" (Pallas 1783:273). This area harbors Kuban tur now (Dinnik 1910; Heptner et al. 1961; Tsalkin 1955), but Daghestan tur may also occur there (Vereshchagin 1959). The description of *C. caucasica* is unclear but suits Kuban tur more than Daghestan tur (Heptner et al. 1961; Tsalkin 1955). However, Lydekker's opinion (1913) was accepted by Ellerman and Morrison-Scott (1966) and created confusion because *C. caucasica* is applied either to Kuban tur (Grubb 1993; Heptner et al. 1961; Schaller 1977) or to Daghestan tur (Ellerman and Morrison-Scott 1966).

Several combinations of generic and specific names, which do not belong to the synonymy, have added confusion: *Ovis* (*Aegoceros*) *pallasii* Reichenbach, 1846:98 (pl. XLIX) and *Aegoceros pallasi* Radde in Sclater, 1887:552.

Classification of tur remains uncertain. Sokolov (1959) and Tembotov (1972) suggest only 1 species *C. caucasica* with 3 subspecies. Their opinion was partly supported by Aiunts and Kolomyts (1986), who studied the degree of spiraling horn twist in tur and concluded that it increases clinally from west to east. Grubb (1993), Heptner et al. (1961), Lydekker (1898), and Tsalkin (1955) recognized 2 species, *C. cylindricornis* and *C. caucasica*. Hilzheimer (1922), on the basis of Lydekker (1898), proposed a subgenus *Turus* for both tur and the Spanish goat (*C. pyrenaica*). Ellerman and Morrison-Scott (1966) and Schaller (1977) divided both tur, considering Daghestan tur a separate species, whereas the Kuban tur was regarded as a subspecies of ibex and thus lumped with Alpine, Siberian, and Nubian conspecifics. This opinion is rejected by Russian zoologists (e.g., Heptner et al. 1961). Analysis of horn shape and coat-color patterns indicate that morphological differences between Kuban and Daghestan tur are clearly less than those between either of them and all other *Capra* (Veinberg 1993). Heptner et al. (1961), Veinberg (1993), and Vereshchagin (1959) stated that Kuban tur (*C. caucasica*) are morphologically intermediate between ibexes and Daghestan tur (*C. cylindricornis*), the latter being evolutionarily younger. In contrast, Geist (1971, 1985) and Lydekker (1913) regarded Daghestan tur as a primitive goat and maybe even a link between aberrant goats (*Ammotragus* and *Pseudois*) and true goats (*Capra*). Preliminary data on cytochrome *b* and mitochondrial DNA sequences suggest affinity between *C. cylindricornis* and *C. aegagrus* but indicate a considerable distance between *C. cylindricornis* and *C. caucasica* (Hassanin et al. 1998; Manceau et al. 1999).

A 2nd vernacular name for Daghestan tur is the East Caucasian tur. Etymologically, *Capra* is Latin for goat, and *cylindricornis* is a reference to the distinctive shape of the horns.

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