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Taurotragus oryx.

By Lindsay A. Pappas

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Taurotragus Wagner, 1855

Antilope Pallas, 1766:9. Type species *Antilope oryx* Pallas, 1766.
Oreas Desmarest, 1822:471. Type species *Antilope oreas* Pallas, 1777. Not *Oreas* Hübner (Insecta).
Taurotragus Wagner, 1855:438. Type species *Antilope oreas* Pallas, 1777.
Doratoceros Lydekker, 1891:130. Type species *Antilope triangularis* Günther, 1889.

CONTEXT AND CONTENT. Order Artiodactyla, family Bovidae, subfamily Bovinae, tribe Tragelaphini, genus *Taurotragus*. *Taurotragus* has 2 living species, *T. oryx*, the eland, and *T. derbianus* (Gray 1847), the giant eland, and 1 extinct species, *T. arkelli* (Leakey 1965).

Taurotragus oryx (Pallas, 1766)

Eland

Antilope oryx Pallas, 1766:9. Type locality not given.
Antilope oreas Pallas, 1777:17. Type locality "high mountains of southern Africa."
Bos barbatus Kerr, 1792:340. Type locality "country north from the Cape [of Good Hope] . . . the country of the Namaques."
Cemas alces Oken, 1816:735. Type locality "South Africa, especially east of the Cape, in level country."
Damalis canna Hamilton Smith, 1827:359. Type locality "beyond the Gareep, upon the Great Desert," South Africa.
Oreas livingstonii Sclater, 1864:105. Type locality "on the left bank of the Zambezi, in the neighbourhood of the Kafue."
Antilope triangularis Günther, 1889:74. Type locality "Southern Central Africa."
Taurotragus oryx selousi Lydekker, 1910:328. Type locality "Mashonaland."
Oreas oreas kaufmanni Matschie, 1912:119. Type locality "Caprivi Peak," Southwest Africa.
Oreas oryx niediecki Matschie, 1913:249. Type locality "upper Zambesi."
Taurotragus oryx billingae Kershaw, 1923:598. Type locality "Uleti, Iringa."

CONTEXT AND CONTENT. Content as for genus. Three subspecies are recognized (Kingdon 1997):

T. o. livingstonii (Sclater, 1864):105, see above (*kaufmanni* Matschie, *niediecki* Matschie, *selousi* Lydekker, and *triangularis* Gunther are synonyms).
T. o. oryx (Pallas, 1766), see above (*alces* Oken, *barbatus* Kerr, *canna* H. Smith, and *oreas* Pallas are synonyms).
T. o. pattersonianus Lydekker, 1906:579. Type locality "Portuguese East Africa," corrected to "Laikipia plateau, British East Africa" (Lydekker 1907) (*billingae* Kershaw is a synonym).

DIAGNOSIS. *Taurotragus oryx* (Fig. 1) is slightly smaller than the giant eland, *T. derbianus*, and has much shorter (less than twice the length of its head) and more tightly spiraled horns. Also, horn cores have a stronger anterior keel and are set further apart (Gentry and Gentry 1978). In addition, the eland has narrow, pointed ears, as compared with the wide and very rounded ears of the giant eland. *T. oryx* does not have spotted cheeks, and the coat color is nearly uniform over the whole body, whereas each cheek of the giant eland has a large white spot, and hair on sides of neck is darker than hair on rest of body. Finally, the dewlap of the eland is limited to throat region, whereas that of the giant eland reaches to the chin (Ansell 1972).

GENERAL CHARACTERS. The eland is the second largest African antelope, with males being larger than females (Underwood 1979). Shoulder height averages 163 cm (range, 151–183 cm; no sample size given) for males and 142 cm (range, 125–153 cm; no sample size given) for females. Body mass averages 500–600 kg (range, 450–942 kg; no sample size given) for males and 340–445 kg (range 317–470 kg; no sample size given) for females (Estes 1991). Tail is ca. 60 cm (range, 54–75 cm; no sample size given) long and is tufted at tip (Kingdon 1982). Pelage color varies from dark gray brown to reddish brown, and males tend to turn blue-gray as they age (Hillman 1974). A crest of hair runs from nape to a small hump on withers, and a tuft of hair on the forehead of males is particularly thick (Hosking and Withers 1996). Both sexes have a dewlap. The dewlap, particularly of the males, becomes very large and distinctive over time, hanging down nearly to wrists (Kingdon 1997). The eland has 2–15 transverse white stripes, which are more distinct anteriorly (Haltenorth and Diller 1980). Pelage color and prominence of stripes vary throughout distributional range and among subspecies. Hair color is lighter and stripes are less pronounced on animals in the southern area of the range as compared with animals in northern areas (Skinner and Smithers 1990). All eland have a black spot on the posterior upper region of the forelegs, along with a dark dorsal stripe running down the dorsum (Posselt 1963).

Both species of *Taurotragus* have large supraorbital pits, pronounced lateral flanges at front of nasals and more anteriorly set toothrows (Fig. 2; Gentry and Gentry 1978). Both sexes of *T. oryx* have spiraled horns, but horns of males are shorter, thicker, and have tighter, more pronounced spirals. Horn length of males averages 54 cm (range, 43–67 cm; no sample size given—Estes 1991). Horns of females are longer, thinner, and average 60.5 cm (range, 51–69.6 cm; no sample size given—Estes 1991).

DISTRIBUTION. Eland live throughout ca. one-third of Africa (Fig. 3). The northern limit of their range cuts northeast through Angola and southern Zaire and then north to include Tanzania, Kenya, and southern Somalia. Populations occurring in the southern tip of the continent, including parts of South Africa, Botswana, and Namibia, are primarily reintroduced, whereas northern populations are native (Estes 1993; Skinner and Smithers 1990). Within this region, nomadic eland roam seasonally based on availability of food and water (Kingdon 1982). The animals use open plains, savannahs, and lightly wooded areas and avoid thick forests

FIG. 1. Adult *Taurotragus oryx* from Ngorongoro Crater, Tanzania. Photograph by D. C. Gordon. Used with permission from Robert S. Sikes, Chair, American Society of Mammalogists, Mammal Images Library.

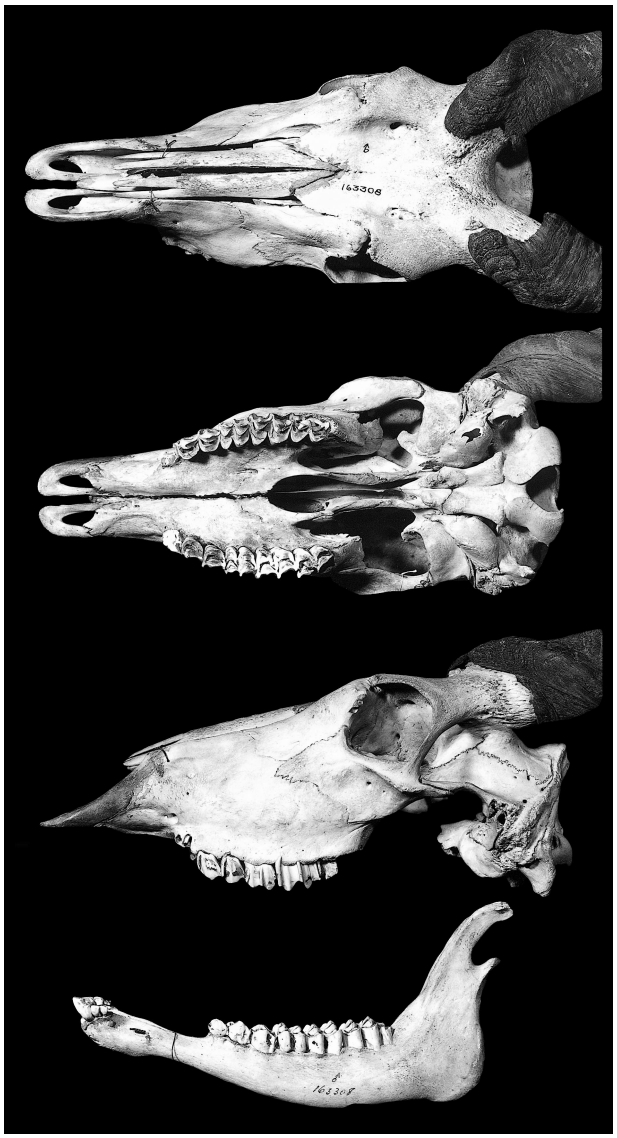

FIG. 2. Dorsal, ventral, and lateral views of the cranium and lateral view of the mandible of an adult male *Taurotragus oryx* (USNM 163308 [United States National Museum mammal collection]) from Sotik, Nguasso Ngiro Agates, Kenya. Collected 11 June 1909 by T. Roosevelt. Occipitonasal length is 446 mm. Photograph by Don Hurlbert, Smithsonian Institution, NMNH–MSC Photo Services.

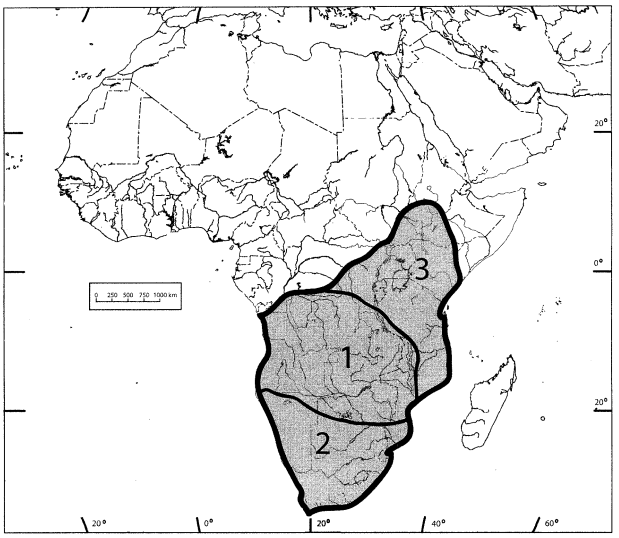

FIG. 3. Geographic distribution of *Taurotragus oryx*. Subspecies are (1) *T. o. livingstonii*, (2) *T. o. oryx*, and (3) *T. o. pattersonianus*. Map modified from Ansell (1972) and Estes (1993).

(Hosking and Withers 1996). They live at altitudes up to 4,600 m (Estes 1993).

FOSSIL RECORD. Bovids first appeared some 20 million years ago. Although some fossils have been found in France, the most comprehensive paleontological record is found in sub-Saharan Africa (Essop et al. 1997). The tribe Tragelaphini first appeared in Africa during the late Miocene (6.5–5 million years ago), and eland fossils are common at South African sites (Vrba 1985). Fragments of crania, mandibles, and teeth have been found throughout the region (Gentry and Gentry 1978). Also, a single cranium of *T. arkelli* was discovered in northern Tanzania, at Olduvai Gorge, Bed IV, a lower Pleistocene site (1.8–0.7 million years ago—Leakey 1965). A specimen of *T. oryx* was also unearthed at Olduvai Gorge (Gentry et al. 1995) and at Ternifine in Algeria (Arambourg 1962). The Ternifine fossils date to the late Pleistocene and then disappear at the start of the Holocene. None of these specimens was assigned to the older, more primitive species, *T. arkelli*, because the horn cores inserted at a lower inclination, which is more like that of the living eland (Gentry 1978; Gentry et al. 1995). *T. arkelli* differs from *T. oryx* because top of braincase is longer and is not depressed to form a transverse crest across top of occipital. In addition, cranium is high and narrow, and supraorbital pits are closer together (Gentry and Gentry 1978).

ONTOGENY AND REPRODUCTION. The eland reproduces yearly (Jeffery 1979). Sexual maturity in females is ca. 2.5 years of age, whereas that in males is ca. 4 years of age (Hall 1975; Hosking and Withers 1996). Although eland can reproduce at any time of the year, they have peak breeding and calving seasons. Peak calving months are between August and November (Jeffery 1979; McNaughton 1990; Posselt 1963; Skinner and Van Zyl 1969), and calving usually peaks during the wet season, when food availability is greatest. Estrus occurs at 21- to 26-day intervals and lasts for 3 days (n = 8—Posselt 1963). Gestation is 271 ± 2.9 (*SE*) days (n = 14—Skinner and Van Zyl 1969), and parturition usually takes place at night. Females exhibit estrus 2 weeks after parturition, but only 1 of 8 cows conceived after this short interval (Posselt 1963).

At birth, male calves weigh 30 ± 1.3 (*SE*) kg (n = 20), and female calves weigh 25.5 ± 0.7 kg (n = 30—Skinner and Van Zyl 1969). Calves stand shortly after birth and move freely about their immediate area. Vocalizations are frequent. Calves mimic the mothers' browsing behavior almost immediately postpartum, but suckling is the primary form of feeding. Eland calves need eland milk for the first 10 days of life, after which cow's milk can be used in combination with eland milk in domestic situations (Uspenskii and Saglandskii 1952). Most calves are weaned by 6 months of age (Underwood 1979).

FORM AND FUNCTION. Four inguinal mammae are present (Haltenorth and Diller 1980). Milk is high in fat, and fat content ranges from 11% to 17.3% 5 days postpartum (Posselt 1963). Dental formula is i 0/3, c 0/1, p 3/3, m 3/3, total 32 (Jeffery and Hanks 1981).

Eland have a high metabolic rate for their size, compared with Hereford cattle. In fact, the eland's metabolism is 30% higher than the Hereford's within the thermal neutral zone (5.74 ± 0.15 versus 4.35 ± 0.11 l oxygen kg^{-1} day^{-1}). Eland also excreted a greater amount of urea in their urine. At 22°C, with restricted access to water, eland (n = 3) excreted 637 ± 107 (*SE*) mmol/l urea, whereas Hereford cattle (n = 3) excreted 136 ± 19 (*SE*) mmol/l urea (Taylor and Lyman 1967). Eland need a high protein diet composed of succulent leaves from a variety of flowering plants. They will, however, eat any plant material that is available, even if it is of lower quality (Buys 1990).

ECOLOGY. Eland occur in savanna, woodland, open grassland plains, and montane grassland with a wide variety of flowering plants (Rowe-Rowe 1983). Common trees and shrubs include *Acacia*, *Combretum*, *Commiphora*, *Diospyros*, *Grewia*, *Rhus*, and *Ziziphus*, and many of these are components of the eland's diet. In

addition, eland eat forbs (nonwoody dicotyledons) from the family Compositae, including *Acanthospermum*, *Bidens*, *Tagestes*, and *Tarchonanthus*, and fruits from *Securinega* and *Strychnos* (Buys 1990; Fabricius and Mentis 1990; Kingdon 1997; Skinner and Smithers 1990). Dominant grasses include *Setaria* and *Themeda* (Hillman 1979). Densely wooded forests are avoided (Rowe-Rowe 1983).

Eland have been classified both as intermediate feeders, preferring forbs along with foliage of shrubs and trees (Hofmann and Stewart 1972), and as browsers that have adapted to grazing (Buys 1990; McNaughton and Georgiadis 1986). Eland may graze during the rainy season, when grasses are plentiful, but browse more during drier winter months (Buys 1990). Forbs are eaten in summer and winter months in addition to grasses and browse (Buys and Dott 1991; Rowe-Rowe 1983). Although eland drink water when it is plentiful, they obtain most of their water from their diet (Skinner and Smithers 1990).

Because eland use a variety of food resources, these nomadic animals move from region to region based on season and food availability. In general, females use more habitats than males and have a larger home range. Female eland in Nairobi have home ranges of 174–422 km^2 (Hillman 1979). Because of their size, eland need a large area per animal in which to feed. Therefore, these animals have a high "inter-individual distance" (Lewis 1978). However, seasonal fluctuations exist, and eland populations tend to be larger during the wet season (Estes and Small 1981). This most likely reflects abundance of food and greater numbers of mothers with calves.

Eland are resistant to trypanosomiasis, a disease transmitted by tsetse flies (Hansen et al. 1985; Posselt 1963) but are not resistant to theileriosis, a bacterial disease transmitted by ticks of the genus *Rhipicephalus*. Unlike cattle, eland are often asymptomatic or show only mild symptoms when infected. Nonetheless, the bacterium *Theileria taurotragi* is pathogenic and has caused eland deaths (Grootenhuis et al. 1980; Young et al. 1980). Eland host a variety of ticks; 1 eland examined postmortem was host to 7 species of tick (*Amblyomma gemma*, *A. variegatum*, *Boophilus decoloratus*, *Rhipicephalus appendiculatus*, *R. evertsi*, *R. pulchellus*, and *R. pravus*—Grootenhuis et al. 1980).

Blood serum tests found *Brucella* antibodies in eland but no antibodies for *Mycobacterium paratuberculosis*, contagious bovine pneumonia, or contagious caprine pneumonia (Paling et al. 1988). Paratuberculosis, however, was documented in a herd of eland in Russia in 1935 (Uspenskii and Saglanskii 1952). Eland are susceptible to *Clostridium chauvoei* (Ocaido et al. 1996).

Population densities and mortality rates are often affected by food supply, predation, disease, and presence of humans (Knight 1995; McNaughton and Georgiadis 1986). By putting up fences for cattle, ranchers disturb natural migration routes of eland. This affects access to an adequate food supply. Also, drought-related mortality is common after several seasons of below average rainfall (Knight 1995). Eland, particularly calves, are vulnerable to attacks by wild dogs (*Lycaon pictus*), lions (*Panthera leo*), cheetahs (*Acinonyx jubatus*), and spotted hyaenas (*Crocuta crocuta*—Estes 1993; Underwood 1979). Although an eland can live for 25 years, average life expectancy is 15–20 years (Haltenorth and Diller 1980).

Capture methods for eland can vary, based on terrain and animal density. Eland can be darted with etorphine and xylazine HCl from a helicopter, or they can be herded horseback into catching areas or into suspended nets or drop nets (Ganhao et al. 1988).

BEHAVIOR. Eland are crepuscular and feed in early morning and in evening. Environmental factors account for 80% of the variability in daily feeding times (Lewis 1978). Eland spend more time in shade on hot days and more time in sunny areas on windy days. Eland may also spend more time in shade where food sources are concentrated. Eland are powerful animals and superb jumpers. Young eland can clear 3-m-high fences from a standing position (Hillman 1979).

Eland are social and occur in large herds of hundreds of animals (up to 500—Estes 1991). Membership within a herd is variable. Individuals stay in a herd for several hours to several months. Females and juveniles tend to stay close together, whereas males form smaller herds or wander individually. Groups form most often when females are in estrus (Hillman 1979). Unlike many antelope, eland lack territorial behavior (Underwood 1981).

Eland communicate via visual displays, olfactory cues, and auditory signals. Communication associated with postural movements, protective movements, orientation movements, and movements related to cutaneous irritation occurs (Kiley-Worthington 1978).

The shorter and thicker horns of males may be more effective during fights between males in rut, wherein male elands wrestle with their horns and ram heads (Lundrigan 1996). Females use their long, thin horns to deliver quick stabs to predators. During a 2-day observation, 10 eland mothers made 20 attempts to gore intruding animals and 30 attempts to gore intruding humans (Kiley-Worthington 1978).

Eland perform flehmen, a lip curling behavior that may transfer chemical stimuli from the mouth to the vomeronasal organ. Ninety percent of flehmen reactions performed by male eland are in response to direct contact with female urine or genitals (Hart et al. 1989). Female eland will urinate to alert males of estrus or to alert harassing males of their nonreproductive status.

A male will closely pursue a female in estrus and will lick and nuzzle her rump to test for receptiveness. At this time, the male will chase and can attack a less dominant male that attempts to approach the female. The male will continue with this behavior for 2–4 h until the female allows him to mount. The actual mating process takes ca. 4 s (Kiley-Worthington 1978).

Before birth, the cow becomes very restless and begins to show interest in other calves and in birth fluids of other cows. She lies down during delivery and stands shortly after delivery. Early maternal interactions involve nose thrusting, licking, chewing, and a variety of vocalizations by both mother and calf. These vocalizations include moos, clicks, and grunts from the mother, and bleats and whimpers from the calf. Mother and calf bond very quickly, and most cows will not interact with any calf other than their own. Mothers conceal their calves during the first 2 weeks of life, after which calves are introduced to the herd and begin socializing with other cows and calves. Calving behavior, mother–calf behavior, and behavioral ontogeny have been described in extensive detail (Underwood 1979).

ANIMAL HUSBANDRY. Eland can be raised for meat and dairy production. Eland are easily tamed and can be fully domesticated (Lightfoot and Posselt 1977). In general, they have a mild temperament and are quite calm (Hansen et al. 1985). They require a large area in which to graze, but their diet can be supplemented with maize, sorghums, melons, and beans. Salt licks are necessary (Lightfoot and Posselt 1977; Posselt 1963).

Disadvantages to domestication exist. The cost of supplemental food for these large animals can be high, and great quantities of food are necessary to maintain a level of health comparable to wild eland. Also, eland will sometimes graze at night to avoid heat stress. But allowing eland to graze at night is risky, and herders usually corral them to avoid predation and losses caused by wandering (Hillman 1979). In addition, keeping eland inside enclosures is difficult because eland are good jumpers. Because of their sheer mass, they can also break through a fence or divider. Wild eland, particularly males, have broken into paddocks where domesticated eland were held (Hillman 1979).

Captive eland reproduce successfully, although calf survival is low, and some females seem to lack sufficient mothering skills. Calves are sometimes removed from the group to ensure they remain healthy and well fed (Lightfoot and Posselt 1977).

Advantages of domesticating eland include their low demand for water (Posselt 1963) and abundant milk production. Eland can produce up to 15 pounds of rich, creamy milk per day, and the taste is quite pleasing (Hall 1975). The milk is also easily preserved and lasts much longer than that of domestic cattle, *Bos taurus*. Eland milk exposed to air for 2 h and then stored at 37°C will last up to 8 months, whereas milk of domestic cattle, under similar circumstances, decomposes in a matter of days (Uspenskii and Saglanskii 1952).

GENETICS. The eland has a diploid number of 31 chromosomes for males and 32 chromosomes for females. The X chromosome is large and acrocentric, and 1 X is late replicating in females. The Y chromosome is translocated to an acrocentric autosome, and, again, is late replicating. The karyotype of the eland is very similar to that of the greater kudu *Tragelaphus strepsiceros* (Hsu and Benirschke 1971; Wurster 1972).

A male eland and a female greater kudu produced a male hybrid. No data exist as to the fertility of this animal (Van Gelder 1977). A sterile male hybrid was produced from an eland × kudu cross at the San Diego Wild Animal Park (Jorge et al. 1976). Bongo (*Tragelaphus euryceros*) embryos have also been successfully transferred to surrogate eland mothers (Dresser 1984).

CONSERVATION. The current international CITES list does not report *T. oryx* as threatened or endangered.

REMARKS. The name eland comes from the Dutch word meaning elk and was so given when early Dutch settlers encountered these large antelope in southern Africa (Hillman 1979). Although *Taurotragus* is currently accepted as the genus name, the eland has been placed in the genus *Tragelaphus* on the basis of molecular data (Essop et al. 1997). The eland and the giant eland are the only antelope in the tribe Tragelaphini to be given a generic name other than *Tragelaphus*. Pallas' (1766) description of *Antilope oryx* does not list an exact type locality for the animal, and the only geographical reference is through the term "Cape Eland."

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LINDSAY A. PAPPAS, SMITHSONIAN INSTITUTION, NATIONAL MUSEUM OF NATURAL HISTORY, NHB 390 MRC 108, WASHINGTON, D.C. 20560-0108.