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Cervus nippon.  By George A. Feldhamer

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Cervus nippon Temminck, 1836

Sika Deer

Cervus nippon Temminck, 1836:xii. Type locality “Isles of Japan.”

Cervus pseudaxis Eydoux and Souleyet, 1841:64. Type locality Java.

Cervus sika Temminck, 1845:54, pl. 17. Objective synonym of nippon.


Cervus taiouanus Blyth, 1861:90. Type locality Formosa.

Cervus taochus Schaller, 1862:152 (for taiouanus Blyth).

Cervus hortularum Swinhoe 1864:169. Type locality Gardens of Summer Palace, Peking.

Cervus manchuricus Swinhoe 1864:169. Type locality Newchang, Manchuria.

Cervus mandarinus Milne-Edwards 1871:184. Type locality northern China.

Pseudaxis taiouanus Gray, 1872:70. Type locality Formosa.

Pseudaxis manchurica Gray, 1872:72. Type locality northern China.

Pseudaxis sika Gray, 1872:72. Type locality Japan.

Cervus kyogeki Swinhoe, 1873:574. Type locality Kienchang, eastern Kiangsu, China.

Cervus europus Swinhoe, 1874:151. Type locality “Newchang, Manchuria.”

Cervus lutosus Tschurz, 1876:123. Type locality southern Ussuria, district of Manchuria.

Cervus tai-ororis Heude, 1881:184. Type locality Formosa.

Cervus frinianus Heude, 1881:185. Type locality between Lake Poyang and the Yangzte River.

Cervus gracilis Heude, 1881:185. Type locality between Lake Poyang and the Yangzte River.

Cervus andreamus Heude, 1881:186. No location.

Cervus ignotus Heude, 1881:186. No location.

Cervus luctuosus Heude, 1881:186. No location.

Cervus desillenus Heude, 1881:187. Type locality Formosa.

Cervus joreianus Heude, 1881:187. Type locality northeast Lake Poyang.

Cervus cyclopocinus Heude, 1881:188. Type locality province of Shan-tung (Shantung).

Cervus kyemalas Heude, 1881:188. Type locality province of Shantung.

Sika brachyphloius Heude, 1884:2. Type locality right bank of Yangzte River, below Lake Poyang, Prefecture of Tche-chou; for this and the following six names.

Sika cycloceros Heude, 1884:2.

Sika grilloanus Heude, 1884:3.

Sika microdontus Heude, 1884:3.

Sika pouwelianus Heude, 1884:3.

Sika oxycephalus Heude, 1884:4.

Sika yuenas Heude, 1884:5.

Sika dominicanus Heude, 1884:6. Type locality Formosa; for this and the following three names.

Sika morrisonianus Heude, 1884:6.

Sika noxoninus Heude, 1884:6.

Sika schultzianus Heude, 1884:6.

Sika fuscas Heude, 1884:7. Type locality “small islands south of Japan”; for this and the following four names.

Sika infelix Heude, 1884:7.

Sika schlelegi Heude, 1884:7.

Sika brachyphus Heude, 1884:8.

Sika hollandianus Heude, 1884:8.

Sika orthopus Heude, 1884:8. Type locality Kobe, central Japan.

Sika blakistonius Heude, 1884:9. Type locality “Nipon and Yeso”; for this and the following two names.

Sika dolichorhinos Heude, 1884:9.

Sika legrandianus Heude, 1884:9.

Sika aplodontus Heude, 1884:10. Type locality north of Tokyo, Japan.

Sika mitratus Heude, 1884:10. Type locality Tokyo, Japan.

Sika yessoensis Heude, 1884:10. Type locality Yesso Island.

Sika microspilus Heude, 1884:11. Type locality Nicou-tchouang, Manchuria.

Sika sylvanus Heude, 1884:11. Type locality “Nipon and Yeso.”

Sika xendaiensis Heude, 1884:11. Type locality Sendai.

Sika grassianus Heude, 1884:12. Type locality Tsinlo-Ishien, northern Shansi, China.

Sika granulosus Heude, 1888:pl. 0, Fig. 2. No type locality.

Sika surdecen Heude, 1888:pl. 1A, Fig. 9. No type locality.

Sika pacichus Heude, 1888:pl. 16, Fig. 1. Type locality Goto Islands, Japan.

Sika aceros Heude, 1888:pl. 18, Fig. 2. Type locality Goto Islands, Japan.

Sika minutus Heude, 1888:pl. 18, Fig. 3. No type locality.

Sika regis Heude, 1888:pl. 18, Fig. 5. Type locality Fukuoye Island, Goto Islands, Japan.

Sika dejardinius Heude, 1888:pl. 18, Fig. 6. Type locality Goto Islands, Japan.

Figure 1. Sika buck showing shaggy neck mane in winter, numerous white spots, rump patch and gray metatarsal area. Photo by Leonard Lee Rue, III.
Sika *kematoscoros* Heude, 1888:pl. 19, Fig. 1. No type locality.
Sika *modestus* Heude, 1888:pl. 19, Fig. 4. No type locality.
Sika *marmandianus* Heude, 1888:pl. 19, Fig. 6. Type locality Goto Islands, Japan.
*Sika imperialis* Heude, 1894:146. Type locality Manchuria.
*Sika rivertianus* Heude, 1894:153. Type locality Lake Poyang.
*Sika ducgenesanus* Heude, 1894:156. No type locality.
*Sika arietinus* Heude, 1894:162. No type locality.
*Sika sendaiensis* Heude, 1897:98. (For *sendaiensis*, 1884.)
*Sika schizodonticus* Heude, 1897:101. Type locality Tokyō, Japan.
*Sika orthopodus* Heude, 1897:101. (For *orthopus*, 1884.)
*Sika elegans* Heude, 1897:103. Type locality Sendai, Japan.
*Sika ellipticus* Heude, 1897:103. Type locality Sendai, Japan.
*Sika minoensis* Heude, 1897:104. Type locality Mino, Japan.
*Sika rutulus* Heude, 1897:105. Type locality Hokkaido, Japan.
*Sika daimius* Heude, 1898:101. Type locality Goto Islands, Japan; for this and the following four names.
*Sika regalis* Heude, 1898:103.
*Sika sicarius* Heude, 1898:105.
*Sika consobrinus* Heude, 1898:107.
*Sika latidens* Heude, 1898:108.
*Cervus matsumotei* Kishida, 1924:56. Type locality Hokkaido.
*Cervus centralis* Kishida, 1936:275. Type locality Nikko, north of Tokyo.

**CONTEXT AND CONTENT.** Order Artiodactyla, Family Cervidae, Genus *Cervus*. Subgenus Sika. The number of subpecies of sika deer has yet to be resolved and some nomenclatorial assignments are uncertain (see Remarks) but generally between 6 and 14 subspecies are recognized. The following is after Corbet (1978) and Groves and Smeenk (1978). Names in synonyms are Heude's except where noted otherwise.

C. n. *nippon* Temminck, 1836:xxii, see above (aceros, brachypus, centraltis Kishida, consobrinus, daimius, dejardinus, fuscus, hollandianus, infelix, japonicus Sundevall, kerame Kuroda, latidens, magashimae Kuroda and Okada, marmandianus, minor Brooke, orthopodius, orthopus, paschalis, regulus, rex, schlegeli, sica, sicarius, sika Gray, typicus Lydekker, and yakushimae Kuroda and Okada are synonyms).

C. n. *aplodontus* Heude, 1884:10, see above (aplopondtus, centraltis Kishida, elegans, ellipticus, minoensis, mitratus, schizodonticus, sendaiensis, and sendaiensis are synonyms).

C. n. *taianus* Blyth 1861:90, see above (trestleanus, dominicanus, mortizianus, nosionianus, schulzianus, tai-oranus, and tainanb Gray, are synonyms).

C. n. *hortularum* Swinhoe 1864:169, see above (andrenus, arletius, brachyrinus, cyclorrhineus, ducgenesanus, dybowski Taczanowski, eupon Swinhoe, fritianus, gracilis, granulosus, grassinianus, gillooanis, hyemalis, ignotus, imperialis, jorietianus, kopchii Swinhoe, lacrymosus, mandarinnus Milne-Edwards, manchuricus Gray, manchuricus Swinhoe, microdonta, micropus, oxyphelys, pouretianus, pseudaxis Eydoux and Souleiet, rivertianus, surdescens, swinhoei Glover, 1856:104, not swinhoiii Sclater, and yuanaus are synonyms).

C. n. *yesoensis* (Heude, 1884:10), see above (blakistoninus, dolichorhinus, legrandianus, matsumotei Kishida, rutulus, sylvanus, and yesoensis are synonyms).


C. n. of uncertain status are *hematoscoros, minutus*, and *modestus.*

**DIAGNOSIS.** Sika deer are small to medium in size and exhibit much variation among subspecies. Pelage ranges from chestnut-brown to reddish-olive, grading to a yellow-brown, tan or gray, depending on the subspecies (Whitehead, 1972). Numerous white spots, occurring in seven or eight rows, are present on the upper sides (Fig. 1). Spots generally are more noticeable in the summer than in winter. The mid-dorsal area is darker than the rest of the coat and forms a line from the head to the rump, where a large white rump-patch is evident. This erectile caudal patch is bordered with the dark stripe. Chin, throat, and belly are off-white or gray. Both sexes have a dark neck mane in the winter. Antlers are narrow, stand erect over the head, and are directed slightly posteriorly. There are from two to five points on antler. An upswept brow tine arises about 25 mm above the cor.

**GENERAL CHARACTERISTICS.** Sika deer exhibit sexual dimorphism, with males being larger than females. Average body measurements of adult males (*N* = 21) and females (*N* = 27) from an introduced population in Maryland (*C. n. nippon*) were as follows (in mm): total length 1,357 (1,192 to 1,510) and 1,254 (1,029 to 1,433); length of tail 109 (76 to 130) and 97 (75 to 120); length of ear to notch 114 (90 to 135) and 106 (95 to 114); length of hind foot 362 (340 to 378) and 340 (317 to 365); and height of shoulder 759 (729 to 811) and 692 (640 to 754). Body measurements of adult males averaged 8.7% greater than those of females (Feldhamer, unpublished data). The mean adult body weights of

**Figure 2.** Skull and mandible of *Cervus nippon*. From top: dorsal surface, ventral surface and mandible, and lateral view. Drawn by Wilma Martin from a male (Appalachian Environmental Laboratory Museum #1073) taken from Dorchester County, Maryland, in December 1977.
dressed carcasses (viscera and fluids removed) at the end of November. Males were 32.7 kg, females 26.2 kg. General descriptions of various subspecies of sika deer are given in Bromley (1956) and Flerov (1952) for C. n. hortorum, in Kudo and Ohtaiishi (1977) for C. n. yessoensis, Horwood and Masters (1970), Davidson (1973) and Whitehead (1972).

The following mean cranial measurements (in mm) are for adult male (N = 5) and female (N = 9) C. n. nippon from Maryland. All measurements are as described in Lowe and Gardiner (1974): Condylarbasal length, 240 and 219; basilar length, 218 and 200; length of rostrum, 116 and 110; palatal length, 134 and 127; prosthion to p1, 70 and 66; length of premaxillary, 59 and 58; length of nasal, 78 and 72; breadth of nasals, 29 and 24; breadth of frontals, 106 and 93; width of maxilla, 33 and 29; interorbital width, 70 and 58; breadth of braincase, 71 and 66; condylar breadth, 45 and 40; zygomatic breadth, 102 and 95; and palatal depth, 59 and 55. Cranial measurements of other subspecies are listed in Imazumi (1970). The dental formula is i 0/3, c 1/1, p 3/3, m 3/3, s 3/4.

Kiddie (1962) described the winter coat as very dense, with fine curly wool near the hide, and normal long guard hairs projecting through it. The length of hairs in the winter coat is 50 to 70 mm, and it is thicker than summer pelage (Flerov, 1952). Summer pelage is fine, straight, and no more than 30 mm in length. Metatarsal glands are oblong, about 25 mm long, and surrounded by tufts of grayish-tan hairs. Paired suborbital or facial glands are present, and Kiddie (1962) described small lateral glands that gave the tail a rounded appearance. There are no tarsal or interdigital glands, however. The hooves of adult males are about 60 mm in length and 40 mm in width, while those of females are slightly smaller.

**DISTRIBUTION.** The original range of sika deer was described by Ellerman and Morrison-Scott (1951) as the "southern USSR district of eastern Siberia; Japan, Manchuria, Formosa; in China—Chihi, Shanhi, and the eastern Yangtze Basin from Chekiang and Kiangsu into northern Kwangtung." Whitehead (1972) and Corbet (1978) included portions of Vietnam in the native range (Fig. 3). Numerous introductions of sika deer have been made; introduced populations currently are found in England, Scotland, Ireland, Denmark, France and other European countries, Australia and New Zealand. In the United States, introductions were made in several states and feral populations remain in Texas, Maryland, Wisconsin, and Virginia.

**Fossil Record.** Flerov (1952) stated that the Pleistocene deer of Asia were preserved almost unchanged in the form of C. nippon. Otaka (1977) discussed fossil deer of the late Pleistocene deposits of Japan that were very similar to the present Japanese deer (see also Matsumoto and Mori, 1971).

**Form and Function.** There are two molts annually. The molt into winter pelage occurs in northern temperate climates during a two to four week period in September. The summer molt is less abrupt; summer pelage is acquired over a period of as long as three months, beginning in March, and thus is worn for a relatively short period of time (Bromley, 1956). In New Zealand, sika deer are in winter pelage from the end of March until October; older animals are first to molt. Although males enter the rut in winter pelage, females occasionally are in summer pelage for the duration of the breeding season (Kiddie, 1962; Davidson, 1973).

In the Northern Hemisphere, males are in velvet antlers from May until August, when fraying begins. Most are in "hard horn" by early September prior to the rut. Thus, the growth phase lasts for approximately 130 days (Goss, 1969). Antlers are shed in May. Older individuals generally shed their antlers before younger animals do, and the new set begins growing immediately. Antler growth in sika deer was "entrenched by increasing day lengths in deer previously sensitized by decreasing days" in experiments conducted by Goss (1969). Ohtaiishi and Tii (1974) found that the temperature of the "velvet" antlers of sika deer paralleled extreme ambient temperatures, while other portions of the body did not.

During the fall rutting season, males quickly deplete reserves of body fat, and may lose 20 to 30% of their body weight (Chapman, 1970). Females, however, do not lose body fat until mid-winter, when severe weather and increased fetal growth result in high energy demands; they lack excess fat in the spring. Fawns generally lack fat deposits during their first year (Bromley, 1956). As in most other cervids, four mammary are present. Flerov (1952) described the milk as rather fatty. At the end of the lactation period it contains 30% fat as compared to 13% at the start of lactation.

**Ontogeny and Reproduction.** The rut begins in late September and lasts for 6 weeks, with greatest activity in October. If unbred, females enter estrus again following a short diestrous period. The proportion of pregnant adult females is high in most feral populations (Razevski, 1972), although sterility of up to 70% of a population has been noted for sika deer confined in parks (Bromley, 1956). The gestation period is about 30 weeks; calving occurs from May through June and occasionally as late as August (Etvushevskaia, 1974; Maruyama et al., 1975). This variation in parturition dates was noted in the Soviet Union (Bromley, 1956), and also in Japan, where Kiddie (1962) found that pregnant females, collected at the same time, carried fetuses that were from 3 to 12 weeks from parturition. Bromley (1956) discussed the ontogeny of sika deer (probably C. n. hortorum), although apparently from limited samples as was noted by Kinderlair. Kiddie (1962) described the fetal development extending from 100 to 150 of gestation (310 mm total length; weight of 645.0 g) the fetus remained naked and without any pigmented areas. Long tactile hairs appeared around the chin, upper lip and eyes of a 170-day-old fetus (300 mm total length; weight 1,300 g), which also had pigmenting areas around the nostrils. In addition, the skull apparently was ossified by this stage. At day 180 of gestation (440 mm total length; weight 1,600 g), long vibrissae were present and faint spots were noted along the back and rump. At about day 190 (510 mm total length; weight 2,700 g), all fetuses had spotted pelage, with long hairs on the rump and muzzle (Bromley, 1956). At birth, calves weighed between 4.5 and 7.0 kg and averaged 570 mm in total length. Males were slightly larger than females; the female is 10 cm shorter (Bromley, 1956). A single calf is usually produced, although twins occasionally have been reported. The majority of calves are dropped in forested areas, but small outlaying patches of cover may be used, and some calves are born in open fields. Calves grow rapidly and by month 8 may be only 5 cm shorter at the shoulder and 9 kg lighter than their mother (Horwood and Masters, 1970). The following mean weights (kg) and measurements (mm) were acquired from C. n. nippon males and females (N = 3): C. n. hortorum in months 9 to 12: weight, 54.0 and 50.7; total length, 1,350 and 1,323; length of tail, 153 and 140; length of ear, 154 and 152; height at shoulder, 907 and 907; chest girth, 897 and 894; skeletal growth is completed by age 2. Males continue to increase in weight until years 7 to 10, whereas females increase in weight until years 4 to 6 (Flerov, 1952; Kudo and Ohtaiishi, 1977). Kiddie (1962) stated that...
calves were weaned prior to the upcoming rut. However, Florov (1952) claimed they continued nursing for at least eight to ten months, or almost until the next parturition.

Sika deer attain sexual maturity between months 16 and 18 after birth. The testes and epididymides of sika calves are small but increase in size about 10-fold by the time they become sexually active (Chapman, 1970). Chapman and Horwood (1970) considered pregnancy in sika calves to be unusual, but Horwood and Masters (1970) felt that, in England, pregnant sika calves were uncommon.

ECOLOGY. Sika deer are found at elevations ranging from sea level to 1,800 m. They prefer forested areas with dense understorey, both within their native range and where introduced. However, they are quite adaptable and do well in a variety of habitats. In England, they are found in both deciduous and coniferous woodlands as well as estuarine reed beds and similar wet areas (Page, 1964). In Maryland, they are generally found in association with water bodies such as ponds, streams, and marshes, as well as along roadsides when antlers are cast following the rut. During the calving season, females and their young form groups of two to three, possibly with the previous year's offspring, and remain separated from other members of the population. Large herds of over 50 animals may be observed at certain times of the year (Ito, 1967; Miura, 1974). During the summer in Japan, Shihata (1969) observed a total of 68 animals in nine groups of three to 15 individuals. For the 300 to 350 sika on the island in the Soviet Arctic, groups of only 10 were observed more often than groups of more than 10 (Prisjahnik and Prisjahnik, 1974). In Japan, the mean number of animals per group varied in relation to season, topography and vegetation, and in the past, groups of over 100 were common. In contrast to other ungulates, sika deer are known for their ability to graze on the most difficult of food sources, including grasses and sedges (Carex sp.), and even on the occasional conifer needles. They have been observed grazing on the needles of Japanese larch (Larix kaempferi) and Japanese beech (Fagus crenata), as well as on a variety of other conifers and deciduous trees. Sika deer are also known to select and consume a wide variety of crops and weeds, including rice, soybeans, and other agricultural crops. In the wild, sika deer are known to feed on a variety of plant materials, including leaves, stems, and flowers of a wide range of plant species. In captivity, they are known to consume a variety of forage materials, including grasses, browse, and browse supplements.

Sika deer are a highly adaptable species, able to thrive in a wide range of habitats and climates. They are known to prefer forested areas, but are also found in a variety of other environments, including grasslands, meadows, and even urban areas. They are known to be highly social animals, forming large herds during the summer months and smaller groups during the winter. They are also known to be highly opportunistic feeders, able to consume a wide variety of plant materials, including fruits, vegetables, and even crops. They are known to be highly vocal animals, producing a variety of calls, including alarm calls, feeding calls, and even mating calls.

Little work has been done on the food habits and preferences of sika deer in the United States. In Maryland, Flyer and Warren (1974) observed that sika deer preferred browse and forage, with a preference for browse species such as Viburnum dilatatum and Rhododendron (Rhododendron coronaria). In New Zealand, plant species commonly browsed include fieveing (Vithopaenus arborium), konin (Ficus compacta), karamu (Cramus lucidus), cair (Hoechoptera radiata), ragwort (Senecio jacobus), and bee (Rhizopogon violaceus), and seedlings of red and silver beech (Nothofagus spp.). Even generally unpalatable species, such as ground ferns (Blechnum sp.), may be used as a food source during certain periods of the year (Kidde, 1962; Wodzicki, 1950).

Rybov (1974) reported that 80% of the diet of wolves (Canis lupus) on the Khoper Reserv, Soviet Union, consisted of sika deer, and wolves accounted for 60 to 80% of known predation on sika deer. Feral dogs (Canis domesticus) were also of importance as predators (Brodmeyer, 1956). California wolves may prey to small carnivores, including foxes (Vulpes spp.), lynx (Felis lynx), or large raptors. Isolated instances of calves being killed by flocks of crows (Corvus brachyrhynchos) have been reported (Shihata, 1969). Predation on sika deer in Japan has been observed to occur in the ratio 1:1:1:5 (Kazevskyi, 1974), although not all were attributed to predation. Kazevskyi (1972) estimated that under normal conditions, 50% of each calf group failed to survive the first year of predation. Observations of sika deer generally did not appear to be affected by average normal predation pressure.

Ochrochenko (1963) distinguished two groups of nematodes affecting sika deer, those of the genus Oesophagostomum and Oxyuris, present at all ages, and those that are not specific for cervids and generally do not occur in deer more than three years of age. This latter group included species such as Nematodirus helvetianus and Capillaria sp. Ticks (Dermacentor reticulatus and Ixodes persulcatus) were found on 20 of 30 sika deer examined by Brodmeyer (1956). Other ectoparasites noted were bloodsuckers (Zoophobas cerni), black flies (Simulium maculatum), and the biting midge (Culicoides obsoletus). Endoparasites included nasal (Pharyngomyia hicta), the liver fluke (Dicrocelium lanceolaratum), and abdominal nematodes (Necator tenuicollus and C. setaria). A tick, Haemaphysalis mageshinaensis, specific to sika deer on Mage Island, Japan, was described by Saito and Hoostraal (1973). Ohbayashi (1966) described two nematodes, Rinada japonica and Spiculopteragia yamashita, found in the small intestine of a sika deer from Hokkaido, Japan. Of six sika deer examined in Czechoslovakia, one simple infection of footworm (Wehrdickmania ceroidea) and one mixed infection of W. cerevedis and Onchocerca flexuosa were found (Dykyo and Blazek, 1972). Robinson et al. (1977) found Elaenia schneideri in sika deer from Texas, and considered this species of deer to be an aberrant host. Sika deer may also be infected with several species of spirochetes. Vysotskii and Ryashchenko (1961) examined blood samples from 450 sika deer for a range of 38 species, including 3. pomona antigens, 23 to L. tarsosai antigens, and 4 to L. saxoeung antigens. In New Zealand, however, sika deer are of
lITTLE significance as reservoirs of Leptospira sp. or of Brucella abortus and Salmonella sp. (Daniel, 1967). Piroplasmosis was reported by Flerov (1952) to be extremely widespread among sika deer populations in their native range. Malignant catarrhal fever (MCF), a viral infection of domestic ruminants, was noted in three captive sika in an import with domestic species (Sanford et al., 1977). Antibodies to Mycoplasma paratuberculosis 3, a virus associated with man and domestic livestock, were detected in only one of 12 sika deer tested from the Maryland-Virginia area (Shah et al., 1965).

BEHAVIOR. During the summer, adult males begin to establish territories for the upcoming rut. Males dig holes up to 1.6 m deep in which to copulate with their partners or to urinate frequently. These holes, together with the threshing of surrounding ground cover with the antlers, delimit the boundaries of individual territories. Kiddie (1962) felt that 2 ha represented the mature male's territory, but this study did not confirm that delimitation.

Three by four. The breeding group of a successful territorial male may number as many as 12 females (Kiddie, 1962). Bucks follow available females and attempt to drive them to their territories, where mating takes place. Chases may be prolonged, and the female may refuse to mate. This behavior is apparent effort to initiate mating (Horwood and Masters, 1970). A male may mount a female several times unsuccessfully, with each attempt followed by an interval of from 10 to 15 min of relative inactivity. A successful copulation lasts only about 1 min at any time of the day and night (Kiddie, 1962). Bucks remain on their territories and often do not feed until the latter stages of the rutting season. Females, however, appear to feed normally throughout this period, and may move through adjacent territories and associate with other bucks to do so. Kiddie (1962) reported that when a territorial buck had three or more females in a group, it was not uncommon to also find two or three younger bucks in the group. These subordinate males did a major portion of the "roaring" vocalizations and investigated preliminary territorial challenges. Young bucks apparently do not breed, however (Kiddie, 1963). Bucks wallow during the rut and usually have a "filthy, matted appearance, particularly around the neck and shoulders" (Horwood and Masters, 1970).

Pregnant or lactating females apparently engage in behavior that minimizes intrusion into their calving area by other females, and which aids in dispersing these females. During this period, adult sika move strongly and other sika move with the forest floor (Maruyama et al., 1975a). Dispersion also may be facilitated by vocalizations of females.

This species probably is one of the most vocal members of the Cervidae breeding season in Japan. Kiddie (1957) recorded 10 different vocalizations from a herd of sika deer, although only two types of sounds were considered to be common. Kiddie (1962) noted up to five distinct calls from individual deer. Vocalizations range from soft whistles between females, to "goat-like bleats" from doe to fawn and "soft horse-like neighs" from fawn to doe (Kiddie, 1962). During the rut, both dominant and subordinate males may emit "blood-curdling screamings" (Flyer and Davis, 1964). Approximately one month prior to the beginning of the rut, bucks go through the physical motions of roaring but produce no sounds (Kiddie, 1962). Kiddie felt this behavior served to exercise the proper muscles before initiation of the roar. The alarm call, which may be uttered by either sex and which is audible for 2.5 km, has been described as a "sharp scream" (Page, 1964), a "high-pitched whistle followed by a guttural bark" (Kiddie, 1962), and a "chirp-like sound" (Flyer and Davis, 1964).

When running at slow to medium speed, sika deer use a stiff gallop, but at speeds of up to 3 m in length. At slightly increased speed they exhibit a rather stiff-legged, quadrupedal hopping, with all four hooves simultaneously about 0.3 m off the ground. Bromley (1956) stated that, in this gait, sika deer made bounds up to 6 m and were able to run at a height in excess of 1.2 m in height. Sika deer are reported to be excellent swimmers; they readily enter the water, either to escape predators or of their own volition, and are capable of swimming up to 12 km in the sea (Flerov, 1952).

GENETICS. Gustavsson and Sundt (1969) found variation from 64 to 68 in the diploid chromosome number of 11 C. n. kurtulorum. Two autosomes and the Y chromosome of males were metacentric, while the remaining chromosomes were telocentric (for 2N = 68). Observed variations in number were the result of centric fusions. A female C. n. nippon investigated by Koushik and Goswami (1977) had a 2N of 66, with two pairs of metacentrics and 31 pairs of telocentrics. In two C. n. nippon studied by Gustavsson and Sundt (1968), the modal 2N chromosome number was 67 (range was 65–68), and chromosome structure was similar to that described above. Taylor and Easley (1977) investigated the hemoglobin α-chains of captive sika deer in Florida. A minimum of five and possibly seven, different α-chains were found in the relatively small sample of 10 animals. They also determined that these individuals had two, and possibly as many as four, separate α-chains.

Polydactylyism was reported by Davidson (1971) for a sika deer in New Zealand.

Flerov (1952) noted that hybrids between sika deer and red deer (Cervus elaphus) occurred quite frequently in northern Asia. This phenomenon has also been noted relative to sympatric populations in the United States (though see Howard, 1965, Kiddie, 1962), Ireland (Harrington, 1973), and possibly in Scotland (McNally, 1969). Lowe and Gardiner (1975) tested measurements from the skulls of sika deer, red deer and their hybrids and estimated about 1% introgression. They concluded that much hybridization occurred between these species, but that in England "the degree of hybridization exhibited by the skulls was not reflected in coat color or other body features, and in fact, appeared to be completely independent of them" (Lowe and Gardiner, 1975). They concluded that hybrid offspring were common between females of the mainland subspecies of sika deer and male red deer. Sika females of the island subspecies (C. n. nippon) apparently did not hybridize with red deer. It should also be noted that sympatric populations of C. n. kurtulorum and C. n. taiouanus in England apparently do not interbreed (Gustavsson and Sundt, 1969).

REMARKS. As noted by several researchers, the relationships of populations of the sika deer need further investigation. The situation has been complicated by extensive transplants and hybridization with red deer.

Dr. J. Edward Gates critically reviewed the manuscript. Ms. Cathy Blount, Mammals Section, National Museum of Natural History, assisted in obtaining much of the original literature. This is Contribution No. 85—Appalachian Environmental Laboratory, University of Maryland, Center for Environmental and Estuarine Studies and Federal Aid in Wildlife Restoration project W-49-R-3 Maryland.

Deer [An unfortunate nomenclatural error is apparent in the history of this species, as displayed in the lengthy synonymy. The editor considered changing the regular format in order to shorten this, but decided not to make an exception.]

LITERATURE CITED


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